Oracle® Exadata

System Overview



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Preface

This guide describes Oracle Exadata Database Machine for online transaction processing (OLTP) and enterprise data warehousing. It includes information about the components, restrictions and cabling.

- Audience

Audience

This guide is intended for Oracle Exadata Database Machine customers and those responsible for data center site planning, configuration, and maintenance of Oracle Exadata Database Machine.

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1

Introduction to Oracle Exadata Database Machine and Oracle Exadata Storage Expansion Rack

Oracle Exadata Database Machine is engineered to be the highest performing and most available platform for running Oracle Database.

Oracle Exadata Database Machine and Oracle Exadata Storage Expansion Rack are hardware systems that consist of multiple components. This chapter provides an overview of Exadata systems, and usage information.

> **Note**
>
> For ease of reading, the name "Oracle Exadata Rack" is used when information refers to both Oracle Exadata Database Machine and Oracle Exadata Storage Expansion Rack.

Oracle Exadata Database Machine and Oracle Exadata Storage Expansion Rack are described in the following topics:

- Oracle Exadata Architecture
  Oracle Exadata is a modern architecture featuring scale-out industry-standard database servers, scale-out intelligent storage servers, and an extremely high speed internal RDMA Network Fabric that connects the database and storage servers.
- Oracle Exadata Configurations
  Oracle Exadata can come in a specific configuration, for example the half rack, or use an elastic configuration with a custom number of database servers and storage servers.
- Oracle Exadata Performance Features
  Oracle Exadata not only provides high performance and scalability but also unique technology.
- Oracle Exadata Rack Limits and Restrictions

1.1 Oracle Exadata Architecture

Oracle Exadata is a modern architecture featuring scale-out industry-standard database servers, scale-out intelligent storage servers, and an extremely high speed internal RDMA Network Fabric that connects the database and storage servers.

Oracle Exadata runs all types of database workloads including Online Transaction Processing (OLTP), Data Warehousing, and a consolidation of mixed workloads. Oracle Exadata powers and protects the most important databases, and is the ideal foundation for a consolidated database cloud.

Oracle Exadata includes all the hardware needed to run Oracle Database. The database servers, storage servers and network are preconfigured, pretuned and pretested by Oracle

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engineers, eliminating the weeks of effort typically required to deploy a high performance system. Extensive end-to-end testing ensures all components work together and there are no performance bottlenecks or single points of failure that can affect the complete system. Oracle Exadata also includes the Oracle Exadata System Software, which runs on both database servers and storage servers. Unique software algorithms in Oracle Exadata System Software implement database intelligence in storage, PCI-based flash, and the RDMA Network Fabric network to deliver higher performance and high capacity at lower costs than other platforms.

1.2 Oracle Exadata Configurations

Oracle Exadata can come in a specific configuration, for example the half rack, or use an elastic configuration with a custom number of database servers and storage servers.

Oracle Exadata uses a scale-out architecture for both database servers and storage servers. As Oracle Exadata grows, more database CPUs, storage and networking are added in a balanced fashion, ensuring scalability without bottlenecks.

Early Oracle Exadata models had fixed configurations, such as quarter-rack or half-rack.

Contemporary Oracle Exadata systems use custom configurations called **elastic configurations**. Elastic configurations enable you to build an Oracle Exadata Rack containing a custom number of database servers and storage servers that meet your needs. See Elastic Configuration for details.

In addition to upgrading within a rack, multiple racks can be connected using the integrated RDMA Network Fabric to form larger configurations. For example, a system composed of four full Exadata racks is essentially four times more powerful than a single rack system. The four racks provide quadruple the I/O throughput, storage capacity and processors. The multi-rack system can be configured as a single large system or logically partitioned for consolidation of multiple databases.

When larger storage capacity is required, Oracle Exadata Storage Expansion Rack is available. Oracle Exadata Storage Expansion Rack enables growth of storage capacity and bandwidth for any Oracle Exadata. It is designed for database deployments that require very large amounts of data including historical or archival data, backups, documents, images, XML, large objects (LOBs), and so on. Oracle Exadata Storage Expansion Rack starts with a base configuration that includes four storage servers, and you can add as many additional storage servers as you need, up to the physical capacity of the rack. The servers in the Oracle Exadata Storage Expansion Rack connect to Oracle Exadata using the integrated RDMA Network Fabric.

All Oracle Exadata implementations use time-tested configuration standards, so customers benefit from the experience of other users who have deployed Oracle Exadata for their mission-critical applications.

Oracle Exadata runs standard Oracle Database software. Any applications that run with Oracle Database can be seamlessly migrated to Oracle Exadata with no changes to the application.

- Elastic Configuration

1.2.1 Elastic Configuration

Elastic configuration enables you to customize Oracle Exadata Rack within set limits. For example, using elastic configuration, Oracle Exadata Database Machine X9M-2 can have 0 to 22 database servers, 0 to 19 Exadata Storage Servers, or a combination of database servers and Exadata Storage Servers.

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> **Note**
>
> Oracle Exadata Rack collectively refers to Oracle Exadata Database Machine and Oracle Exadata Storage Expansion Rack.

You can use Oracle Exadata Configuration Assistant (OECA) to quickly and easily define an elastic configuration. OECA automatically validates each Oracle Exadata Rack configuration and produces a report that contains the associated environmental specifications (power requirements, cooling requirements, rack weight, and so on).

OECA is available on Oracle Technology Network:

```
https://www.oracle.com/database/technologies/oeca-download.html
```

1.3 Oracle Exadata Performance Features

Oracle Exadata not only provides high performance and scalability but also unique technology.

The Exadata database servers can offload data-intensive SQL operations to Oracle Exadata Storage Servers. Moving the SQL processing to Oracle Exadata Storage Servers enables data filtering and processing to occur immediately and in parallel across all storage servers as data is read from disk. Exadata storage offload reduces database server CPU consumption and greatly reduces the amount of data moved between the storage and database servers.

Compressing data can provide a dramatic reduction in the storage consumed for large databases. Oracle Exadata Storage Server provides a very advanced compression capability called Hybrid Columnar Compression. Hybrid Columnar Compression enables the highest levels of data compression and provides tremendous cost savings and performance improvements due to reduced I/O. On conventional systems, enabling high data compression has the drawback of reducing performance. Oracle Exadata is able to offload decompression overhead into a large number of processors in Oracle Exadata Storage Servers so most workloads run faster using Hybrid Columnar Compression than they do without it. Hybrid Columnar Compression combines the compression and analytic performance benefits of column storage while avoiding the dramatic slowdown that pure columnar stores experience for drill-down operations.

Oracle Exadata uses the latest PCIe flash technology rather than flash disks. PCIe flash greatly accelerates performance by placing flash directly on the high speed PCIe bus rather than behind slow disk controllers and directors. Refer to Hardware Components of Oracle Exadata Database Machine for information about flash card configurations and capacity.

Exadata Smart Flash Cache automatically caches frequently accessed data in PCIe flash while keeping infrequently accessed data on disk drives. This provides the performance of flash with the capacity and cost of disk. Exadata Smart Flash Cache understands database workloads and when to avoid caching data that will never be reused or fit in the cache. Oracle Database and Oracle Exadata System Software allow the user to provide directives at the database table, index and segment level to ensure that specific data is retained in flash. Tables can be retained in flash without the need to move the table to different tablespaces, files or LUNs as would have to be done with traditional storage and flash disks.

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> **Note**
>
> Oracle Exadata does not include any Oracle software licenses. Appropriate licensing of the following software is required when Oracle Exadata is used as a database server:
>
> - Oracle Database
> - Oracle Exadata System Software
>
> In addition, Oracle recommends that the following software is licensed:
>
> - Oracle RAC
> - Oracle Partitioning

1.4 Oracle Exadata Rack Limits and Restrictions

- Restrictions for Modifying Oracle Exadata Rack Hardware
- Restrictions for Modifying the Oracle Exadata Software Components
  The following restrictions apply to software modifications on Oracle Exadata, including firmware updates and operating system configuration changes. Violating these restrictions may void the warranty and result in the loss of Oracle Support.
- Restrictions for Connecting Oracle Exadata with Other Hardware, Systems, or Networks
  The following restrictions apply to hardware and software modifications to Oracle Exadata Rack. Violating these restrictions can result in loss of warranty and support.
- Maximum Number of Database Processes
  This topic describes the maximum number of database processes on each Exadata database server or virtual machine guest.

1.4.1 Restrictions for Modifying Oracle Exadata Rack Hardware

Modification of Oracle Exadata Rack is generally not required or recommended, and unpermitted modifications can result in loss of warranty and support. However, the following hardware modifications are permitted:

- Customers may perform the following modifications to the included Management Network Switch, which supports the administration network. Modification is only allowed after delivery of the Oracle Exadata Rack, and the customer bears responsibility for all costs and issues that may arise from any change.

  Customers may:

  - Replace the Management Network Switch with an equivalent customer-supplied 1U Gigabit Ethernet switch.
  - Reconfigure the Management Network Switch settings and firmware.
  - Remove the Management Network Switch and cable the administration network connections directly to an external customer-supplied switch or patch panel.
- Subject to validation using Oracle Exadata Configuration Assistant (OECA), customers may install additional equipment into unused rack slots.

  Use the **ADD EQUIPMENT** button in OECA to specify the additional equipment details.

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Additional equipment may only be installed after the resulting configuration is validated using OECA.

Related Topics

- Oracle Exadata Configuration Assistant (OECA) Downloads

1.4.2 Restrictions for Modifying the Oracle Exadata Software Components

The following restrictions apply to software modifications on Oracle Exadata, including firmware updates and operating system configuration changes. Violating these restrictions may void the warranty and result in the loss of Oracle Support.

- You cannot update the firmware directly on the Oracle Exadata Storage Servers. The storage server firmware may only be updated as part of an Oracle Exadata System Software update or using a patch provided by Oracle Support Services.
- You can update the OS and firmware versions on the Management Network Switch to meet customer-specific data center requirements.
- You can update the firmware of the components of the database servers provided the update complies with the restrictions documented in Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930), and its related notes.
- You can update the firmware of the RDMA Network Fabric switches provided the update complies with the validated versions documented in Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930), and its related notes.
- You cannot install any additional software or agents on the Oracle Exadata Storage Servers.
- On Oracle Exadata Storage Servers, you can install qualified Ksplice updates for the Oracle Linux kernel or update individual software packages (RPMs) only in the following circumstances:

  1. To address a critical known security vulnerability with a Common Vulnerability Scoring System (CVSS) score of 9 or greater, and only when the update is not available in a regular Oracle Exadata System Software update. If the updated package is available in an Oracle Exadata System Software update, then you must apply the Exadata update.
  2. To address a Service Request (SR), but only with the express direction and approval of Oracle Support Services.

  Individual RPM updates to Oracle Linux kernel packages, RDMA Network Fabric packages, and firmware packages are not permitted under any circumstances. Qualified Oracle Linux kernel updates are supported only through the Ksplice update mechanism.

  See also Updating Individual Packages on Exadata Storage Servers and Installing Kernel Updates on Oracle Exadata Storage Servers.

- On Oracle Exadata database servers, you can install qualified Ksplice updates for the Oracle Linux kernel.

  Qualified Oracle Linux kernel updates are supported only through the Ksplice update mechanism. Individual RPM updates to Oracle Linux kernel packages are not permitted under any circumstances.

  See also Installing Kernel Updates on Oracle Exadata Database Servers.

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- On Oracle Exadata database servers, you can update individual software packages (RPMs). However, customizing the system by updating individual packages may introduce dependencies that a subsequent Oracle Exadata System Software update cannot handle. Oracle therefore recommends updating individual packages only when necessary. Before updating an individual package, check whether an Exadata update includes the required package update. If it does, apply the Exadata update instead. Where possible, use Exadata Live Update to apply the latest Exadata security updates while maximizing system availability.

  Individual RPM updates to Oracle Linux kernel packages and RDMA Network Fabric packages are not permitted under any circumstances.

  See also Updating Individual Packages on Exadata Database Servers.

- You may load additional software on the database servers. However, to ensure best performance, Oracle discourages adding software except for agents, such as backup agents and security monitoring agents, on the database servers.

  See Installing, Updating, and Managing Additional Software Packages.

- Loading non-standard kernel modules on the operating system of the database servers is allowed but discouraged. Oracle will not support questions or issues with the non-standard modules. If a server crashes, and Oracle suspects the crash may have been caused by a non-standard module, then Oracle support may refer you to the vendor of the non-standard module or ask that the issue be reproduced without the non-standard module.

  Starting with Oracle Exachk version 24.10, Exachk highlights system modules that taint the Linux kernel.

- You can install Oracle Enterprise Manager Cloud Control Management Agents or Oracle Enterprise Manager Grid Control Management Agents on the database servers to monitor the system.

- Installing Oracle Enterprise Manager Ops Center agents to monitor the system is not allowed.

- RDMA Network Fabric-related packages must always be maintained at the officially supported release.

- As part of the initial system configuration, Oracle Exadata Deployment Assistant (OEDA) creates bonded network interfaces by combining two physical network interfaces for the client network and each configured additional network.

  You can manually modify the configuration of each bonded network interface, but Oracle discourages doing so. Oracle does not provide support for questions or issues related to nonstandard bonding configurations. Regardless of any other configuration changes, each bonded network interface must contain at least two physical network interfaces.

1.4.3 Restrictions for Connecting Oracle Exadata with Other Hardware, Systems, or Networks

The following restrictions apply to hardware and software modifications to Oracle Exadata Rack. Violating these restrictions can result in loss of warranty and support.

- Oracle Exadata Storage Expansion Rack can only be connected to Oracle Exadata Database Machine or Oracle SuperCluster, and only supports databases running on the database servers on Oracle Exadata Database Machine or Oracle SuperCluster.

- Standalone Oracle Exadata Storage Servers can only be connected to Oracle Exadata Database Machine or Oracle SuperCluster, and only support databases running on the database servers of Oracle Exadata Database Machine or Oracle SuperCluster.

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- Customers cannot connect USB devices that draw more than 100 mA of power to the database servers.
- Customers cannot connect USB devices to the Oracle Exadata Storage Servers except as documented in the Oracle Exadata documentation. In those documented situations, the USB device should not draw more than 100 mA of power.
- Only switches specified for use in Oracle Exalogic Elastic Cloud, Oracle Big Data Appliance, and Oracle SuperCluster may be connected to the Oracle Exadata Rack RDMA Network Fabric network. It is not supported to connect other RDMA Network Fabric switches, including third-party switches, to the Oracle Exadata Rack RDMA Network Fabric network. Only the RDMA Network Fabric networking topologies specified in this guide and *Oracle Exadata Extending and Multi-Rack Cabling Guide* are supported, and any other RDMA Network Fabric network topology is not supported.

  > **Note**
  >
  > When interconnecting racks, all racks must use the same type of RDMA Network Fabric, either InfiniBand or RDMA over Converged Ethernet (RoCE).

- You may connect external servers, that are not part of Oracle Engineered Systems, to the RDMA Network Fabric switches in Oracle Exadata. However, it is your responsibility to upgrade and maintain the compatibility of the RDMA Network Fabric software of the external servers with the RDMA Network Fabric software release for Oracle Exadata. Oracle highly recommends that you maintain the same release of RDMA Network Fabric software and operating system on the external server as on Oracle Exadata. If an RDMA Network Fabric problem is encountered and an external server is connected, then you may be asked to remove the external server and reproduce the problem.
- You can connect the database servers to external (non-Exadata) storage using iSCSI or NFS subject to the following:
  - The storage is allowed for application input and output files, Data Pump export files and logs, and files associated with backup and recovery operations.
  - The use of non-Oracle storage for Oracle Database files is not supported.
  - The Fibre Channel over Ethernet (FCoE) protocol is not supported.

Related Topics

- Multi-Rack Cabling Tables

1.4.4 Maximum Number of Database Processes

This topic describes the maximum number of database processes on each Exadata database server or virtual machine guest.

The tables in this topic contain the maximum number of database processes supported on each Exadata database server.

In all cases, the best practice is to keep the process count below the specified values. Also, if a subset of the database workload uses parallel queries, the effective limit will be between the values in the "Maximum Number of Processes with No Parallel Queries" and "Maximum Number of Processes with All Running Parallel Queries" columns.

The following table shows the maximum number of database processes supported on each physical Exadata database server in a bare-metal system configuration.

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Table 1-1 Maximum Number of Database Processes on a Bare-Metal Exadata Database Server

Machine Type	RDMA Network Fabric Type	Maximum Number of Processes with No Parallel Queries	Maximum Number of Processes with All Running Parallel Queries
1-socket or 2-socket	RoCE Network Fabric	25,000	16,000
8-socket	RoCE Network Fabric	64,000	44,000
2-socket	InfiniBand Network Fabric	16,000	14,000
8-socket	InfiniBand Network Fabric	64,000	44,000

The following table shows the maximum number of database processes supported on each virtual machine (VM) guest (Oracle VM DomU or KVM guest) in a virtualized system configuration.

Table 1-2 Maximum Number of Database Processes on a Virtual Machine Guest

Machine Type	RDMA Network Fabric Type	Maximum Number of Processes with No Parallel Queries	Maximum Number of Processes with All Running Parallel Queries
1-socket or 2-socket	RoCE Network Fabric without Exadata Secure RDMA Fabric Isolation configured	25,000	16,000
1-socket or 2-socket	RoCE Network Fabric with Exadata Secure RDMA Fabric Isolation configured	50,000	32,000
2-socket	InfiniBand Network Fabric	16,000	14,000

Use the following best practices to optimize resource utilization while supporting a high process count:

- Establish database connections using a set of Oracle Net listeners instead of using local bequeath connections.
- On each database server, the number of Oracle Net listeners should be a multiple of the number of server CPU sockets. For example, on an 8-socket database server, you should configure at least eight listeners.
- Evenly spread the Oracle Net listeners across the available CPU sockets.

  For example, assuming the `listener.ora` file is configured correctly for eight listeners (named `LISTENER0` - `LISTENER7`), you can use the following script to start eight listeners on an 8-socket server with each listener bound to a different CPU socket:

```
#!/bin/bash
export ORACLE_HOME=/u01/app/oracle/product/19.0.0.0/dbhome_1
```


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```
for socket in `seq 0 7`
do
 numactl --cpunodebind=${socket} $ORACLE_HOME/bin/lsnrctl start LISTENER$
{socket}
done
```

- Use Oracle Net connection rate limiting to control connection storms and enhance system stability.

  To avoid excessive client connection timeouts and server-side errors, limit the connection rate on each database server to 400 connections per second. In other words, the sum of the `rate_limit` control parameter should not exceed 400 across all Oracle Net listeners on each database server.

  See Connection Rate Limiter Parameters in *Oracle Database Net Services Reference*.

- Use the following recommended Oracle Net listener control parameter settings to avoid Oracle Net connection errors, such as TNS-12514.

  – `MAX_ALL_CONNECTIONS_`*`listener_name`*`=4096`

  – `MAX_REG_CONNECTIONS_`*`listener_name`*`=2048`

  See Control Parameters in *Oracle Database Net Services Reference*.

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Part I

What's New in Oracle Exadata Database Machine

These topics describe the new features included in each release of Oracle Exadata Database Machine and Oracle Exadata System Software.

- New Features for Oracle Exadata System Software 26ai
  This section describes the new features introduced in Oracle Exadata System Software 26ai (release 26.x).
- New Features for Oracle Exadata System Software 25ai
  This section describes the new features introduced in Oracle Exadata System Software 25ai (release 25.x).
- New Features for Oracle Exadata System Software 24ai
  This section describes the new features introduced in Oracle Exadata System Software 24ai (release 24.x).
- New Features for Oracle Exadata System Software Release 23.x
  This section describes the new features introduced in Oracle Exadata System Software release 23.x.
- New Features for Oracle Exadata System Software Release 22.x
  This section describes the new features introduced in Oracle Exadata System Software release 22.x.
- New Features for Oracle Exadata System Software Release 21.x
  This section describes the new features introduced in Oracle Exadata System Software release 21.x.
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  Several new features were introduced for Oracle Exadata System Software release 20.x.
- New Features for Oracle Exadata System Software Release 19.x
  Several new features were introduced for the various versions of Oracle Exadata System Software Release 19.x.
- New Features for Oracle Exadata System Software Release 18
  Several new features were introduced for Oracle Exadata System Software Release 18.
- New Features for Oracle Exadata System Software Release 12.x
  Several new features were introduced for the various versions of Oracle Exadata System Software Release 12.x.
- New Features for Oracle Exadata System Software Release 11.x
  Several new features were introduced for the various versions of Oracle Exadata System Software Release 11.x.

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2

New Features for Oracle Exadata System Software 26ai

This section describes the new features introduced in Oracle Exadata System Software 26ai (release 26.x).

- What's New in Oracle Exadata System Software Release 26.1

2.1 What's New in Oracle Exadata System Software Release 26.1

- Exadata VM Live Migration
- Exadata Smart Flash Cache Optimization
- Improved Performance Using Partner Cache Reads
- Snapshot-Aware XRMEM Cache
- Storage Server Security Hardening
- Flexible Exascale Storage Pool Management
- Exascale Immutable Snapshots
- Flexible Resource Management Using Resource Profiles for Exascale Volumes
- Exascale Direct Volume Observability
- Migrate Exadata Guest Image Files from Local Storage to Exascale
- IPv4 and IPv6 Coexistence and Conversion
- Custom File System Layout
- Custom Guest Gold-Image
- Extended Cache Space Management in the IORM Cluster Plan
- Other Changes in This Release
- Minimum Versions and Other Requirements

2.1.1 Exadata VM Live Migration

Exadata VM Live Migration enables online migration of a running Oracle Linux KVM guest to another KVM host. The guest remains available throughout the operation, with normal processing continuing except for a very brief pause during the switchover to the new KVM host. Throughout the operation, Exadata VM Live Migration preserves active RDMA connections so database workloads can continue using the high-performance RDMA path.

Using Exadata VM Live Migration, system administrators can:

- Seamlessly move guests to balance resource usage across the available KVM hosts.

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For example, a guest on a fully utilized KVM host could be moved to a different KVM host to accommodate a requirement for additional CPU resources.

- Move running guests off a KVM host to facilitate maintenance operations requiring a server outage or reboot.

  Customers with sufficient system resources can use Exadata VM Live Migration to perform scheduled maintenance on a KVM host without interrupting running guests. They can migrate the guests off the host, perform the required maintenance while the host is idle, and then migrate the guests back to the updated host.

Key system requirements:

- Oracle Exadata X10M or later system hardware.
- Oracle Exadata System Software release 26.1.0.
- The guest being migrated must use Exascale volumes to store the guest image files.
- The system must be configured with Exadata Secure RDMA Fabric Isolation (Secure Fabric) enabled.

For further details and requirements, see Moving a Guest Using Exadata VM Live Migration.

2.1.2 Exadata Smart Flash Cache Optimization

Oracle Exadata System Software release 26.1.0 optimizes Exadata Smart Flash Cache to further improve overall system performance and flash utilization.

Historically, Exadata Smart Flash Cache has focused on online transaction processing (OLTP) and complex analytical workloads, using highly tuned caching policies that protect the performance of those workloads. In this context, large write operations were often not cached, or were quickly removed from the cache, because they were unlikely to benefit from long-term caching.

Starting with release 26.1.0, Exadata Smart Flash Cache dynamically adjusts caching policies based on cache usage. When flash capacity is available, the system can use available cache space for data that otherwise would not be cached. This accelerates write-intensive workloads, data loads, and restore operations, providing an all-flash user experience when the entire working data set fits in the cache.

This optimization extends the versatility of Exadata Smart Flash Cache and helps more workloads benefit from flash cache, while carefully preserving cache fairness and predictability for existing OLTP and analytical workloads.

2.1.3 Improved Performance Using Partner Cache Reads

When a storage server resumes operation following planned maintenance, unplanned failure, or replacement of a hard disk drive or flash device, the Exadata Smart Flash Cache may not contain recently accessed data. However, a secondary copy of the recently accessed data normally resides in the cache of a partner storage server.

Building on existing capabilities, Oracle Exadata System Software release 26.1.0 introduces additional enhancements to caching algorithms and supporting infrastructure, further enabling a storage server to deliver high I/O performance immediately after maintenance by performing a partner read to a remote cache rather than a more expensive disk read on the local server.

In this release, partner cache reads are enabled for analytical workloads (using Smart Scan and Columnar Cache) and OLTP on databases using Oracle ASM or Exascale. In all cases, partner cache reads automatically transform local flash cache misses into remote cache hits,

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improving read I/O performance and minimizing disk reads. No user or administrator effort is required.

Additionally, Exascale uses partner cache reads to proactively accelerate cache warmup when a storage server comes back online.

This capability requires Oracle Database 23ai version 23.9 (July 2025) or later. For Oracle AI Database 26ai version 23.26.0, you must also apply patch 37606114. Later 26ai versions include this update.

Related Topics

- Monitoring Exadata Smart Flash Cache

2.1.4 Snapshot-Aware XRMEM Cache

Oracle Exadata System Software release 26.1.0 enhances XRMEM cache by making it fully Exascale snapshot-aware. With these enhancements, XRMEM cache stores only data blocks that are unique to a snapshot and avoids caching blocks that are unchanged from the snapshot source.

By removing snapshot-related duplication in the cache, this enhancement effectively increases cache capacity, reduces read latency, improves RDMA hit rates, reduces disk I/O, and improves throughput for more users system-wide.

This capability is especially useful in Exascale environments with many snapshots or clones, where duplicate caching can otherwise consume valuable XRMEM cache capacity.

2.1.5 Storage Server Security Hardening

Oracle Exadata System Software release 26.1.0 introduces new capabilities that harden storage server security. These changes reduce risk by enforcing least-privilege access and minimizing root usage, improving protection against credential compromise, unauthorized administrative actions, and other threat vectors often associated with ransomware attacks.

- The Exadata storage server built-in operating system (OS) user accounts (`celladmin` and `cellmonitor`) are restricted to run specific Cell Command Line Interface (CellCLI) and Exascale Command Line Interface (ESCLI) commands, along with a limited set of read-only Linux OS commands.

  Additionally, for Exascale environments, each OS user now uses a separate Exascale keystore (wallet) with appropriate corresponding credentials. By default, the wallet associated with `celladmin` provides Exascale administrator privileges, while the `cellmonitor` wallet provides read-only access to Exascale objects and metadata.

  These changes limit the ability to perform malicious operations using the `celladmin` and `cellmonitor` accounts if their credentials are compromised. They also prevent many possibilities for accidental damage through mistakes by legitimate users.

- Exadata storage servers can now be configured to disable SSH access using the `root` OS administration account. Additionally, Exadata administrators can define site-specific policies to enable or disable remote login using SSH.

  For example, by using the CellCLI `ALTER CELL` command to set the `ACCESSLEVELPERM` and `ACCESSLEVELTEMP` attributes, you can configure a storage server to nominally disable `root` SSH access but allow it for a specific time-bound maintenance window.

  This capability limits the opportunity to perform malicious operations using the `root` OS administration account if it is compromised.

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- Exadata administrators can now configure SSH equivalence for the `celladmin` and `cellmonitor` accounts using CellCLI commands to `CREATE SSHEQUIVALENCE`, `LIST SSHEQUIVALENCE`, and `DROP SSHEQUIVALENCE`.

  This capability removes the requirement for `root` access to configure SSH equivalence and complements the ability to disable `root` SSH access.

- Oracle Exadata Deployment Assistant (OEDA) supports initial deployments using the `celladmin` OS user account. During these deployments, `celladmin` performs the deployment tasks, and `root` SSH access is disabled on all storage servers.

  This enables customers to adopt the strongest available security posture from the beginning of the Exadata deployment process and improves auditability by reducing root usage during deployment.

Related Topics

- Enhanced Default Security Settings for Storage Server Operating System Users
- Managing SSH on Storage Servers
- ALTER CELL
- Deploying Oracle Exadata Using Enhanced Storage Server Security

2.1.6 Flexible Exascale Storage Pool Management

Starting with Oracle Exadata System Software release 26.1.0, you can create multiple storage pools for each media type within a single Exascale cluster. Previously, only one storage pool was permitted for each media type in an Exascale cluster.

In conjunction with this new capability, you can also:

- Provision an Exascale vault with specific storage resources from multiple storage pools using the same media type.
- Specify, either directly or indirectly using a template, the storage pool that contains a newly created file.
- Configure a single database with multiple storage pools of the same media type, enabling more precise placement of different database files or tablespaces.
- Move database data between storage pools online using Automatic Data Optimization (ADO).

These new capabilities provide more flexibility in using and managing Exascale storage resources, facilitating versatile data placement, and precise control of where data resides.

For example, if your Exadata environment includes both older and newer storage servers, you can create separate storage pools for each group. You can then map separate tablespaces to each pool and use ADO features in Oracle AI Database to define policies that place older or less frequently accessed data on the older servers, while keeping the most active data on the newer, higher-performance storage.

Related Topics

- About Exascale Storage Pools
- Provision a Vault Using Multiple Storage Pools for each Media Type
- Create an Exascale File
- Create a Vault Template
- Customizing the File Storage Attributes for Oracle Database Files

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- Using Automatic Data Optimization

2.1.7 Exascale Immutable Snapshots

Starting with Oracle Exadata System Software release 26.1.0, you can lock an Exascale snapshot (file or volume) to prevent its deletion before a specified future date and time. You can also make the lock immutable, which prevents users from removing the lock or changing it to expire earlier.

Immutable snapshots can help organizations meet financial or legal data retention requirements. They also provide tamper-resistant, time-based retention for Exascale files and volumes, helping customers create trusted point-in-time copies for compliance, ransomware recovery, and testing.

For example, during an audit or legal proceeding, an organization may need to preserve relevant data unchanged for the duration of the process. By applying an immutable lock, the organization prevents premature deletion or alteration of the data.

Related Topics

- About Exascale File Snapshots
- Lock File Snapshots
- About Exascale Volume Snapshots
- Lock Volume Snapshots

2.1.8 Flexible Resource Management Using Resource Profiles for Exascale Volumes

An Exascale resource profile is a named collection of resource limits and settings that controls how clients consume storage resources within an Exascale vault, including I/O bandwidth, flash cache space, and XRMEM cache space. Resource profiles simplify and standardize resource management by defining these settings once and applying them consistently to all associated clients. In most deployments, a small set of profiles is used to establish a resource hierarchy, with each client assigned to exactly one profile.

Before Oracle Exadata System Software release 26.1.0, administrators could associate Exascale resource profiles only with Oracle databases. Resource management for Exascale volumes and volume groups required separate configuration for each volume or volume group.

Starting with Oracle Exadata System Software release 26.1.0, administrators can also associate resource profiles with Exascale volumes and volume groups. This change aligns resource management across all clients that share an Exascale vault and enables consistent management of many Oracle databases, Exascale volumes, and volume groups.

Related Topics

- Intra-Vault Resource Management Using Exascale Resource Profiles
- Administer Resource Profiles
- Using Resource Profiles with Exascale Volumes

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2.1.9 Exascale Direct Volume Observability

Oracle Exadata System Software release 26.1.0 introduces the Exascale Direct Volume Statistics utility (`edvstat`), which provides real-time statistics about Exascale Direct Volume (EDV).

The `edvstat` utility improves observability on EDV client systems and enables administrators to understand:

- How much read and write I/O is being performed on each EDV attachment.
- How read and write I/O is being serviced through disk, flash cache, XRMEM cache, and remote direct memory access (RDMA).
- How read and write I/O further breaks down into various categories, including:
  - Large and small I/O.
  - Total number of I/O operations.
  - Total amount of I/O performed.
  - Number of I/O operations each second.
  - Amount of I/O performed each second.

The `edvstat` utility is conceptually similar to the Linux `iostat` utility, providing periodic snapshots of I/O performance for each storage and cache device. Storage administrators can run `edvstat` on demand to view real-time I/O performance and use flexible filtering to identify top-consuming volumes and volume groups. The output can use an `iostat`-like format or JSON format. ExaWatcher also includes `edvstat` output in its log files.

Use this feature to easily observe factors affecting EDV performance, including cache hit rates, RDMA read throughput, queue times, and average transfer rates.

2.1.10 Migrate Exadata Guest Image Files from Local Storage to Exascale

Oracle Exadata System Software release 26.1.0 enables users to migrate existing Exadata guest image files from local storage on the KVM host to Exascale shared storage.

Storing virtual machine (VM) guest image files in Exascale eliminates dependency on local storage in the KVM host, enabling Exadata to support more VM guests. Exascale also provides the storage infrastructure necessary for rapid image cloning, image snapshots, and Exadata VM Live Migration.

Related Topics

- Migrating Exadata Guest VM Images to Exascale Storage

2.1.11 IPv4 and IPv6 Coexistence and Conversion

Oracle Exadata System Software release 26.1.0 enables users to easily and reliably migrate Exadata database servers between IPv4 and IPv6, in either direction. Users can also implement a dual-stack configuration, allowing IPv4 and IPv6 to operate together.

With expanded networking capabilities in the Oracle Exadata Deployment Assistant (OEDA) Command Line Utility (OEDACLI), users can add or remove IPv4 and IPv6 network interfaces without downtime or server reboots.

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This feature extends existing Exadata support for IPv6 and provides more flexible network configuration options for Exadata systems, enabling customers to transition from IPv4 to dual-stack to IPv6 without planned server downtime or reboots.

Related Topics

- Using IPv4 and IPv6 in an Existing Deployment

2.1.12 Custom File System Layout

Oracle Exadata System Software release 26.1.0 enables users to customize the file system layout on Exadata database servers (KVM hosts and bare-metal configurations) using Exadata system hardware X8M-2 and later. Administrators can define site-specific layouts, including custom file system sizes and additional file systems.

This feature provides flexible storage configuration options that align with customer standards and support diverse application requirements in an automated and repeatable way. It can also improve local storage capacity utilization by allocating file system space according to site-specific requirements instead of relying only on the default layout.

Related Topics

- Customizing the Database Server File System Layout

2.1.13 Custom Guest Gold-Image

Oracle Exadata System Software release 26.1.0 introduces a gold-image workflow that enables Exadata administrators to create and maintain customized guest images for Exadata database server virtual machines (VMs). This enables administrators to create a customized Exadata-ready VM image once and use it repeatedly for consistent guest provisioning.

The workflow uses `libguestfs` tooling for offline image modification, along with Oracle Exadata Deployment Assistant (OEDA) Command Line Utility (OEDACLI) and Exascale volumes for cloning and deployment. Administrators can customize the system image, Oracle Grid Infrastructure (GI) software, Oracle Database software, and extra disks, and update the Engineered System XML configuration file to provision new guests from the customized images.

This capability helps Exadata administrators support diverse application requirements, provision repeatable configurations more quickly, and reduce repeated post-provisioning customization.

For further details and requirements, see Customizing the Guest Image.

2.1.14 Extended Cache Space Management in the IORM Cluster Plan

Exadata I/O Resource Management (IORM) enables predictable performance by guaranteeing space in Exadata Smart Flash Cache and Exadata RDMA Memory Cache (XRMEM cache). Existing capabilities govern cache space usage across various container databases (CDBs) and pluggable databases (PDBs), while Exascale also facilitates cache space management across different Exascale vaults and resource groups.

Oracle Exadata System Software release 26.1.0 extends these existing cache management capabilities by enabling cache management definitions in the IORM cluster plan. The IORM cluster plan specifies how storage server resources are allocated across multiple Oracle Grid Infrastructure (GI) clusters. In the cluster plan, each directive specifies an allocation to a GI cluster, rather than an individual database or consumer group.

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Starting with Oracle Exadata System Software release 26.1.0, each directive in the IORM cluster plan can specify separate minimum and maximum space allocations for both Exadata Smart Flash Cache and XRMEM cache. These settings manage cache space at the GI cluster level and enable databases without explicit cache settings to share the respective cluster-level allocation for each cache.

Related Topics

- About Flash Cache Management in IORM Plans
- About XRMEM Cache Management in IORM Plans
- ALTER IORMPLAN

2.1.15 Other Changes in This Release

Please note the following changes that take effect with Oracle Exadata System Software release 26.1.0:

- In the I/O Resource Management (IORM) plan, the `flashCacheLimit` and `xrmemCacheLimit` attributes are deprecated, and a warning message is issued when either attribute is set in the IORM interdatabase plan (`dbplan`).

  See also, ALTER IORMPLAN.

- The default administrator username for the GRUB boot loader changes from `root` to `grub-admin`.

  See also, Default User Accounts for Oracle Exadata.

- Java is unbundled from Oracle Exadata Deployment Assistant (OEDA).

  If you are using a version of OEDA released in conjunction with Oracle Exadata System Software release 26.1.0 or later, ensure that any system running OEDA programs contains Java Development Kit (JDK) version 17 or later. You can download a supported JDK from https://www.oracle.com/java/technologies/downloads/.

  See also, Overview of Oracle Exadata Deployment Assistant.

- The Oracle Exadata Deployment Assistant (OEDA) application server, which powers the OEDA browser-based interface, contains optional support for HTTPS.

  See also, Getting Started with the OEDA Browser-Based User Interface.

- The `patchmgr` and `dcli` utilities include options to accept paths to customer-trusted executables for `scp` and `ssh`. This helps customers use approved executable paths in hardened environments.

  See also:

  - Patchmgr Syntax for Storage Servers
  - Patchmgr Syntax for Database Servers
  - dcli Syntax

2.1.16 Minimum Versions and Other Requirements

The following list outlines the minimum versions and other requirements that apply to Oracle Exadata System Software release 26.1.0:

- Minimum supported Oracle Grid Infrastructure releases:
  - Release 19c: Version 19.28, July 2025 Release Update (RU)

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  - Release 23ai: Version 23.9 (July 2025)
  - Release 26ai: Version 26ai (Oct 2025)
- Minimum supported Oracle Database releases:
  - Release 19c: Version 19.28, July 2025 Release Update (RU)
  - Release 23ai: Version 23.9 (July 2025)
  - Release 26ai: Version 26ai (Oct 2025)
- Minimum system hardware versions:
  - 2-socket: Oracle Exadata X7-2
  - 8-socket: Oracle Exadata X7-8
- Minimum Oracle Exadata System Software version required on an existing system before updating to release 26.1.0:
  - Oracle Exadata System Software 24.1.13 (June 2025)
  - Oracle Exadata System Software 25.1.6 (June 2025)
  - Oracle Exadata System Software 25.2.0 (July 2025)

> **Note**
>
> On systems configured with virtual machines (VMs) on the database servers, you can upgrade the hypervisor (Oracle VM Server or Oracle Linux KVM) before or after the guest VMs. However, each VM guest must meet the minimum Oracle Exadata System Software requirement before being upgraded. Likewise, the hypervisor must meet the minimum Oracle Exadata System Software requirement before being upgraded.

Related Topics

- Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930)

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3

New Features for Oracle Exadata System Software 25ai

This section describes the new features introduced in Oracle Exadata System Software 25ai (release 25.x).

- What's New in Oracle Exadata System Software Release 25.2
- What's New in Oracle Exadata System Software Release 25.1

3.1 What's New in Oracle Exadata System Software Release 25.2

- Exadata Storage Server X11M Extended (XT)
- AI Smart Scan Enhancements
- Immediate Reuse of Flash Cache for Temporary Data
- Improved OLTP Performance Using Partner Cache Reads
- Prioritize Critical Large Writes in Flash Cache
- Improved Data Durability with Exascale Delta Tracking
- Exascale Intelligent Free Space Management
- Exascale Volume Groups
- JSON Support in Exascale Shell (XSH)
- Stronger Security with SELinux Enabled by Default
- Optimized Linux OS Image
- Elastic Rack Configurations in OEDA
- Storage Server SQL Query Statistics Monitoring
- Minimum Versions and Other Requirements

3.1.1 Exadata Storage Server X11M Extended (XT)

Oracle Exadata System Software release 25.2.0 introduces support for Exadata Storage Server X11M Extended (XT).

Exadata Storage Server X11M XT is the first XT storage server available with Oracle Exadata Exascale, enabling many users and database clusters to share a large pool of cost-effective online storage for less frequently accessed data, with strict security and data isolation.

To maximize storage capacity, you may use Exadata Hybrid Columnar Compression in conjunction with Exadata X11M XT storage. Also, you can optionally license Oracle Exadata System Software on X11M XT to utilize smart storage capabilities such as Exadata Smart Scan.

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For seamless expansion of existing implementations, you can add Exadata X11M XT storage to systems with previous-generation XT storage servers.

Each Exadata X11M XT storage server comes equipped with:

- 1 x AMD EPYC 32-core CPU, which is up to 11% faster than the CPUs in previous generation XT storage servers.
- 2 x 6.8 TB performance-optimized flash devices, making it the first XT storage server with Exadata Smart Flash Cache.
- 12 x 22 TB hard disk drives, providing 264 TB of raw disk capacity on each Exadata X11M XT server.

See Exadata Storage Server X11M Extended Hardware Components for details.

3.1.2 AI Smart Scan Enhancements

Oracle AI Database includes artificial intelligence (AI) vector search capabilities designed to efficiently query data based on semantic similarities. Oracle AI Vector Search enables applications like voice assistants, chatbots, language translators, recommendation systems, and anomaly detection systems. AI Vector Search also facilitates sophisticated search and recognition capabilities on images and videos.

Complementing Oracle AI Vector Search, Oracle Exadata System Software includes AI Smart Scan, a collection of Exadata-specific optimizations capable of improving the performance of various AI vector query operations by orders of magnitude.

AI Smart Scan automatically accelerates Oracle AI Vector Search with optimizations that deliver low-latency parallelized scans across massive volumes of vector data. It processes vector data at memory speed, leveraging ultra-fast Exadata RDMA Memory (XRMEM) and Exadata Smart Flash Cache in the Exadata storage servers. AI Smart Scan also performs vector distance computations and top-K filtering at the data source, avoiding unnecessary network data transfer and database server processing.

Oracle Exadata System Software release 25.2.0 includes the following AI Smart Scan enhancements:

- Optimized support for neighbor partition vector indexes with included columns.

  Previously, queries combining business data and AI vector searches required reads on the base table to evaluate relational predicates. For example, in the following query, rows returned by the vector search still require additional reads on the `houses` table to apply the filters on `price` and `zipcode`, and to retrieve the `address` and `price` values.

  ```
  SQL> SELECT address, price
       FROM houses
       WHERE price < 950000 and zipcode = 94065
       ORDER BY VECTOR_DISTANCE(description_vector, :query_vector)
       FETCH APPROX FIRST 10 ROWS ONLY;
  ```

  Starting with Oracle AI Database release 23.7, neighbor partition vector indexes can include additional columns containing business data. For example:

  ```
  SQL> CREATE VECTOR INDEX house_idx ON houses(description_vector)
       INCLUDE (address, price, zipcode)
       ORGANIZATION NEIGHBOR PARTITIONS;
  ```


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With Oracle Exadata System Software release 25.2.0, AI Smart Scan can process these types of queries using only the vector index, with the included relational columns, which significantly improves overall query performance by eliminating the base table lookups.

- Sparse vectors

  In conjunction with Oracle AI Database release 23.7 or later, Oracle Exadata System Software release 25.2.0 enables AI Smart Scan using sparse vectors.

  Sparse vectors typically have many dimensions but contain very few non-zero values. Sparse encoding models, such as SPLADE and BM25, generate sparse vectors. In suitable applications, such as natural language processing, sparse vectors offer considerable performance advantages, enabling faster query processing while reducing memory and CPU usage.

3.1.3 Immediate Reuse of Flash Cache for Temporary Data

Oracle Database uses temporary (TEMP) segments to store intermediate results during various operations such as table joins and data sorting. On Exadata, TEMP data is primarily written to Exadata Smart Flash Cache to maximize performance.

Historically, like other data, TEMP data is written to disk when 'hotter' data requires the flash cache space. However, in many cases, the data written to disk is never reused because the database has completed the associated operation.

Oracle Exadata System Software release 25.2.0 introduces optimizations that enable a storage server to discard TEMP data from the flash cache immediately after Oracle Database completes the operation using it. This capability, which is unique to Exadata, optimizes flash cache space utilization and improves overall system performance by avoiding unnecessary disk I/Os and immediately freeing up valuable flash cache resources for reuse by other clients.

This capability is automatically enabled in conjunction with the following Oracle Database versions:

- Oracle Database 19c version 19.31 (April 2026) or later
- Oracle Database 26ai version 23.26.0 (October 2025) or later

3.1.4 Improved OLTP Performance Using Partner Cache Reads

When a storage server resumes operation following planned maintenance, unplanned failure, or replacement of a hard disk drive or flash device, the Exadata Smart Flash Cache may not contain recently accessed data. However, a secondary copy of the recently accessed data normally resides in the cache of a partner storage server.

Oracle Exadata System Software release 25.2.0 introduces enhancements to caching algorithms and supporting infrastructure, enabling a storage server to perform a partner read to a remote cache rather than a more expensive disk read on the local server.

In this release, partner cache reads are enabled for OLTP workloads from clients using Oracle ASM. In this case, partner cache reads automatically transform local flash cache misses into remote cache hits, improving read I/O performance and minimizing disk reads. No user or administrator effort is required.

This capability also requires Oracle Database with patch 38047996.

Related Topics

- Monitoring Exadata Smart Flash Cache

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3.1.5 Prioritize Critical Large Writes in Flash Cache

Exadata optimizes the performance of large analytical queries and data-loading operations by absorbing large writes in Exadata Smart Flash Cache. Exadata limits the amount of flash cache space allocated to this purpose so that large writes cannot flood the cache and impact other workloads. However, Exadata historically could not distinguish between different categories of large writes, and all large writes had to share the same flash cache resources regardless of their relative performance implications.

Oracle Exadata System Software release 25.2.0 introduces algorithms to prioritize large writes in Exadata Smart Flash Cache. Under this arrangement, priority is granted to large writes associated with specific operations that consistently deliver the greatest performance benefits. The priority list primarily includes large writes associated with temporary (TEMP) segments and flashback logging.

Prioritization of large writes in Exadata Smart Flash Cache occurs only when flash cache utilization exceeds 50%, either in terms of overall flash cache space usage or in terms of the flash cache space allocated to the associated Exadata I/O Resource Management (IORM) group. When utilization is below the 50% threshold, all large writes have the same opportunity to use the cache as before. While utilization exceeds the 50% threshold, only prioritized large writes are allowed to use the cache.

3.1.6 Improved Data Durability with Exascale Delta Tracking

Oracle Exadata System Software release 25.2.0 introduces optimizations for handling multiple failures impacting all mirrored data copies on Exascale.

Previously, Exascale responded to disk failure by forcibly dropping the associated pool disk. This approach enabled the storage pool to quickly start a rebalance operation and restore full redundancy, but it provided no opportunity to rescue the failed disk. Also, in the rare case where multiple failures impact all mirrored data copies, forcibly dropping all of the corresponding pool disks causes data loss within the storage pool.

Starting with Oracle Exadata System Software release 25.2.0, Exascale immediately responds to a disk failure by taking the affected pool disks offline rather than dropping them. If any mirror copies remain intact, Exascale simultaneously tracks new writes as deltas on the remaining online disks and begins rebuilding full data redundancy on other available disks.

If a failed disk comes back online before full redundancy is restored, it is quickly synchronized using the stored deltas, minimizing impact and enhancing data durability.

Data durability is further improved in the rare event that all mirrors are affected by multiple simultaneous failures. In such cases, the affected storage pool ring goes offline but can be restored by bringing any one of the failed disks back online.

3.1.7 Exascale Intelligent Free Space Management

Starting with Oracle Exadata System Software release 25.2.0, Exascale monitors every storage pool to ensure that there is sufficient free space to restore full data redundancy in the event of a disk failure. If the available free space drops below the minimum requirement while all disks are healthy, a low-space alert is issued, warning that redundancy will be compromised if a disk fails.

Furthermore, if a disk fails while there is insufficient space to restore redundancy, the rebuild operation triggered by the disk failure is automatically paused. This pause allows administrators to add storage space or delete unnecessary files. Then, when the storage pool

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contains the necessary free space, Exascale automatically resumes the rebuild to restore full data redundancy.

3.1.8 Exascale Volume Groups

Oracle Exadata System Software release 25.2.0 introduces volume groups in Exascale. A volume group is a specific collection of Exascale volumes.

Volume groups can be used to:

- Easily identify volumes with a common purpose or inherent relationship, such as the volumes with a specific virtual machine (VM).
- Efficiently create point-in-time consistent snapshots of all volumes in a volume group.
- Collectively manage I/O resources consumed by all volumes in the group.

Related Topics

- About Volume Groups

3.1.9 JSON Support in Exascale Shell (XSH)

Oracle Exadata System Software release 25.2.0 introduces JSON support in the Exascale shell command-line interface (XSH). Using this feature, you can instruct XSH to provide command output in JSON format. This capability enables the production of complex output in JSON format for parsing by downstream processes.

The JSON output provided by XSH supports additional details, which may include the command string, XSH version, trace location, wallet location, and error code. By default, the JSON is in a human-readable format with standardized spacing and indentation. Optionally, you can request JSON output in a condensed format optimized for digital processing without unnecessary white space or indentation.

Related Topics

- Using XSH

3.1.10 Stronger Security with SELinux Enabled by Default

Starting with Oracle Exadata System Software release 25.2.0, all new Exadata implementations use SELinux in permissive mode by default, significantly strengthening the default Exadata security posture.

The default configuration includes a pre-built SELinux policy that is custom-engineered for Exadata and Oracle Database, enabling seamless adoption. Additional custom policies are also allowed to support 3rd-party or implementation-specific software requirements.

Monitoring SELinux in permissive mode enables the identification of potential issues, providing the opportunity to take corrective action to ensure the security and integrity of Exadata environments. Starting with permissive mode enables easy adoption and is the ideal preparation before manually moving to a mode that strictly enforces the SELinux security policies.

Related Topics

- Using Security-Enhanced Linux

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3.1.11 Optimized Linux OS Image

Oracle Exadata System Software release 25.2.0 contains further optimizations to the Linux operating system (OS) image, reducing the overall image size by refining the included packages and dependencies. Apart from improving resource utilization by reducing storage space requirements, the optimized Linux OS image facilitates stronger security and integrity by minimizing exposure to potential vulnerabilities and exploits.

3.1.12 Elastic Rack Configurations in OEDA

Oracle Exadata System Software release 25.2.0 introduces enhancements to Oracle Exadata Deployment Assistant (OEDA), supporting the configuration and deployment of fully elastic racks. With the release, the OEDA Web user interface continues to support all factory-shipped Exadata configurations, along with elastic rack configurations mixing valid combinations of storage and compute servers spanning different hardware models.

Elastic rack configuration drastically improves flexibility, enabling:

- Easy consolidation of hardware spanning multiple generations in a rack to save data center space.
- Flexible reuse and re-racking of existing Exadata hardware to prolong its usefulness.
- Flexible server placement in each rack to maximize rack density.
- Complex network configurations with a mixture of network speeds and interfaces.
- Complex storage configurations supporting multiple ASM disk groups and Exascale storage pools across a mixture of storage media types (High Capacity [HC], Extreme Flash [EF], and Extended [XT]) and storage server models (X11M, X10M, and so on).
- Faster deployment and better life-cycle management for all deployments.

3.1.13 Storage Server SQL Query Statistics Monitoring

Oracle Exadata System Software release 25.2.0 introduces the Exadata Storage Server SQL Statistics utility (`cellsqlstat`), which provides real-time query-level statistics in each storage server.

The `cellsqlstat` utility enables administrators to better monitor and understand query-level storage server resource utilization, providing detailed insight into numerous statistics including:

- CPU and memory consumption
- I/O savings associated with storage index and columnar cache
- Flash cache and XRMEM cache hits
- Scanned bytes and scan rate
- Passthru bytes and rate

The `cellsqlstat` utility provides a periodic snapshot of performance statistics for the top SQL statements, helping administrators to:

- Quickly summarize the query workload on each storage server.
- Rapidly identify resource-heavy queries and understand their resource utilization.
- Identify performance bottlenecks and "noisy neighbor" issues.

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Storage administrators can run `cellsqlstat` on demand to understand real-time SQL performance. Additionally, ExaWatcher includes `cellsqlstat` output in its log files.

3.1.14 Minimum Versions and Other Requirements

The following list outlines the minimum versions and other requirements that apply to Oracle Exadata System Software 25.2.0:

- Minimum supported Oracle Grid Infrastructure releases:
  - Release 19c: Version 19.24, July 2024 Release Update (RU)
  - Release 23ai: Version 23.5 (July 2024)
- Minimum supported Oracle Database releases:
  - Release 19c: Version 19.24, July 2024 Release Update (RU)
  - Release 23ai: Version 23.5 (July 2024)
- Minimum system hardware versions:
  - 2-socket: Oracle Exadata X7-2
  - 8-socket: Oracle Exadata X7-8
- Minimum Oracle Exadata System Software version required on an existing system before updating to release 25.2.0:
  - Oracle Exadata System Software 22.1.24 (June 2024)
  - Oracle Exadata System Software 23.1.15 (June 2024)
  - Oracle Exadata System Software 24.1.1 (June 2024)
  - Oracle Exadata System Software 25.1.0 (December 2024)

> **Note**
>
> On systems configured with virtual machines (VMs) on the database servers, you can upgrade the hypervisor (Oracle VM Server or Oracle Linux KVM) before or after the guest VMs. However, each VM guest must meet the minimum Oracle Exadata System Software requirement before being upgraded. Likewise, the hypervisor must meet the minimum Oracle Exadata System Software requirement before being upgraded.

Related Topics

- Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930)

3.2 What's New in Oracle Exadata System Software Release 25.1

- Oracle Exadata X11M Support
- Advanced Power Management on Exadata Database Servers
- AI Smart Scan Enhancements
- Simpler Management of Additional Software Packages During Database Server Updates

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- Automatic Tuning of ASM Rebalance Operations
- Improved Free Space Management in Exascale
- Creating an Exascale Volume Clone Directly from an Existing Volume
- Secure Fabric is Recommended and Enabled by Default
- Exadata Cache Observability Enhancements
- Faster Software Upgrade on Cisco Network Switches
- Other Changes in This Release
- Minimum Versions and Other Requirements
- Desupport of the IORM Category Plan

3.2.1 Oracle Exadata X11M Support

Oracle Exadata System Software release 25.1.0 introduces support for the Oracle Exadata X11M system family.

Exadata X11M is the fourth generation of system hardware based on RoCE Network Fabric and builds on the outstanding capabilities of previous models. Highlights include:

- Exadata X11M database servers and storage servers are equipped with the latest 5th generation AMD EPYC™ CPUs, which provide more processing power and are more energy efficient than previous generations.
- Exadata X11M database servers include advanced power management capabilities that enable users to reduce power consumption by:
  - Switching off unused database server CPU cores.
  - Specifying an overall power consumption target for the database server.
  - Using a low power mode when low usage is anticipated, such as overnight or during the weekend.

  See Advanced Power Management on Exadata Database Servers.
- Exadata X11M database servers and storage servers are equipped with high-performance 6400MT/s DDR5 DRAM, providing increased performance for memory-based operations.
- Exadata X11M storage servers are equipped with PCIe Gen 5 (PCIe 5.0) performance-optimized flash devices, delivering increased performance for Exadata Smart Flash Cache and Exadata Smart Flash Log.

In addition to the overall system improvements, Exadata X11M introduces new system options, providing customers with more choice and flexibility:

- New Exadata X11M-Z database and storage servers make Exadata accessible for smaller applications and databases while delivering legendary Exadata performance and scalability.
- All Exadata X11M systems are offered as flexible configurations, starting with at least two database servers and three storage servers. Customers can start with an economical and flexible configuration using Exadata X11M-Z database and storage servers. Later, they can expand the system by adding more X11M-Z servers or larger X11M servers. As a result, the fixed Eighth Rack configuration is not required and is no longer available.

See Hardware Components of Oracle Exadata Database Machine for details.

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For Oracle Grid Infrastructure and Oracle Database version compatibility, see Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930).

3.2.2 Advanced Power Management on Exadata Database Servers

In conjunction with Exadata X11M system hardware, Oracle Exadata System Software release 25.1.0 introduces advanced power management capabilities that enable users to reduce power consumption on Exadata database servers. These include:

- Powering off unused database server CPU cores.

  On each Oracle Exadata X11M database server, you can automatically power off 64 unused CPU cores (32 CPU cores on each socket) by setting the `pendingCoreCount` attribute to 128 or lower and then rebooting the server. Powering off these unused CPU cores provides substantial energy savings without affecting overall system performance.

  When required, you can power on and enable the unpowered CPU cores by setting the `pendingCoreCount` attribute to a value above 128 and then rebooting the server.

- Specifying an overall power consumption target for the database server.

  Using this capability, you can limit database server power consumption to fulfill regulatory requirements, control cooling requirements, or meet environmental targets.

  Note that limiting the server power consumption also constrains the peak server processing capacity. When processing demands are lower than the processing capacity available under the power consumption target, limiting power consumption does not affect performance. However, system performance is impacted when the workload requires more processing capacity than is available under the power consumption target. Typically, there is a good correlation between power consumption and server processing capacity. For example, if you reduce power consumption by 10%, you should expect a similar reduction in peak processing capacity.

- Using a low power mode at times when low usage is anticipated, such as overnight or during the weekend, for example.

  Using this capability, you can define a schedule to automatically use a low power mode during predictable low-demand periods. You can also manually switch the low power mode on or off. At all times, the system monitors demand and automatically switches off the low power mode to protect system performance if required.

Related Topics

- Managing Exadata Database Server Power Consumption

3.2.3 AI Smart Scan Enhancements

Oracle AI Database includes artificial intelligence (AI) vector search capabilities designed to efficiently query data based on semantic similarities. Oracle AI Vector Search enables applications like voice assistants, chatbots, language translators, recommendation systems, and anomaly detection systems. AI Vector Search also facilitates sophisticated search and recognition capabilities on images and videos.

Complementing Oracle AI Vector Search, Oracle Exadata System Software includes AI Smart Scan, a collection of Exadata-specific optimizations capable of improving the performance of various AI vector query operations by orders of magnitude.

AI Smart Scan automatically accelerates Oracle AI Vector Search with optimizations that deliver low-latency parallelized scans across massive volumes of vector data. It processes

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vector data at memory speed, leveraging ultra-fast Exadata RDMA Memory (XRMEM) and Exadata Smart Flash Cache in the Exadata storage servers. AI Smart Scan also performs vector distance computations and top-K filtering at the data source, avoiding unnecessary network data transfer and database server processing.

In Oracle Exadata System Software release 25.1.0, AI Smart Scan includes the following enhancements:

- Top-K filtering performance and efficiency improve by maintaining a running top-K set in each storage server.

  Before Oracle Exadata System Software release 25.1.0, AI Smart Scan returns the top-K results to the database server for each region of data being processed.

  With Oracle Exadata System Software release 25.1.0, each storage server maintains a running set for each AI Smart Scan top-K operation. As the operation proceeds, each storage server only returns results that improve the previously returned results. Results outside the running top-K are filtered out and not sent to the database server. This method sends much less data to the database server for processing, reducing traffic on the storage network and improving top-K search performance.

- AI Smart Scan supports vectors with INT8 or BINARY dimensions.

  Before Oracle Exadata System Software release 25.1.0, AI Smart Scan supported vectors with high-precision (FLOAT32 or FLOAT64) dimensions. Vectors with high-precision dimensions facilitate very accurate vector comparison and search operations, requiring more memory and processing power.

  Oracle Exadata System Software release 25.1.0 extends AI Smart Scan to support vectors with INT8 or BINARY dimensions. Vectors using INT8 or BINARY dimensions trade away a modest degree of accuracy for significant efficiency and performance gains.

  For example, compared with FLOAT32, vectors with BINARY dimensions are 32 times smaller, and distance computation is up to 40 times faster. But the effect on search accuracy is minimal with some evaluations using the Massive Text Embedding Benchmark (MTEB) showing only a 6% difference in search quality. Also, vectors with INT8 dimensions are one-quarter the size of FLOAT32 (4x compression), and some MTEB evaluations show a negligible difference in search quality between them.

- AI Smart Scan projects vector distances.

  Before Oracle Exadata System Software release 25.1.0, AI Smart Scan performed filtering operations based on vector distance calculations to avoid transmitting unnecessary vector data to the database server. However, when vector distance was selected (projected) as part of the query, that vector distance calculation was performed on the database server.

  With Oracle Exadata System Software release 25.1.0, for projected vector distances, AI Smart Scan performs CPU-intensive vector distance calculations inside the storage server and sends the calculated values back to the database server. This optimization avoids sending large amounts of vector data to the database server for vector distance calculations, reducing traffic on the storage network and improving performance for queries with vector distance projections.

3.2.4 Simpler Management of Additional Software Packages During Database Server Updates

Installing and updating additional (non-Exadata) software packages (RPMs) is allowed on Oracle Exadata database servers as long as the kernel and RDMA Network Fabric packages are not altered.

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However, customizing the operating system by adding or updating packages may introduce problems when applying an Oracle Exadata System Software update because the additional software may introduce new dependencies outside the scope of the Exadata update. For this reason, Oracle recommends only minimal and essential customization.

Before Oracle Exadata System Software release 25.1.0, customers managed update issues associated with additional software using various non-integrated approaches. Typically, the most reliable approach was to remove the additional software before performing the Exadata update and then re-install the additional software afterward. This approach required extra work, increasing the maintenance window. Furthermore, removing additional security-related software could conflict with company policies, introduce auditing and compliance issues, and even lock down the server in question.

For updates that do not change the major Oracle Linux version number, Oracle Exadata System Software release 25.1.0 introduces options to update additional non-Exadata software packages as part of an Exadata database server update operation. This integrated capability enables you to easily handle software package dependency issues that arise when additional non-Exadata software packages are installed on the system.

With this capability, you can iteratively run patchmgr with the `--precheck` option to find and resolve package dependency issues associated with any additional non-Exadata software packages installed on the system. After you understand the additional package updates required for a clean update, you can confidently perform the Exadata database server update and update the additional packages at the same time.

Related Topics

- Installing, Updating, and Managing Additional Software Packages
- Patchmgr Syntax for Database Servers

3.2.5 Automatic Tuning of ASM Rebalance Operations

Occasionally, Oracle Automatic Storage Management (Oracle ASM) must perform a data rebalance operation. A data rebalance operation may be required for various reasons, including:

- To resynchronize data after a storage server rolling update.
- To restore the desired data redundancy after a hard disk failure.
- To maintain even data distribution after adding a storage server.

Oracle ASM uses the `asm_power_limit` parameter to control the resource limit for data rebalance operations. Setting `asm_power_limit` to a low value provides minimal resources, which enables the operation to proceed slowly with minimal disruption to other database workloads. Setting `asm_power_limit` to a high value offers more resources, resulting in quicker data rebalance operations. However, this can adversely impact other database workloads.

In conjunction with Oracle Grid Infrastructure release 23ai or later, Oracle Exadata System Software release 25.1.0 introduces enhancements and algorithms that dynamically tune `asm_power_limit` to enable data rebalance operations to run as fast as possible without negatively impacting other database workloads.

Under this capability, Oracle Exadata System Software continuously monitors I/O performance and automatically raises the `asm_power_limit` value when the system has plenty of available I/O bandwidth. Likewise, when the system detects client database workloads, it automatically lowers the `asm_power_limit` value to prioritize those workloads.

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3.2.6 Improved Free Space Management in Exascale

Oracle Exadata System Software release 25.1.0 introduces improvements in the internal space management algorithms for Exascale storage pools. With these enhancements, administrators need to maintain significantly less free space to perform an automatic data rebalance operation after the failure of a main storage device.

For example, when an Exascale storage pool occupies three High Capacity (HC) storage servers (each with 12 disks), the amount of free space that should be maintained to successfully rebalance a storage pool after losing one disk is 12%.

Furthermore, less free space must be maintained as more storage servers are used. When an Exascale storage pool occupies nine or more HC storage servers, the free space that should be maintained drops to only 3%.

Related Topics

- Maintain Free Space in a Storage Pool to Protect Against Disk Failure

3.2.7 Creating an Exascale Volume Clone Directly from an Existing Volume

Oracle Exadata System Software release 25.1.0 introduces the capability to create an Exascale volume clone directly from an existing Exascale volume using a single command.

This new capability simplifies the procedure for cloning a volume. Previously, you had to use separate commands to:

1. Create an Exascale volume snapshot.
2. Clone the snapshot.

Related Topics

- Create a Volume Clone Directly from an Existing Volume

3.2.8 Secure Fabric is Recommended and Enabled by Default

Exadata Secure RDMA Fabric Isolation is recommended and enabled by default on all new Oracle Exadata configurations using VM clusters.

Exadata Secure RDMA Fabric Isolation enables strict network isolation for virtual machine (VM) clusters on Oracle Exadata systems that use RDMA over Converged Ethernet (RoCE).

Secure Fabric provides critical infrastructure for secure consolidation of multiple tenants on Oracle Exadata, where each tenant resides in a dedicated VM cluster. Using this feature ensures that:

- Database servers in separate clusters cannot communicate with each other. They are completely isolated from each other on the network.
- Database servers in multiple clusters can share all of the storage server resources. However, even though the different clusters share the same storage network, no cross-cluster network traffic is possible.

In the Oracle Exadata Deployment Assistant (OEDA) included with Oracle Exadata System Software release 25.1.0, the option to enable Secure Fabric is selected by default for all new configurations using VM clusters. Secure Fabric is also enabled by default in all OEDA versions commencing with the October 2024 Oracle Exadata System Software maintenance releases (24.1.5, 23.1.19, and 22.1.28).

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Related Topics

- Using Exadata Secure RDMA Fabric Isolation

3.2.9 Exadata Cache Observability Enhancements

Oracle Exadata System Software release 24.1.0 introduced the Exadata Storage Cache Statistics utility (`ecstat`), which provides real-time statistics about Exadata Smart Flash Cache.

The `ecstat` utility improves cache observability on each Exadata storage server, enabling valuable insight into various aspects of storage server performance, including:

- What is the balance of I/O operations across the main storage and Exadata Smart Flash Cache?
- How are different types of I/O operations (small reads, large reads, small writes, and large writes) serviced in the storage server?
- What is the I/O throughput provided by main storage and Exadata Smart Flash Cache?
- Is Exadata Smart Flash Cache performing well, or is it undersized?

The `ecstat` utility is conceptually similar to the Linux `iostat` utility, providing a periodic snapshot of I/O performance for each storage and cache device. Storage administrators can run `ecstat` on demand to understand real-time I/O performance. Additionally, ExaWatcher includes `ecstat` output in its log files.

The `ecstat` utility in Oracle Exadata System Software release 25.1.0 contains the following enhancements:

- In addition to providing aggregated statistics about I/Os to main storage, `ecstat` also displays the top reasons why I/O was not satisfied using Exadata Smart Flash Cache. For example, the I/O was "marked as nocache", or the data was not cached as part of a "large write". This enhancement enables administrators to understand why some I/Os cannot be cached and also highlights I/Os that could benefit from a larger cache or redistribution of the available caching resources.
- In addition to displaying I/O performance statistics for each storage and cache device, `ecstat` also displays performance statistics for the top I/O consumers. The top consumers are displayed in two ways:
  - The top space consumers are ranked according to the total space allocated to each consumer in Exadata Smart Flash Cache. In this context, consumers can be databases that are explicitly specified in the IORM plan or they can be other entities that are implicitly included in the IORM plan, such as Exascale vaults and volumes.
  - The top IOPS consumers are sorted by total I/O throughput, in I/Os per second (IOPS). In this case, metadata embedded with each I/O identifies the consumers.

  By default, each list of top I/O consumers displays the top 10 consumers. However, `ecstat` can display up to 100 consumers in each list.

  These enhancements provide additional insight into the consumption of Exadata Smart Flash Cache resources, which can be used to adjust resource allocations or confirm that existing arrangements are working as expected.

3.2.10 Faster Software Upgrade on Cisco Network Switches

Oracle Exadata System Software release 25.1.0 includes NX-OS 10.3(6), which is the current recommended Cisco system software release for the Cisco Management Network Switch and the Cisco RoCE Network Fabric Switches.

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In addition to the general performance and security enhancements contained in NX-OS 10.3(6), the update procedure for NX-OS 10.3(6) has been optimized, resulting in substantially quicker updates. Depending on the switch being updated and its configuration, the overall time required to perform the update is reduced by up to 44%.

3.2.11 Other Changes in This Release

Please note the following change that takes effect with Oracle Exadata System Software release 25.1.0:

- Non-root operating system user accounts on Oracle Exadata database servers and storage servers are automatically locked after 35 days of inactivity.

  See also, Default User Security Settings.

> **Note**
>
> When updating from any Oracle Exadata System Software release earlier than 25.1.0, non-root user accounts that have been inactive for more than 35 days may be locked immediately after updating to release 25.1.0 or later.

3.2.12 Minimum Versions and Other Requirements

The following list outlines the minimum versions and other requirements that apply to Oracle Exadata System Software 25.1.0:

- Minimum supported Oracle Grid Infrastructure releases:
  - Release 19c: Version 19.23, April 2024 Release Update (RU)
  - Release 23ai: Version 23.5 (July 2024)
- Minimum supported Oracle Database releases:
  - Release 19c: Version 19.21, October 2023 Release Update (RU)
  - Release 23ai: Version 23.5 (July 2024)
- Minimum system hardware versions:
  - 2-socket: Oracle Exadata X7-2
  - 8-socket: Oracle Exadata X7-8
- Minimum Oracle Exadata System Software version required on an existing system before updating to release 25.1.0:
  - Oracle Exadata System Software 22.1.18 (December 2023)
  - Oracle Exadata System Software 23.1.9 (December 2023)
  - Oracle Exadata System Software 24.1.0 (May 2024)

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> **Note**
>
> On systems configured with virtual machines (VMs) on the database servers, you can upgrade the hypervisor (Oracle VM Server or Oracle Linux KVM) before or after the guest VMs. However, each VM guest must meet the minimum Oracle Exadata System Software requirement before being upgraded. Likewise, the hypervisor must meet the minimum Oracle Exadata System Software requirement before being upgraded.

Related Topics

- Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930)

3.2.13 Desupport of the IORM Category Plan

Starting with Oracle Exadata System Software release 25.1.0, the Exadata I/O Resource Management (IORM) category plan (`catplan`) is removed and no longer supported.

Related Topics

- Deprecation of the IORM Category Plan

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4

New Features for Oracle Exadata System Software 24ai

This section describes the new features introduced in Oracle Exadata System Software 24ai (release 24.x).

- What's New in Oracle Exadata System Software Release 24.1

4.1 What's New in Oracle Exadata System Software Release 24.1

- AI Smart Scan
- Oracle Exadata Exascale
- Increased Number of Virtual Machines on Database Servers
- Columnar Cache on Exadata RDMA Memory (XRMEM)
- Exadata Cache Observability
- Automatic Loading of KEEP Objects into Exadata Smart Flash Cache
- Improved RoCE Network Resilience
- Enhanced RoCE Network Discovery
- Exadata Live Update
- Ready-to-go System Image for New KVM Guests
- KVM Guest Secure Boot
- SNMP Security Enhancements
- JSON Output from Management Server
- Features Coupled with Oracle Database 23ai
- Minimum Versions and Other Requirements

4.1.1 AI Smart Scan

Oracle AI Database includes artificial intelligence (AI) vector search capabilities designed to efficiently query data based on semantic similarities. Oracle AI Vector Search enables applications like voice assistants, chatbots, language translators, recommendation systems, and anomaly detection systems. AI Vector Search also facilitates sophisticated search and recognition capabilities on images and videos.

Complementing Oracle AI Vector Search, Oracle Exadata System Software release 24.1.0 introduces AI Smart Scan, a collection of Exadata-specific optimizations capable of improving the performance of various AI vector query operations by orders of magnitude.

AI Smart Scan automatically accelerates Oracle AI Vector Search with optimizations that deliver low-latency parallelized scans across massive volumes of vector data. AI Smart Scan

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processes vector data at memory speed, leveraging ultra-fast Exadata RDMA Memory (XRMEM) and Exadata Smart Flash Cache in the Exadata storage servers, and performs vector distance computations and top-K filtering at the data source, avoiding unnecessary network data transfer and database server processing.

4.1.2 Oracle Exadata Exascale

Oracle Exadata System Software release 24.1.0 introduces Oracle Exadata Exascale.

Oracle Exadata Exascale further empowers Exadata to meet the most demanding corporate and cloud computing requirements by decoupling Oracle Database and Oracle Grid Infrastructure clusters from the underlying Exadata storage servers. With Exascale, you can centrally manage a large fleet of Exadata storage servers connected by the Exadata RDMA Network Fabric. This architecture allows multiple Oracle Grid Infrastructure clusters and databases to securely access a large pool of shared storage resources, providing:

- Secure storage sharing with strict data isolation, ensuring users and databases can access only the data for which they have the proper privileges
- Flexible, dynamic storage provisioning for many users and databases
- Increased storage utilization and efficiency, maximizing your return on investment
- Improved utilization of storage processing resources to boost overall performance

Furthermore, Exascale introduces advanced snapshot and cloning capabilities that are tightly integrated with Oracle Database. For example, Oracle Database provides native snapshot and cloning functionality for pluggable databases (PDBs) through the `CREATE PLUGGABLE DATABASE` and `ALTER PLUGGABLE DATABASE` SQL commands. When Oracle Database utilizes Exascale storage, the pluggable database snapshot and snapshot copy (cloning) functions automatically use native Exascale snapshots and clones, which are space-efficient file copies based directly on the underlying Oracle Database files, thereby eliminating the need for a test master database to support snapshots and clones on Exadata.

In addition to unparalleled support for Oracle Database, Exascale provides block storage services, which deliver sophisticated capabilities to create and manage arbitrary-sized raw block volumes based on Exascale storage.

While end users can create and use Exascale block volumes for numerous applications, Exadata also leverages Exascale block volumes internally to store Exadata database server virtual machine images. Placing virtual machine images in Exascale removes the dependency on local storage inside the Exadata compute nodes, which enables the creation of more virtual machines and provides the infrastructure to support seamless migration of virtual machines between different Exadata compute nodes.

Despite the fact that Exascale transforms Exadata storage, Exascale also preserves the proven strengths and benefits of Exadata:

- Scalability - including efficient support for hundreds of Exadata storage servers in an Exascale cluster
- High availability - based on a clustered architecture with built-in redundancy and dynamic fail-over of software services
- High performance - utilizing Exadata RDMA memory and Exadata Smart Flash Cache
- Reliability - using proven Exadata storage server technologies
- Security - employing advanced security protocols and automatic encryption

Exascale runs on all Oracle Exadata system hardware with RoCE Network Fabric (X8M-2 or later), except systems with 8-socket database servers (X8M-8 and X9M-8). For full-featured

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native Oracle Database file storage in Exascale, you must use Oracle Database 23ai release 23.5.0 or later. You can also employ Exascale block volumes to support databases using older Oracle Database software releases back to Oracle Database 19c.

Related Topics

- Oracle Exadata Exascale User's Guide

4.1.3 Increased Number of Virtual Machines on Database Servers

Starting with Exadata X10M database server hardware, Oracle Exadata System Software release 24.1.0 introduces various optimizations that enable up to fifty (50) virtual machine (VM) guests on each KVM host. This capability gives customers much greater flexibility to utilize the large number of CPU cores available starting with Exadata X10M.

In addition to enabling more guests, the optimizations in Oracle Exadata System Software release 24.1.0 reduce the deployment time for each guest to approximately half of the time required in earlier releases. Regardless of whether you need to deploy 50 guests or just a few, this improvement benefits all users on all systems using Oracle Linux KVM.

Related Topics

- Oracle Linux KVM Deployment Specifications and Limits

4.1.4 Columnar Cache on Exadata RDMA Memory (XRMEM)

First introduced in Oracle Exadata System Software release 12.2.1.1.0, the storage server columnar cache is a portion of Exadata Smart Flash Cache containing data in columnar format, typically used to accelerate complex analytical queries. Based on query and data profiles, Exadata software automatically identifies and converts selected data in Exadata Smart Flash Cache to columnar format and writes it in the columnar cache, transparently aiding query performance.

Oracle Exadata System Software release 24.1.0 extends the storage server columnar cache to leverage Exadata RDMA Memory (XRMEM) on Exadata storage server models starting with Exadata X10M. With this capability, the most active columnar data regions in the flash cache are automatically replicated into the XRMEM cache, providing substantially quicker columnar read performance and improved query performance.

4.1.5 Exadata Cache Observability

Oracle Exadata System Software release 24.1.0 introduces the Exadata Storage Cache Statistics utility (`ecstat`), which provides real-time statistics about Exadata Smart Flash Cache.

The `ecstat` utility improves cache observability on each Exadata storage server and enables administrators to understand:

- What is the balance of I/O operations across the main storage and Exadata Smart Flash Cache?
- How are different types of I/O operations (small reads, large reads, small writes, and large writes) serviced in the storage server?
- What is the I/O throughput, in I/Os per second (IOPS) and megabytes per second (MB/s), handled by main storage and Exadata Smart Flash Cache?
- Is Exadata Smart Flash Cache undersized or performing acceptably?

The `ecstat` utility is conceptually similar to the Linux iostat utility, providing a periodic snapshot of I/O performance for each storage and cache device. Storage administrators can run `ecstat`

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on demand to understand real-time I/O performance. Additionally, ExaWatcher includes `ecstat` output in its log files.

4.1.6 Automatic Loading of KEEP Objects into Exadata Smart Flash Cache

Exadata enables users to override the automatic caching policy for Exadata Smart Flash Cache and elevate the priority for various database objects, such as regular tables and indexes, partitioned tables and indexes, and index-organized tables.

You can use the SQL `CREATE` or `ALTER` command to elevate the caching priority for a specific database object by including `CELL_FLASH_CACHE KEEP` in the `STORAGE` clause.

For example, assuming sufficient cache space, the following command instructs Exadata to keep data from `t1` in Exadata Smart Flash Cache:

```
SQL> ALTER TABLE t1 STORAGE (CELL_FLASH_CACHE KEEP);
```

Starting with Oracle Exadata System Software release 24.1.0 in conjunction with Oracle Database 23ai, database objects configured with the `KEEP` option are automatically loaded into Exadata Smart Flash Cache. This feature benefits online transaction processing (OLTP) workloads by avoiding cache misses on database objects configured with the `KEEP` option. Previously, the `KEEP` option was only effective after the data was read into the cache.

4.1.7 Improved RoCE Network Resilience

Oracle Exadata relies on the high-performance RoCE Network Fabric that connects all the database and storage servers. Occasionally, administrator errors or network firmware issues can interfere with the RoCE Network Fabric, resulting in seemingly functional network links that cannot support network traffic. If left unattended, such cases can cause various failures, including database instance failures and cluster outages.

Oracle Exadata System Software release 24.1.0 contains an automatic monitoring function that constantly checks the RoCE Network Fabric. If network traffic stalls without any apparent link error, the associated IP address automatically migrates to the partner link. Later, when the stalled link resumes functioning, the IP address automatically returns to the working link.

This capability improves the resilience of the RoCE Network Fabric and automatically guards against a variety of potential failures caused by issues in the RoCE Network Fabric.

4.1.8 Enhanced RoCE Network Discovery

Oracle Exadata relies on the high-performance RoCE Network Fabric that connects all the database and storage servers. Oracle Exadata System Software release 24.1.0 introduces new capabilities that make it easier to discover and monitor the RoCE Network Fabric:

- `configure_roce_hostinfo.sh` scans the RoCE Network Fabric and labels each RoCE switch port, identifying the hostname, IP address, and port number of the link target. This information makes it easy to understand what each RoCE switch port is connected to and can be used to construct a map of the RoCE Network Fabric.
- `rocelinkinfo` scans the RoCE Network Fabric and presents real-time status information for each link. The output is presented using the same format as the output of the Linux `iblinkinfo` command. This utility does not depend on `configure_roce_hostinfo.sh`. However, the output from `rocelinkinfo` is more informative after all of the RoCE switch ports have been labeled by running `configure_roce_hostinfo.sh`.

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Related Topics

- The ibdiagtools Utilities

4.1.9 Exadata Live Update

Oracle Exadata System Software release 24.1.0 introduces Exadata Live Update, a suite of enhancements to the mechanisms that orchestrate Exadata software updates on Exadata database servers.

Exadata Live Update includes the following key capabilities:

- Exadata Live Update uses online update capabilities based on standard Linux technologies, such as RPM and Ksplice. Depending on the specific contents of the update, the update operation might occur without interrupting databases or rebooting the server.

  Any update items that cannot be completed online are staged for completion during a later server reboot. You can schedule the outstanding items to be completed at a specific time or during the next graceful server reboot. You can also choose to defer the outstanding items indefinitely.
- Exadata Live Update enables partial updates to address security issues. When using Exadata Live Update, you must choose from the following options:
  - `highcvss`: Performs only critical security updates to address vulnerabilities with a Common Vulnerability Scoring System (CVSS) score of 7 or greater.
  - `allcvss`: Performs only security updates to address vulnerabilities with a CVSS score of 1 or greater.
  - `full`: Performs a full update, which includes all security-related updates and all other non-security updates.
- Exadata Live Update can be controlled using the Exadata `patchmgr` utility, which provides an easy and familiar experience for existing Exadata users.

Related Topics

- About Exadata Live Update

4.1.10 Ready-to-go System Image for New KVM Guests

Oracle Exadata System Software release 24.1.0 introduces a new highly-optimized base system image for Oracle Linux KVM guests known as the ready-to-go system image.

With the ready-to-go system image, generic configuration work previously conducted during guest creation is included in the image. Consequently, deploying each new KVM guest is significantly faster, especially when creating multiple guests concurrently. Furthermore, using the ready-to-go system image, customers may optionally configure new guests utilizing the UEFI boot framework in Oracle Linux KVM, which also underpins the KVM Guest Secure Boot feature.

On new system deployments using Oracle Exadata System Software release 24.1.0 (or later), all KVM guests use the ready-to-go system image by default. On previously deployed systems, you can use the ready-to-go system image for new KVM guests after you update to Oracle Exadata System Software release 24.1.0 (or later) and then download and install the ready-to-go system image.

By default, the base ready-to-go system image file uses the following file name format: `/EXAVMIMAGES/System.first.boot.`*`version.date-stamp`*`.rtg.img`. If the base ready-to-go

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system image is configured to utilize the UEFI boot framework, the file name format is `/EXAVMIMAGES/System.first.boot.version.date-stamp.uefi.img`.

Related Topics

- KVM Guest Secure Boot

4.1.11 KVM Guest Secure Boot

Oracle Exadata System Software release 24.1.0 extends Secure Boot to Oracle Linux KVM guests.

KVM Guest Secure Boot leverages the UEFI boot framework in Oracle Linux KVM to restrict which binaries can boot the KVM guest, only allowing boot loaders that carry the cryptographic signature of trusted entities. During each reboot of the KVM guest, every component in the boot sequence is verified, preventing malware from hiding embedded code in the boot sequence.

For details, see Restricting the Binaries Used to Boot the System in *Oracle Exadata Security Guide*.

Related Topics

- Secure Boot

4.1.12 SNMP Security Enhancements

Oracle Exadata System Software release 24.1.0 introduces the following security enhancements for SNMP connections used by Management Server (MS) on all Exadata storage servers and database servers to propagate management information and alerts.

- For all SNMP subscriber definitions, the administrator must specify the SNMP connection type, which implies the SNMP version being used. SNMP V3 is supported and encouraged for general subscribers (`type=v3`) and Oracle Auto Service Request (ASR) subscribers (`type=v3ASR`). The original type definitions for SNMP V1 (`type=v1`) and Oracle ASR (`type=ASR`) remain available. However, new SNMP V1 subscriber definitions are discouraged by a warning message recommending SNMP V3.
- For all SNMP V1 (`type=v1`) and Oracle ASR subscribers (`type=ASR`), the administrator must specify the SNMP community. Furthermore, common default community values, such as `public` and `private`, are discouraged by a warning message.
- For all SNMP V3 subscribers (`type=v3` or `type=v3ASR`), the following SHA2 authentication protocols are available: `SHA-224`, `SHA-256`, `SHA-384`, and `SHA-512`.

  These protocols may be specified when adding a user for SNMP V3 subscriptions. For example:

  ```
  CellCLI> alter cell
  snmpuser.exampleuser512=(authprotocol='SHA-512',authpassword=*)
  ```

4.1.13 JSON Output from Management Server

Oracle Exadata System Software release 24.1.0 introduces support for JSON output from the Exadata Management Server (MS).

This capability enables JSON formatted output from CellCLI, DBMCLI, ExaCLI, and the MS REST interface.

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Related Topics

- Starting CellCLI
- Starting DBMCLI
- ExaCLI Command Reference
- Running Commands Remotely Using REST

4.1.14 Features Coupled with Oracle Database 23ai

Oracle Exadata System Software release 24.1.0 introduces the following capabilities in conjunction with Oracle Database 23ai.

- Smart Scan on Wide Tables
- Smart Scan on Index-Organized Tables
- Smart Scan on AES-XTS Encrypted Data
- Smart Scan during Online Encryption
- Smart Scan during Timezone Upgrades
- Smart Scan for Oracle Database 23ai Functions and Operators
- In-Memory Columnar Speed JSON Query
- Transparent Cross-Tier Scan
- Faster Opening of Pluggable Databases
- Pipelined Log Writes
- Faster Hash Joins on Large Tables

4.1.14.1 Smart Scan on Wide Tables

Oracle Database 23ai introduces support for wide tables containing up to 4096 columns. Wide tables facilitate applications that use denormalized (flat) schemas to avoid SQL joins. Use cases include modern analytics, machine learning, and Internet of Things (IoT) applications.

In conjunction with Oracle Database 23ai, Oracle Exadata System Software release 24.1.0 enables Exadata Smart Scan on wide tables.

Support for wide tables must be configured in the database by setting `MAX_COLUMNS=EXTENDED` in the database parameter file (`init.ora`). Once enabled in the database, the full power of Exadata Smart Scan is automatically and transparently applied to wide tables.

4.1.14.2 Smart Scan on Index-Organized Tables

In conjunction with Oracle Database 23ai, Oracle Exadata System Software release 24.1.0 introduces support for Exadata Smart Scan on index-organized tables (IOTs), including all types of compressed IOTs.

This capability substantially improves query performance for applications that use index-organized tables and requires no initial configuration or ongoing administration.

You can verify the usage of Smart Scan on IOTs by viewing the query execution plan generated using the `EXPLAIN PLAN` SQL command. In the output, Smart Scan on an IOT is indicated when either of the following `STORAGE` operations appear:

- `INDEX STORAGE FAST FULL SCAN`

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- `INDEX STORAGE FULL SCAN`

4.1.14.3 Smart Scan on AES-XTS Encrypted Data

Oracle Database 23ai with Transparent Database Encryption (TDE) introduces support for tablespace encryption using AES-XTS, a de-facto industry standard for protecting data at rest.

In conjunction with Oracle Database 23ai, Oracle Exadata System Software release 24.1.0 transparently enables Exadata Smart Scan on data in tablespaces encrypted using AES-XTS. AES-XTS provides improved security and better performance, especially on Exadata where TDE can take advantage of parallel processing and specialized instructions built into processor hardware.

4.1.14.4 Smart Scan during Online Encryption

In conjunction with Oracle Database 23ai, Oracle Exadata System Software release 24.1.0 enables Exadata Smart Scan during online encryption operations. With this new feature, Exadata Smart Scan remains fully enabled during long-running online encryption, decryption, and rekeying operations. Previously, Exadata Smart Scan was disabled during such operations.

4.1.14.5 Smart Scan during Timezone Upgrades

Oracle Database uses timezone definitions to handle time calculations and daylight-saving time transitions. Timezone changes potentially alter data stored in columns using the `TIMESTAMP WITH TIMEZONE` data type. Previously, Exadata Smart Scan was disabled for the entire database during an upgrade of the timezone definitions.

In conjunction with Oracle Database 23ai, Oracle Exadata System Software release 24.1.0 reduces the impact of timezone upgrades. Under the new arrangement, Exadata Smart Scan remains enabled for queries on all tables without `TIMESTAMP WITH TIMEZONE` columns. Furthermore, the impact of timezone changes is now contained within a pluggable database (PDB). So, if a timezone change impacts one PDB, Exadata Smart Scan remains enabled for all the other PDBs.

4.1.14.6 Smart Scan for Oracle Database 23ai Functions and Operators

Oracle Exadata System Software release 24.1.0 enables Exadata Smart Scan in conjunction with the following new functions and operators introduced in Oracle Database 23ai:

- `CEIL (datetime)` function
- `CEIL (interval)` function
- `FLOOR (datetime)` function
- `FLOOR (interval)` function
- `ROUND (interval)` function
- `TRUNC (interval)` function
- `TO_BOOLEAN` function
- `IS FALSE` predicate operator
- `IS NOT FALSE` predicate operator
- `IS TRUE` predicate operator
- `IS NOT TRUE` predicate operator

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4.1.14.7 In-Memory Columnar Speed JSON Query

In conjunction with Oracle Database 23ai and Oracle Database In-Memory, Oracle Exadata System Software release 24.1.0 introduces in-memory columnar caching of data in JSON documents. When Exadata encounters JSON data, using either the JSON data type introduced in Oracle Database 21c or the OSON-formatted BLOB data type available in Oracle Database 19c, the key/value pairs in the JSON are transparently and automatically converted to an in-memory columnar format and stored in Exadata Smart Flash Cache.

Subsequent queries on the JSON data can use Exadata Smart Scan and the cached JSON data to offload the processing of JSON operators to Exadata storage and substantially improve query performance. JSON operators supported by Exadata Smart Scan include `JSON_EXISTS`, `JSON_VALUE`, `JSON_QUERY`, `IS JSON`, and `IS NOT JSON`.

4.1.14.8 Transparent Cross-Tier Scan

In conjunction with Oracle Database 23ai and Oracle Database In-Memory, Oracle Exadata System Software release 24.1.0 enables a single query to utilize the combined power of in-memory columnar scan on the database servers along with Exadata Smart Scan and columnar cache on the storage servers. Previously, a single query could use an in-memory columnar scan on the database servers or Exadata Smart Scan and columnar cache on the storage servers, but not both.

Known as Transparent Cross-Tier Scan, this capability enables a query to efficiently utilize all available system resources and data representations to deliver better query performance. A Transparent Cross-Tier Scan ideally suits analytical queries on large tables where the data is spread across the database servers and storage servers.

4.1.14.9 Faster Opening of Pluggable Databases

In conjunction with Oracle Exadata System Software release 24.1.0, Oracle Database 23ai contains enhancements to store the database control file in Exadata RDMA Memory (XRMEM) on the storage servers and perform multiple concurrent reads using remote direct memory access (RDMA). Previously, RDMA reads to a database control file in XRMEM were serialized (one by one).

This capability enables multiple pluggable databases (PDBs) to open in parallel on Exadata systems, which considerably speeds up the process of opening PDBs, particularly in environments where a container database (CDB) contains many PDBs. Speeding up the process of opening PDBs also minimizes the application impact when a PDB opens on another database server in response to a database instance failure or a database shutdown for a planned maintenance operation.

4.1.14.10 Pipelined Log Writes

Redo log latency has always been critical for On-Line Transaction Processing (OLTP) performance. Previously, to streamline processing and avoid potential interruptions associated with process coordination, each log write was treated as a serial atomic operation.

Starting with Exadata X10M, the Oracle Database log writer can use the high-performance Exadata RoCE Network Fabric and Exadata Smart Flash Log to facilitate pipelined log writes. This capability leverages advancements in modern system hardware to run multiple concurrent log writes in parallel without impacting the latency of each redo log write. The result is a considerable overall improvement in OLTP performance by minimizing the need to queue log writes.

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In conjunction with Oracle Exadata System Software release 24.1.0, this feature is available in Oracle Database 23ai and is also incorporated in the January 2024 release update for Oracle Database 19c.

4.1.14.11 Faster Hash Joins on Large Tables

A Bloom Filter is a data structure used to efficiently check if an element is a member of a set. Exadata Smart Scan uses Bloom Filters to perform hash joins inside the storage servers.

In conjunction with Oracle Database 23ai, Oracle Exadata System Software release 24.1.0 relaxes the previous internal limitation on the maximum size of a Bloom Filter sent to the storage servers. By enabling larger Bloom Filters, Exadata Smart Scan can perform more efficient hash joins with substantially faster results, especially on complex join queries involving large tables.

4.1.15 Minimum Versions and Other Requirements

The following list outlines the minimum versions and other requirements that apply to Oracle Exadata System Software 24.1.0:

- Minimum supported Oracle Database and Oracle Grid Infrastructure releases:
  - Release 19c: Version 19.15, April 2022 Release Update (RU)

    > **Note**
    >
    > Systems using Oracle Grid Infrastructure 19c versions before 19.23 (April 2024) also require patch 36114443 (19.22.0.0.240116ACFSRU) before upgrading to Oracle Exadata System Software release 24.1.0. The patch applies to all Oracle Grid Infrastructure 19c versions before 19.23 and is included in Oracle Grid Infrastructure 19c releases starting with version 19.23.

  - Release 21c: Version 21.6, April 2022 Release Update (RU)

    > **Note**
    >
    > Systems using Oracle Grid Infrastructure 21c versions before 21.14 (April 2024) also require patch 36114443 (21.13.0.0.240116ACFSRU) before upgrading to Oracle Exadata System Software release 24.1.0. The patch applies to all Oracle Grid Infrastructure 21c versions before 21.14 and is included in Oracle Grid Infrastructure 21c releases starting with version 21.14.

- Minimum system hardware versions:
  - 2-socket: Oracle Exadata X6-2
  - 8-socket: Oracle Exadata X6-8
- Minimum Oracle Exadata System Software version required on an existing system before updating to release 24.1.0: Oracle Exadata System Software 21.2.10 (March 2022)

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> **Note**
>
> On systems configured with virtual machines (VMs) on the database servers, you can upgrade the hypervisor (Oracle VM Server or Oracle Linux KVM) before or after the guest VMs. However, each VM guest must meet the minimum Oracle Exadata System Software requirement before being upgraded. Likewise, the hypervisor must meet the minimum Oracle Exadata System Software requirement before being upgraded.

Related Topics

- Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930)

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5

New Features for Oracle Exadata System Software Release 23.x

This section describes the new features introduced in Oracle Exadata System Software release 23.x.

- What's New in Oracle Exadata System Software Release 23.1

5.1 What's New in Oracle Exadata System Software Release 23.1

- Oracle Exadata X10M Support
- Exadata RDMA Memory
- Higher Compression for Storage Server Columnar Compression
- Oracle Linux 8 Support
- Centralized Identification and Authentication of OS Users
- Minimum Versions and Other Requirements
- Desupported Features in Oracle Exadata System Software Release 23.1.0

5.1.1 Oracle Exadata X10M Support

Oracle Exadata System Software release 23.1.0 introduces support for the Oracle Exadata X10M system family.

Exadata X10M is the third generation of system hardware based on RoCE Network Fabric, and offers performance and capacity improvements throughout. Highlights include:

- Exadata X10M database servers and storage servers are equipped with AMD EPYC™ CPUs that contain substantially more CPU cores than previous Exadata systems.

  In a flexible configuration:

  – Each Exadata X10M database server contains 192 CPU cores (up from 64 previously).

  – Each Exadata X10M High Capacity (HC) or Extreme Flash (EF) storage server contains 64 CPU cores (up from 32 previously).

  – Each Exadata X10M Extended (XT) storage server contains 32 CPU cores (up from 16 previously).

  In an Eighth Rack configuration, each Exadata X10M storage server contains 32 CPU cores (up from 16 previously).

  The increased CPU resources enable Exadata X10M systems to handle more users and more CPU-intensive operations, such as data compression and data encryption.

- Each Exadata X10M High Capacity (HC) and Extreme Flash (EF) storage server contains some high-performance DDR5 DRAM reserved for Exadata RDMA Memory Cache (XRMEM cache). This new caching tier benefits workloads that require ultra-low response

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time, such as stock trades and IoT devices, enabling them to take advantage of RDMA to access storage server data.

See Exadata RDMA Memory for details.

- Exadata X10M database servers move to a 2 rack-unit (RU) form factor. This server format accommodates the more powerful AMD EPYC™ CPUs, and enables each server to accommodate up to 3 TB of high-performance DDR5 DRAM (up from 2 TB previously) and up to 5 network interface cards (up from 3 previously) for more flexible client connectivity. The 2 RU form factor also assists with system cooling.
- Exadata X10M EF storage servers now contain two types of flash storage devices. Each EF storage server contains:
  - 4 x 6.8 TB performance-optimized flash devices. These flash devices are the same as those in the X10M HC storage servers. They are primarily used for high-performance low-latency caching with Exadata Smart Flash Cache and Exadata Smart Flash Log.
  - 4 x 30.72 TB capacity-optimized flash devices. These flash devices, combined with the performance-optimized flash devices, increase the raw data storage capacity of EF storage servers by almost 300% while still delivering much better performance and latency than hard disk drives.
- Exadata X10M HC and XT storage servers contain 22 TB disk drives (up from 18 TB previously), which increases raw data storage capacity by 22%.

See Hardware Components of Oracle Exadata Database Machine in the *Oracle Exadata System Overview* for details.

For Oracle Grid Infrastructure and Oracle Database version compatibility, see Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930).

5.1.2 Exadata RDMA Memory

Oracle Exadata System Software release 23.1.0 introduces Exadata RDMA Memory (XRMEM). XRMEM incorporates all of the Exadata capabilities that provide direct access to storage server memory using Remote Direct Memory Access (RDMA), enabling faster response times and lower read latencies.

XRMEM encompasses previous Exadata data and commit accelerators based on persistent memory (PMEM), which is only available in Exadata X8M and X9M storage server models. Starting with Exadata X10M, XRMEM enables the benefits of RDMA without needing specialized persistent memory and is primed to leverage developments in memory and storage hardware.

On Exadata X10M systems, workloads requiring ultra-low response times, such as stock trades and IoT devices, can take advantage of XRMEM cache. When database clients read from XRMEM cache, the client software performs an RDMA read of the cached data, which bypasses the storage server software and networking layers, eliminates expensive CPU interrupts and context switches, and delivers results much faster than Exadata Smart Flash Cache. In this case, XRMEM cache operates only in write-through mode, with database writes saved to persistent storage.

On Exadata X10M, XRMEM cache is available on High Capacity (HC) and Extreme Flash (EF) Exadata X10M storage servers, leveraging the high-performance dynamic random-access memory (DRAM) available on the servers. In this environment, XRMEM cache functions automatically, requiring no separate configuration or ongoing administration.

On existing Exadata X8M and X9M systems with Oracle Exadata System Software release 23.1.0, the persistent memory data accelerator, also known as PMEM cache (or `PMEMCACHE`), is

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now called the XRMEM cache (or `XRMEMCACHE`). Likewise, the persistent memory commit accelerator, also known as PMEM log (or `PMEMLOG`), is now XRMEM log (or `XRMEMLOG`). However, the CellCLI commands to manage `PMEMCACHE` and `PMEMLOG` resources are still available for backward compatibility.

Oracle Exadata System Software release 23.1.0 does not implement `XRMEMLOG` on Exadata X10M systems.

5.1.3 Higher Compression for Storage Server Columnar Compression

Starting with Oracle Exadata System Software release 23.1.0 and Exadata X10M storage servers, Exadata uses a more space-efficient compression algorithm for in-memory columnar compression in the storage server.

The algorithm uses the increased CPU resources in Exadata X10M storage servers to achieve better compression, which increases the amount of columnar format data that can be cached while maintaining excellent performance.

5.1.4 Oracle Linux 8 Support

Oracle Exadata System Software 23.1.0 uses Oracle Linux 8 with the UEK6 kernel as the server operating system for all storage servers, bare-metal database servers, KVM hosts, KVM guests, and Oracle VM (OVM) guests (DomU).

Rolling upgrade is supported from Oracle Linux 7 to Oracle Linux 8.

OVM management domains (Dom0) do not require Oracle Linux 8 and remain on Oracle Linux 7 with UEK5.

Related Topics

- Oracle Linux 8 Documentation Library
- Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930)

5.1.5 Centralized Identification and Authentication of OS Users

Oracle Exadata System Software 23.1.0 introduces support for infrastructure enabling centralized identification and authentication of operating system (OS) users.

Specifically, in this release, you can configure the Linux System Security Services Daemon (SSSD) to facilitate Exadata database server and storage server access using LDAP to provide identity services and Kerberos as the authentication protocol. Oracle Exadata System Software contains the Linux packages to support SSSD, which you may configure according to your specific requirements. Furthermore, Oracle Exadata System Software maintains the existing SSSD configuration details during system updates.

The SSSD support is enabled in conjunction with an Exadata-specific security profile using the Linux `authselect` utility on Oracle Linux 8. Consequently, in this release, Exadata support for Linux SSSD is not available on Xen management domains (dom0), which use Oracle Linux 7.

5.1.6 Minimum Versions and Other Requirements

The following list outlines the minimum versions and other requirements that apply to Oracle Exadata System Software 23.1.0:

- Minimum supported Oracle Database and Oracle Grid Infrastructure (GI) releases:

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  - Release 19c: Version 19.15, April 2022 Release Update (RU)
  - Release 21c: Version 21.6, April 2022 Release Update (RU)
- Minimum system hardware version: Oracle Exadata X5-2
- Minimum Oracle Exadata System Software version required on an existing system before updating to release 23.1.0: Oracle Exadata System Software 21.2.10 (March 2022)

> **Note**
>
> On systems configured with virtual machines (VMs) on the database servers, you can upgrade the hypervisor (Oracle VM Server or Oracle Linux KVM) before or after the guest VMs. However, each VM guest must meet the minimum Oracle Exadata System Software requirement before being upgraded. Likewise, the hypervisor must meet the minimum Oracle Exadata System Software requirement before being upgraded.

Related Topics

- Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930)

5.1.7 Desupported Features in Oracle Exadata System Software Release 23.1.0

The following features are no longer available in Oracle Exadata System Software release 23.1.0:

- Prior to Oracle Exadata System Software release 23.1.0, you can configure PMEM cache to operate in write-back mode. Also known as write-back PMEM cache, this mode enables the cache to service write operations.

  However, since Oracle Exadata System Software release 20.1.0, the best practice recommendation was to configure PMEM cache in write-through mode. This configuration provides the best performance and availability.

  Commencing with Oracle Exadata System Software release 23.1.0, PMEM cache only operates in write-through mode.

  When a system upgrades to Oracle Exadata System Software release 23.1.0, PMEM cache is automatically flushed and converted to write-through mode if required.
- Cell RAM Cache. See Deprecation of RAM Cache.
- USB Images. See Deprecation of USB Images.

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6

New Features for Oracle Exadata System Software Release 22.x

This section describes the new features introduced in Oracle Exadata System Software release 22.x.

- What's New in Oracle Exadata System Software Release 22.1

6.1 What's New in Oracle Exadata System Software Release 22.1

- Real-Time Insight
- Oracle VM Server Management Domain Upgrade to Oracle Linux 7
- Exadata Upgrade Improvements

6.1.1 Real-Time Insight

Commencing with Oracle Exadata System Software 22.1.0, Real-Time Insight provides the infrastructure to automatically stream up-to-the-second metric observations from all of the servers in your Exadata fleet and feed them into customizable monitoring dashboards for real-time analysis and problem-solving.

You can choose which of the 200+ Exadata metrics are included in the stream and use standard Web protocols to automatically propagate the stream to popular observability platforms, time-series databases, and visualization applications.

Related Topics

- Using Real-Time Insight

6.1.2 Oracle VM Server Management Domain Upgrade to Oracle Linux 7

Oracle Exadata System Software 22.1.0 includes an upgrade to Oracle Linux 7 for the Oracle VM Server management domain (Dom0).

This upgrade modernizes the Oracle VM Server management domain, delivers numerous stability and security improvements, and removes the last dependence on Oracle Linux 6 in Oracle Exadata System Software.

The upgrade is transparent to the Oracle VM user domains (DomU), and the existing volume and filesystem structures continue to reside inside the management domain.

This change only applies to Exadata systems configured with virtual machines (VMs) on Exadata X8-2 and earlier 2-socket hardware models, which contain InfiniBand Network Fabric.

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6.1.3 Exadata Upgrade Improvements

Oracle Exadata System Software 22.1.0 includes numerous changes that deliver quicker upgrades for Exadata database servers. The changes include:

- Optimizing the sequence of operations to remove unnecessary repetition, unnecessary checks, and unnecessary reboots.
- Performing operations and checks asynchronously (in the background) and in parallel where possible.
- Optimizing the packaging of Exadata software images to remove unnecessary repackaging.
- Pre-staging software and firmware images where possible.

The improvements cover all aspects of the upgrade process, including the Operating System (OS) upgrade procedures, Oracle software upgrade procedures, Exadata software imaging procedures, and firmware upgrade procedures.

Individual results vary depending on many variables, including the system configuration, system load, pre-upgrade software version, and system size. In most cases, each server upgrade is at least 10% faster. In some cases, the upgrade duration is half that of comparable previous upgrades.

Furthermore, the benefit multiplies across multiple servers. So, depending on the size of the rack, or the number of racks in the fleet, these improvements can reduce the overall time to perform an upgrade by hours or even days.

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7

New Features for Oracle Exadata System Software Release 21.x

This section describes the new features introduced in Oracle Exadata System Software release 21.x.

- What's New in Oracle Exadata System Software Release 21.2

7.1 What's New in Oracle Exadata System Software Release 21.2

- Oracle Exadata X9M Support
- Persistent Storage Index
- Persistent Columnar Cache
- IORM Cluster Plan
- Smart Scan Metadata Sharing
- Oracle ASR Support for Cisco RoCE Network Fabric Switches and Management Network Switch
- Patch Manager Support for the Management Network Switch
- Options to Preserve Redundancy while Dropping a Physical Disk
- Faster Upgrades with ILOM Pre-Staging
- Faster Recovery from Flash Cache Failure
- Automatic Recovery from Disk Controller Cache Failure
- Enhanced Database Server Alerting
- Oracle ACFS I/O Caching in Flash Cache
- Smart Scan Fast Decryption
- Caching Flashback Log Writes in Exadata Smart Flash Cache
- Deprecated Features in Oracle Exadata System Software Release 21.2

7.1.1 Oracle Exadata X9M Support

Oracle Exadata System Software release 21.2.0 introduces support for the Oracle Exadata X9M system family.

Exadata X9M is the second generation of system hardware based on RoCE Network Fabric, and offers performance and capacity improvements throughout.

See Hardware Components of Oracle Exadata Database Machine in the *Oracle Exadata System Overview* for details.

Minimum requirements:

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- Oracle Exadata System Software release 21.2.0
- Oracle Exadata X9M

7.1.2 Persistent Storage Index

Storage indexes help Oracle Exadata System Software to avoid unnecessary I/O operations. By avoiding unnecessary I/O, affected operations perform better. Also, overall system throughput increases because the saved I/O bandwidth can be used to perform other work.

Oracle Exadata System Software creates and maintains a storage index in shared memory on Exadata Storage Server. For each storage region, the storage index automatically tracks minimum and maximum column values and set membership. Storage index functionality works transparently with no user input. There is no need to create, drop, or tune the storage index.

Starting with Oracle Exadata System Software release 21.2.0, the storage index can persist across cell restarts and upgrades. When the feature is enabled, the storage index shared memory segments are written to the storage server system disks during a graceful shutdown, and these are automatically restored during restart. In the event of a cell server crash or offload server crash, the storage index shared memory segments are retained by the operating system and are immediately available when the software service restarts.

On Oracle Exadata Database Machine X7-2 and later systems with M.2 solid-state drives (SSD), persistence can also be maintained across Oracle Exadata System Software upgrades.

This feature eliminates the need to rebuild the storage index and enables more consistent query performance immediately after a cell restart.

The feature is controlled by setting the `storageIndexPersMode` cell attribute.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0
- Oracle Database 12c Release 2 (12.2)

Related Topics

- ALTER CELL - Persistence Attributes

7.1.3 Persistent Columnar Cache

The columnar cache is a portion of Exadata Smart Flash Cache that contains data in columnar format. Data in Exadata Smart Flash Cache is automatically converted to columnar format and stored in the columnar cache to aid query performance.

Before Oracle Exadata System Software release 21.2.0, metadata for managing the columnar cache is lost when the cell fails or shuts down. Consequently, the columnar cache must be rebuilt following each cell restart.

Starting with Oracle Exadata System Software release 21.2.0, the columnar cache can persist across cell restarts and upgrades. This feature saves resources associated with rebuilding the cache and enables more consistent query performance immediately after a cell restart.

To use persistent columnar cache, Exadata Smart Flash Cache must be in Write-Back mode. The feature is controlled by setting the `columnarCachePersMode` cell attribute.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0

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Related Topics

- ALTER CELL - Persistence Attributes

7.1.4 IORM Cluster Plan

Oracle Exadata System Software release 21.2.0 extends I/O Resource Management (IORM) to include the cluster plan. The IORM cluster plan specifies how storage server resources are allocated across multiple Oracle Grid Infrastructure clusters. Each directive in a cluster plan specifies an allocation to an Oracle Grid Infrastructure cluster, rather than an individual database or consumer group.

For example, consider a system hosting two clusters; `clusterA` and `clusterB`. Now, imagine a cluster plan with share-based resource allocation where `clusterA` has three shares, and `clusterB` has one share. In that case, and in the absence of any other IORM plans, all of the databases running in `clusterA` share 75% of the I/O resources, while the databases in `clusterB` share the remaining 25%.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0
- To operate the IORM cluster plan, ASM-scoped security must be configured.

Related Topics

- Managing I/O Resources
- ALTER IORMPLAN

7.1.5 Smart Scan Metadata Sharing

During Smart Scan operations, Oracle Database sends query metadata to the Exadata Storage Servers. The query metadata contains information like predicated columns, projected columns, predicates, database session information, Bloom filters, and so on, which is required to offload the query to the storage servers. Historically, during parallel query execution, each Oracle Database parallel query server process sends serialized and compressed query metadata to the storage server, where it is uncompressed and deserialized before use. Furthermore, for each parallel query, a significant portion of the metadata is common to all of the parallel query server processes.

Starting with release 21.2.0, Oracle Exadata System Software shares common query metadata across Smart Scan sessions belonging to the same parallel query. This feature reduces the memory and processing footprint for parallel queries in Exadata Storage Server. In turn, the saved resources can support other work and increase the overall system throughput. The benefit is greatest for sophisticated operations that typically require more metadata, such as join queries using Bloom filters, data mining models, external tables, and tables with JSON/XML types.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0

7.1.6 Oracle ASR Support for Cisco RoCE Network Fabric Switches and Management Network Switch

Oracle Exadata System Software release 21.2.0 introduces new capabilities to monitor Cisco switches using Oracle Auto Service Request (ASR). This capability covers the Cisco

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Management Network Switch and RoCE Network Fabric Switches present in X8M and later systems. It also covers Management Network Switch model 9348 present in earlier X8 and some X7 systems.

With this release, when you use the Patch Manager utility (`patchmgr`) to upgrade the Cisco switch firmware, a new monitoring component is also installed on the Cisco switch. The new monitoring component propagates switch alerts to Oracle ASR, enabling automated problem detection and resolution.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0
- Oracle Exadata Database Machine X8M, or earlier models with Cisco Management Network Switch model 9348.

Related Topics

- Configuring Cisco Switches for Oracle ASR

7.1.7 Patch Manager Support for the Management Network Switch

Commencing with Oracle Exadata System Software release 21.2.0, the Patch Manager utility (`patchmgr`) introduces capabilities to manage firmware upgrades on the 9000 series Management Network Switch found on Oracle Exadata Database Machine X7-2 and later systems.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0
- Oracle Exadata Database Machine X7-2

Related Topics

- Patchmgr Syntax for the Cisco Management Switch

7.1.8 Options to Preserve Redundancy while Dropping a Physical Disk

Oracle Exadata System Software release 21.2.0 introduces the `MAINTAIN REDUNDANCY` and `NOWAIT` options to the CellCLI `ALTER PHYSICALDISK DROP FOR REPLACEMENT` command.

The `MAINTAIN REDUNDANCY` option streamlines Exadata Storage Server administration by automatically rebalancing data before dropping the corresponding ASM disks. In previous releases, maintaining redundancy required additional administrator intervention to manually drop the corresponding ASM disks and rebalance the data prior to using the `ALTER PHYSICALDISK DROP FOR REPLACEMENT` command.

The `NOWAIT` option allows the `ALTER PHYSICALDISK` command to complete immediately while the `DROP FOR REPLACEMENT` operation runs asynchronously in the background.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0

Related Topics

- ALTER PHYSICALDISK
- Replacing a Hard Disk Proactively

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7.1.9 Faster Upgrades with ILOM Pre-Staging

The upgrade process for Oracle Exadata System Software typically includes a firmware upgrade for Integrated Lights Out Manager (ILOM). Historically, the ILOM firmware upgrade was performed as a serial process, taking approximately 30% of the total software upgrade time on each physical server (database server or storage server).

ILOM version 5 introduces support for pre-staging of new ILOM firmware. With this feature, pre-staging occurs in parallel with other server upgrade activities, and the new ILOM firmware is automatically enabled when the server reboots at the end of the upgrade procedure.

On Exadata X7 and newer systems, this approach approximately halves the ILOM firmware upgrade time on each server, which translates to an improvement of approximately 15% for the total software upgrade time.

Minimum requirements:

- This feature is automatically used on Exadata X7 and newer systems, except for X8-2L servers, when upgrading Oracle Exadata System Software from at least version 19.3.11 or 20.1.1.
- For X8-2L servers only, this feature is automatically used when upgrading Oracle Exadata System Software from at least version 19.3.12 or 20.1.2.

7.1.10 Faster Recovery from Flash Cache Failure

This feature reduces the recovery time following flash cache failure by staging flash cache metadata to the M.2 solid-state drives (SSD) found on Oracle Exadata Database Machine X7 and later systems. Using the M.2 SSD speeds up resilvering table creation and the assignment of caching devices following flash failure. This feature reduces the overall brownout time following a flash failure.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0
- Oracle Exadata Database Machine X7-2

7.1.11 Automatic Recovery from Disk Controller Cache Failure

Earlier (pre-X10M) High Capacity (HC) and Extended (XT) Oracle Exadata Storage Server models have a disk controller that contains a write-back cache, which is separate and distinct from the write-back flash cache.

A multiple-bit ECC error on the disk controller cache can crash the server, resulting in the loss of unflushed data in the disk controller cache and leaving stale data on the disks. If not handled carefully, such errors are severe and can result in data loss.

Oracle Exadata System Software release 21.2.0 supports automatic recovery following a disk controller cache failure. Where possible, this feature automatically detects the problem and copies data from other mirrors to recover all of the disks in the failed server.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0

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7.1.12 Enhanced Database Server Alerting

Oracle Exadata System Software release 21.2.0 introduces enhanced alerting on the database servers.

With this capability, the DBMCLI `LIST ALERTHISTORY` command now shows incidents relating to Oracle Grid Infrastructure and Oracle Database software.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0

Related Topics

- `LIST ALERTHISTORY`

7.1.13 Oracle ACFS I/O Caching in Flash Cache

To optimize I/O efficiency, small sequential writes to Oracle Advanced Cluster File System (Oracle ACFS) are automatically combined into 1 MB chunks. However, before Oracle Exadata System Software release 21.2.0, these larger writes would bypass the cache and go directly to disk.

Commencing with Oracle Exadata System Software release 21.2.0, all Oracle ACFS I/O is eligible for caching in Exadata Smart Flash Cache.

This feature enhances Oracle ACFS performance, especially for applications such as Oracle GoldenGate trail files, having an I/O profile dominated by small sequential writes and fast subsequent reads.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0

7.1.14 Smart Scan Fast Decryption

In conjunction with applicable hardware first introduced in Oracle Exadata X9M, Oracle Exadata System Software release 21.2.0 uses VAES and AVX512 instruction sets and implements cache-friendly algorithms to improve Smart Scan performance on encrypted tables and compressed tables.

Minimum requirements:

- Oracle Exadata System Software release 21.2.0
- Oracle Exadata X9M

7.1.15 Caching Flashback Log Writes in Exadata Smart Flash Cache

Building on optimizations introduced in Exadata System Software 12.2.1.1.0 that enable Faster Performance for Large Analytic Queries and Large Loads, this release automatically caches flashback log writes, which can significantly improve flashback database performance.

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7.1.16 Deprecated Features in Oracle Exadata System Software Release 21.2

The following features are deprecated in this release, and may be desupported in a future release:

- Deprecation of RAM Cache
- Deprecation of USB Images
- Deprecation of the IORM Category Plan

7.1.16.1 Deprecation of RAM Cache

Commencing with the September 2022 Oracle Exadata System Software maintenance releases (versions 21.2.16 and 22.1.3), the cell RAM Cache feature is deprecated.

Existing RAM Cache installations continue to operate as they did in previous releases. However, new RAM Cache creation requests are not allowed after the deprecation.

The cell RAM Cache feature was introduced in Oracle Exadata System Software version 18.1.0. See In-Memory OLTP and Consolidation Acceleration.

7.1.16.2 Deprecation of USB Images

Commencing with the September 2022 Oracle Exadata System Software maintenance releases (versions 21.2.16 and 22.1.3), USB images are deprecated.

After the deprecation, USB images are no longer available for imaging or re-imaging an Oracle Exadata Database Machine server and are not included in the Secure Eraser package (`secureeraser_`*`label`*`.zip`). Instead of USB image files, use the PXE option with ISO image files.

7.1.16.3 Deprecation of the IORM Category Plan

Starting with Oracle Exadata System Software release 21.2.0, the Exadata I/O Resource Management (IORM) category plan (`catplan`) is deprecated, and a warning message is issued when a category plan is specified.

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8

New Features for Oracle Exadata System Software Release 20.x

Several new features were introduced for Oracle Exadata System Software release 20.x.

- What's New in Oracle Exadata System Software Release 20.1.0

8.1 What's New in Oracle Exadata System Software Release 20.1.0

The following features are new for Oracle Exadata System Software Release 20.1.0:

- Exadata Secure RDMA Fabric Isolation
- Smart Flash Log Write-Back
- Fast In-Memory Columnar Cache Creation
- Cell-to-Cell Rebalance Preserves PMEM Cache Population
- Control Persistent Memory Usage for Specific Databases
- Application Server Update for Management Server

8.1.1 Exadata Secure RDMA Fabric Isolation

Exadata Secure RDMA Fabric Isolation enables strict network isolation for virtual machine (VM) clusters on Oracle Exadata systems that use RDMA over Converged Ethernet (RoCE).

Secure Fabric provides critical infrastructure for secure consolidation of multiple tenants on Oracle Exadata, where each tenant resides in a dedicated VM cluster. Using this feature ensures that:

- Database servers in separate clusters cannot communicate with each other. They are completely isolated from each other on the network.
- Database servers in multiple clusters can share all of the storage server resources. However, even though the different clusters share the same storage network, no cross-cluster network traffic is possible.

Exadata Secure RDMA Fabric Isolation uses RoCE VLANs to ensure that network packets from one VM cluster cannot be seen by another VM cluster. VLAN tag enforcement is done at the KVM host level, which means that security cannot be bypassed by any software exploits or misconfiguration on the database server VMs.

See Using Exadata Secure RDMA Fabric Isolation.

Minimum requirements:

- Oracle Exadata System Software release 20.1.0
- Oracle Exadata X8M-2
- Deployment must contain VM clusters using Oracle Linux KVM

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- Oracle Grid Infrastructure:
  - 19.6.0.0.200114 with patches
  - 18.8.0.0.191015 with patches
  - 12.2.0.1.191015 with patches
  - 12.1.0.2.190716 with patches
- Oracle Database:
  - 19.6.0.0.200114 with patches
  - 18.8.0.0.191015 with patches
  - 12.2.0.1.191015 with patches
  - 12.1.0.2.180831
  - 11.2.0.4.180717

Refer to My Oracle Support document KB153930 for details about the required patches.

Related Topics

- Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930)

8.1.2 Smart Flash Log Write-Back

On High Capacity Oracle Exadata Storage Servers, all redo log entries must be written to the hard disk drives (HDDs). Even though Exadata Smart Flash Log prevents occasional log write outliers, the total log write throughput is still bound by the HDDs. Consequently, log writes can become a performance bottleneck when I/O bandwidth is saturated on the HDDs, either because of high-volume redo log activity or because of other I/O-intensive activities such as Golden Gate log mining, log archiving, and RMAN backup and restore.

The Smart Flash Log Write-Back feature automatically and transparently stores the entire contents of redo log files using Exadata Smart Flash Cache in Write-Back mode, thereby eliminating the HDDs as a potential performance bottleneck. Depending on the system workload, overall log write throughput can improve up to 250%.

Smart Flash Log Write-Back works transparently in conjunction with Exadata Smart Flash Log. Smart Flash Log Write-Back boosts overall log write throughput, while Exadata Smart Flash Log continues to prevent log write latency outliers.

Smart Flash Log Write-Back works with Oracle Data Guard Primary and Standby databases, boosting throughput for online redo log files and standby redo log files.

If flash cache space resource management is configured in the IORM plan, then caching of redo log files is included in the space accounting for each multitenant container database (CDB) or non-CDB database.

Minimum requirements:

- Oracle Exadata System Software release 20.1.0.
- Oracle Exadata Database Machine X7.
- Exadata Smart Flash Cache in Write-Back mode.
- Oracle Database in `ARCHIVELOG` mode.

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8.1.3 Fast In-Memory Columnar Cache Creation

Columnar cache with in-memory database formats is created when data is read from the hard disks, where it is stored in the hybrid columnar format. With this feature, columnar cache with in-memory database formats is also created when reading data in an intermediate format from the flash cache.

This feature provides a significant performance improvement for columnar cache creation, especially when there are concurrent workloads utilizing hard disk IO bandwidth. For example, a backup that utilizes the hard disk bandwidth no longer needs to share that bandwidth with the in-memory columnar cache creation. As a result, both the backup and the in-memory columnar cache creation run faster.

See In-Memory Columnar Format Support in the *Oracle Exadata System Software User's Guide* for more information about the in-memory columnar cache format.

Minimum requirements:

- Oracle Exadata System Software release 20.1.0

8.1.4 Cell-to-Cell Rebalance Preserves PMEM Cache Population

Data rebalancing may occur for a variety of reasons. For example, a rebalance operation might happen to maintain data redundancy when a hard disk suffers a real or predictive failure. When a rebalance operation moves data to a different storage server, some of the data might be cached in the persistent memory (PMEM) cache, also known as Persistent Memory Data Accelerator.

Commencing with Oracle Exadata System Software release 20.1.0, relevant PMEM cache entries are automatically replicated to the target storage server when a rebalance operation moves data to a different storage server.

This feature builds on existing features that preserve data in Exadata Smart Flash Cache during cell-to-cell rebalance operations, resulting in more consistent application performance after a rebalance operation.

Minimum requirements:

- Oracle Exadata System Software release 20.1.0.
- Oracle Exadata Database Machine X8M.

8.1.5 Control Persistent Memory Usage for Specific Databases

This feature introduces `pmemcache` and `pmemlog`, which are two new directives for the interdatabase IORM plan. With these directives, you can control persistent memory usage for specific databases and ensure that valuable persistent memory resources are reserved for mission-critical databases, especially in consolidated environments.

You can set `pmemcache=off` to prevent the specified database from using the persistent memory (PMEM) cache. Likewise, setting `pmemlog=off` prevents the specified database from using the PMEM log. By default, all databases can use persistent memory for caching and logging.

You can check the current IORM plan settings by issuing the command `LIST IORMPLAN DETAIL` in CellCLI.

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See Using IORM to Control Database Access to Flash and PMEM Resources and Controlling Access to PMEM Cache and PMEM Log in the *Oracle Exadata System Software User's Guide* for more information.

Minimum requirements:

- Oracle Exadata System Software release 20.1.0
- Oracle Exadata X8M

8.1.6 Application Server Update for Management Server

In this release, Eclipse Jetty replaces Oracle WebLogic Server as the application server engine that is used internally by Oracle Exadata System Software, in particular Management Server (MS).

Oracle Exadata System Software does not need most of the sophisticated functionality provided by Oracle WebLogic Server. Consequently, moving to Eclipse Jetty delivers the following benefits:

- Speed — Eclipse Jetty is a light-weight web server, which consumes considerably fewer system resources than a full-featured application server, like Oracle WebLogic Server. Consequently, Eclipse Jetty can perform the required tasks more efficiently and free up resources to improve system performance across the board.
- Security — As a light-weight web server, Eclipse Jetty improves security by presenting fewer attack vectors. Furthermore, the security of Eclipse Jetty is demonstrated by its use in a wide variety of projects and products, both in development and production.

Minimum requirements:

- Oracle Exadata System Software release 20.1.0.

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9

New Features for Oracle Exadata System Software Release 19.x

Several new features were introduced for the various versions of Oracle Exadata System Software Release 19.x.

- What's New in Oracle Exadata Database Machine 19.3.0
- What's New in Oracle Exadata Database Machine 19.2.0
- What's New in Oracle Exadata Database Machine 19.1.0

9.1 What's New in Oracle Exadata Database Machine 19.3.0

The following features are new for Oracle Exadata System Software 19.3.0:

- Persistent Memory Data Accelerator
- Persistent Memory Commit Accelerator
- Support for Oracle Exadata X8M Systems
- Instant Failure Detection for X8M Systems
- KVM for Virtual Environments
- Faster Encrypted Table Smart Scans
- Smart Aggregation
- Smart In-Memory Columnar Cache with Row IDs
- Smart In-Memory Columnar Cache with Chained Rows
- Encryption of System Logs to Remote Destinations
- Update a Single SNMP User Definition
- Securing Storage Server Software Processes with Memory Protection Keys
- Default XFS File System for X8M Servers
- Oracle Linux Kernel to Unbreakable Enterprise Kernel 5 and Oracle Linux Distribution Upgraded to Oracle Linux 7.7
- Software Certification Ends for Exadata Database Machine X2 Servers

9.1.1 Persistent Memory Data Accelerator

Oracle Exadata Storage Server can now use a Persistent Memory (PMEM) Cache in front of Flash Cache. Known as Persistent Memory Data Accelerator, the PMEM cache uses Intel Optane™ DC Persistent Memory Modules (DCPMM). The Database Server uses remote direct memory access (RDMA) to enable 10x faster access latency to remote persistent memory.

Since the persistent memory is used as a shared cache, caching capacity effectively increases by 10x compared to directly using the persistent memory modules as expensive storage. This

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arrangement makes it cost effective to apply the benefits of persistent memory to multi-terabyte databases.

See Persistent Memory and RDMA for details.

Minimum requirements:

- Oracle Exadata System Software release 19.3.0
- Oracle Database 19c
- Oracle Exadata Storage Server X8M-2

9.1.2 Persistent Memory Commit Accelerator

Consistent low latency for redo log writes is critical for OLTP database performance, since transactions are committed only when redo logs are persisted. Furthermore, slow redo log persistence affects critical database algorithms. With the persistent memory commit accelerator, Oracle Database 19c uses Remote Direct Memory Access (RDMA) to write redo records in persistent memory on multiple storage servers. By using RDMA, the redo log writes are up to 8x faster, and excellent resilience is provided because the redo log is persisted on multiple storage servers.

On each storage server, the persistent memory area contains only the recently written log records and persistent memory space is not required for the entire redo log. Therefore, hundreds of databases can share the persistent memory area, enabling consolidation with consistent performance.

See Persistent Memory and RDMA for details.

Minimum requirements:

- Oracle Exadata System Software release 19.3.0
- Oracle Database 19c
- Oracle Exadata Storage Server X8M-2

9.1.3 Support for Oracle Exadata X8M Systems

A new class of Database and Storage Server, designated X8M, is designed to utilize RDMA over Converged Ethernet. Known as RoCE (pronounced rocky), RDMA over Converged Ethernet is the combination of using the existing Remote Direct Memory Access (RDMA) networking verbs, in association with the InfiniBand™ Trade Association (IBTA) standards based extensions for Converged Ethernet to enable high speed fabrics over Ethernet layer 2 and 3 networks. RoCE shares a common API infrastructure with InfiniBand, differing only at the physical and link layers. All existing Oracle Exadata high-performance architecture and tuning concepts are compatible with the new network.

Oracle Exadata X8M-2 and X8M-8 Database Servers utilize 100Gb/sec RDMA Network cards, which enables higher IO performance, and, when used in conjunction with Oracle Exadata X8M-2 Storage Servers with persistent memory acceleration, experience up to 10x lower latency for RDMA reads. All Oracle Exadata X8M-2 Storage Servers use the 100Gb/sec RDMA network cards, however the Extended Storage Server (XT) does not receive the persistent memory acceleration. High Capacity and Extreme Flash Storage Servers for the X8M generation receive 1.5 TB of persistent memory per server.

See Hardware Components of Oracle Exadata Database Machine in the *Oracle Exadata System Overview* for details.

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The Oracle Database and Oracle Grid Infrastructure software installations on Oracle Exadata X8M database servers must meet the minimum release requirements listed in Oracle Linux Kernel to Unbreakable Enterprise Kernel 5 and Oracle Linux Distribution Upgraded to Oracle Linux 7.7.

Oracle Exadata X8M servers must use Oracle Exadata System Software release 19.3.0 or later.

9.1.4 Instant Failure Detection for X8M Systems

Exadata uses heartbeats to detect the failure of various components. Server failure detection normally requires many missed heartbeats to avoid a false failure diagnosis. Exadata uses remote direct memory access (RDMA) on the RoCE network to quickly confirm server failures. Since RDMA uses hardware, the remote ports respond quickly even when the server is heavily loaded.

Instant failure detection is a unique technology that works transparently and enables incredible availability for OLTP applications.

9.1.5 KVM for Virtual Environments

KVM is the virtualization technology used with Oracle Exadata systems configured with RoCE interconnects. KVM provides kernel level hypervisor support, so the host kernel and KVM guest kernel are the same. Oracle Exadata Deployment Assistant (OEDA) is used to create KVM guests and clusters, and a KVM guest uses SR IOV virtual functions for RoCE network connectivity.

Xen is not supported for Oracle Exadata systems configured with RoCE interconnects, and KVM is not supported on Oracle Exadata systems configured with InfiniBand interconnects.

See Managing Oracle VM Domains using KVM for more information.

9.1.6 Faster Encrypted Table Smart Scans

Scans of encrypted tables stored in the in-memory columnar format have been improved by decrypting columns only when needed. Columns in the SELECT set or predicates are the only columns decrypted, not the entire flash cache cacheline. If the first predicate does not return any matches, then the columns for the second predicate are not accessed. This feature accelerates encrypted Smart Scan operations by up to 30% and reduces storage server CPU usage.

For example, consider the following query:

```
SELECT ename FROM emp
WHERE job LIKE ‘%VP’ AND sal + bonus > 500000
```

Only the projected columns (`ename`) and one or more predicated columns are decrypted. Salary values in data regions that do not have a VP are not accessed.

Minimum requirements:

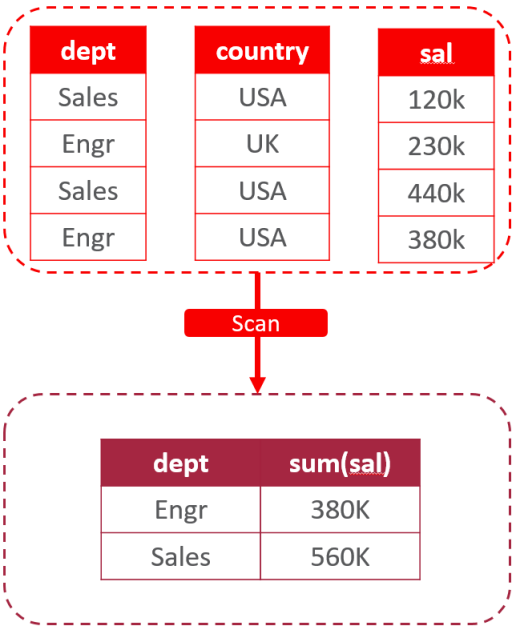
- Oracle Exadata System Software release 19.3.0
- Oracle Database In-Memory option

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9.1.7 Smart Aggregation

`SUM` and `GROUP BY` SQL operations are now smart scan enabled with in-memory columnar format. This feature benefits SQL statements with a low degree of parallelism, such as the following example:

```
SELECT dept, sum(sal) FROM emp
WHERE country='USA' GROUP BY dept;
```



Performance benefits of this feature include:

- Reduces data sent to the database server
- Improves CPU utilization on the database server
- Queries run up to 2x faster

Minimum requirements:

- Oracle Exadata System Software release 19.3.0
- Oracle Database 18c
- Oracle Database In-Memory option

9.1.8 Smart In-Memory Columnar Cache with Row IDs

Oracle Exadata System Software evaluates the predicate in a DML statement to determine the rows of interest. These rows are sent back from the storage servers to the database servers, which then uses the ROWIDs to update the rows. This feature expands this functionality to return ROWIDs for data stored in columnar compression format.

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For example, consider the following SQL query:

```
UPDATE weather_history SET temp = (temp – 32) * (5/9)
WHERE country = 'ENGLAND'
```

Smart scan is used to find the rows that satisfy `country = 'ENGLAND'` using ROWID values returned from a previous phase of the command processing.

This feature can improve the performance of DML statements by up to 5x.

Minimum requirements:

- Oracle Exadata System Software release 19.3.0
- Oracle Database release 18.3.0.0.180717DBRU

9.1.9 Smart In-Memory Columnar Cache with Chained Rows

Wide tables, large rows or row migration on update can create chained rows. Smart In-Memory Columnar Cache works by creating optimized Single Instruction Multiple Data (SIMD) representation for chained rows when the head and tail pieces fit in the same 1 MB region. This results in up to 3x faster scans for wide tables.

Minimum requirements:

- Oracle Exadata System Software release 19.3.0

9.1.10 Encryption of System Logs to Remote Destinations

Management Server (MS) on storage servers and database servers supports the `syslogconf` attribute, which enables log transfer configuration. This feature adds encryption transfer support for `rsyslog`.

See Encrypting System Log Information for more information.

Minimum requirements:

- Oracle Exadata System Software release 19.3.0

9.1.11 Update a Single SNMP User Definition

This feature adds new syntax to `ALTER CELL` and `ALTER DBSERVER` commands to allow SNMP V3 users to be added, altered, and deleted individually instead of configuring all users in one command string. This feature makes it easier to change the password for an individual SNMP user.

See ALTER CELL and ALTER DBSERVER for details.

Minimum requirements:

- Oracle Exadata System Software release 19.3.0

9.1.12 Securing Storage Server Software Processes with Memory Protection Keys

Memory Protection Keys is a hardware feature found in Oracle Exadata X7-2 and newer systems. Memory Protection Keys provide a thread local permission control on memory pages

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without incurring the high cost of Page Table Entry (PTE) modifications and Translation Look-aside Buffer (TLB) flushes.

The Exadata storage server process that performs block IO (`cellsrv`) and the processes that perform smart scans (`celloflsrv`) are now enhanced to run with memory protection keys. This feature is enabled out of the box with no tuning needed. Each thread in these processes needs to obtain access to the appropriate memory protection key before it can access the data. Any access to a piece of memory that does not have the correct key traps the process. This enhances the security and robustness of the storage server processes by eliminating a class of potential memory corruptions.

Minimum requirements:

- Oracle Exadata System Software release 19.3.0
- Oracle Exadata X7-2

9.1.13 Default XFS File System for X8M Servers

To further improve the security of Oracle Exadata, the new X8M servers will use the XFS file system for bare metal, KVM guests, and storage servers.

New partitions are created for `/home`, `/tmp`, `/var`, and `/var/log/audit`.

Minimum requirements:

- Oracle Exadata System Software release 19.3.0
- Oracle Exadata X8M servers

9.1.14 Oracle Linux Kernel to Unbreakable Enterprise Kernel 5 and Oracle Linux Distribution Upgraded to Oracle Linux 7.7

This release upgrades Oracle Linux to Unbreakable Enterprise Kernel (UEK) 5, (4.14.35-x.el7uek.x86_64). Oracle Linux Kernel UEK5 introduces support for persistent memory, RoCE, and KVM on Exadata. The Linux distribution is upgraded to Oracle Linux 7.7.

Minimum requirements to upgrade to Oracle Exadata System Software release 19.3.0:

- Oracle Grid Infrastructure:
  - 19c
    - 19.5.0.0.191015 with patches or
    - 19.4.0.0.190716 with patches
  - 18.7.0.0.190716 with patches
  - 12.2.0.1.0.190716 with patches
  - 12.1.0.2.0.190716 with patches
- Oracle Database:
  - 19.4.0.0.0.190716 with patches
  - 18.7.0.0.0.190716 with patches
  - 12.2.0.1.0.181016
  - 12.1.0.2.0.180831
  - 11.2.0.4.0.180717

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Refer to My Oracle Support document KB153930 for details about the required patches.

Related Topics

- Exadata Database Machine and Exadata Storage Server Supported Versions (My Oracle Support Doc ID KB153930)

9.1.15 Software Certification Ends for Exadata Database Machine X2 Servers

Software certification ends for Oracle Exadata Database Machine X2 servers. This includes the following servers:

- Sun Fire X4170 M2 Server
- Sun Fire X4800 Server
- Sun Fire X4270 M2 Server

9.2 What's New in Oracle Exadata Database Machine 19.2.0

The following features are new for Oracle Exadata System Software 19.2.0:

- Support for New Hardware - X8 Servers
- Exadata Extended (XT) Storage Server
- Changes to IORM flashcachesize Attribute and Hard Disk I/O Limits

9.2.1 Support for New Hardware - X8 Servers

This release includes support for the following hardware:

- Oracle Exadata Database Machine X8-2
- Oracle Exadata Database Machine X8-8
- 14 TB high-capacity drives for Exadata Storage Server X8-2

Minimum requirements:

- Oracle Exadata System Software release 19.2.0

9.2.2 Exadata Extended (XT) Storage Server

A new storage configuration is available starting with Oracle Exadata X8-2. The XT model does not have Flash drives, only 14 TB hard drives with HCC compression. This is a lower cost storage option, with only one CPU, less memory, and with SQL Offload capability turned off by default. If used without the SQL Offload feature, then you are not required to purchase the Oracle Exadata System Software license for the servers.

If you purchase the Oracle Exadata System Software license for the servers and want to enable the SQL Offload capability for the XT storage servers, then you can use this CellCLI command on *each* XT storage server to dynamically enable the SQL Offload feature:

```
$ cellcli -e 'ALTER CELL enableSmartStorage=true'
```

Minimum requirements:

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- Oracle Exadata System Software release 19.2.0
- Oracle Exadata Rack X4

9.2.3 Changes to IORM flashcachesize Attribute and Hard Disk I/O Limits

The `flashcachesize` IORM attribute and the hard disk I/O limit have been changed:

- The IORM `flashcachesize` attribute can now be used to over-provision the total flash cache.
- The IORM maximum utilization limit does not apply to hard disks.

See Monitoring IORM Utilization and Understanding I/O Resource Management in the *Oracle Exadata System Software User's Guide* for details.

Minimum requirements:

- Oracle Exadata System Software release 19.2.0

9.3 What's New in Oracle Exadata Database Machine 19.1.0

The following features are new for Oracle Exadata System Software 19.1.0:

- Oracle Linux Upgraded to Oracle Linux 7.5
- Automated Cloud Scale Performance Monitoring
- Faster Smart Scans Using Column-level Checksum
- Enhanced OLTP High Availability During Cell Outages and Flash Failures
- Support for Host and ILOM on Separate Network
- DB_UNIQUE_NAME Support for Multiple Clusters Sharing Exadata Storage
- Secure Eraser Updates
- Server Time Synchronization Uses Chrony
- Quorum Disk Manager Service Change
- Audit Rules File
- Customizable SYSLOG Format
- Caching Large Copy Writes in Exadata Smart Flash Cache
- Security Improvements
- Deprecated Features in Oracle Exadata System Software Release 19.1.0
- Desupported Features in Oracle Exadata System Software Release 19.1.0

9.3.1 Oracle Linux Upgraded to Oracle Linux 7.5

With Oracle Exadata System Software release 19.1.0, the operating system used on the database servers and storage servers has been updated to Oracle Linux 7.5. The Oracle Linux kernel UEK4 that has been used in previous releases continues to stay the same.

The following Oracle Database and Oracle Grid Infrastructure software releases are supported with Oracle Exadata System Software release 19.1.0 and Oracle Linux 7.5.

Oracle Exadata System Software 19.1.0 and later supports the following Oracle Database software releases:

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- Oracle Database and Oracle Grid Infrastructure 19c
- Oracle Database and Oracle Grid Infrastructure 18c
  - Minimum version 18.3.0.0.180717
- Oracle Database and Oracle Grid Infrastructure 12c Release 2 (12.2.0.1.0)
  - Minimum version 12.2.0.1.180717
- Oracle Database and Oracle Grid Infrastructure 12c Release 1 (12.1.0.2.0)
  - Minimum version 12.1.0.2.180831
- Oracle Database 11g Release 2 (11.2.0.4.0)
  - Minimum version 11.2.0.4.180717
  - Requires Oracle Grid Infrastructure release 12.1.0.2.180831 or higher
- Oracle Database 11g Release 2 (11.2.0.3.0)
  - Minimum version 11.2.0.3.28
  - Requires Oracle Grid Infrastructure release 12.1.0.2.180831 or higher
  - Installation of the Oracle Database software is a manual task for this release and is not covered by OEDA.

> **Note**
>
> There are no further bundle patches for Oracle Database 11g Release 2 (11.2.0.3.0). The patching end date for this release was August 27, 2015.

Refer to New Features and Changes in the *Oracle Linux 7 Release Notes* for information about the Oracle Linux 7 release.

9.3.2 Automated Cloud Scale Performance Monitoring

Starting with Oracle Exadata System Software release 19.1.0, Exadata Database Machine provides automated, cloud-scale performance monitoring covering a wide range of sub-systems, including CPU, memory, file system, IO, and network. This feature combines artificial intelligence, years of real-world performance triaging experience, and best practices.

Oracle Exadata System Software can automatically detect performance issues and figure out the root cause without human intervention. Examples of how this feature operates include:

- If a spinning process is taking up all the resources on the system and impacting database performance, Oracle Exadata System Software automatically detects the CPU spin, pinpoints the exact process that is causing the spin, and generates an alert.
- If the Oracle database is not properly configured with huge pages according to the best practice recommendation, Oracle Exadata System Software automatically detects the misconfiguration and generates an alert for the affected database instances.

There is no configuration required for this feature. To receive alerts, you must configure the notification mechanism. See Monitoring Requests and Alerts for Oracle Exadata Storage Server and ALTER DBSERVER.

As a part of this feature, Management Server (MS) is enabled on user domains (domU) in addition to storage servers, database servers (bare metal configuration), and management domains (dom0).

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Minimum requirements:

- Oracle Exadata System Software 19.1.0

9.3.3 Faster Smart Scans Using Column-level Checksum

Checksum computation and validation helps to detect errors that may happen during storage or retrieval of data. A checksum is computed when a piece of data is written to Exadata Flash Cache and the checksum is verified on a subsequent read.

Prior to the Oracle Exadata System Software release 19.1.0, a checksum was computed on a block on flash after it was read. This block usually contains multiple columns, but a typical Data Warehousing query only accesses a few columns of a table. In Oracle Exadata System Software release 19.1.0, the unit of checksum computation is reduced to a single column. A checksum is computed for each column and stored in the column compression unit (CU) header. This optimization is enabled only for In-memory Columnar format on Exadata Smart Flash Cache.

The key benefits of the column level checksum approach are:

- **Selective checksum computation**: When smart scan reads a flash block containing the columns of interest, checksum verification is performed only for those specific column CUs even though there are many other columns present in the cache line. This reduces the amount of data on which the checksum is performed resulting in lower CPU usage. For example, consider the predicate `A < 5 and Z < 10`. The flash block where column A resides could contain columns B, C, and D. However, because B, C, and D are not referenced in the query, checksums are not performed for B, C, and D.
- **Just in time checksum computation**: Checksums are performed only when a column is processed. For example, consider the predicate `A < 5 and Z < 10`. Checksum is computed on the column CU for column A and the predicates are evaluated. If there are no rows satisfying the predicate `A < 5`, then there is no reason to evaluate `Z < 10`. Checksum computation is not performed on the column CU for column Z. This can greatly reduce the amount of data on which the checksum is performed resulting in lower CPU usage.

This feature is automatically enabled when you configure the `INMEMORY_SIZE` database initialization parameter and upgrade to Oracle Exadata System Software release 19.1.0; no further configuration is required to use this feature.

See Offloading of Data Search and Retrieval Processing in *Oracle Exadata System Software User's Guide* for more information.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0
- Exadata Smart Flash Cache
- Oracle Database In-Memory option

9.3.4 Enhanced OLTP High Availability During Cell Outages and Flash Failures

Oracle Exadata System Software release 19.1.0 enhances application performance after the failure of a flash device or storage server by partially duplicating hot data in the flash cache of multiple storage servers.

If a cell goes offline or a flash device fails, then the databases redirect IOs to use secondary mirrors for data read operations because the primary mirrors are unavailable due to the

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outage. However, the secondary mirrors might not be in the flash cache of the respective cell, so the databases must read the data from hard disks. This can negatively impact application performance due to flash cache misses.

With this feature, Oracle Exadata System Software prefetches the secondary mirrors of the OLTP data that is most frequently accessed into the flash cache. This prefetching is done as a background task. Oracle Exadata System Software automatically manages the secondary mirrors in the flash cache in an optimal way so that newer or more active secondary mirrors replace the cold data in the cache. In addition, when a flash device is replaced, this feature also ensures that the newly replaced flash device is made more current (warmed up) before redirecting database read operations to the new flash device. Thus, this feature provides better high availability for application performance by greatly reducing the secondary mirror flash cache misses during cell or flash device failures and flash device replacements.

This feature is useful for OLTP workloads only. Oracle Exadata System Software does not cache the secondary mirrors for scan data. Also, this feature is only enabled for write-back Flash Cache. No secondary mirror caching is done for write-through Flash Cache.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0
- Oracle Database 19c
- Exadata Write Back Flash Cache on High Capacity storage servers
- Exadata Database Machine X6 or later (due to flash cache size requirements)

9.3.5 Support for Host and ILOM on Separate Network

Previously Exadata servers and Integrated Lights Out Manager (ILOM) needed to use the same Administrative network for certain features to function properly, like alert notification in Oracle Exadata System Software. Oracle Exadata System Software release 19.1.0 or later eliminates this network dependency while maintaining all the features previously supported.

This feature helps improve security by enabling you to configure a separate network for ILOM so that the Exadata servers and ILOM are completely separate from each other.

See Configuring a Separate Network for ILOM in *Oracle Exadata Installation and Configuration Guide*.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0

Related Topics

- Overview of Network Requirements

9.3.6 DB_UNIQUE_NAME Support for Multiple Clusters Sharing Exadata Storage

You can now use the same `DB_UNIQUE_NAME` value for databases that share the same storage. This feature enables Oracle Multitenant clustered databases sharing the same storage cells to have the same `DB_UNIQUE_NAME`.

In previous releases, multiple clusters could share Exadata storage if the `DB_UNIQUE_NAME` value for each instance was globally unique across all clusters. In Oracle Exadata System Software release 19.1.0, each cluster can have its own `DB_UNIQUE_NAME` namespace. This means matching `DB_UNIQUE_NAME` values are allowed between different clusters. For example,

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in prior releases, `cluster1` and `cluster2` could have only one database (either in `cluster1` or `cluster2`) with the `DB_UNIQUE_NAME` parameter set to `db1`. In this release, if each cluster configures ASM-scoped security, then both clusters can have a database with the `DB_UNIQUE_NAME` parameter set to `db1`.

This feature eliminates the need for different clusters that share Exadata storage to coordinate the `DB_UNIQUE_NAME` assignments to avoid a name conflict. Each cluster is free to choose any `DB_UNIQUE_NAME` value, without having to coordinate with other clusters, as long as ASM-scoped security is configured for each cluster.

When ASM-scoped security is configured, the ASM cluster name is used to qualify the `DB_UNIQUE_NAME` for access to the storage servers. The metrics and stats collected for each database also use the `asmcluster.database` name qualification in various areas including I/O Resource Management (IORM), Flash Cache, quarantines, and cell offloading.

> **Warning**
>
> If you configure databases to have the same `DB_UNIQUE_NAME`, then those databases cannot be backed up to Oracle Zero Data Loss Recovery Appliance. The `DB_UNIQUE_NAME` for each database instance must be unique within the scope of the Oracle Zero Data Loss Recovery Appliance.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0
- Each database with the same `DB_UNIQUE_NAME` must be in a different Oracle ASM cluster
- ASM-scoped security configured for each Oracle ASM cluster

Related Topics

- ASSIGN KEY command
- About Exadata Storage Server Security Modes
- About Interdatabase Resource Management

9.3.7 Secure Eraser Updates

With Oracle Exadata System Software release 19.1.0, various improvements were made to Secure Eraser.

- Automatic Upgrading of Multi-pass Disk Erasure to Secure Eraser
- Automatic Secure Eraser as Part of Imaging
- Secure Eraser Improvements and New Features

9.3.7.1 Automatic Upgrading of Multi-pass Disk Erasure to Secure Eraser

If you specify to erase disks using 1pass, 3pass, or 7pass method, Oracle Exadata System Software automatically uses the optimal Secure Eraser method, if it is supported by the underlying hardware.

As disks get larger and larger, the traditional multi-pass overwrite methods such as 1-pass, 3-pass and 7-pass take more time to complete than the erasure method used by Secure Eraser. For example, a 10 TB hard drive can take more than 4 days for 7-pass erase, but only 1

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minute using Secure Eraser. See Securely Erasing Database Servers and Storage Servers for a table of supported hardware and estimated erasure times.

It is much faster and more secure to use Secure Eraser on the disks when it is supported. The Secure Eraser methods used in `DROP CELL` and `DROP CELLDISK` are the same as those in the Secure Eraser feature and are fully compliant with NIST SP-800-88r1 standard.

See DROP CELL and DROP CELLDISK for more information.

Minimum requirements:

- Oracle Exadata System Software 19.1.0
- Oracle Exadata Database Machine X5-2 or later

9.3.7.2 Automatic Secure Eraser as Part of Imaging

When re-purposing an Oracle Exadata Rack, it is typically a two-part process where you would first use the Secure Eraser feature introduced in Oracle Exadata System Software release 12.2.1.1.0 to securely erase the data first and then re-image the rack with the desired Oracle Exadata image.

Starting with Oracle Exadata System Software release 19.1.0, Secure Eraser is automatically started during re-imaging if the hardware supports Secure Eraser. This significantly simplifies the re-imaging procedure while maintaining performance. Now, when re-purposing a rack, you only have to image the rack and the secure data erasure is taken care of transparently as part of the process.

See Overview of Secure Erasure in *Oracle Exadata Security Guide* for more information.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0
- Oracle Exadata Database Machine X5-2 or later

9.3.7.3 Secure Eraser Improvements and New Features

In this release, the following new features and command options were added to Secure Eraser:

- The timezone is now included with the timestamps in the certificate
- Support for erasing individual devices (`--devices_to_erase`)

See Secure Eraser Syntax in *Oracle Exadata Security Guide* for more information.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0
- Oracle Exadata Database Machine X5-2 or later (for crypto erase)

9.3.8 Server Time Synchronization Uses Chrony

Starting with Oracle Exadata System Software release 19.1.0, Exadata database servers and storage servers running Oracle Linux 7 no longer use `ntpd`. Instead, `chrony` is used to synchronize the system clock on the servers with NTP servers. `chrony` can usually synchronize the system clock faster and with better time accuracy compared to `ntpd`.

When you upgrade from Oracle Linux 6 to Oracle Linux 7, the NTP server settings are migrated to `chrony`.

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All Oracle Grid Infrastructure and Oracle Database releases certified with Oracle Linux 7 also support `chrony`.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0

Related Topics

- https://chrony.tuxfamily.org/comparison.html

9.3.9 Quorum Disk Manager Service Change

Oracle Exadata database servers and storage servers running Oracle Linux 7 use the `target` service instead of the `tgtd` service for the Exadata Quorum Disk Manager.

During the upgrade from Oracle Linux 6 to Oracle Linux 7, Oracle Exadata database servers that use Quorum Disk Manager are migrated to use the new underlying `target` service. The migration can be done in a rolling fashion. The administration interface for the Quorum Disk Manager remains the same and can be used if any changes are needed after the upgrade to Oracle Linux 7.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0

Related Topics

- Overview of Quorum Disk Manager

9.3.10 Audit Rules File

During the upgrade from Oracle Linux 6 to Oracle Linux 7 on Exadata database servers, the Oracle Linux 6 audit settings are migrated and moved into the audit file `01-exadata_audit.rules`. Rules that are not specific to Oracle Exadata are not migrated during the upgrade. You must reconfigure these rules separately. Oracle recommends creating and maintaining a custom audit rules file for rules that are not specific to Oracle Exadata.

See Operating System Activity Monitoring on Oracle Exadata Storage Servers in the *Oracle Exadata System Software User's Guide* for more information.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0

9.3.11 Customizable SYSLOG Format

A new cell and database server attribute, `syslogFormat`, can be used to change the standard syslog format to any format desired.

When the attribute is set, Management Server (MS) modifies the `/etc/rsyslog.conf` file to contain the format string specified, and restarts the syslog daemon. Setting `syslogFormat` to an empty string removes the format change and the default format is restored.

See ALTER CELL in *Oracle Exadata System Software User's Guide* or ALTER DBSERVER in *Oracle Exadata Maintenance Guide* for details.

Minimum requirements:

- Oracle Exadata System Software release 19.1.0

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9.3.12 Caching Large Copy Writes in Exadata Smart Flash Cache

Building on optimizations introduced in Exadata System Software 12.2.1.1.0 that enable Faster Performance for Large Analytic Queries and Large Loads, large writes associated with data file copy operations are now eligible for caching when the hard disk drives (HDDs) are busy. This optimization enables the storage server to utilize spare flash capacity and I/O bandwidth to deliver consistently better overall performance.

Minimum requirements:

- Oracle Database 21c (21.1)

9.3.13 Security Improvements

With Oracle Exadata System Software release 19.1.0, various security improvements were introduced.

- Access Control for RESTful Service
- Password Expiration for Remote Users
- Advanced Intrusion Detection Environment (AIDE)
- Implementing the Principle of Least Privilege to Improve Security
- Increased Security for Storage Server Processes
- SSHD ClientAliveInterval Changed to 600 Seconds
- Stronger Password Requirements
- Upload DIAGPACK to Oracle ASR Manager using HTTPS

9.3.13.1 Access Control for RESTful Service

Oracle Exadata System Software release 19.1.0 or later introduces a new capability for users to configure access control lists on the HTTPS access to the Exadata RESTful service. Users can specify a list of IP addresses or IP subnet masks to control who can access the RESTful service via HTTPS. Alternatively, if the RESTful service is not used, users can choose to disable HTTPS access to the node altogether. This feature applies to both Oracle Exadata Database Server and Oracle Exadata Storage Server.

See the following topics for more information:

- ALTER CELL
- CREATE CELL
- ALTER DBSERVER
- CREATE DBSERVER

Minimum requirements:

- Oracle Exadata System Software release 19.1.0

9.3.13.2 Password Expiration for Remote Users

You can now configure password expiration for remote users that access the Exadata RESTful service or use ExaCLI. On the Exadata server, you can set attributes to configure password expiration time and whether the user is allowed to remotely change an expired password.

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Additional attributes can be set to specify the length of the warning period before the password expires, and how long after the password expires before the user account is locked.

> **Note**
>
> This feature applies only to remote users and does not apply to operating system users like `celladmin` or `oracle`.

If these attributes are set on the server, then when a user attempts to connect to an account with an expired password, one of two things happens:

- If the server is configured to permit changing the password remotely, then the user is prompted to change the password immediately.
- If the server does not allow changing the password remotely, then the user is presented with an error indicating the password is expired and they will need assistance in getting it changed.

See the following topics for more information:

- Security Policies for Oracle Exadata Storage Servers
- DESCRIBE DBSERVER
- DESCRIBE CELL

Minimum requirements:

- Oracle Exadata System Software release 19.1.0

9.3.13.3 Advanced Intrusion Detection Environment (AIDE)

Oracle Exadata System Software release 19.1.0 adds support for Advanced Intrusion Detection Environment (AIDE) to help guard against unauthorized access to the files on your Exadata system. AIDE is a security feature that reports any malicious or unplanned change to the system. AIDE creates a database of files on the system, and then uses that database to ensure file integrity and to detect system intrusions.

See the following topics for more information:

- Guarding Against Unauthorized Operating System Intrusions
- https://en.wikipedia.org/wiki/Advanced_Intrusion_Detection_Environment

Minimum requirements:

- Oracle Exadata System Software release 19.1.0

9.3.13.4 Implementing the Principle of Least Privilege to Improve Security

Security best practices require that each process run with the lowest privileges needed to perform the task. The following processes now run as non-privileged users:

- **Smart Scan processes**

  The processes that perform a smart scan on the Oracle Exadata Storage Server used to run with the `root` user privilege. Performing predicate evaluation does not require root privileges. Starting with Oracle Exadata System Software release 19.1.0, these smart scan processes are owned by a new operating system user called `cellofl`. The user `cellofl`

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and group `celltrace` are automatically created when you perform a Software Update to Oracle Exadata System Software release 19.1.0.

- **Select ExaWatcher processes**

  The ExaWatcher infrastructure is responsible for collecting and archiving system statistics on both the Oracle Exadata Database Servers and Oracle Exadata Storage Servers. Some of the commands that collect `iostat`, `netstat`, `ps`, `top`, and other information have been modified to run without requiring `root` user privilege. The new operating system user `exawatch` and group `exawatch` are automatically created when you perform a Software Update on the Oracle Exadata Storage Server, Oracle Exadata Database Server, and within a virtual machine running on the Oracle Exadata Database Server.

As a result of these changes, the number of processes running as the `root` user is significantly reduced which improves security on Oracle Exadata servers.

This feature is automatically enabled by performing a software update to Oracle Exadata System Software release 19.1.0. No additional configuration is required.

See the following topics for more information:

- Understanding User Accounts
- Offloading of Data Search and Retrieval Processing
- ExaWatcher Charts

9.3.13.5 Increased Security for Storage Server Processes

The secure computing (seccomp) feature in the Oracle Linux kernel is used to restrict the system calls that can be made from a process.

The Oracle Linux kernel has a few hundred system calls, but most of them are not needed by any given process. A seccomp filter defines whether a system call is allowed or restricted. Seccomp filters are installed for cell server and cell offload server processes automatically on an upgrade. An allowlist of system calls are allowed to be made from cell server and cell offload server. For certain allowlist system calls, the seccomp filters perform an additional validation of the arguments.

Seccomp filters provide a higher level of security for the cell processes. This feature is automatically enabled in Oracle Exadata System Software release 19.1.0.

9.3.13.6 SSHD ClientAliveInterval Changed to 600 Seconds

The `ClientAliveInterval` parameter causes the SSH client to time out automatically after a period of inactivity, which is specified in seconds. When the specified time limit has been reached, if no data has been received from the client, SSHD sends a message through the encrypted channel to request a response from the client. If no response is received from the server side, then the connection is discarded. Previously `ClientAliveInterval` was set to 2 hours on the storage servers and 24 hours on the database servers. These large values were required to keep the `dcli` calls made from `patchmgr` from timing out.

The `patchmgr` utility has also been modified. `dcli` calls made from `patchmgr` use run-time parameters to extend the timeout limit. This prevents the calls from timing out if there is no communication from the server for more than 10 minutes.

If you require a long-running connection to the database servers, such as when taking operating system backups, you can specify a larger value for ClientAliveInterval in the `/etc/ssh/sshd_config` file. You must restart the SSH service for changes to take

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effect. After the long running operation completes, you must remove the modification to the ClientAliveInterval and restart the SSH service.

9.3.13.7 Stronger Password Requirements

When creating operating system users on the database servers and storage servers, the new Exadata default password policy rules are:

- Minimum characters: 8
- Minimum numbers: 1
- Minimum lowercase characters: 1
- Minimum uppercase characters: 1
- Minimum special characters: 1
- Maximum consecutive repeating characters: 3
- Maximum consecutive repeating characters of the same class: 4
- Minimum number of different characters: 8
- Minimum days for password change: 1
- Maximum days for password change: 60
- Dictionary words are not valid or accepted.
- The last ten passwords cannot be reused

> **Note**
>
> Passwords that were created before the new restrictions were added in Oracle Exadata System Software release 19.1.0 will continue to work without issue. If you use SSH equivalence, then you should notice no difference.

See the following topics for more information:

- Default Security Setting Enacted by OEDA
- Security Policies for Oracle Exadata Storage Servers

Minimum requirements:

- Oracle Exadata System Software release 19.1.0

9.3.13.8 Upload DIAGPACK to Oracle ASR Manager using HTTPS

For enhanced security, you can configure Management Server (MS) and Oracle ASR Manager to upload diagnostic packages using HTTPS.

See Enabling Automatic Diag Pack Upload for ASR for information.

9.3.14 Deprecated Features in Oracle Exadata System Software Release 19.1.0

The following features are deprecated in this release, and may be desupported in a future release:

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- Deprecation of Interleaved Grid Disks
- Deprecation of nfsimg Images

9.3.14.1 Deprecation of Interleaved Grid Disks

The interleaving option for grid disks has been deprecated. Attempts to create interleaved grid disks will be automatically converted to a normal grid disk creation.

Interleaved grid disks created before Oracle Exadata System Software release 19.1.0 continue to work as they did in previous releases.

9.3.14.2 Deprecation of nfsimg Images

When imaging or re-imaging an Oracle Exadata Database Machine server, starting with Oracle Exadata System Software release 19.1.0, NFS images have been deprecated. Use the PXE option with ISO image files instead of NFS image files.

The Secure Eraser package (`secureeraser_`*`label`*`.zip`) also contains ISO images instead of NFS images starting with Oracle Exadata System Software release 19.1.0.

The relevant sections in the documentation have been updated to reflect this change.

- Imaging a New System in the *Oracle Exadata Installation and Configuration Guide* has the updated imaging instructions
- Securely Erasing Oracle Exadata Database Machine in the *Oracle Exadata Security Guide* has the updated Secure Eraser instructions

9.3.15 Desupported Features in Oracle Exadata System Software Release 19.1.0

Oracle Exadata V2 is no longer certified, starting with Oracle Exadata System Software release 19.1.0. The current certification information can be found in Exadata System Software Certification and Error Correction (My Oracle Support Doc ID KB467937).

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10

New Features for Oracle Exadata System Software Release 18

Several new features were introduced for Oracle Exadata System Software Release 18.

- What's New in Oracle Exadata Database Machine 18c (18.1.0)
- Oracle Exadata Database Machine X7 New Features
  The following new features are available with Oracle Exadata Database Machine X7:

10.1 What's New in Oracle Exadata Database Machine 18c (18.1.0)

The following features are new for Oracle Exadata System Software 18c (18.1.0):

- In-Memory OLTP and Consolidation Acceleration
- In-Memory Columnar Caching on Storage Servers
- Oracle Exadata Storage Server Cloud Scale Software Update
- Faster Oracle Exadata Database Server Software Update
- Improved Ethernet Performance in Oracle VM
- Performance Improvement Following Disk Online Completion
- Improved High Availability After Flash Failures
- IORM Maximum Utilization Limit Applies to Flash Devices
- OEDA Command Line Interface

10.1.1 In-Memory OLTP and Consolidation Acceleration

Oracle Exadata Storage Servers add a new memory cache in front of flash memory. This is similar to how the current flash cache is in front of hard disks. This feature provides 100 microsecond (µs) online transaction processing (OLTP) read IO latency, which is 2.5 times lower than the 250 µs flash OLTP read IO latency. You can use existing memory upgrade kits to add more memory to storage servers to take advantage of this feature.

Cell RAM cache is a cache in front of the Flash Cache on storage servers and is an extension of the database cache. It is faster than the Flash Cache, but has smaller capacity. When buffers are aged out of the database buffer cache, the database notifies the cells so that the cell RAM cache can be populated with these buffers according to caching policies. These buffers are exclusively cached in the cell RAM cache. If a data block needs to be returned to the database buffer cache, then the buffer, if present, is evicted from the cell RAM cache. The cell RAM cache is an exclusive cache — the data block is present only in the cell RAM cache or in the database buffer cache, but not in both.

During read operations, if a data block is not found in the database buffer cache (cache miss), then the database issues a read for the data block from the cell. CELLSRV checks the RAM cache before accessing a lower layer in the IO stack (flash memory or hard disk):

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- If the data block is found in the RAM cache, then the data block is returned synchronously to the database. If the data block is going to be cached in database buffer cache, then the storage server evicts the data block from RAM cache.
- If the data block is not found in RAM cache, then the storage server looks in the Flash cache. If the data block is not found in the Flash cache, then the data block is read from disk. The data block is returned to the database, but the data block is not added to the RAM cache.

During write operations, the database issues a write for a data block to the storage server. Cell Server (CELLSRV) checks the RAM cache before accessing a lower layer in the IO stack (Flash Cache or hard disk):

- If the data block is found in the RAM cache, then CELLSRV invalidates the corresponding cache line in the RAM cache, and sends the data block to the lower layer to be written to disk. The RAM cache is not populated.
- If the data block is not found in RAM cache, then the storage server sends the data block to the lower layer to be written to disk. The RAM cache is not populated.

Unlike the flash cache, the RAM cache on the storage servers is an exclusive cache — the data block stored is present either in RAM cache or in the buffer cache of the database, but not both. When the database evicts a data block from buffer cache, it instructs CELLSRV to populate the data block in the RAM cache. CELLSRV populates the RAM cache in an asynchronous manner.

In the event of storage server failure on the primary mirror, the database sends the RAM cache population to the secondary mirror, so that the blocks are now cached in the RAM cache for the secondary mirror. When the primary mirror comes back online, the blocks are populated back in the primary mirror's RAM cache.

A new Memory Cache section is available in the AWR report for monitoring RAM cache status and activities.

Minimum requirements:

- Oracle Exadata System Software 18c (18.1.0)
- Oracle Exadata Storage Server X6 or X7
- Oracle Database version 12.2.0.1 April 2018 DBRU or 18.1 or higher

Related Topics

- Managing the RAM Cache on the Storage Servers

10.1.2 In-Memory Columnar Caching on Storage Servers

Oracle Exadata System Software release 12.2.1.1.0 introduced the support for In-Memory Columnar Caching on Oracle Exadata Storage Servers for Exadata Hybrid Columnar Compression tables. Oracle Exadata System Software 18c (18.1.0) extends the support for In-Memory Columnar Caching on storage servers for additional table types, specifically uncompressed tables and OLTP compressed tables.

By extending the Database In-Memory format for uncompressed tables and OLTP compressed tables, smart scan queries on more table types can benefit from fast vector-processing in-memory algorithms on data stored in the storage flash cache. With this format, most in-memory performance enhancements are supported in Smart Scan including joins and aggregation. Database In-Memory format is space efficient and usually takes up less space than uncompressed or OLTP compressed formats. Storing data in Database In-memory format results in better storage flash cache space utilization.

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Rewriting data from the traditional uncompressed or OLTP compressed format to Database In-Memory format is very CPU intensive. Oracle Exadata System Software has built-in intelligence to cache data in Database In-Memory format for regions that are not modified frequently.

Data from normal (unencrypted) as well as encrypted tablespaces can be cached in the in-memory columnar cache format.

Just as with Oracle Database In-Memory, the new Database In-Memory format is created by a background process so that it does not interfere with the performance of queries.

This feature is enabled by default when you configure the INMEMORY_SIZE database initialization parameter; no further configuration is required to use this feature. If `INMEMORY_SIZE` is not configured, then uncompressed tables and OLTP compressed table data is cached in Flash Cache in its native format and not in the Database In-Memory columnar format.

If you need to disable this feature, you can use a new DDL keyword `CELLMEMORY` with the `ALTER TABLE` command. See "Enabling or Disabling In-Memory Columnar Caching on Storage Servers" in *Oracle Exadata System Software User's Guide*.

Minimum requirements:

- Oracle Exadata System Software 18c (18.1.0)
- Oracle Database 12*c* release 1 (12.1.0.2) version 12.1.0.2.161018DBBP or Oracle Database 12*c* release 2 (12.2.0.1)
- Patch for bug 24521608 if using Oracle Database 12*c* release 1 (12.1.0.2)
- (Recommended) Patch for bug 26261327 (Enables better reverse offload functionality for complex queries)

10.1.3 Oracle Exadata Storage Server Cloud Scale Software Update

The Oracle Exadata Storage Server Cloud Scale Software Update feature introduces a brand new cloud-scale software update process for storage servers. You point the storage servers to a software store. The storage servers download new software in the background. You can schedule the preferred time of software update. Storage servers automatically upgrade the Oracle Exadata System Software in a rolling fashion while keeping the databases online. A single software repository can be used for hundreds of storage servers. This feature provides simpler and faster software updates for Cloud and On-Premise customers.

Each storage server downloads the software to its active partition, and then loads the software on its passive partition. The storage servers then reboot to the new version according to a specified schedule.

This feature improves scalability of software updates by allowing storage servers to update without dedicated `patchmgr` sessions. When updating hundreds of storage servers, administrators can use `dcli` to issue `ALTER SOFTWAREUPDATE` commands to set the software location and time parameters for all storage servers. Multiple software locations could be used for very large deployments to reduce contention.

See Scheduling Automated Updates of Storage Servers in the *Oracle Exadata Maintenance Guide* for details.

Minimum requirements:

- Oracle Exadata System Software 18c (18.1.0). You can use this feature to install subsequent software updates.

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10.1.4 Faster Oracle Exadata Database Server Software Update

The Oracle Exadata Database Server software update process now takes significantly less time than before and is up to 40% faster compared to previous releases. This helps reduce the cost and effort required to update the software on the database server.

Minimum requirements:

- Oracle Exadata System Software 18c (18.1.0)

10.1.5 Improved Ethernet Performance in Oracle VM

Oracle Exadata System Software 18c (18.1.0) has optimized receive and transmit of Ethernet packets for systems using virtualization. This optimization provides significant network performance boost with lower network latency and improved CPU utilization on the management domain (dom0) and user domains (domU).

Minimum requirements:

- Oracle Exadata System Software 18c (18.1.0)

10.1.6 Performance Improvement Following Disk Online Completion

In previous releases, during Oracle ASM resync operations, if the cachelines are not cached in source storage server, even if they have been cached in target storage server, Oracle Exadata System Software evicts them from the flash cache of the target storage server. This potentially impacted primary mirrors, resulting in cache misses and degraded performance.

Starting with this release, Oracle Exadata System Software ensures that cachelines in the Oracle ASM resync chunk region that are already in the flash cache are preserved, instead of being invalidated. This helps prevent cache misses. Compared to earlier releases, this feature provides significant performance improvement for Oracle ASM resync operations.

Minimum requirements:

- Oracle Exadata System Software 18c (18.1.0)

10.1.7 Improved High Availability After Flash Failures

Overall system performance after flash failures has been improved. Previously, after a flash failure, Oracle ASM would start reading from the disks on the affected Oracle Exadata Storage Server as soon as flash resilvering completes. However, the storage server would still have fewer than the normal number of flash devices, so performance on that storage server was affected. Starting with Oracle Exadata System Software 18c (18.1.0), Oracle ASM starts reading from the disks only after all failed flash devices are replaced on that storage server.

Minimum software required:

- Oracle Exadata System Software 18c (18.1.0)

10.1.8 IORM Maximum Utilization Limit Applies to Flash Devices

Starting with Oracle Exadata System Software release 18c (18.1.0), using `LIMIT` in an I/O Resource Management (IORM) plan directive or `max_utilization_limit` in an intra-database resource plan directive restricts the I/O utilization for a database on flash devices as well as hard disks.

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The concept of maximum utilization limit (`LIMIT`) is supported by IORM. In addition to specifying the resource allocation values, you can also provide a maximum utilization limit for a given database. This directive ensures that the database never utilizes I/O resources beyond the specified limits. For example, if a production and test database are sharing the Exadata cell, then you could specify `LIMIT` for the test database to limit the I/O utilization for the test database.

If a maximum utilization limit is specified, then excess capacity is never used by the databases. It is possible that the disks are running below full capacity when maximum utilization limits are specified.

See ALTER IORMPLAN or Understanding I/O Resource Management.

Minimum software required:

- Oracle Exadata System Software 18c (18.1.0)

10.1.9 OEDA Command Line Interface

The Oracle Exadata Deployment Assistant (OEDA) command-line interface (`oedacli`) is a new interface you can use to update an existing `es.xml` file. These updates are called **Actions**. An Action is a single atomic task. An example of an Action might be to create a new Guest. An Action can have many sub commands; however, most actions are single commands. Examples of multi-command steps are `CLONE GUEST` and `CLONE CELL`.

You can use `oedacli` to help with various Exadata life cycle management tasks, such as:

- Add node to or remove node from a Virtual Cluster on Oracle Exadata Database Machine
- Add database home to or remove database home from physical cluster
- Add or remove storage cells
- Resize Oracle ASM disk groups
- Add or remove additional databases
- Add or remove additional database homes to an Oracle VM cluster

See About the OEDA Command Line Interface in the *Oracle Exadata Installation and Configuration Guide* for details.

Minimum software required:

- Oracle Exadata System Software 18c (18.1.0)
- Oracle Exadata Deployment Assistant (OEDA), August 2017 release

10.2 Oracle Exadata Database Machine X7 New Features

The following new features are available with Oracle Exadata Database Machine X7:

- Do Not Service LED on Storage Servers
- Online Flash Disk Replacement for Oracle Exadata Storage Server X7
- New Configuration for System Partitions on Storage Servers
- Secure Boot

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10.2.1 Do Not Service LED on Storage Servers

Powering off an Oracle Exadata Storage Server in a cluster with reduced redundancy may cause Oracle ASM disk group force dismount and compromise data availability. To prevent human errors such as mistakenly powering off the wrong storage server, Oracle Exadata X7-2 storage servers come with a new Do Not Service LED. This LED indicates whether it is safe to power off the Oracle Exadata Storage Server for servicing. Starting with Oracle Exadata System Software release 18.1, the Do Not Service LED is turned on automatically in real-time when redundancy is reduced to inform system administrators or field engineers that the storage server should not be powered off for servicing.

For example, if a storage server or disk is offline, Oracle Exadata System Software automatically turns on the Do Not Service LED on the storage servers that contain the partner disks to indicate these servers should not be turned off for servicing. When redundancy is restored, Oracle Exadata System Software automatically turns off the Do Not Service LED to indicate that the storage server can be powered off for servicing.

See the following for additional details:

- Exadata Storage Server X7-2 LEDs in the *Oracle Exadata Maintenance Guide*
- LIST CELL in the *Oracle Exadata System Software User's Guide*

Minimum requirements:

- Oracle Exadata System Software release 18.1.0.0.0
- Oracle Grid Infrastructure:
  - Release 12.1.0.2 July 2017 BP with ARU 21405133
  - Release 12.1.0.2 October 2017 BP or later
  - Release 12.2.0.1 July 2017 BP with ARU 21405125
  - Release 12.2.0.1 October 2017 BP or later
- Oracle Exadata Database Machine X7-2 or X7-8 (storage servers only)

10.2.2 Online Flash Disk Replacement for Oracle Exadata Storage Server X7

Previous generations of Oracle Exadata Database Machine allowed for online flash disk replacement in Oracle Exadata Storage Server X7-2 Extreme Flash, but flash disk replacement in Oracle Exadata Storage Server X7-2 High Capacity still required server downtime. Starting with Oracle Exadata Database Machine X7-2L and X7-8, flash disks in Oracle Exadata Storage Server X7-2 High Capacity can also be replaced online without server downtime.

Oracle Exadata System Software constantly monitors flash disk health. If a flash disk fails or experiences poor performance, then the disk can be replaced right away. If a flash disk enters predictive failure, then, to ensure redundancy, flash disk should not be replaced until:

- Oracle ASM disk rebalance completes if the device is used as a data grid disk
- Flash cache flush completes if the device is used for flash cache

Oracle Exadata System Software automatically monitors the progress of Oracle ASM disk rebalance and flash cache flush operations and sends a notification to users once the flash disk can be safely replaced without compromising redundancy. In any case, when it's safe to replace a flash disk, Oracle Exadata System Software automatically prepares the flash disk for

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online replacement and moves the flash disk to `dropped for replacement` status to indicate it's ready to be replaced. In addition, Oracle Exadata System Software automatically turns on the attention LED on the flash card and turns off the power LED on the card to help identify the card to replace.

System administrators or field engineers can open the chassis without shutting down the storage server, easily identify the card by the LED pattern, and replace the disks.

See Performing a Hot Pluggable Replacement of a Flash Disk in *Oracle Exadata Maintenance Guide* for details.

Minimum requirements:

- Oracle Exadata Storage Server X7-2 Extreme Flash
- Oracle Exadata System Software release 18.1.0.0.0 and Oracle Exadata Storage Server X7-2 High Capacity or Oracle Exadata Database Machine X7-8

10.2.3 New Configuration for System Partitions on Storage Servers

Previous generations of Oracle Exadata Database Machine use portions of two disks at slot 0 and 1 as system partitions. This is where the operating system and Oracle Exadata System Software are installed. Starting with Oracle Exadata Database Machine X7, there are two M.2 disks dedicated for system partitions. All hard disks on Oracle Exadata Storage Server X7-2 High Capacity and all flash disks on Oracle Exadata Storage Server X7-2 Extreme Flash are dedicated now for data storage only.

This configuration separates the system I/Os from the data I/Os and improves the performance on data disks at slot 0 and 1. Storage server disks now can be created on the entire disks at slot 0 and 1 and have a uniform size across all disks.

Additionally, Oracle Exadata System Software creates system partitions on the M.2 disks with the latest Intel Rapid Storage Technology enterprise (Intel RSTe) RAID, which delivers faster performance and better data protection compared to the traditional software RAID.

Oracle Exadata System Software also supports online replacement of the M.2 disks. The M.2 disks can be replaced without server downtime.

See Maintaining the M.2 Disks of Exadata Storage Servers in *Oracle Exadata Maintenance Guide* for details.

Minimum software required:

- Oracle Exadata System Software 18c (18.1.0)
- Oracle Exadata Database Machine X7-2 or Oracle Exadata Database Machine X7-8

10.2.4 Secure Boot

Secure Boot is a method used to restrict which binaries can boot the system. With Secure Boot, the system UEFI firmware will only allow boot loaders that carry the cryptographic signature of trusted entities. In other words, anything run in the UEFI firmware must be *signed* with a key that the system recognizes as trustworthy. With each reboot of the server, every component in the boot sequence is verified. This prevents malware from hiding embedded code in the boot sequence.

- Intended to prevent boot-sector malware or kernel code injection
- Hardware-based code signing
- Extension of the UEFI firmware architecture

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- Can be enabled or disabled through the UEFI firmware

See Restricting the Binaries Used to Boot the System in *Oracle Exadata Security Guide* for details.

Minimum software required:

- Oracle Exadata System Software release 18c (18.1.0)
- Oracle Exadata Database Machine X7-2 or X7-8
- Bare metal installation

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11

New Features for Oracle Exadata System Software Release 12.x

Several new features were introduced for the various versions of Oracle Exadata System Software Release 12.x.

- What's New in Oracle Exadata Database Machine 12.2.1.1.0
- What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.3.0)
- What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.2.0)
- What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.1.2)
- What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.1.1)
- What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.1.0)
- What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.1.1.1)
- What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.1.1.0)

11.1 What's New in Oracle Exadata Database Machine 12.2.1.1.0

The following features are new for Oracle Exadata Database Machine 12.2.1.1.0:

- In-Memory Columnar Caching on Storage Servers
- Columnar Flash Cache for Encrypted Tablespace
- Set Membership in Storage Indexes
- Storage Index to Store Column Information for More Than Eight Columns
- 5x Faster Oracle Exadata System Software Updates
- Faster Performance for Large Analytic Queries and Large Loads
- Secure Eraser
- Cell-to-Cell Offload Support for ASM-Scoped Security
  To perform cell-to-cell offload operations efficiently, storage servers need to access other storage servers directly, instead of through a database server.
- Adding an Additional Network Card to Oracle Exadata Database Machine X6-2 Database Servers
- Automatic Diagpack Upload for Oracle ASR
- CREATE DIAGPACK and LIST DIAGPACK Commands Available for Oracle Exadata Database Servers
- Rescue Plan
- Support for IPv6 Oracle VM and Tagged VLANs
- Management Server Can Remain Online During NTP, DNS, and ILOM Changes

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- New Charts in ExaWatcher
- New Metrics for Redo Log Writes
  New metrics are available to help analyze redo log write performance.
- Quarantine Manager Support for Cell-to-Cell Rebalance and High Throughput Write Operations
- ExaCLI and REST API Enabled for Management Server
  Both ExaCLI and REST API are enabled for Management Server (MS) on the database servers.
- New Features in Oracle Grid Infrastructure 12.2.1.1.0
- New Features in Oracle Database 12c Release 2 (12.2.0.1)
- Oracle Linux Kernel Upgraded to Unbreakable Enterprise Kernel 4 and Oracle VM Upgraded to 3.4.2

11.1.1 In-Memory Columnar Caching on Storage Servers

Oracle Exadata System Software release 12.2.1.1.0 can use fast vector-processing in-memory algorithms on data in the storage flash cache. This feature is available if you have licensed the Oracle Database In-Memory (Database In-Memory) option.

Oracle Exadata System Software release 12.1.2.1.0 added a columnar flash cache format which automatically stored Exadata Hybrid Columnar Compression data in pure columnar Exadata Hybrid Columnar Compression format in the flash cache. This release extends support for Exadata Hybrid Columnar Compression data to enable the cached data to be rewritten into Database In-Memory format, which enables ultra-fast single instruction, multiple data (SIMD) predicates to be used in Smart Scan. With this format, most in-memory performance enhancements are supported in Smart Scan including joins and aggregation.

Data from normal (unencrypted) as well as encrypted tablespaces can be cached in the in-memory columnar cache format.

Just as with Oracle Database In-Memory, the new Database In-Memory format is created by a background process so that it does not interfere with the performance of queries.

This feature is enabled by default when the `INMEMORY_SIZE` database initialization parameter is configured and the user does not need to do anything to get this enhancement. See INMEMORY_CLAUSE_DEFAULT in *Oracle AI Database Reference* for information about `INMEMORY_SIZE`. If `INMEMORY_SIZE` is not configured, then the Exadata Hybrid Columnar Compression format columnar cache is still used exactly as in 12.1.2.1.0.

If you need to disable this feature, you can use a new DDL keyword `CELLMEMORY` with the `ALTER TABLE` command. See Enabling or Disabling In-Memory Columnar Caching on Storage Servers in *Oracle Exadata System Software User's Guide*.

Minimum requirements:

- Oracle Database 12c release 1 (12.1.0.2), minimum software version required is 12.1.0.2.161018DBBP or
- Oracle Database 12c release 2 (12.2.0.1)
- Patch for bug 24521608

Related Topics

- *Oracle AI Database In-Memory Guide*
- Enabling or Disabling In-Memory Columnar Caching on Storage Servers

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11.1.2 Columnar Flash Cache for Encrypted Tablespace

In Oracle Exadata System Software 12.2.1.1.0, columnar flash cache support has been extended to encrypted tablespaces. If you have licensed the Oracle Database In-Memory (Database In-Memory) option, the encrypted tablespace data is stored in in-memory columnar format on storage flash cache. If you have not licensed the option, the encrypted tablespace data is stored in pure columnar Exadata Hybrid Columnar Compression format on storage server flash cache.

Minimum requirements:

- Oracle Database 12*c* release 1 (12.1.0.2), minimum software version required is 12.1.0.2.161018DBBP or
- Oracle Database 12*c* release 2 (12.2.0.1)
- Patch for bug 24521608

11.1.3 Set Membership in Storage Indexes

In Oracle Exadata System Software release 12.2.1.1.0, when data has been stored using the in-memory format columnar cache, Oracle Exadata Database Machine stores these columns compressed using dictionary encoding. For columns with fewer than 200 distinct values, the storage index creates a very compact in-memory representation of the dictionary and uses this compact representation to filter disk reads based on equality predicates. This feature is called **set membership**. A more limited filtering ability extends up to 400 distinct values.

For example, suppose a region of disk holds a list of customers in the United States and Canada. When you run a query looking for customers in Mexico, Oracle Exadata Storage Server can use the new set membership capability to improve the performance of the query by filtering out disk regions that do not contain customers from Mexico. In Oracle Exadata System Software releases earlier than 12.2.1.1.0, which do not have the set membership capability, a regular storage index would be unable to filter those disk regions.

Minimum requirements:

- Oracle Database 12*c* release 1 (12.1.0.2), minimum software version required is 12.1.0.2.161018DBBP or
- Oracle Database 12*c* release 2 (12.2.0.1)
- Patch for bug 24521608

11.1.4 Storage Index to Store Column Information for More Than Eight Columns

In Oracle Exadata System Software releases earlier than 12.2.1.1.0, storage indexes can hold column information for up to eight columns. In Oracle Exadata System Software release 12.2.1.1.0, storage indexes have been enhanced to store column information for up to 24 columns.

Space to store column information for eight columns is guaranteed. For more than eight columns, space is shared between column set membership summary and column minimum/maximum summary. The type of workload determines whether set membership summary gets stored in storage index.

See Set Membership in Storage Indexes for more information.

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11.1.5 5x Faster Oracle Exadata System Software Updates

Updating Oracle Exadata System Software now takes even less time. The Oracle Exadata System Software update process is now up to 2 times faster compared to 12.1.2.3.0, and up to 5 times faster compared to releases earlier than 12.1.2.3.0. A faster update time reduces the cost and effort required to update the software.

11.1.6 Faster Performance for Large Analytic Queries and Large Loads

Temp writes and temp reads are used when large joins or aggregation operations don't fit in memory and must be spilled to storage. In Oracle Exadata System Software releases earlier than 12.2.1.1.0, temp writes were not cached in flash cache; both temp writes and subsequent temp reads were from hard disk only. In Oracle Exadata System Software release 12.2.1.1.0, temp writes are sent to flash cache so that subsequent temp reads can be read from flash cache as well. This significantly speeds up queries that spill to temp if they are temp I/O bound. For certain queries, performance can improve up to four times faster. This is comparable to putting the temporary tablespace entirely in flash. Write-back flash cache has to be enabled for this feature to work.

Prior to Oracle Exadata System Software release 12.2.1.1.0, there was a size threshold for writes to the flash cache. Most writes over 128 KB are routed straight to disk because these writes are not expected to be read any time soon. For example, direct load writes, flashback database log writes, archived log writes, and incremental backup writes would bypass flash cache. Starting with Oracle Exadata System Software release 12.2.1.1.0, the flash cache algorithms have been enhanced to redirect such large writes into the flash cache, provided that such large writes do not disrupt the higher priority OLTP or scan workloads. Such writes are later written back to the disks when the disks are less busy. This feature allows Oracle Exadata Storage Server to utilize additional spare flash capacity and I/O bandwidth to provide better overall performance.

Note that this feature is supported on all Oracle Exadata Database Machine hardware except for V2 and X2 storage servers. On X3 and X4 storage servers, flash caching of temp writes and large writes is not supported when flash compression is enabled.

New statistics and report sections related to this feature were added to Automatic Workload Repository (AWR) reports in Oracle Database 18c (18.1.0), also available in the 12.1.0.2.0 July 2017 DBBP and the 12.2.0.1.0 Oct 2017 RUR.

Minimum requirements:

- Oracle Exadata Database Machine X3-2 or later
- Oracle Exadata System Software 12.2.1.1.0
- Oracle Database (one of the following):
  - Oracle Database 11*g* release 2 (11.2) with the fix for bug 24944847 applied
  - Oracle Database 12*c* release 1 (12.1) — 12.1.0.2.0 July 2017 DBBP
  - Oracle Database 12*c* release 2 (12.2.0.1) — 12.2.0.1.0 Oct 2017 RUR
  - Oracle Database 18c (18.1.0)

11.1.7 Secure Eraser

Oracle Exadata System Software release 12.2.1.1.0 or later provides a secure erasure solution, called Secure Eraser, for every component within Oracle Exadata Database Machine.

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This is a comprehensive solution that covers all Exadata Database Machines V2 and higher, including both 2-socket and 8-socket servers.

In earlier versions of Oracle Exadata Database Machine, you could securely erase user data through CellCLI commands like `DROP CELL ERASE`, `DROP CELLDISK ERASE`, or `DROP GRIDDISK ERASE`. However, these `DROP` commands only cover user data on hard drives and flash devices. Secure Eraser sanitizes all content, not only user data but also operating system, Oracle Exadata System Software, and user configurations. In addition, Secure Eraser covers a wider range of hardware components including hard drives, flash devices, internal USB, and ILOM.

The Secure Eraser securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to factory default. You can use this feature to decommission or repurpose an Oracle Exadata machine. The Secure Eraser completely erases all traces of data and metadata on every component of the machine.

For details on the Secure Eraser utility, see *Oracle Exadata Security Guide*.

11.1.8 Cell-to-Cell Offload Support for ASM-Scoped Security

To perform cell-to-cell offload operations efficiently, storage servers need to access other storage servers directly, instead of through a database server.

If you have configured ASM-scoped security in your Exadata environment, you need to set up **cell keys** to ensure storage servers can authenticate themselves to other storage servers so that they can communicate with each other directly. This applies to Oracle ASM resync, resilver, rebuild and rebalance operations, and database high-throughput write operations

Related Topics

- Enabling Cell-to-Cell Operations

11.1.9 Adding an Additional Network Card to Oracle Exadata Database Machine X6-2 Database Servers

Oracle Exadata Database Machine X6-2 database servers offer a highly available copper 10 Gbps network on the motherboard, and an optical 10 Gbps network via a PCI card on slot 2.

Starting with Oracle Exadata System Software release 12.2.1.1.0, you can add an additional Ethernet card if you require additional connectivity. The additional card can provide either dual port 10 GbE optical connectivity (part number X1109A-Z) or dual port 10 GbE copper connectivity (part number 7100488). You can install this part in PCIe slot 1 on the Oracle Exadata Database Machine X6-2 database server.

After you install the network card and connect it to the network, Oracle Exadata System Software release 12.2.1.1.0 automatically recognizes the new card and configures the two ports as `eth6` and `eth7` interfaces on the database server. You can use these additional ports for providing an additional client network, or for creating a separate backup or disaster recovery network. On a database server that runs virtual machines, you could use this network card to isolate traffic from two virtual machines.

See Also

Oracle Exadata Maintenance Guide

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11.1.10 Automatic Diagpack Upload for Oracle ASR

In Oracle Exadata System Software release 12.2.1.1.0, Management Server (MS) communicates with Oracle ASR Manager to upload a diagnostic package containing information relevant to the Oracle ASR automatically. In earlier releases you had to manually upload other diagnostics information after an automatic service request (SR) has been opened. By automating this step, this feature significantly reduces the turnaround time of Oracle ASRs.

This feature adds two new attributes to the `AlertHistory` object:

- The new `serviceRequestNumber` attribute shows the associated service request number.
- The new `serviceRequestLink` attribute shows the URL to the associated service request number.

Other feature highlights include:

- The diagnostic package RESTful page (`https://`*hostname*`/diagpack/download?name=`*diagpackname*) has a new column showing a link to the corresponding service request.
- Oracle ASR alert emails include SR links.

To enable Automatic Diagpack Upload for Oracle ASR, you must enable `http_receiver` in the Oracle ASR Manager:

- To check if `http_receiver` is enabled, run the following command from Oracle ASR Manager:

  ```
  asr show_http_receiver
  ```

- To enable the `http_receiver`, use the following command, where *port* is the port the `http_receiver` listens on.

  ```
  asr enable_http_receiver -p port
  ```

> **Note**
>
> The port specified here has to be the same as the `asrmPort` specified for the subscriber on the database server or on the storage server. The following commands show how to verify the `asrmPort` on a database server and storage server.
>
> ```
> DBMCLI> LIST DBSERVER ATTRIBUTES snmpSubscriber
>      ((host=test-engsys-asr1.example.com,
> port=162,community=public,
> type=ASR,fromIP=10.242.0.55,asrmPort=16168))
>
> CellCLI> LIST CELL ATTRIBUTES snmpSubscriber
>      ((host=test-engsys-asr1.example.com,port=162,community=public,
> type=ASR,asrmPort=16168))
> ```

If you do not want to automatically upload diagnostic data to a service request, you can run `ALTER CELL diagPackUploadEnabled=FALSE` to disable the automatic upload.

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Minimum software required: Oracle ASR Manager Release 5.7

Related Topics

- *Oracle Exadata Maintenance Guide*
- Enabling Automatic DiagPack Upload for ASR

11.1.11 CREATE DIAGPACK and LIST DIAGPACK Commands Available for Oracle Exadata Database Servers

The diagnostic package feature, which is available for storage servers, is now available for database servers as well. Management Server (MS) on database servers automatically collects customized diagnostic packages that include relevant logs and traces upon generating a database server alert. This applies to all critical database server alerts. Timely collection of diagnostic information prevents rollover of critical logs.

MS on database servers sends the diagnostic package as an email attachment for every critical email alert. Users can create hourly custom diagnostic packages by providing the start time and duration using the new `CREATE DIAGPACK` DBMCLI command.

See CREATE DIAGPACK and LIST DIAGPACK in the *Oracle Exadata Maintenance Guide* for details.

11.1.12 Rescue Plan

In Oracle Exadata System Software releases earlier than 12.2.1.1.0, after an Oracle Exadata Database Server or Oracle Exadata Storage Server rescue, you must re-run multiple commands to configure items such as I/O Resource Management (IORM) plans, thresholds, and storage server and database server notification setting.

In Oracle Exadata System Software release 12.2.1.1.0, there is a new attribute called `rescuePlan` for the `cell` and `dbserver` objects. You can use this attribute to get a list of commands, which you can store as a script. You can then run the script after a cell rescue to restore the settings.

For details on the `rescuePlan` attribute, see *Oracle Exadata Maintenance Guide*.

11.1.13 Support for IPv6 Oracle VM and Tagged VLANs

Oracle Exadata System Software release 12.2.1.1.0 supports IPv6 Oracle VM and tagged virtual LANs (VLANs) using Oracle Exadata Deployment Assistant (OEDA).

IPv6 VLANs are now supported on the management network. In earlier releases, this was not supported.

See *Oracle Exadata Installation and Configuration Guide*.

11.1.14 Management Server Can Remain Online During NTP, DNS, and ILOM Changes

If you are changing NTP, DNS, or ILOM parameters, the Management Server (MS) can remain online during the operation and does not need to be restarted.

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> **See Also**
>
> *Oracle Exadata Maintenance Guide*

11.1.15 New Charts in ExaWatcher

In Oracle Exadata System Software release 12.2.1.1.0, `GetExaWatcherResults.sh` generates HTML pages that contain charts for IO, CPU utilization, cell server statistics, and alert history. The IO and CPU utilization charts use data from `iostat`, while the cell server statistics use data from `cellsrvstat`. Alert history is retrieved for the specified timeframe.

For details, see ExaWatcher Charts in the *Oracle Exadata Maintenance Guide*.

11.1.16 New Metrics for Redo Log Writes

New metrics are available to help analyze redo log write performance.

Previously, when Automatic Workload Repository (AWR) reported an issue with redo log write wait time for database servers, the storage cells often indicated no issue with redo log write performance. New metrics help to give a better overall picture. These metrics provide insight into the following concerns:

- Is the I/O latency high, or is it some other factor (for example, network)?
- How many redo log writes bypassed Flash Log?
- What is the overall latency of redo log writes on each cell, taking into account all redo log writes, not just those which were handled by Flash Log?

Oracle Exadata System Software release 12.2.1.1.0 introduces the following metrics related to redo log write requests:

- `FL_IO_TM_W`: Cumulative redo log write latency. It includes latency for requests not handled by Exadata Smart Flash Log.
- `FL_IO_TM_W_RQ`: Average redo log write latency. It includes write I/O latency only.
- `FL_RQ_TM_W`: Cumulative redo log write request latency. It includes networking and other overhead.

  To get the latency overhead due to factors such as network and processing, you can use (`FL_RQ_TM_W - FL_IO_TM_W`).
- `FL_RQ_TM_W_RQ`: Average redo log write request latency.
- `FL_RQ_W`: Total number of redo log write requests. It includes requests not handled by Exadata Smart Flash Log.

  To get the number of redo log write requests not handled by Exadata Smart Flash Log, you can use (`FL_RQ_W - FL_IO_W`).

11.1.17 Quarantine Manager Support for Cell-to-Cell Rebalance and High Throughput Write Operations

Quarantine manager support is enabled for rebalance and high throughput writes in cell-to-cell offload operations. If Oracle Exadata System Software detects a crash during these operations, the offending operation is quarantined, and an alternative path is used to continue the operation.

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The quarantine types for the new quarantines are `ASM_OFFLOAD_REBALANCE` and `HIGH_THROUGHPUT_WRITE`.

See Quarantine Manager Support for Cell-to-Cell Offload Operations in the *Oracle Exadata System Software User's Guide* for details.

11.1.18 ExaCLI and REST API Enabled for Management Server

Both ExaCLI and REST API are enabled for Management Server (MS) on the database servers.

You can now perform remote execution of MS commands. You can access the interface using HTTPS in a web browser, or curl. See *Oracle Exadata Maintenance Guide* for more information.

11.1.19 New Features in Oracle Grid Infrastructure 12.2.1.1.0

The following new features in Oracle Grid Infrastructure 12.2.1.1.0 affect Oracle Exadata Database Machine:

- Oracle ASM Flex Disk Groups
  An Oracle ASM flex disk group is a disk group type that supports Oracle ASM file groups.
- Oracle Flex ASM
  Oracle Flex ASM enables Oracle ASM instances to run on a separate physical server from the database servers.
- Faster Redundancy Restoration After Storage Loss
  Using Oracle Grid Infrastructure 12c Release 2 (12.2), redundancy restoration after storage loss takes less time than in previous releases.
- Dynamic Power Change
  You can adjust the value of the `ASM_POWER_LIMIT` parameter dynamically.
- Quorum Disk Support in Oracle Universal Installer
  You can specify a quorum failure group during the installation of Oracle Grid Infrastructure.

11.1.19.1 Oracle ASM Flex Disk Groups

An Oracle ASM flex disk group is a disk group type that supports Oracle ASM file groups.

An Oracle ASM file group describes a group of files that belong to a database, and enables storage management to be performed at the file group, or database, level. In general, a flex disk group enables users to manage storage at the granularity of the database, in addition to at the disk group level.

See Managing Flex Disk Groups in *Oracle Automatic Storage Management Administrator's Guide*.

11.1.19.2 Oracle Flex ASM

Oracle Flex ASM enables Oracle ASM instances to run on a separate physical server from the database servers.

If the Oracle ASM instance on a node in a standard Oracle ASM cluster fails, then all of the database instances on that node also fail. However, in an Oracle Flex ASM configuration, Oracle 12*c* database instances would not fail as they would be able to access another Oracle ASM instance remotely on another node.

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With Oracle Flex ASM, you can consolidate all the storage requirements into a single set of disk groups. All these disk groups are mounted by and managed by a small set of Oracle ASM instances running in a single cluster. You can specify the number of Oracle ASM instances with a cardinality setting.

Oracle Flex ASM is enabled by default with Oracle Database 12*c* release 2 (12.2). Oracle Exadata Database Machine ships with cardinality set to `ALL`, which means an Oracle ASM instance is created on every available node. See the following topics for details:

- About Oracle Flex ASM in *Oracle Automatic Storage Management Administrator's Guide*
- Managing Oracle Flex ASM in *Oracle Automatic Storage Management Administrator's Guide*
- About Oracle Flex ASM Clusters Networks in *Oracle Grid Infrastructure Installation and Upgrade Guide for Linux*

11.1.19.3 Faster Redundancy Restoration After Storage Loss

Using Oracle Grid Infrastructure 12c Release 2 (12.2), redundancy restoration after storage loss takes less time than in previous releases.

A new `REBUILD` phase was introduced to the rebalance operation. The `REBUILD` phase restores redundancy first after storage failure, greatly reducing the risk window within which a secondary failure could occur. A subsequent `BALANCE` phase restores balance.

Oracle Grid Infrastructure release 12.1.0.2 with DBBP 12.1.0.2.170718 also includes the Oracle ASM `REBUILD` phase of rebalance.

> **Note**
>
> In Oracle Grid Infrastructure 12c release 2 (12.2), rebuild is tracked in V$ASM_OPERATION via a separate pass (REBUILD). In Oracle Grid Infrastructure 12c release 1 (12.1), both rebuild and rebalance phases are tracked in the same pass (REBALANCE).

Related Topics

- Manually Rebalancing Disk Groups

11.1.19.4 Dynamic Power Change

You can adjust the value of the `ASM_POWER_LIMIT` parameter dynamically.

If the `POWER` clause is not specified in an `ALTER DISKGROUP` statement, or when rebalance is implicitly run by adding or dropping a disk, then the rebalance power defaults to the value of the `ASM_POWER_LIMIT` initialization parameter. You can adjust the value of this parameter dynamically. The range of values for the `POWER` clause is the same for the `ASM_POWER_LIMIT` initialization parameter.

The higher the power limit, the more quickly a rebalance operation can complete. Rebalancing takes longer with lower power values, but consumes fewer processing and I/O resources which are shared by other applications, such as the database.

See Tuning Rebalance Operations in *Oracle Automatic Storage Management Administrator's Guide*.

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11.1.19.5 Quorum Disk Support in Oracle Universal Installer

You can specify a quorum failure group during the installation of Oracle Grid Infrastructure.

On Oracle Exadata Storage Servers, quorum disk groups are automatically created during deployment. A quorum failure group is a special type of failure group that is used to store the Oracle Clusterware voting files. The quorum failure group is used to ensure that a quorum of the specified failure groups are available.

The installer for Oracle Grid Infrastructure 12.2 was updated to allow you to specify quorum failure groups during installation instead of configuring the quorum failure group after installation using the Quorum Disk Manager utility.

See Identifying Storage Requirements for Oracle Automatic Storage Management in *Oracle Grid Infrastructure Installation and Upgrade Guide for Linux*

11.1.20 New Features in Oracle Database 12c Release 2 (12.2.0.1)

The following new features in Oracle Database 12c release 2 (12.2.0.1) affect Oracle Exadata:

- Database Server I/O Latency Capping
- Exadata Smart Scan Offload for Compressed Index Scan
- Exadata Smart Scan Offload Enhancements for In-Memory Aggregation (IMA)
- Exadata Smart Scan Offload Enhancements for XML
- Exadata Smart Scan Offload Enhancements for LOBs
- New Features in Oracle Exadata Snapshots

11.1.20.1 Database Server I/O Latency Capping

On very rare occasions there may be high I/O latency between a database server and a storage server due to network latency outliers, hardware problems on the storage servers, or some other system problem with the storage servers. Oracle ASM and Oracle Exadata Storage Server software automatically redirect read I/O operations to another storage server when the latency of the read I/O is much longer than expected. Any I/Os issued to the last valid mirror copy of the data are not redirected.

This feature works with all Exadata Storage Software releases. You do not have to perform any configuration to use this feature.

Minimum software required: Oracle Database and Oracle Grid Infrastructure 12*c* release 2 (12.2.0.1.0)

11.1.20.2 Exadata Smart Scan Offload for Compressed Index Scan

In Oracle Exadata Storage Server Software 12.1.2.3.0 and prior releases, smart scan offload supported normal uncompressed indexes and bitmap indexes.

In Oracle Exadata Storage Server Software 12.2.1.1.0, smart scan offload has been implemented for compressed indexes. Queries involving compressed index scan on Oracle Exadata can benefit from this feature.

Minimum software required: Oracle Database 12*c* release 2 (12.2.0.1.0) and Oracle Exadata Storage Server software release 12.2.1.1.0

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11.1.20.3 Exadata Smart Scan Offload Enhancements for In-Memory Aggregation (IMA)

Oracle Exadata Storage Server software supports offloading many SQL operators for predicate evaluation. The In-Memory Aggregation feature attempts to perform a "vector transform" optimization which takes a star join SQL query with certain aggregation operators (for example, `SUM`, `MIN`, `MAX`, and `COUNT`) and rewrites it for more efficient processing. A vector transformation query is similar to a query that uses Bloom filter for joins, but is more efficient. When a vector transformed query is used with Oracle Exadata Storage Server release 12.1.2.1.0, the performance of joins in the query is enhanced by the ability to offload filtration for rows used for aggregation. You will see “KEY VECTOR USE” in the query plan when this optimization kicks in.

In Oracle Exadata Storage Server software release 12.2.1.1.0, vector transformed queries benefit from more efficient processing due to the application of group-by columns (key vectors) to the Exadata Storage Index.

Additionally, vector transformed queries that scan data in in-memory columnar format on the storage server can offload processing of aggregation work. These optimizations are automatic and do not depend on user settings.

Minimum software required: Oracle Database 12*c* release 2 (12.2.0.1.0) and Oracle Exadata Storage Server software release 12.2.1.1.0

11.1.20.4 Exadata Smart Scan Offload Enhancements for XML

When XML data is stored using a SecureFiles LOB of less than 4 KB, the evaluation in a SQL WHERE clause of Oracle SQL condition `XMLExists` or Oracle SQL function `XMLCast` applied to the return value of Oracle SQL function `XMLQuery` can sometimes be offloaded to an Oracle Exadata Storage Server.

Minimum software required: Oracle Database 12*c* Release 2 (12.2.0.1.0) and Oracle Exadata Storage Server software release 12.2.1.1.0.

11.1.20.5 Exadata Smart Scan Offload Enhancements for LOBs

In Oracle Exadata Storage Server 12.2.1.1.0, offload support has been extended for the following LOB operators: `LENGTH`, `SUBSTR`, `INSTR`, `CONCAT`, `LPAD`, `RPAD`, `LTRIM`, `RTRIM`, `LOWER`, `UPPER`, `NLS_LOWER`, `NLS_UPPER`, `NVL`, `REPLACE`, `REGEXP_INSTR`, `TO_CHAR`.

Exadata smart scan offload evaluation is supported only on uncompressed inlined LOBs (less than 4 KB in size).

Minimum software required: Oracle Database 12*c* release 2 (12.2.0.1.0) and Oracle Exadata Storage Server software release 12.2.1.1.0.

11.1.20.6 New Features in Oracle Exadata Snapshots

- Hierarchical snapshot databases

  You can create space-efficient snapshot databases from a parent that is itself a snapshot. This allows for hierarchical snapshot databases. The parent snapshot is also space-efficient, all the way to the base test master. Multiple users can create their own snapshots from the same parent snapshot. The set of snapshots can be represented as a tree, where the root of the tree is the base test master. All the internal nodes in the tree are read-only databases and all the leaves in the tree are read/write databases. All Oracle Exadata

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features are supported on the hierarchical snapshot databases. For hierarchical snapshot databases, because there is a performance penalty with every additional depth level of the snapshot, Oracle recommends having a snapshot tree with a maximum depth of 10.

- Spare Test Master databases

  You can also create and manage a sparse test master, while having active snapshots from it. This feature allows the sparse test master to sync almost continuously with Oracle Data Guard, except for small periods of time when users are creating a snapshot directly from the sparse test master. This feature utilizes the hierarchical snapshot feature described above, by creating read-only hidden parents. Note that Oracle Exadata snapshot databases are intended for test and development databases only.

- Sparse backup and recovery

  When you choose to perform a sparse backup on DB0, the operation copies data only from the delta storage space of the database and the delta space of the sparse data files. A sparse backup can be either in the backup set format (default) or the image copy format. RMAN restores sparse data files from sparse backups and then recovers them from archive and redo logs. You can perform a complete or a point-in-time recovery on sparse data files. Sparse backups help in efficiently managing storage space and facilitate faster backup and recovery.

  See *Oracle AI Database Backup and Recovery User's Guide* for information about sparse backups.

Minimum hardware: Storage servers must be X3 or later

Minimum software: Oracle Database and Grid Infrastructure 12*c* release 2 (12.2), and Oracle Exadata Storage Server software release 12.2.1.1.0.

11.1.21 Oracle Linux Kernel Upgraded to Unbreakable Enterprise Kernel 4 and Oracle VM Upgraded to 3.4.2

This release upgrades Oracle Linux to Unbreakable Enterprise Kernel (UEK) 4, (4.1.12-61.28.1.el6uek.x86_64). For systems using virtualization, the DOM0 is upgraded to Oracle VM 3.4.2. This enables you to use Oracle Linux 6 on the dom0. The Linux kernels used on the dom0 and domU are now unified.

For systems previously using virtualization on the compute nodes, you must upgrade the Oracle Grid Infrastructure home to release 12.1.0.2.161018DBBP or later in all domU's before upgrading the Oracle Exadata Storage Server software to release 12.2.1.1.0. The Oracle Exadata Storage Server software upgrade to release 12.2.1.1.0 requires you to upgrade all the domU's first before you upgrade the dom0. This requirement is enforced by the `patchmgr` software.

If you use Oracle Advanced Cluster File System (Oracle ACFS), then you must apply the fix for bug 22810422 prior to the upgrade of the Oracle Grid Infrastructure home to enable Oracle ACFS support on the UEK4 kernel. In addition, Oracle recommends that you install the fix for bug 23642667 on both the Oracle Grid Infrastructure home and the Oracle Database home to increase OLTP workload performance.

11.2 What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.3.0)

The following features are new for Oracle Exadata Database Machine 12c Release 1 (12.1.2.3.0):

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- Performance Improvement for Oracle Exadata System Software Updates
- Quorum Disk Manager Utility
- VLAN Support
- Adaptive Scrubbing Schedule
- IPv6 Support in ASR Manager
- Increased Maximum Number of Database Processes
- Cell-to-Cell Rebalance Preserves Storage Index
- ASM Disk Size Checked When Reducing Grid Disk Size
- Support for Alerts in CREATE DIAGPACK

11.2.1 Performance Improvement for Oracle Exadata System Software Updates

Updating Oracle Exadata System Software now takes significantly less time. By optimizing internal processing even further, the cell update process is now up to 2.5 times faster compared to previous releases.

11.2.2 Quorum Disk Manager Utility

In earlier releases, when Oracle Exadata systems with fewer than 5 storage servers were deployed with HIGH redundancy, the voting disk for the cluster was created on a disk group with NORMAL redundancy. If two cells go down in such a system, the data is still preserved due to HIGH redundancy but the cluster software comes down because the voting disk is on a disk group with NORMAL redundancy.

Quorum disks enable users to deploy and leverage disks on database servers to achieve highest redundancy in quarter rack or smaller configurations. Quorum disks are created on the database servers and added into the quorum failure group.

For new systems to be configured with HIGH redundancy but having fewer than 5 storage servers, Oracle Exadata Deployment Assistant can be used to automatically create such quorum disks.

Users who have deployed such systems can use the new quorumdiskmgr utility manually. quorumdiskmgr enables you to manage quorum disks on database servers. With this utility, you can create, list, delete, and alter quorum disk configurations, targets, and devices.

See "Managing Quorum Disks for High Redundancy Disk Groups" in the Oracle Exadata Database Machine Maintenance Guide for details.

Minimum software required:

- Oracle Exadata Storage Server Software release 12.1.2.3.0
- Grid Infrastructure release 12.1.0.2.160119 with these patches: 22722476 and 22682752; or Grid Infrastructure release 12.1.0.2.160419 or later
- Patch 23200778 for all Database homes

11.2.3 VLAN Support

OEDA now supports the creation of VLANs on compute nodes and storage servers for the admin network, ILOM, client and the backup access network. Note the following:

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- Client and backup VLAN networks must be bonded. The admin network is never bonded.
- If the backup network is on a tagged VLAN network, the client network must also be on a separate tagged VLAN network.
- The backup and client networks can share the same network cables.
- OEDA supports VLAN tagging for both physical and virtual deployments.
- IPv6 VLANs are supported for bare metal on all Oracle Exadata systems except for X2 and V2 systems.

  IPv6 VLAN with VM is not supported currently.

> **Note**
>
> If your system will use more than 10 VIP addresses in the cluster and you have VLAN configured for the Oracle Clusterware client network, then you must use 3 digit VLAN ids. Do not use 4 digit VLAN ids because the VLAN name can exceed the 15 character operating system interface name limit.

The following table shows IPv4 and IPv6 support on the admin, client, and backup networks for the different Exadata systems and Oracle Database versions.

Version of Oracle Database	VLAN Tagging on Admin Network	Client and Backup Networks
11.2.0.4	Only supported with IPv4 addresses on X3-2 and above for two-socket servers, and X4-8 and above for eight-socket servers.	Supported with IPv4 and IPv6 on all hardware models.
12.1.0.2	Only supported with IPv4 addresses on X3-2 and above for two-socket servers, and X4-8 and above for eight-socket servers.	Supported with IPv4 on all hardware models. Supported with IPv6 on all hardware models with fix for 22289350.

See "Using Network VLAN Tagging with Oracle Exadata Database Machine" in the *Oracle Exadata Installation and Configuration Guide* for details.

11.2.4 Adaptive Scrubbing Schedule

Oracle Exadata System Software automatically inspects and repairs hard disks periodically when the hard disks are idle. The default schedule of scrubbing is every two weeks.

However, once a hard disk starts to develop bad sectors, it is better to scrub that disk more frequently because it is likely to develop more bad sectors. In release 12.1.2.3.0, if a bad sector is found on a hard disk in a current scrubbing job, Oracle Exadata System Software will schedule a follow-up scrubbing job for that disk in one week. When no bad sectors are found in a scrubbing job for that disk, the schedule will fall back to the scrubbing schedule specified by the `hardDiskScrubInterval` attribute.

If the user has changed the `hardDiskScrubInterval` to less than or equal to weekly, Oracle Exadata System Software will use the user-configured frequency instead of the weekly follow-up schedule even if bad sectors are found. See the ALTER CELL section in the *Oracle Exadata System Software User's Guide* for more information about scrubbing.

Minimum software required:

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- Oracle Exadata System Software release 12.1.2.3.0
- Grid Infrastructure home:
  - 11.2.0.4.16 (April 2015) or higher
  - 12.1.0.2.4 (January 2015) or higher

11.2.5 IPv6 Support in ASR Manager

Systems using IPv6 can now connect to Auto Service Request (ASR) using ASR Manager 5.4.

11.2.6 Increased Maximum Number of Database Processes

Table 11-1 shows the maximum number of database processes supported per database node. These numbers are higher than in previous releases. The best practice is to keep the process count below these values. If a subset of your workload is running parallel queries, the maximum database process count will be between the values in the "Maximum Number of Processes with No Parallel Queries" column and the "Maximum Number of Processes with All Running Parallel Queries" column.

Table 11-1 Maximum Number of Database Processes Per Node

Machine Type	InfiniBand Bonding Type	Maximum Number of Processes with No Parallel Queries	Maximum Number of Processes with All Running Parallel Queries
8-socket (X2-8, X3-8)	Active passive	28,500	25,000
8-socket (X4-8, X5-8)	Active bonding	64,000	44,000
2-socket (X2-2, X3-2)	Active passive	12,500	10,000
2-socket (X4-2, X5-2, X6-2)	Active bonding	16,000	14,000

Table 11-2 shows the maximum number of database processes supported per Oracle VM user domain. These numbers are higher than in previous releases. The best practice is to keep the process count below these values. If a subset of your workload is running parallel queries, the maximum database process count will be between the "Maximum Number of Processes with No Parallel Queries" column and the "Maximum Number of Processes with All Running Parallel Queries" column.

Table 11-2 Maximum Number of Database Processes Per Oracle VM User Domain

Machine Type	InfiniBand Bonding Type	Maximum Number of Processes with No Parallel Queries	Maximum Number of Processes with All Running Parallel Queries
2-socket (X2-2, X3-2)	Active passive	11,500	8,000
2-socket (X4-2, X5-2, X6-2)	Active bonding	23,000	14,000

The machines are configured as follows:

- On an 8-socket database node with active bonding InfiniBand configurations (X4-8 and X5-8), there are 8 IP addresses across 4 InfiniBand cards (8 InfiniBand ports).

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- On an 8-socket database node with active-passive InfiniBand configurations (X2-8 and X3-8), there are 4 IP addresses across 4 InfiniBand cards (8 InfiniBand ports).
- On a 2-socket database node with active bonding InfiniBand configurations (X4-2, X5-2, and X6-2), there are 2 IP addresses on 1 InfiniBand card (2 InfiniBand ports).
- On a 2-socket database node with active-passive InfiniBand configurations (X2-2 and X3-2), there is 1 IP address on 1 InfiniBand card (2 InfiniBand ports).

Up to 50,000 RDS sockets are allocated per InfiniBand IP address for database usage. Each IO-capable database process will consume RDS sockets across IPs with even load balancing.

Starting with Exadata 12.1.2.3.0, there is no connection limit on the cell side.

In addition to the higher process count supported by the Exadata image and the Oracle kernel, the following related products have also been enhanced:

- Oracle Exadata Deployment Assistant automatically configures higher limits in *Grid_home*`/crs/install/s_crsconfig_`*nodename*`env.txt` at deployment time.
- Exadata Patch Manager (`patchmgr` and `dbnodeupdate.sh`) automatically configures higher limits in *Grid_home*`/crs/install/s_crsconfig_`*nodename*`env.txt` during database node upgrades.

The following best practices should be followed to ensure optimal resource utilization at high process count:

- Application-initiated Oracle foregrounds should be established through a set of Oracle listeners running on the Exadata database nodes instead of using local bequeath connections.
- The number of listeners should be at least as high as the number of database node CPU sockets, and every database node CPU socket should run the same number of listeners. For example, on an Oracle Exadata X5-8 database node, eight listeners could be configured, one per database node CPU socket.
- Listeners should spawn Oracle processes evenly across database node CPU sockets. This can be done by specifying the socket they will run on at startup time. For example, assuming the `listener.ora` file is configured correctly for listeners 0 through 7, the following script could be used to spawn eight listeners on an X5-8 database node, each on a different socket:

```
#!/bin/bash
export ORACLE_HOME=/u01/app/oracle/product/12.1.0.2/dbhome_1
for socket in `seq 0 7`
do
 numactl --cpunodebind=${socket} $ORACLE_HOME/bin/lsnrctl start LISTENER$
{socket}
done
```

- Listener connection rate throttling should be used to control login storms and provide system stability at high process counts.
- The total number of connections established per second, in other words, the sum of `rate_limit` for all listeners, should not be more than 400 to avoid excessive client connection timeouts and server-side errors.

Minimum software required:

- Oracle Exadata System Software release 12.1.2.3.0

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- Oracle Database 12c Release 1 (12.1) release 12.1.0.2.160119 with these patches: 22711561, 22233968, and 22609314

11.2.7 Cell-to-Cell Rebalance Preserves Storage Index

Storage index provides significant performance enhancement by pruning I/Os during a smart scan. When a disk hits a predictive failure or a true failure, data needs to be rebalanced out to disks on other cells. This feature enables storage index entries, created for regions of data in the disk that failed, to be moved along with the data during the cell-to-cell offloaded rebalance to maintain application performance.

This feature provides significant performance improvement compared to earlier releases for application performance during a rebalance due to disk failure.

Minimum software required:

- Oracle Exadata Storage Server Software release 12.1.2.3.0
- Grid Infrastructure release 12.1.0.2.160119 with patch 22682752

11.2.8 ASM Disk Size Checked When Reducing Grid Disk Size

In releases earlier than 12.1.2.3.0, a user might accidentally decrease the size of a grid disk before decreasing the size of an ASM disk that is part of the disk group. In release 12.1.2.3.0, the resize order is checked so that the user cannot reduce the size of the grid disk to be smaller than the ASM disk.

A new attribute `asmDiskSize` is added to grid disk to support ASM disk size query. When the user runs ALTER GRIDDISK to alter the grid disk size, the command now checks the ASM disk size and prevents the user from making the grid disk smaller than the ASM disk.

The check works for both normal data disk and sparse disk. If it is a sparse grid disk, the check is performed when the virtual size is being changed. If it is a normal grid disk, the check is performed when size is being changed.

For example, suppose the following command:

```
CellCLI> list griddisk DATAC1_CD_00_adczarcel04 attributes name,asmdisksize
```

returns the following output:

```
DATAC1_CD_00_adczarcel04     14880M
```

When you try to reduce the size of the grid disk to be smaller than the ASM disk:

```
CellCLI> alter griddisk DATAC1_CD_00_adczarcel04 size=10G
```

the command returns an error:

```
CELL-02894: Requested grid disk size is smaller than ASM disk size. Please resize ASM
disk DATAC1_CD_00_ADCZARCEL04 first.
```

Minimum software required:

- Oracle Exadata Storage Server Software release 12.1.2.3.0
- Grid Infrastructure release 12.1.0.2.160119 with patch 22347483

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11.2.9 Support for Alerts in CREATE DIAGPACK

The `CREATE DIAGPACK` command now supports creating diagnostic packages for a specified alert using the `alertName` parameter.

See `CREATE DIAGPACK` in *Oracle Exadata System Software User's Guide* for details.

11.3 What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.2.0)

The following features are new for Oracle Exadata Database Machine 12c Release 1 (12.1.2.2.0):

- 8 TB Hard Disk Support
- IPv6 Support on Database and Storage Servers
- Running CellCLI Commands from Compute Nodes
- Disabling SSH on Storage Servers
- Fixed Allocations for Databases in the Flash Cache
- Oracle Exadata Storage Statistics in AWR Reports
- Increased Maximum Number of Database Processes
- Custom Diagnostic Package for Storage Server Alerts
- Updating Nodes Using patchmgr
- kdump Operational for 8-Socket Database Nodes
- Redundancy Check When Powering Down the Storage Server
- Specifying an IP Address for SNMP Traps
- Reverse Offload Improvements
- Cell-to-Cell Rebalance Preserves Flash Cache Population

11.3.1 8 TB Hard Disk Support

In this software release, Exadata storage server supports 8 TB high capacity disks. Supporting 8 TB high capacity disks has the following advantages:

- Doubles the disk capacity of the previous Exadata machines, up to 1344 TB per rack
- Provides more storage for scaling out your existing databases and data warehouses

Requirements for using 8 TB high capacity disks:

- Exadata 12.1.2.1.2 or higher
- Grid Infrastructure home requires one of the following:
  - 12.1.0.2.11 or higher BP
  - 12.1.0.2.10 or lower BP plus the following patches: 21281532, 21099555, and 20904530
  - 11.2.0.4.18 or higher BP
  - 11.2.0.4.17 or lower BP plus patch 21099555

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- 11.2.0.3 plus patch 21099555

11.3.2 IPv6 Support on Database and Storage Servers

Oracle Exadata database and storage servers are now enabled to use IPv6 for the admin network, ILOM, and the client access network. This works for both bare metal and virtualized deployments.

See IPv6 Support for details.

11.3.3 Running CellCLI Commands from Compute Nodes

The new ExaCLI utility enables you to run CellCLI commands on storage servers remotely from database servers. This is useful in cases where you locked the storage servers by disabling SSH access, as described in Disabling SSH on Storage Servers.

ExaCLI also provides an easier to use interface for storage server management, and enables you to separate the roles of a storage user from a storage administrator.

To run ExaCLI, you need to create one or more Exadata users on the storage servers, and grant the appropriate role to each user. A role assigns privileges to a user, determining which CellCLI commands they are allowed to run. When connecting to a storage server, ExaCLI authenticates the specified user name, and checks that the user has the appropriate privileges to run the specified command.

The new `exadcli` utility is similar to the `dcli` utility: `exadcli` enables you to run CellCLI commands across multiple storage servers.

For details, see:

- Using the ExaCLI Utility in the *Oracle Exadata Maintenance Guide*
- Using the exadcli Utility in the *Oracle Exadata System Software User's Guide*

You can control which commands users can run by granting privileges to roles, and granting roles to users. For example, you can specify that a user can run the `LIST GRIDDISK` command but not `ALTER GRIDDISK`. This level of control is useful in Oracle Cloud environments, where you might want to allow full access to the system to only a few users.

You also need to create users if you are using the new ExaCLI utility. You use the `CREATE USER`, `GRANT PRIVILEGE`, and `GRANT ROLE` commands to create users, specify privileges to roles, and grant roles to users. For details, see Creating Exadata Software Users and Roles in the *Oracle Exadata System Software User's Guide*.

11.3.4 Disabling SSH on Storage Servers

By default, SSH is enabled on storage servers. If required, you can "lock" the storage servers to disable SSH access. You can still perform operations on the cell using ExaCLI, which runs on compute nodes and communicates using HTTPS and REST APIs to a web service running on the cell.

When you need to perform operations that require you to log in to the cell, you can temporarily unlock the cell. After the operation is complete, you can re-lock the cell.

For details, see Disabling SSH on Storage Servers in the *Oracle Exadata System Software User's Guide*.

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11.3.5 Fixed Allocations for Databases in the Flash Cache

The `ALTER IORMPLAN` command has a new attribute called `flashcachesize` which enables you to allocate a fixed amount of space in the flash cache for a database. The value specified in `flashcachesize` is a hard limit, which means that the database cannot use more than the specified value. This is different from the `flashcachelimit` value, which is a "soft" maximum: databases can exceed this value if the flash cache is not full.

`flashcachesize` is ideal for situations such as Cloud and "pay for performance" deployments where you want to limit databases to their allocated space.

For details, see the following:

- Managing I/O Resources chapter in the *Oracle Exadata System Software User's Guide*
- `ALTER IORMPLAN` command in the *Oracle Exadata System Software User's Guide*

11.3.6 Oracle Exadata Storage Statistics in AWR Reports

The Exadata Flash Cache Performance Statistics sections have been enhanced in the AWR report:

- Added support for Columnar Flash Cache and Keep Cache.
- Added a section on Flash Cache Performance Summary to summarize Exadata storage cell statistics along with database statistics.

The Exadata Flash Log Statistics section in the AWR report now includes statistics for first writes to disk and flash.

Minimum software: Oracle Database release 12.1.0.2 Bundle Patch 11

11.3.7 Increased Maximum Number of Database Processes

Minimum software required: 12.1.0.2 BP11, or 11.2.0.4 BP18

The following table shows the maximum number of database processes supported per database node. These numbers are higher than in previous releases. The best practice is to keep the process count below these values. If a subset of your workload is running parallel queries, the maximum database process count will be between the "Number of Processes with No Parallel Queries" column and the "Number of Processes with All Running Parallel Queries" column.

Table 11-3 Maximum Number of Database Processes Per Node

Machine Type	InfiniBand Bonding Type	Maximum Number of Processes with No Parallel Queries	Maximum Number of Processes with All Running Parallel Queries
8-socket (X2-8, X3-8)	Active passive	28,500	25,000
8-socket (X4-8, X5-8)	Active bonding	50,000	44,000
2-socket (X2-2, X3-2)	Active passive	12,500	10,000
2-socket (X4-2, X5-2)	Active bonding	16,500	14,000

The machines are configured as follows:

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- On an 8-socket database node with active bonding InfiniBand configurations (X4-8 and X5-8), there are 8 IP addresses across 4 InfiniBand cards (8 InfiniBand ports).
- On an 8-socket database node with active-passive InfiniBand configurations (X2-8 and X3-8), there are 4 IP addresses across 4 InfiniBand cards (8 InfiniBand ports).
- On a 2-socket database node with active bonding InfiniBand configurations (X4-2 and X5-2), there are 2 IP addresses on 1 InfiniBand card (2 InfiniBand ports).
- On a 2-socket database node with active-passive InfiniBand configurations (X2-2 and X3-2), there is 1 IP address on 1 InfiniBand card (2 InfiniBand ports).

50,000 RDS sockets are provisioned per IP for database usage. Each IO-capable database process will consume RDS sockets across IPs with even load balancing.

Note that cells have the following connection limits:

- On X4 and X5 systems, the cell connection limit is 120,000 processes.
- On X2 and X3 systems, the cell connection limit is 60,000 processes.

This means that the total number of database processes cannot exceed the above limits on the cell nodes. For example, a full rack of 8 databases running at the maximum process count will exceed the cell connection limit.

Related Topics

- Increased Exadata Cell Connection Limit

11.3.8 Custom Diagnostic Package for Storage Server Alerts

Oracle Exadata Storage Servers automatically collect customized diagnostic packages that include relevant logs and traces upon generating a cell alert. This applies to all cell alerts, including both hardware alerts and software alerts. The timely collection of the diagnostic information prevents rollover of critical logs.

Management Server (MS) sends the diagnostic package as an email attachment for every email alert. You can access the following URL to download an existing diagnostic package if the email attachment is misplaced. In the following URL, *hostname* refers to the host name of the cell.

```
https://hostname/diagpack
```

You can also download the packages using ExaCLI.

You can create hourly custom diagnostic packages by providing the start time and duration using the `CREATE DIAGPACK` CellCLI command.

For details, see `CREATE DIAGPACK` in the *Oracle Exadata System Software User's Guide*.

11.3.9 Updating Nodes Using patchmgr

Starting with Oracle Exadata System Software release 12.1.2.2.0, Oracle Exadata database nodes (releases later than 11.2.2.4.2), Oracle Exadata VM management domains (dom0), and Oracle Exadata VM user domains (domU) can be updated, rolled back, and backed up using patchmgr. You can still run `dbnodeupdate.sh` in standalone mode, but using patchmgr enables you to run a single command to update multiple nodes; you do not need to run dbnodeupdate.sh separately on each node. patchmgr can update the nodes in a rolling or non-rolling fashion.

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The updated patchmgr and dbnodeupdate.sh are available in the new `dbserver.patch.zip` file, which can be downloaded from My Oracle Support document KB444935.

Related Topics

- Overview of Performing Exadata Database Servers Updates
- dbnodeupdate.sh and dbserver.patch.zip: Updating Exadata Database Server Software using the DBNodeUpdate Utility and patchmgr (My Oracle Support Doc ID KB444935)

11.3.10 kdump Operational for 8-Socket Database Nodes

In releases earlier than 12.1.2.2.0, kdump, a service that creates and stores kernel crash dumps, was disabled on Exadata 8-socket database nodes because generating the vmcore took too long and consumed too much space. Starting with Exadata release 12.1.2.2.0, kdump is fully operational on 8-socket database nodes due to the following optimizations:

- Hugepages and several other areas of shared memory are now exposed by the Linux kernel to user space, then filtered out by makedumpfile at kernel crash time. This saves both time and space for the vmcore.
- Memory configuration for the kexec kernel has been optimized.
- Overall memory used has been reduced by blocking unnecessary modules.
- Snappy compression is enabled on the database nodes to speed up vmcore generation.

11.3.11 Redundancy Check When Powering Down the Storage Server

If you try to shut down gracefully a storage server by pressing the power button on the front or going through ILOM, the storage server performs an ASM data redundancy check. If shutting down the storage server could lead to an ASM disk group force dismount due to reduced data redundancy, the shutdown is canceled and the LEDs blink as follows to alert the user that shutting down the storage server is not safe:

- On high capacity cells, all three LEDs on all hard drives blink for 10 seconds.
- On extreme flash cells, the blue OK-to-Remove LED blinks for 10 seconds, and the amber LED is lit.

You should not attempt a hard reset on the storage server.

If a storage server cannot be safely shut down due to reduced redundancy (the command "`cellcli -e list griddisk attributes name, deactivationOutcome`" will show all the offline and unhealthy disks), then you need to restore the data redundancy first. If there are other offline disks, you need to bring them back online and wait for resync to finish. If there is rebalance running to force drop failed disks or resilvering running to resilver data blocks after write back flash cache failure, you need to wait for the rebalance or resilvering to complete. Once data redundancy is restored, you may proceed to shut down the storage server again.

11.3.12 Specifying an IP Address for SNMP Traps

If the IP address associated with eth0 is not registered with Oracle ASR Manager, you can specify a different IP address using the new `fromIP` field in the `ALTER CELL` command (for storage servers) or the `ALTER DBSERVER` command (for database servers).

For details, see the description for:

- `ALTER CELL` in the *Oracle Exadata System Software User's Guide*
- `ALTER DBSERVER` in the *Oracle Exadata Maintenance Guide*

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11.3.13 Reverse Offload Improvements

Minimum software required: 12.1.0.2 BP11

The reverse offload feature enables a storage cell to push some offloaded work back to the database node when the storage cell's CPU is saturated.

Reverse offload from storage servers to database nodes is essential in providing a more uniform usage of all the database and storage CPU resources available in an Exadata environment. In most configurations, there are more database CPUs than storage CPUs, and the ratio may vary depending on the hardware generation and the number of database and cell nodes.

Different queries running at the same time need different rates of reverse offload to perform optimally with regard to elapsed time. Even the same query running in different instances may need different rates of reverse offload.

In this release, a number of heuristic improvements have been added for elapsed time improvement of up to 15% for multiple database instances and different queries running in parallel.

11.3.14 Cell-to-Cell Rebalance Preserves Flash Cache Population

Minimum software required: 12.1.0.2 BP11

When a hard disk hits a predictive failure or true failure, and data needs to be rebalanced out of it, some of the data that resides on this hard disk might have been cached on the flash disk, providing better latency and bandwidth accesses for this data. To maintain an application's current performance SLA, it is critical to rebalance the data while honoring the caching status of the different regions on the hard disk during the cell-to-cell offloaded rebalance.

This feature provides significant performance improvement compared to earlier releases for application performance during a rebalance due to disk failure or disk replacement.

When data is rebalanced from one cell to another, the data that was cached on the source cell is also cached on the target cell.

11.4 What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.1.2)

The following features are new for Oracle Exadata Database Machine 12c Release 1 (12.1.2.1.2):

- InfiniBand Partitioning for Virtualized Exadata Environments

11.4.1 InfiniBand Partitioning for Virtualized Exadata Environments

InfiniBand partitioning is now available for virtualized Exadata environments and can be configured with the Oracle Exadata Deployment Assistant (OEDA).

Use the graphical user interface of OEDA to define the InfiniBand partitions on a per-cluster basis, and the command line interface of OEDA to configure the guests and the InfiniBand switches with the appropriate partition keys and membership requirements to enable InfiniBand partitions.

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InfiniBand partitions can be defined on a per-cluster basis. If storage servers are shared among multiple clusters, then all clusters will use the same storage partition key.

11.5 What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.1.1)

The following features are new for Oracle Exadata Database Machine 12c Release 1 (12.1.2.1.1):

- Flash Performance Improvement in X5 Storage Servers
- Oracle Exadata Virtual Machines
- Infrastructure as a Service (IaaS) with Capacity-on-Demand (CoD)
- Improved Flash Cache Metrics
- Leap Second Time Adjustment
- Network Resource Management
- DBMCLI Replaces /opt/oracle.cellos/compmon/exadata_mon_hw_asr.pl Script

11.5.1 Flash Performance Improvement in X5 Storage Servers

Changes were made in the NVMe flash firmware to improve I/O task handling resources and modifications to the background refresh algorithms and operations. The flash performance is equivalent or slightly higher in this release.

11.5.2 Oracle Exadata Virtual Machines

Consolidated environments can now use Oracle Virtual Machine (Oracle VM) on X5-2, X4-2, X3-2, and X2-2 database servers to deliver higher levels of isolation between workloads. Virtual machine isolation is desirable for workloads that cannot be trusted to restrict their security, CPU, or memory usage in a shared environment.

11.5.3 Infrastructure as a Service (IaaS) with Capacity-on-Demand (CoD)

Oracle Exadata Infrastructure as a Service (IaaS) customers now have the Capacity-on-Demand feature to limit the number of active cores in the database servers in order to restrict the number of required database software licenses. Exadata 12.1.2.1.1 Software allows CoD and IaaS to coexist on the same system. Note that IaaS-CoD, the ability to turn on/off a reserved set of cores, is still included with IaaS.

11.5.4 Improved Flash Cache Metrics

This release contains integrated block cache and columnar cache metrics for better flash cache performance analysis.

11.5.5 Leap Second Time Adjustment

This release contains leap second support in anticipation of the June 30, 2015 leap second adjustment.

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11.5.6 Network Resource Management

- Oracle 1.6TB NVMe SSD firmware update to 8DV1RA12 in X5-2 Extreme Flash (EF) Storage Servers
- Oracle Flash Accelerator F160 PCIe card's firmware update to 8DV1RA12 in X5-2 High Capacity (HC) Storage Servers

11.5.7 DBMCLI Replaces /opt/oracle.cellos/compmon/exadata_mon_hw_asr.pl Script

Starting in Oracle Exadata Storage Server Release 12.1.2.1.0, a new command-line interface called DBMCLI is introduced to configure, monitor, and manage the database servers. DBMCLI is pre-installed on each database server and on DOM0 of virtualized machines. DBMCLI configures Auto Service Request, capacity-on-demand, Infrastructure as a Service, and database server e-mail alerts. DBMCLI replaces the `/opt/oracle.cellos/compmon/exadata_mon_hw_asr.pl` Perl script. Refer to the *Oracle Exadata Database Machine Maintenance Guide* for information on how to use DBMCLI.

11.6 What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.2.1.0)

The following features are new for Oracle Exadata Database Machine 12c Release 1 (12.1.2.1.0):

- Oracle Exadata Database Machine Elastic Configurations
- Sparse Grid Disks
- Snapshot Databases for Test and Development
- Columnar Flash Caching
- Oracle Exadata System Software I/O Latency Capping for Write Operations
- Elimination of False Drive Failures
- Flash and Disk Life Cycle Management Alert
- Performance Optimization for SQL Queries with Minimum or Maximum Functions
- Oracle Exadata Storage Server Software Performance Statistics in AWR Reports
- Exafusion Direct-to-Wire Protocol
- Management Server on Database Servers
- SQL Operator Offloading for JSON and XML
- I/O Resource Management for Flash
- Flash Cache Space Resource Management
- I/O Resource Management Profiles
- Write Back Flash Cache on Extreme Flash Cells
- Secure Erase for 1.6 TB Flash Drives in Extreme Flash and High Capacity Systems
- Increased Exadata Cell Connection Limit

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- Support for SNMP v3
- Federal Information Processing Standards (FIPS) 140-2 Compliant Smart Scan
- Oracle Exadata Virtual Machines

11.6.1 Oracle Exadata Database Machine Elastic Configurations

Elastic configurations allow Oracle Exadata Racks to have customer-defined combinations of database servers and Exadata Storage Servers. At least 2 database servers and 3 storage servers must be installed in the rack. The storage servers must all be the same type. Oracle Exadata Database Machine X5-2 Elastic Configurations and Oracle Exadata Database Machine X4-8 Elastic Configuration can have 2 to 19 database servers, 3 to 20 Exadata Storage Servers, or a combination of database servers and Exadata Storage Servers. Oracle Exadata Storage Expansion Rack X5-2 Elastic Configurations can have 4 to 19 storage servers.

Elastic configurations allow Oracle Exadata Racks to have customer-defined combinations of database servers and Exadata Storage Servers. This allows the hardware configuration to be tailored to specific workloads such as Database In-Memory, OLTP, Data Warehousing, or Data Retention.

- Oracle Exadata Database Machine X5-2 Elastic Configurations start with a quarter rack containing 2 database servers and 3 Exadata Storage Servers. Additional database and storage servers (High Capacity (HC) or Extreme Flash (EF)) can be added until the rack fills up or a rack maximum of 22 total servers is reached.
- Oracle Exadata Storage Expansion Rack X5-2 Elastic Configurations start with a quarter rack containing 4 Exadata Storage Servers. Additional storage servers (HC or EF) can be added to a total of 19 storage servers per rack.
- Oracle Exadata Database Machine X4-8 Elastic Configurations start with a half rack containing 2 database server X4-8 8-socket servers and 3 Exadata Storage Servers. Up to 2 additional X4-8 8-socket servers can be added per rack. Up to 11 additional Exadata Storage Servers (HC or EF) can be added per rack.

See Also

Elastic Configurations

11.6.2 Sparse Grid Disks

Sparse grid disks allocate space as new data is written to the disk, and therefore have a virtual size that can be much larger than the actual physical size. Sparse grid disks can be used to create a sparse disk group to store database files that will use a small portion of their allocated space. Sparse disk groups are especially useful for quickly and efficiently creating database snapshots on Oracle Exadata. Traditional databases can also be created using a sparse disk group.

Minimum hardware: Storage nodes must be X3 or later

Minimum software: Oracle Database 12c Release 1 (12.1) release 12.1.0.2 BP5 or later.

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11.6.3 Snapshot Databases for Test and Development

Space-efficient database snapshots can now be quickly created for test and development purposes. Snapshots start with a shared read-only copy of the production database (or pluggable database (PDB)) that has been cleansed of any sensitive information. As changes are made, each snapshot writes the changed blocks to a sparse disk group.

Multiple users can create independent snapshots from the same base database. Therefore multiple test and development environments can share space while maintaining independent databases for each task. Snapshots on Exadata Storage Servers allow testing and development with Oracle Exadata Storage Server Software features such as Smart Scan.

Exadata database snapshots are integrated with the Multi-tenant Database Option to provide an extremely simple interface for creating new PDB snapshots.

Minimum hardware: Storage nodes must be X3 or later

Minimum software: Oracle Database 12c Release 1 (12.1) release 12.1.0.2 BP5 or later.

11.6.4 Columnar Flash Caching

Oracle Exadata System Software release 12.1.2.1.0 can efficiently support mixed workloads, delivering optimal performance for both OLTP and analytics. This is possible due to the dual format architecture of Exadata Smart Flash Cache that enables the data to be stored in hybrid columnar for transactional processing and also stored in pure columnar, which is optimized for analytical processing.

In addition, Exadata Hybrid Columnar Compression balances the needs of OLTP and analytic workloads. Exadata Hybrid Columnar Compression enables the highest levels of data compression and provides tremendous cost-savings and performance improvements due to reduced I/O, especially for analytic workloads.

In Oracle Exadata System Software release 12.1.2.1.0, Exadata Smart Flash Cache software transforms hybrid columnar compressed data into pure columnar during flash cache population for optimal analytics processing. Flash caches on pure columnar data in flash run faster because they read only the selected columns, reducing flash I/Os and storage server CPU consumption.

Oracle Exadata System Software release 12.1.2.1.0 has the ability to cache Exadata Hybrid Columnar Compression table data on flash cache in a pure columnar layout. When Exadata Hybrid Columnar Compression tables are accessed using Smart Scan, the Exadata Hybrid Columnar Compression compressed data is reformatted to a pure columnar layout in the same amount of storage space on flash cache.

The percentage of data for a given column in a compression unit (CU) for a wide table is small compared to narrow table. This results in more CUs being fetched from disks and flash to get data for the entire column. Queries reading only a few columns of a wide Exadata Hybrid Columnar Compression table exhibit high I/O bandwidth utilization due to irrelevant columns being read from storage. Storing the data in a columnar format on flash cache alleviates the need for reading the irrelevant columns and provides a significant performance boost.

Depending on the type of workload (OLTP or data warehousing), the same region of data can be cached in both the traditional block format as well as the columnar format in flash cache.

This feature is enabled by default; you do not need to configure anything to use this feature.

Columnar Flash Caching accelerates reporting and analytic queries while maintaining excellent performance for OLTP style single row lookups.

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Columnar Flash Caching implements a dual format architecture in Oracle Exadata Database Machine flash by automatically transforming frequently scanned Exadata Hybrid Columnar Compression compressed data into a pure columnar format as it is loaded into the flash cache. Smart Scans operating on pure columnar data in flash run faster because they read only the selected columns reducing flash I/Os and storage server CPU.

The original Exadata Hybrid Columnar Compression formatted data can also be cached in the flash cache if there are frequent OLTP lookups for the data. Therefore the Exadata Smart Flash Cache automatically optimizes the format of the cached data to accelerate all types of frequent operations.

This feature is enabled by default; you do not need to configure anything to use this feature.

Minimum software: Oracle Exadata System Software release 12.1.2.1.0 running Oracle Database 12*c* release 12.1.0.2.0.

See Also

Oracle Exadata System Software User's Guide for information about the flash cache metrics

11.6.5 Oracle Exadata System Software I/O Latency Capping for Write Operations

This feature helps eliminate outliers due to slow writes. It prevents write outliers that would otherwise have been visible to applications.

Disk drives, disk controllers, and flash devices are complex components that can, occasionally, exhibit high latencies while the device is performing an internal maintenance or recovery operation. In addition, devices that are close to failing sometimes exhibit high latencies before they fail. Previously, devices exhibiting high latencies could occasionally cause slow SQL response times. Oracle Exadata System Software I/O latency capping for write operations ensures excellent SQL I/O response times on Oracle Exadata Database Machine by automatically redirecting high latency I/O operations to a mirror copy.

In Oracle Exadata System Software releases 11.2.3.3.1 and 12.1.1.1.1, if Oracle Exadata Database Machine tries to read from a flash device but the latency of the read I/O is longer than expected, the Oracle Exadata System Software automatically redirects the read I/O operations to another storage server (cell). The database server that initiated the read I/O is sent a message that causes the database server to redirect the read I/O to another mirror copy of the data. Any read I/O issued to the last valid mirror copy of the data is not redirected.

In Oracle Exadata System Software release 12.1.2.1.0, if a write operation encounters high latency, then Oracle Exadata System Software automatically redirects the write operation to another healthy flash device on the same storage server. After the write completes successfully, the write I/O is acknowledged as successful to the database server, thereby eliminating the write outlier.

Requirements:

- Minimum software:
  - Oracle Database 11*g* release 2 (11.2) Monthly Database Patch For Exadata (June 2014 - 11.2.0.4.8)

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  - Oracle Grid Infrastructure 11*g* release 2 (11.2) Monthly Database Patch For Exadata (June 2014 - 11.2.0.4.8)
- Enable write-back flash cache on the storage server (cell).

11.6.6 Elimination of False Drive Failures

Disk drives and flash drives are complex components that can occasionally appear to fail due to internal software lockups without actually physically failing. In the event of an apparent hard drive failure on X5-2 High Capacity cell or an apparent flash drive failure on X5-2 Extreme Flash cell, Oracle Exadata System Software automatically redirects I/Os to other drives, and then power cycles the drive. If the drive returns to normal status after the power cycle, then it will be re-enabled and resynchronized. If the drive continues to fail after being power cycled, then it will be dropped. This feature allows Oracle Exadata System Software to eliminate false-positive disk failures and therefore helps to preserve data redundancy and reduce management.

11.6.7 Flash and Disk Life Cycle Management Alert

Oracle Exadata Storage Server Software now monitors Oracle ASM rebalance operations due to disk failure and replacement. Management Server sends an alert when a rebalance operation completes successfully, or encounters an error.

In previous releases, the user would have to periodically monitor the progress of rebalance operations by querying the V$ASM_OPERATION view. Now the user can subscribe to alerts from Management Server, and receive updates on Oracle ASM rebalance operations.

Minimum software: Oracle Database release 12.1.0.2 BP4 or later, and Oracle Exadata Storage Server Software release 12.1.2.1.0 or later.

11.6.8 Performance Optimization for SQL Queries with Minimum or Maximum Functions

SQL queries using minimum or maximum functions are designed to take advantage of the storage index column summary that is cached in Exadata Storage Server memory. As a query is processed, a running minimum value and a running maximum value are tracked. Before issuing an I/O, the minimum/maximum value cached in the storage index for the data region is checked in conjunction with the running minimum/maximum value to decide whether that I/O should be issued or can be pruned. Overall, this optimization can result in significant I/O pruning during the course of a query and improves query performance. An example of a query that benefits from this optimization is:

```
Select max(Salary) from EMP where Department = 'sales';
```

Business intelligence tools that get the shape of a table by querying the minimum or maximum value for each column benefit greatly from this optimization.

The following session statistic shows the amount of I/O saved due to storage index optimization.

```
cell physical IO bytes saved by storage index
```

Minimum software: Oracle Database release 12.1.0.2.

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11.6.9 Oracle Exadata Storage Server Software Performance Statistics in AWR Reports

Exadata Storage Server configuration and performance statistics are collected in the Automatic Workload Repository (AWR), and the data is available in the AWR report. The Oracle Exadata sections of the AWR report are available in HTML or active report format.

The following are the three main Exadata sections in the AWR report:

- Exadata Server Configuration: Hardware model information, software versions, and storage configuration
- Exadata Server Health Report: Offline disks and open alerts
- Exadata Performance Statistics: Operating system statistics, storage server software statistics, smart scan statistics, and statistics by databases

The AWR report provides storage level performance statistics, not restricted to a specific instance or a database. This is useful for analyzing cases where one database can affect the performance of another database.

Configuration differences are highlighted using specific colors for easy analysis. For example, a cell with a different software release than the other cells, or a cell with different memory configuration than the other cells are highlighted.

Outliers are automatically analyzed and presented for easy performance analysis. Outliers are appropriately colored and linked to detailed statistics.

Minimum software: Oracle Database release 12.1.0.2, and Oracle Exadata Storage Server Software release 12.1.2.1.0.

11.6.10 Exafusion Direct-to-Wire Protocol

Exafusion Direct-to-Wire protocol allows database processes to read and send Oracle Real Applications Cluster (Oracle RAC) messages directly over the InfiniBand network bypassing the overhead of entering the OS kernel, and running the normal networking software stack. This improves the response time and scalability of the Oracle RAC environment on Oracle Exadata Database Machine. Exafusion is especially useful for OLTP applications because per message overhead is particularly apparent in small OLTP messages.

Minimum software: Oracle Exadata Storage Server Software release 12.1.2.1.0 contains the OS, firmware, and driver support for Exafusion and Oracle Database software release 12.1.0.2.0 BP1.

11.6.11 Management Server on Database Servers

Management Server (MS) on database servers implements a web service for database server management commands, and runs background monitoring threads. The management service provides the following:

- Comprehensive hardware and software monitoring including monitoring of hard disks, CPUs, and InfiniBand ports.
- Enhanced alerting capabilities.
- Important system metric collection and monitoring.

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- A command-line interface called DBMCLI to configure, monitor, and manage the database servers. DBMCLI is pre-installed on each database server and on DOM0 of virtualized machines. DBMCLI configures Auto Service Request, capacity-on-demand, Infrastructure as a Service, and database server e-mail alerts.

The Oracle Exadata Database Machine Command-Line Interface (DBMCLI) utility is the command-line administration tool for managing the database servers. DBMCLI runs on each server to enable you to manage an individual database server. DBMCLI also runs on virtual machines. You use DBMCLI to configure, monitor, and manage the database servers. The command-line utility is already installed when Oracle Exadata Database Machine is shipped.

DBMCLI provides an integrated client interface to configure Auto Service Request, capacity-on-demand, Infrastructure as a Service, and database server e-mail alerts. It also provides for monitoring of hard disks, CPUs, InfiniBand ports, as well as system metrics and thresholds.

See Also

Oracle Exadata Database Machine Maintenance Guide for additional information about DBMCLI

11.6.12 SQL Operator Offloading for JSON and XML

Oracle Exadata System Software supports offload of many SQL operators for predicate evaluation. The following SQL operators are now supported for offload by Oracle Exadata System Software:

- JSON Operators
  - `JSON_VALUE`
  - `JSON_EXISTS`
  - `JSON_QUERY`
  - `IS JSON`
  - `IS NOT JSON`
- XML Operators
  - `XMLExists`
  - `XMLCast(XMLQuery())`

Minimum software: Oracle Database release 12.1.0.2 for offload of JSON. Oracle Database release 12.1.0.2 BP1 for XML operator offload.

11.6.13 I/O Resource Management for Flash

I/O Resource Management (IORM) now manages flash drive I/Os in addition to disk drive I/Os to control I/O contention between databases, pluggable databases, and consumer groups. Because it is very rare for Oracle Exadata environments to be limited by OLTP I/Os, IORM automatically prioritizes OLTP flash I/Os over smart scan flash I/Os, ensuring fast OLTP response times with little cost to smart scan throughput.

Minimum software: Exadata cell software release 12.1.2.1.0 running Oracle Database 11*g* or Oracle Database 12*c* releases

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Minimum hardware: Exadata releases X2-*

11.6.14 Flash Cache Space Resource Management

Flash cache is a shared resource. Flash Cache Space Resource Management allows users to specify the minimum and maximum sizes a database can use in the flash cache using interdatabase IORM plans. Flash Cache Space Resource Management also allows users to specify the minimum and maximum sizes a pluggable database (PDB) can use in the flash cache using database resource plans.

Minimum software: Oracle Exadata System Software release 12.1.2.1.0 running Oracle Database 11*g* or Oracle Database 12*c* Release 1 (12.1) release 12.1.0.2

Minimum hardware: Oracle Exadata Database Machine model X2-*

See Also

Oracle Exadata System Software User's Guide

11.6.15 I/O Resource Management Profiles

IORM interdatabase plans now support profiles that reduce management of interdatabase plans for environments with many databases. Previously, a storage administrator had to specify resources for every database in the interdatabase plan. The plan needed updates each time a new database was created. IORM profiles greatly reduce this management. The storage administrator can now create profile directives that define different profile types based on performance requirements. Next, the administrator maps new and existing databases to one of the defined profiles in the interdatabase plan using the database parameter DB_PERFORMANCE_PROFILE. Each database inherits all its attributes from the specified profile directive automatically.

Minimum software: Exadata cell software release 12.1.2.1.0 running Oracle Database 12c Release 1 (12.1) release 12.1.0.2 Exadata Bundle Patch 4.

11.6.16 Write Back Flash Cache on Extreme Flash Cells

On Extreme Flash cells, flash cache runs in write back mode by default, and takes 5 percent of the flash space. Flash cache on Extreme Flash cells is not used as a block cache because user grid disks are already created on flash and therefore caching is not needed. However, flash cache is still useful for the following advanced operations:

- Columnar caching caches Exadata Hybrid Columnar Compression (EHCC) table data on flash cache in a pure columnar layout on an Extreme Flash cell.
- Write I/O latency capping cancels write I/O operations to a temporarily stalled flash, and redirects the write to be logged in the write back flash cache of another healthy flash device on an Extreme Flash cell
- Fast data file creation persists the metadata about the blocks in the write back flash cache, eliminating the actual formatting writes to user grid disks, on an Extreme Flash cell.

Administrators can choose to configure flash cache in write through mode on Extreme Flash cells. Columnar caching works in write through flash cache mode, but write I/O latency capping and fast data file creation require write back flash cache to be enabled.

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11.6.17 Secure Erase for 1.6 TB Flash Drives in Extreme Flash and High Capacity Systems

With this release, Oracle Exadata System Software supports secure erase for 1.6 TB flash drives in the Extreme Flash and High Capacity systems. The 1.6 TB flash drives take approximately 5.5 hours to securely erase.

See Also

Exadata Secure Erase

11.6.18 Increased Exadata Cell Connection Limit

Oracle Exadata X5-2 and X4-2 cells can now support up to 120,000 simultaneous connections from one or more database servers using active-active bonding. This means that up to 120,000 processes can remain connected to a cell and perform I/O operations simultaneously.

See Also

Exadata Cell Connection Limit

11.6.19 Support for SNMP v3

Oracle Exadata Database Machine database and storage servers support SNMP v3 for sending alerts. SNMP v3 provides authentication and encryption for alerts sent from the servers to administrators and Oracle Auto Service Request (ASR).

See Also

- *Oracle Exadata Maintenance Guide*
- *Oracle Exadata System Software User's Guide*

11.6.20 Federal Information Processing Standards (FIPS) 140-2 Compliant Smart Scan

The U.S. Federal Information Processing Standard (FIPS) 140-2 specifies security requirements for cryptographic modules. To support customers with FIPS 140-2 requirements, Oracle Exadata version 12.1.2.1.0 can be configured to use FIPS 140-2 validated cryptographic modules. These modules provide cryptographic services such as Oracle Database password hashing and verification, network encryption (SSL/TLS and native encryption), as well as data at rest encryption (Transparent Data Encryption).

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When Transparent Data Encryption is used and Oracle Database is configured for FIPS 140 mode, Oracle Exadata Smart Scan offloads will automatically leverage the same FIPS 140 validated modules for encryption and decryption operations of encrypted columns and encrypted tablespaces.

Starting with Oracle Database release 12.1.0.2.0, the database parameter `DBFIPS_140` controls the FIPS 140 cryptographic processing mode inside the Oracle Database and Exadata Storage Server.

For example, you can use the following SQL command to enable FIPS 140 mode:

```
SQL> ALTER SYSTEM SET DBFIPS_140=TRUE SCOPE=BOTH;
```

The following hardware components are now FIPS compliant with the firmware updates in the specified releases:

- Oracle Server X5-2 and later systems are designed to be FIPS 140–2 compliant
- Oracle Sun Server X4-8 with ILOM release 3.2.4
- Sun Server X4-2 and X4-2L with SW1.2.0 and ILOM release 3.2.4.20/22
- Sun Server X3-2 and X3-2L with SW1.4.0 and ILOM release 3.2.4.26/28
- Sun Server X2-2 with SW1.8.0 and ILOM release 3.2.7.30.a
- Cisco Catalyst 4948E-F Ethernet Switch

FIPS compliance for V1, X2-* and database node X3-8 generations of Exadata Database Machine Servers is not planned.

Minimum software: Oracle Database release 12.1.0.2.0 BP3, Oracle Database release 11.2.0.4 with MES Bundle on Top of Quarterly Database Patch For Exadata (APR2014 - 11.2.0.4.6), Oracle Exadata Storage Server Software release 12.1.2.1.0, ILOM 3.2.4.

See Also

Oracle AI Database Security Guide for additional information about FIPS

11.6.21 Oracle Exadata Virtual Machines

Consolidated environments can now use Oracle Virtual Machine (Oracle VM) on X5-2, X4-2, X3-2, and X2-2 database servers to deliver higher levels of isolation between workloads. Virtual machine isolation is desirable for workloads that cannot be trusted to restrict their security, CPU, or memory usage in a shared environment. Examples are hosted or cloud environments, cross department consolidation, test and development environments, and non-database or third party applications running on a database machine. Oracle VM can also be used to consolidate workloads that require different versions of clusterware, for example SAP applications that require specific clusterware patches and versions.

The higher isolation provided by virtual machines comes at the cost of increased resource usage, management, and patching because a separate operating system, clusterware, and database install is needed for each virtual machine. Therefore it is desirable to blend Oracle VM with database native consolidation by consolidating multiple trusted databases within a virtual machine. Oracle Resource Manager can be used to control CPU, memory, and I/O usage for the databases within a virtual machine. The Oracle Multitenant option can be used to provide the highest level of consolidation and agility for consolidated Oracle databases.

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Exadata Virtual Machines use high speed InfiniBand networking with Single Root I/O Virtualization (SR-IOV) to ensure that performance within a virtual machine is similar to Exadata's famous raw hardware performance. Exadata Smart Scans greatly decrease virtualization overhead compared to other platforms by dramatically reducing message traffic to virtual machines. Exadata Virtual Machines can dynamically expand or shrink CPUs and memory based on the workload requirement of the applications running in that virtual machine.

Virtual machines on Exadata are considered Trusted Partitions, and therefore software can be licensed at the virtual machine level instead of the physical processor level. Without Trusted Partitions, database options and other Oracle software must be licensed at a server or cluster level even though all databases running on that server or cluster may not require a particular option.

11.7 What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.1.1.1)

The preceding release 11.2.3.3.1 features are described in "What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.3.3.1)."

The following feature is new for Oracle Exadata Database Machine 12c Release 1 (12.1.1.1.1):

- Offloading Conditions for LOB and CLOB

11.7.1 Offloading Conditions for LOB and CLOB

Oracle Exadata Storage Server Software supports offload of many SQL operators and conditions for predicate evaluation. The following SQL operators are now supported for offload by Oracle Exadata Storage Server Software:

- LOB and CLOB Conditions
  - `LIKE`
  - `REGEXP_LIKE`

Smart Scan evaluates the LOB operators and conditions only when a LOB is inlined (stored in the table row). In addition, Smart Scan handles Secure File compression. Using Secure File compression helps reduce the size of LOBs so that they can be inlined.

Minimum software: Oracle Database release 12.1.0.2 for offload of LOB/CLOB

See Also

Oracle Database SecureFiles and Large Objects Developer's Guide for information about inline LOBs

11.8 What's New in Oracle Exadata Database Machine 12c Release 1 (12.1.1.1.0)

The following are new for Oracle Exadata Database Machine 12c Release 1 (12.1.1.1.0):

- Support for Oracle Database Releases 12c Release 1 (12.1) and 11g Release 2 (11.2)

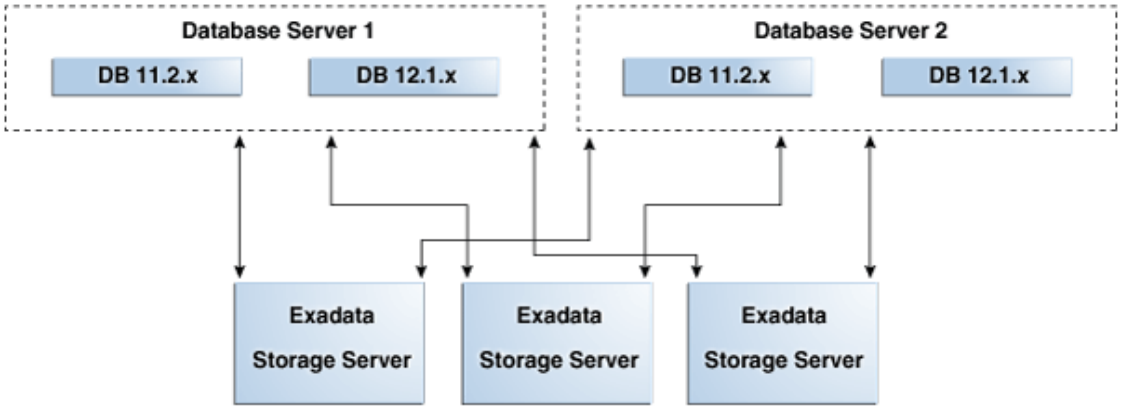
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- IORM Support for CDBs and PDBs
- Cell to Cell Data Transfer
- Desupport of HP Oracle Database Machine Hardware

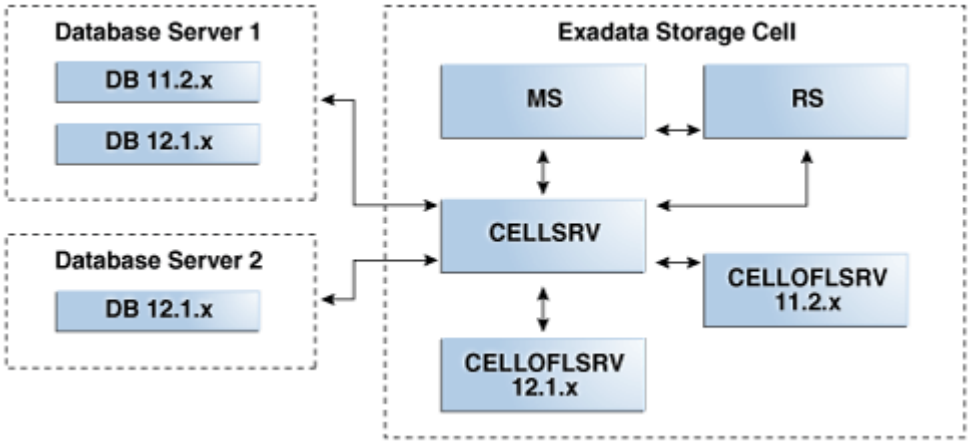
11.8.1 Support for Oracle Database Releases 12*c* Release 1 (12.1) and 11*g* Release 2 (11.2)

Oracle Exadata Storage Server Software 12*c* Release 1 (12.1) supports Oracle Database releases 12*c* Release 1 (12.1) and 11*g* Release 2 (11.2) running on a single Oracle Exadata Database Machine. The database servers get full performance, such as smart scans, fast file creation, and fast incremental backup, from all Exadata Storage Servers running Oracle Exadata Storage Server Software release 12*c* Release 1 (12.1).

Oracle Exadata Storage Server Software 12*c* Release 1 (12.1) is able to support multiple database releases by running appropriate cell offload servers to handle the offload requests. Offload requests coming from Oracle Database 11*g* Release 2 (11.2) are handled by a release 11*g* offload server, and offload requests coming from Oracle Database 12*c* Release 1 (12.1) database are handled by a 12c offload server.



Oracle Exadata Storage Server Software 12*c* Release 1 (12.1) now contains separate offload servers for each major database release so that it can fully support all offload operations. Offload requests coming from Oracle Database 11*g* Release 2 (11.2) are handled automatically by a release 11*g* offload server, and offload requests coming from Oracle Database 12*c* Release 1 (12.1) database are handled automatically by a 12c offload server.



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Exadata Storage Server 12*c* Release 1 (12.1) can support the following releases of Oracle Database:

Database Release	Minimum Required Release
11.2.0.2	Bundle patch 22
11.2.0.3	Bundle patch 20
11.2.0.4	Current release
12.1.0.1	Current release

11.8.2 IORM Support for CDBs and PDBs

Oracle Database 12c Release 1 (12.1) supports a multitenant architecture. In a multitenant architecture, a container is a collection of schemas, objects, and related structures in an Oracle Multitenant container database (CDB) that appears logically to an application as a separate database. In a CDB, administrators can create multiple pluggable databases (PDBs) to run their workloads. In a CDB, there are multiple workloads within multiple PDBs competing for shared resources.

By using CDB plans and PDB plans, I/O Resource Management (IORM) provides the ability to manage I/O resource utilization among different PDBs as well as manage the workloads within each PDB.

Oracle Database 12c Release 1 (12.1) supports IORM prioritization to manage I/O resource utilization among different PDBs as well as manage the workloads within each PDB.

Related Topics

- About the Multitenant Architecture
- About Interdatabase IORM Plan Directives

11.8.3 Cell to Cell Data Transfer

In earlier releases, Exadata Cells did not directly communicate to each other. Any data movement between the cells was done through the database servers. Data was read from a source cell into database server memory, and then written out to the destination cell. Starting with Oracle Exadata Storage Server Software 12*c* Release 1 (12.1), database server processes can offload data transfer to cells. A database server instructs the destination cell to read the data directly from the source cell, and write the data to its local storage. This reduces the amount of data transferred across the fabric by half, reducing InfiniBand bandwidth consumption, and memory requirements on the database server. Oracle Automatic Storage Management (Oracle ASM) resynchronization, resilver, and rebalance use this feature to offload data movement. This provides improved bandwidth utilization at the InfiniBand fabric level in Oracle ASM instances. No configuration is needed to utilize this feature.

Minimum software: Oracle Database 12*c* Release 1 (12.1) or later, and Oracle Exadata Storage Server Software 12*c* Release 1 (12.1) or later.

11.8.4 Desupport of HP Oracle Database Machine Hardware

Oracle Exadata System Software 12*c* Release 1 (12.1) is not supported on HP Oracle Database Machine hardware. Oracle continues to support HP Oracle Database Machines running Oracle Exadata System Software 11*g* Release 2 (11.2).

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12

New Features for Oracle Exadata System Software Release 11.x

Several new features were introduced for the various versions of Oracle Exadata System Software Release 11.x.

- What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.3.3.1)
- What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.3.3.0)
- What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.3.2)
- What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.3.1)
- What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.2.4)
- What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.2.3)
- What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.1.2)
- What's New in Oracle Exadata Database Machine 11g Release 2 (11.2)

12.1 What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.3.3.1)

The following are new for Oracle Exadata System Software 11g Release 2 (11.2.3.3.1):

- Oracle Capacity-on-Demand for Database Servers
- Exadata I/O Latency Capping
- Oracle Exadata Storage Server I/O Timeout Threshold
- Support for New Hardware

12.1.1 Oracle Capacity-on-Demand for Database Servers

Oracle allows users to limit the number of active cores in the database servers in order to restrict the number of required database software licenses. The reduction of processor cores is implemented during software installation using Oracle Exadata Database Machine Deployment Assistant (OEDA). The number of active cores can be increased at a later time, when more capacity is needed, but not decreased. The number of active processor cores must be the same on every socket of a database server.

Capacity-on-demand differs from Oracle Exadata Infrastructure as a Service (IaaS) as follows:

- The number of active cores for capacity-on-demand cannot be decreased after initial installation.
- Software licenses are only needed for the active cores when using capacity-on-demand.

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> **Note**
>
> Reducing the number of active cores lowers the initial software licensing cost. It does not change the hardware cost.

> **See Also**
>
> - *Oracle Exadata Maintenance Guide* for information about increasing the number of active cores
> - *Oracle Exadata Licensing Information User's Guide* for information about licensing and restrictions

12.1.2 Exadata I/O Latency Capping

Disk drives or flash devices can, on rare occasion, exhibit high latencies for a small amount of time while an internal recovery operation is running. In addition, drives that are close to failing can sometimes exhibit high latencies before they fail. This feature masks these very rare latency spikes by redirecting read I/O operations to a mirror copy.

Oracle Exadata Storage Server Software automatically redirects read I/O operations to another cell when the latency of the read I/O is much longer than expected. This is performed by returning a message to the database that initiated the read I/O. The database then redirects the I/O to another mirror copy of the data. Any I/Os issued to the last valid mirror copy of the data are not redirected.

Minimum software: Oracle Database 11g Release 2 (11.2) release Monthly Database Patch For Exadata (June 2014 - 11.2.0.4.8). The same release is required for Grid Infrastructure.

12.1.3 Oracle Exadata Storage Server I/O Timeout Threshold

The I/O timeout threshold can be configured for Oracle Exadata Storage Servers. Storage server I/O that takes longer than the defined threshold is canceled. Oracle Automatic Storage Management (Oracle ASM) redirects the I/O to another mirror copy of the data. Any write I/Os issued to the last valid mirror copy of the data are not canceled, even if the timeout threshold is exceeded.

Setting the timeout threshold too low can negatively impact system performance. Oracle recommends reviewing the Automatic Workload Repository (AWR) reports of peak I/O loads, and setting the threshold value to a value higher than the peak I/O latency with sufficient safety margin.

Minimum software: Oracle Database 11*g* Release 2 (11.2) release Monthly Database Patch For Exadata (June 2014 - 11.2.0.4.8). The same release is required for Oracle Grid Infrastructure.

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> **See Also**
>
> *Oracle Exadata System Software User's Guide* for additional information about the `ALTER CELL` I/O threshold timeout attribute

12.1.4 Support for New Hardware

This release includes support for the following hardware:

- Oracle Exadata Database Machine X4-8 Full Rack
- 4 TB high-capacity drives for Exadata Storage Server X4-2, Exadata Storage Server X3-2, and Exadata Storage Server X2-2

Minimum software: Oracle Exadata Storage Server Software release 11.2.3.3.1

12.2 What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.3.3.0)

The following are new for Oracle Exadata System Software 11g Release 2 (11.2.3.3.0):

- Flash Cache Compression
- Automatic Flash Caching for Table Scan Workloads
- Fast Data File Creation
- Network Resource Management
- Active Bonding Network
- Oracle ASM Disk Group in Appliance Mode
- Automatic Hard Disk Scrub and Repair
- Drop Hard Disk for Replacement
- Drop BBU for Replacement
- Oracle Exadata Database Machine Eighth Rack Configuration
- Cell Alert Summary
- Secure Erase for Larger Drives
- Periodic ILOM Reset
- Oracle ExaWatcher Replaces Oracle OSWatcher
- Enhancements for Hardware and Software

12.2.1 Flash Cache Compression

Flash cache compression dynamically increases the logical capacity of the flash cache by transparently compressing user data as it is loaded into the flash cache. This allows much more data to be kept in flash, and decreases the need to access data on disk drives. The I/Os to data in flash are orders of magnitude faster than the I/Os to data on disk. The compression and decompression operations are completely transparent to the application and database, and have negligible performance overhead, even when running at rates of millions of I/Os per second.

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Depending on the user data compressibility, Oracle Exadata System Software dynamically expands the flash cache size up to two times. Compression benefits vary based on the redundancy in the data. Tables and indexes that are uncompressed have the largest space reductions. Tables and indexes that are OLTP compressed have significant space reductions. Tables that use Hybrid Columnar Compression have minimal space reductions. Oracle Advanced Compression Option is required to enable flash cache compression.

This feature is available only on Exadata X3-2 and X4-2 storage server models and is controlled using the `flashCacheCompress` cell attribute. The `flashCacheCompress` cell attribute is no longer available starting with Oracle Exadata System Software release 24.1.0.

12.2.2 Automatic Flash Caching for Table Scan Workloads

Oracle Exadata Storage Server Software automatically caches objects read by table and partition scan workloads in flash cache based on how frequently the objects are read. The algorithm takes into account the size of the object, the frequency of access of the object, the frequency of access to data displaced in the cache by the object, and the type of scan being performed by the database. Depending on the flash cache size, and the other concurrent workloads, all or only part of the table or partition is cached. There is no risk of thrashing the flash cache by trying to cache an object that is large compared to the size of the flash cache, or by caching a table that is accessed by maintenance operations.

This feature largely eliminates the need for manually keeping tables in flash cache except to guarantee low response times for certain objects at the expense of potentially increasing total disk I/Os. In earlier releases, database administrators had to mark a large object as `KEEP` to have it cached in flash cache for table scan workloads.

This feature primarily benefits table scan intensive workloads such as Data Warehouses and Data Marts. Random I/Os such as those performed for Online Transaction Processing (OLTP) continue to be cached in the flash cache the same way as in earlier releases.

Minimum software: Oracle Exadata Storage Server Software release 11.2.3.3

12.2.3 Fast Data File Creation

Fast data file creation more than doubles the speed at which new data files are formatted. Instead of writing the newly formatted blocks to disk or flash, the flash cache just persists the metadata about the blocks in the write back flash cache, eliminating the actual formatting writes to disks. For example, creating a 1 TB data file on Oracle Exadata Full Rack running release 11.2.3.3 takes 90 seconds when using fast data file creation. Creating the same 1TB data file on earlier releases takes 220 seconds. This feature works automatically when write back flash cache is enabled, and the correct software releases are in use.

Minimum software: Oracle Exadata Storage Server Software release 11.2.3.3 running Oracle Database 11*g* Release 2 (11.2) release 11.2.0.4, or Oracle Database 12*c* Release 1 (12.1) release 12.1.0.1

12.2.4 Network Resource Management

Network Resource Management automatically and transparently prioritizes critical database network messages through the InfiniBand fabric ensuring fast response times for latency critical operations. Prioritization is implemented in the database, database InfiniBand adapters, Oracle Exadata Storage Server Software, Exadata storage InfiniBand adapters, and InfiniBand switches to ensure prioritization happens through the entire InfiniBand fabric.

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Latency sensitive messages such as Oracle RAC Cache Fusion messages are prioritized over batch, reporting, and backup messages. Log file write operations are given the highest priority to ensure low latency for transaction processing.

This feature works in conjunction with CPU and I/O Resource Management to help ensure high and predictable performance in consolidated environments. For example, given an online transaction processing (OLTP) workload, commit latency is determined by log write latency. This feature enables log writer process (LGWR) network transfer to be prioritized over other database traffic in the same or other databases, such as backups or reporting.

This feature is enabled by default, and requires no configuration or management.

Minimum software: Oracle Exadata Storage Server Software release 11.2.3.3 running Oracle Database 11*g* Release 2 (11.2) release 11.2.0.4, or Oracle Database 12*c* Release 1 (12.1) release 12.1.0.1, and switch firmware release 2.1.3-4

12.2.5 Active Bonding Network

Oracle Exadata Database Machine X4-2 database servers and storage servers enable active bonding support for both ports of an InfiniBand card. Active bonding provides much higher network bandwidth when compared to active passive bonding in earlier releases because both InfiniBand ports are simultaneously used for sending network traffic.

The active bonding capability improves network bandwidth on Oracle Exadata Database Machine X4-2 because it features a new InfiniBand card that supports much higher throughput than previous InfiniBand cards. Active bonding does not improve bandwidth on earlier generation hardware because earlier InfiniBand cards were not fast enough to take advantage of the faster bandwidth provided by the latest generation server PCI bus.

Note the following about active bonding on an InfiniBand card:

- Database servers running Oracle Linux provide the active bonding capability.
- Oracle Clusterware requires the same interconnect name on each database server in the cluster. It is advisable to keep legacy bonding on the database servers when expanding existing Oracle Exadata Database Machine X3-2 and Oracle Exadata Database Machine X2-2 systems with Oracle Exadata Database Machine X4-2 systems.
- Two IP addresses are required for each InfiniBand card for increased network bandwidth.

The following table provides guidelines on how to configure systems:

Operating System	Database Servers in Oracle Exadata Database Machine X4-2	Storage Servers in Oracle Exadata Database Machine X4-2	Database Servers in Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X4-2L Servers
Oracle Linux	Active bonding	Active bonding	Legacy bonding, single port per HCA active
Oracle Solaris	IPMP, single port active	Active bonding	IPMP, single port per HCA active

Minimum hardware: Oracle Exadata Database Machine X4 generation servers

Minimum software: Oracle Exadata Storage Server Software release 11.2.3.3

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12.2.6 Oracle ASM Disk Group in Appliance Mode

The Oracle ASM `appliance.mode` attribute improves disk rebalance completion time when dropping one or more Oracle ASM disks. This means that redundancy is restored faster after a failure. The attribute is automatically enabled when creating a new disk group. Existing disk groups must explicitly set the attribute using the `ALTER DISKGROUP` command.

The attribute can only be enabled on disk groups that meet the following requirements:

- The Oracle ASM disk group attribute `compatible.asm` is set to release 11.2.0.4, or later.
- The `cell.smart_scan_capable` attribute is set to `TRUE`.
- All disks in the disk group are the same type of disk, such as all hard disks or extreme flash disks.
- All disks in the disk group are the same size.
- All failure groups in the disk group have an equal number of disks.
- No disk in the disk group is offline.

Minimum software: Oracle Exadata System Software release 11.2.3.3 running Oracle Database 11*g* Release 2 (11.2) release 11.2.0.4 or Oracle Database 12*c* Release 1 (12.1) release 12.1.0.2

> **See Also**
>
> *Oracle Exadata System Software User's Guide* for additional information about the `appliance.mode` attribute

12.2.7 Automatic Hard Disk Scrub and Repair

Oracle Exadata System Software automatically inspects and repairs hard disks periodically when hard disks are idle. If bad sectors are detected on a hard disk, then Oracle Exadata System Software automatically sends a request to Oracle ASM to repair the bad sectors by reading the data from another mirror copy. By default, the hard disk scrub runs every two weeks.

Minimum software: Oracle Exadata System Software release 11.2.3.3 running Oracle Database 11*g* Release 2 (11.2) release 11.2.0.4 or Oracle Database 12*c* Release 1 (12.1) release 12.1.0.2.

> **See Also**
>
> *Oracle Exadata System Software User's Guide* for additional information about setting the scrub interval

12.2.8 Drop Hard Disk for Replacement

Before replacing a normal hard disk that is not in any failure status, the Oracle Exadata Database Machine administrator must run the `ALTER PHYSICALDISK DROP FOR REPLACEMENT` command, and confirm its success before removing the hard disk from Oracle Exadata

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Storage Server. The command checks to ensure that the grid disks on that hard disk can be safely taken offline from Oracle ASM without causing a disk group force dismount. If all the grid disks can be offlined without leading to disk group force dismount, then the command puts the grid disks offline from Oracle ASM, disables the hard disk, and then turns on the service LED on the storage server.

Minimum software: Oracle Exadata System Software release 11.2.3.3

See Also

Oracle Exadata System Software User's Guide for additional information about the `ALTER PHYSICALDISK` command

12.2.9 Drop BBU for Replacement

Before performing an online BBU (battery backup unit) replacement on an Oracle Exadata Database Machine database server or storage server, the Oracle Exadata Database Machine administrator must run the `ALTER CELL BBU DROP FOR REPLACEMENT` command, and confirm the success of the command. The command changes the controller to write-through caching and ensures that no data loss can occur when the BBU is replaced in case of a power loss.

Minimum hardware: Oracle Exadata Database Machine X3-2 or Oracle Exadata Database Machine X3-8 Full Rack, with disk-form-factor BBU

Minimum software: Oracle Exadata System Software release 11.2.3.3

See Also

- *Oracle Exadata Maintenance Guide* for information about replacing the BBU
- *Oracle Exadata System Software User's Guide* for information about the `ALTER CELL BBU DROP FOR REPLACEMENT` command

12.2.10 Oracle Exadata Database Machine Eighth Rack Configuration

Oracle Exadata Database Machine Eighth Rack configuration for storage cells can be enabled and disabled using the `ALTER CELL eighthRack` command. No more than 6 cell disks are created on hard disks and no more than 8 cell disks are created on flash disks when using an eighth rack configuration.

Minimum software: Oracle Exadata Storage Server Software release 11.2.3.2.1

See Also

Oracle Exadata Maintenance Guide for additional information about configuring Oracle Exadata Database Machine Eighth Rack

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12.2.11 Cell Alert Summary

Oracle Exadata System Software periodically sends out an e-mail summary of all open alerts on Oracle Exadata Storage Servers. The open alerts e-mail message provides a concise summary of all open issues on a cell. The summary includes the following:

- Cell name
- Event time
- Severity of the alert
- Description of the alert
- Information about configuring the alert summary

Alerts created since the previous summary are marked with an asterisk.

Minimum software: Oracle Exadata System Software release 11.2.3.3

See Also

Oracle Exadata System Software User's Guide for additional information about configuring the alert summary

12.2.12 Secure Erase for Larger Drives

With this release, Oracle Exadata Storage Server Software supports secure erase for larger hard drives, and flash drives. The following are the approximate times needed to securely erase the drives using the supported algorithms:

Type of Drive	One Pass (1pass)	Three Pass (3pass)	Seven Pass (7pass)
1.2 TB drive	1.67 hours	5 hours	11.67 hours
4 TB drive	8 hours	24 hours	56 hours
186 GB flash drive	NA	NA	36 minutes

See Also

"Exadata Secure Erase"

12.2.13 Periodic ILOM Reset

Management Server (MS) automatically resets the Integrated Lights Out Manager (ILOM) after it has been running for 90 days as a proactive measure to prevent the ILOM from entering an unstable state after running for an extended period.

Minimum software: Oracle Exadata System Software release 11.2.3.3.0

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12.2.14 Oracle ExaWatcher Replaces Oracle OSWatcher

Starting with this release, Oracle ExaWatcher replaces Oracle OSWatcher. Oracle ExaWatcher has better collection and reporting functionality than Oracle OSWatcher.

> **See Also**
>
> *Oracle Exadata System Software User's Guide* for information about Oracle ExaWatcher.

12.2.15 Enhancements for Hardware and Software

The following enhancements have been added for the hardware and software:

- Enhancements for Sun Datacenter InfiniBand Switch 36 switches
  - Sun Datacenter InfiniBand Switch 36 switches in Oracle Exadata are upgraded in a rolling manner using the patchmgr utility. See Understanding Rolling and Non-Rolling Updates for additional information.
  - Switch software release 2.1.3-4 includes the ability to automatically disable intermittent links. The InfiniBand specification stipulates that the bit error rate on a link must be less than 10^{12}. If the number of symbol errors is greater than 3546 bit errors per day, or 144 bit errors per hour, then the link is disabled. The InfiniBand switch software provides the `autodisable` command, and the patchmgr utility automatically enables this feature when the switch is upgraded to release 2.1.3-4.
  - The new switch software release 2.1.3-4 can create fat-tree topologies with two switches, or with an unbalanced number of links across multiple spine switches in the fabric.
  - The amount of time taken to perform a subnet manager failover has been reduced to subseconds even on multi-rack configurations.
- Enhancements for Patch Application
  - The patchmgr utility provides the ability to send e-mail messages upon completion of patching, as well as the status of rolling and non-rolling patch application. See Patchmgr syntax, and the patch set for additional information.
  - Firmware upgrades on database servers for ILOM/BIOS, InfiniBand HCA, and disk controller happen automatically during component replacements on racks running Oracle Linux and Oracle Solaris.
- Enhancements for Hardware Robustness
  - The time to recover from a bad sector on a hard disk has been reduced by 12 times.
  - The failure state of a hard drive or flash drive is rarely Boolean. Most devices slow down considerably before they fail. Slow and intermittent drives are detected much earlier, and failed by Oracle Exadata System Software before the drives reach `predictive failure` or a hard failure state.
  - If the ILOM on a storage server stops responding, then the management software can automatically reset the ILOM.
- Support for Oracle Solaris 11.1 (SRU 9.5.1)

  This release supports Oracle Solaris 11.1 SRU 9.5.1 on the database servers.

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12.3 What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.3.2)

The following are new for Oracle Exadata System Software 11g Release 2 (11.2.3.2):

- Write-Back Flash Cache with Exadata Smart Flash Cache
- Graceful Shutdown of CELLSRV Services
- LED Notification for Storage Server Disk Removal
- Identification of Underperforming Disks
- Oracle Database File System Support for Oracle Solaris
- Health Factor for Predictive Failed Disk Drop
- Hard Disk Drive Numbering in Servers

12.3.1 Write-Back Flash Cache with Exadata Smart Flash Cache

Exadata Smart Flash Cache transparently caches frequently-accessed data to fast solid-state storage, improving query response times and throughput. Write operations serviced by flash instead of by disk are referred to as **write-back flash cache**. Write-back flash cache allows 20 times more write I/Os per second on X3 systems, and 10 times more on X2 systems. The larger flash capacity on X3 systems means that almost all writes are serviced by flash.

An active data block can remain in write-back flash cache for months or years. Blocks that have not been read recently only keep the primary copy in cache. All data is copied to disk, as needed. This provides for smart usage of the premium flash space.

If there is a problem with the flash cache, then the operations transparently fail over to the mirrored copies on flash. No user intervention is required. The data on flash is mirrored based on their allocation units. This means the amount of data written is proportional to the lost cache size, not the disk size.

- Exadata Smart Flash Cache Persistent After Cell Restart

> **See Also**
>
> *Oracle Exadata System Software User's Guide* for additional information about write-back flash cache and write-through flash cache

12.3.1.1 Exadata Smart Flash Cache Persistent After Cell Restart

Exadata Smart Flash Cache is persistent through power outages, shutdown operations, cell restarts, and so on. Data in flash cache is not repopulated by reading from the disk after a cell restarts. Write operations from the server go directly to flash cache. This reduces the number of I/O operations on the disks. The caching of data on the flash disks is set by the administrator.

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12.3.2 Graceful Shutdown of CELLSRV Services

If a cell or disk is offline, and an administrator tries to restart or shut down CELLSRV services, then the administrator gets a message that the cell cannot be shut down due to reduced redundancy.

12.3.3 LED Notification for Storage Server Disk Removal

When a storage server disk needs to be removed, a blue LED light is displayed on the server. The blue light makes it easier to determine which server disk needs maintenance.

12.3.4 Identification of Underperforming Disks

Underperforming disks affect the performance of all disks because work is distributed equally to all disks. For example, if a disk is performing 30% slower than other disks, then the entire system's I/O capacity will be 30% lower.

When an underperforming disk is detected, it is removed from the active configuration. Oracle Exadata Database Machine then performs a set of performance tests. If the problem with the disk is temporary and it passes the tests, then it is brought back into the configuration. If the disk does not pass the tests, then it is marked as poor performance, and an Auto Service Request (ASR) service request is opened to replace the disk. This feature applies to both hard disks and flash disks.

12.3.5 Oracle Database File System Support for Oracle Solaris

Oracle Database File System (DBFS) manages unstructured data in an Oracle database. Files in DBFS are stored in the database in SecureFiles and inherit all of its performance, scalability, security, availability and rich functionality benefits, such as compression, deduplication, encryption, text search, and XQuery.

In earlier releases, DBFS was only available for Oracle Exadata Database Machine running Linux. With this release, DBFS is also supported on Oracle Exadata Database Machine running Oracle Solaris.

> **See Also**
>
> *Oracle Database SecureFiles and Large Objects Developer's Guide* for additional information about DBFS

12.3.6 Health Factor for Predictive Failed Disk Drop

When a hard disk enters predictive failure on Oracle Exadata Storage Server, Oracle Exadata System Software automatically triggers an Oracle Automatic Storage Management (Oracle ASM) rebalance to relocate data from the disk. The Oracle ASM rebalance first reads from healthy mirrors to restore redundancy. If all other mirrors are not available, then Oracle ASM rebalance reads the data from the predictively-failed disk. This diverts rebalance reads away from the predictively-failed disk when possible to ensure optimal rebalance progress while maintaining maximum data redundancy during the rebalance process.

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Before the data is completely relocated to other healthy disks in the disk group, Oracle Exadata System Software notifies database instances of the poor health of the predictively-failed disk so that queries and smart scans for data on that disk will be diverted to other mirrors for better response time.

12.3.7 Hard Disk Drive Numbering in Servers

The drives in the Exadata Storage Server X3-2 Servers are numbered from left to right in each row. The drives in the bottom row are numbered 0, 1, 2, and 3. The drives in the middle row are numbered 4, 5, 6, and 7. The drives in the top row are numbered 8, 9, 10, and 11.

Figure 12-1 Disk Layout in Exadata Storage Server X3-2 Servers



The drives in the Exadata Storage Server with Sun Fire X4270 M2 Servers and earlier servers were numbered from the lower left to the top, such that the drives in the leftmost column were 0, 1, and 2. The drives in the next column were 3, 4, and 5. The drives in the next column were 6, 7, and 8. The drives in the rightmost column were 9, 10, and 11.

Figure 12-2 Disk Layout in Exadata Storage Server with Sun Fire X4270 M2 Servers



12.4 What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.3.1)

The following are new for Oracle Exadata System Software 11g Release 2 (11.2.3.1):

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- Support for Oracle Solaris 11 (SRU2a)
- Linux Database Server Updates with Unbreakable Linux Network
- Oracle Enterprise Manager Cloud Control for Oracle Exadata Database Machine
- I/O Resource Management Support for More Than 32 Databases
- Oracle Database 11g Release 2 (11.2.0.3)
- Exadata Cell Connection Limit

12.4.1 Support for Oracle Solaris 11 (SRU2a)

This release supports Oracle Solaris 11 (SRU2a) on the database servers.

12.4.2 Linux Database Server Updates with Unbreakable Linux Network

Starting with Oracle Exadata Storage Server Software 11*g* Release 2 (11.2) release 11.2.3.1, the minimal pack is deprecated. The database server update procedure uses the Unbreakable Linux Network (ULN) for the distribution of updates, and the yum utility to apply the updates.

> **See Also**
>
> *Oracle Exadata Database Machine Maintenance Guide* for information about updating the database servers

12.4.3 Oracle Enterprise Manager Cloud Control for Oracle Exadata Database Machine

Oracle Exadata Database Machine can be managed using Oracle Enterprise Manager Cloud Control. Oracle Enterprise Manager Cloud Control combines management of servers, operating systems, firmware, virtual machines, storage, and network fabrics into a single console.

12.4.4 I/O Resource Management Support for More Than 32 Databases

I/O Resource Management (IORM) now supports share-based plans, which can support up to 1024 databases, and up to 1024 directives for interdatabase plans. The share-based plans allocate resources based on shares instead of percentages. A share is a relative distribution of the I/O resources. In addition, the new `default` directive specifies the default value for all databases that are not explicitly named in the database plan.

> **See Also**
>
> *Oracle Exadata System Software User's Guide* for information about IORM

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12.4.5 Oracle Database 11*g* Release 2 (11.2.0.3)

The Smart Scan in Oracle Exadata System Software 11*g* Release 2 (11.2) release 11.2.3.*n* is based on the technology present in Oracle Database software 11*g* Release 2 (11.2) release 11.2.0.3, and is backwards compatible with the 11.2.0.*n* releases of the database.

12.4.6 Exadata Cell Connection Limit

Oracle Database, Oracle ASM, Oracle Clusterware and Oracle utilities perform I/O operations on Exadata Cells. In order for a process to perform I/O operations on Exadata Cell, the process must first establish a connection to the cell. Once a process is connected to Exadata Cell, it remains connected until process termination.

With this release, each Exadata Cell can support up to 60,000 simultaneous connections originating from one or more database servers. This implies that no more than 60,000 processes can simultaneously remain connected to a cell and perform I/O operations. The limit was 32,000 connections in release 11.2.2.4. Prior to release 11.2.2.4, the limit was 20,000 connections.

12.5 What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.2.4)

The following is new for Oracle Exadata System Software 11g release 2 (11.2.2.4):

- Oracle Exadata Smart Flash Log

12.5.1 Oracle Exadata Smart Flash Log

The time to commit user transactions is very sensitive to the latency of log writes. In addition, many performance-critical database algorithms, such as space management and index splits, are sensitive to log write latency. Oracle Exadata Storage Server Software speeds up log writes using battery-backed DRAM cache in the disk controller. Writes to the disk controller cache are normally very fast, but they can become slow during periods of high disk I/O. Oracle Exadata Smart Flash Log takes advantage of flash memory in Exadata Storage Server to accelerate log writes.

Flash memory has very good average write latency, but it has occasional slow outliers that are one to two orders of magnitude slower than the average. Oracle Exadata Smart Flash Log performs redo writes simultaneously to both flash memory and the disk controller cache, and completes the write when the first of the two completes. This improves the user transaction response time, and increases overall database throughput for I/O intensive workloads.

Oracle Exadata Smart Flash Log only uses Exadata flash storage for temporary storage of redo log data. By default, Oracle Exadata Smart Flash Log uses 32 MB on each flash disk, for a total of 512 MB across each Exadata Cell. It is automatically configured and enabled. No additional configuration is needed.

12.6 What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.2.3)

The following are new for Oracle Exadata System Software 11g Release 2 (11.2.2.3):

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- Oracle Solaris Operating System for Database Servers
- Exadata Secure Erase
- Optimized Smart Scan

12.6.1 Oracle Solaris Operating System for Database Servers

The database servers in Oracle Exadata Database Machine have the Linux operating system and Oracle Solaris operating system. During initial configuration, choose the operating system for your environment. After selecting an operating system, you can reclaim the disk space used by the other operating system.

12.6.2 Exadata Secure Erase

Oracle Exadata System Software includes a method to securely erase and clean physical disks before redeployment. The ERASE option overwrites the existing content on the disks with one pass, three passes or seven passes. The one pass option overwrites content with zeros. The three pass option follows recommendations from NNSA and the seven pass option follows recommendations from DOD.

The following table shows the approximate times needed to securely erase a drive using the supported algorithms.

Type of Drive	One Pass	Three Pass	Seven Pass
600 GB drive	1 hour	3 hours	7 hours
2 TB drive	5 hours	15 hours	35 hours
3 TB drive	7 hours	21 hours	49 hours
22.875 GB flash drive	NA	NA	21 minutes
93 GB flash drive	NA	NA	32 minutes

Note

- Oracle Exadata System Software secure data erase uses multiple over-writes of all accessible data. The over-writes use variations of data characters. This method of data erase is based on commonly known algorithms. Under rare conditions even a 7-pass erase may not remove all traces of data. For example, if a disk has internally remapped sectors, then some data may remain physically on the disk. This data will not be accessible using normal I/O interfaces.
- Using tablespace encryption is another way to secure data.

12.6.3 Optimized Smart Scan

Oracle Exadata Storage Server Software detects resource bottlenecks on Exadata Storage Servers by monitoring CPU utilization. When a bottleneck is found, work is relocated to improve performance. Each Exadata Cell maintains the following statistics:

- Exadata Cell CPU usage and push-back rate snapshots for the last 30 minutes.
- Total number of 1MB blocks that had a push-back decision on.
- Number of blocks that have been pushed back to the database servers.

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- The statistic `Total cpu passthru output IO size` in KB.

12.7 What's New in Oracle Exadata Database Machine 11g Release 2 (11.2.1.2)

The following features are new for Oracle Exadata System Software 11g release 2 (11.2.1.2):

- Exadata Smart Flash Cache
- Hybrid Columnar Compression
- Storage Index
- Smart Scan of Encrypted Data
- Interleaved Grid Disks
- Data Mining Scoring Offload
- Enhanced Manageability Features

12.7.1 Exadata Smart Flash Cache

Exadata Smart Flash Cache provides a caching mechanism for frequently-accessed data on each Exadata Cell. It is a write-through cache which is useful for absorbing repeated random reads, and very beneficial to online transaction processing (OLTP). It provides a mechanism to cache data in `KEEP` mode using database-side storage clause hints at a table or index level. The Exadata Smart Flash Cache area on flash disks is automatically created on Exadata Cells during start up.

Oracle Exadata Storage Servers are equipped with high-performance flash disks in addition to traditional rotational hard disks. These high-performance flash disks can be used to create Exadata grid disks to store frequently accessed data. It requires the user to do accurate space planning, and to place the most active tablespaces on the premium disks. The recommended option is to dedicate all or part of flash disk space for Exadata Smart Flash Cache. In this case, the most frequently-accessed data on the spinning disks are automatically cached in the Exadata Smart Flash Cache area on high-performance flash disks. When the database needs to access this data Oracle Exadata Storage Server fetches the data from Exadata Smart Flash Cache instead of getting it from slower rotational disks.

When a partition or a table is scanned by the database, Exadata Storage Server can fetch the data being scanned from the Exadata Smart Flash Cache if the object has the `CELL_FLASH_CACHE` attribute set. In addition to serving data from the Exadata Flash Cache, Exadata Storage Server also has the capability to fetch the object being scanned from hard disks.

The performance delivered by Exadata Storage Server is additive when it fetches scanned data from the Exadata Smart Flash Cache and hard disks. Exadata Storage Server has the ability to utilize the maximum Exadata Smart Flash Cache bandwidth and the maximum hard disk bandwidth to scan an object, and give an additive maximum bandwidth while scanning concurrently from both.

Oracle Database and Exadata Smart Flash Cache software work closely with each other. When the database sends a read or write request to Oracle Exadata Storage Server, it includes additional information in the request about whether the data is likely to be accessed again, and should be cached. For example, when writing data to a log file or to a mirrored copy, the database sends a hint to skip caching. When reading a table index, the database sends a

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hint to cache the data. This cooperation allows optimized usage of Exadata Smart Flash Cache space to store only the most frequently-accessed data.

Users have additional control over which database objects, such as tablespace, tables, and so on, should be cached more aggressively than others, and which ones should not be cached at all. Control is provided by the new storage clause attribute, `CELL_FLASH_CACHE`, which can be assigned to a database object.

For example, to pin table `CALLDETAIL` in Exadata Smart Flash Cache one can use the following command:

```
ALTER TABLE calldetail STORAGE (CELL_FLASH_CACHE KEEP)
```

Exadata Storage Server caches data for the `CALLDETAIL` table more aggressively and tries to keep this data in Exadata Smart Flash Cache longer than cached data for other tables. If the `CALLDETAIL` table is spread across several Oracle Exadata Storage Servers, then each one caches its part of the table in its own Exadata Smart Flash Cache. If the caches are sufficiently large, then the `CALLDETAIL` table is likely to be completely cached over time.

12.7.2 Hybrid Columnar Compression

Exadata Hybrid Columnar Compression offers higher compression levels for direct path loaded data. This new compression capability is recommended for data that is not updated frequently. You can specify Hybrid Columnar Compression at the partition, table, and tablespace level. You can also specify the desired level of compression, to achieve the proper trade-off between disk usage and CPU overhead. Included is a compression advisor that helps you determine the proper compression levels for your application.

This feature allows the database to reduce the number of I/Os to scan a table. For example, if you compress data 10 to 1, then the I/Os are reduced 10 to 1 as well. In addition, Hybrid Columnar Compression saves disk space by the same amount.

This feature also allows the database to offload Smart Scans for a column-compressed table to Oracle Exadata Storage Servers. When a scan is done on a compressed table, Oracle Exadata Storage Server reads the compressed blocks from the disks for the scan. Oracle Exadata System Software then decompresses the referenced columns, does predicate evaluation of the data, and applies the filter. The storage server then sends back qualifying data in an uncompressed format. Without this offload, data decompression would take place on the database server. Having Oracle Exadata Storage Server decompress the data results in significant CPU savings on the database server.

> **See Also**
>
> *Oracle Exadata System Software User's Guide* for information about Hybrid Columnar Compression

12.7.3 Storage Index

Storage indexes are a very powerful capability provided in Oracle Exadata System Software that help avoid I/O operations. Oracle Exadata System Software creates and maintains a storage index in Exadata memory. The storage index keeps track of minimum and maximum values of columns per storage region for tables stored on that cell. This functionality is done transparently, and does not require any administration by the user.

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When a query specifies a `WHERE` clause, Oracle Exadata System Software examines the storage index to determine if rows with the specified column value exist in disk regions associated with the query by comparing the column value to the minimum and maximum values maintained in the storage index. If the column value is outside the minimum and maximum range, then scan I/O in that region for that query is avoided. Many SQL operations run dramatically faster because large numbers of I/O operations are automatically replaced by a few in-memory lookups. To minimize operational overhead, storage indexes are created and maintained transparently and automatically by Oracle Exadata System Software.

Storage indexes provide benefits for encrypted tablespaces. However, storage indexes do not maintain minimum and maximum values for encrypted columns.

12.7.4 Smart Scan of Encrypted Data

Oracle Exadata System Software offloads decryption, and performs Smart Scans on encrypted tablespaces and encrypted columns. While the earlier release of Oracle Exadata System Software fully supported encrypted tablespaces and encrypted columns, it did not benefit from Exadata offload processing. For encrypted tablespaces, Oracle Exadata System Software can decrypt blocks and return the decrypted blocks to the Oracle Database, or it can perform smart scan which returns rows and columns. When Oracle Exadata System Software performs the decryption instead of the database there is significant CPU savings because CPU usage is offloaded to Exadata Cells.

12.7.5 Interleaved Grid Disks

This feature is deprecated in Oracle Exadata System Software release 19.1.0.

Space for grid disks can be allocated in an interleaved manner. Grid disks that use this type of space allocation are referred to as interleaved grid disks. This method attempts to equalize the performance of the grid disks residing on the same cell disk rather than having the grid disks that occupy the outer tracks getting better performance at the expense of the grid disks on the inner tracks.

A cell disk is divided into two equal parts, the outer half (upper portion) and the inner half (lower portion). When a new grid disk is created, half of the grid disk space is allocated on the outer half of the cell disk, and the other half of the grid disk space is allocated on the inner half of the cell disk. The upper portion of the grid disk starts on the first available outermost offset in the outer half depending on free or used space in the outer half. The lower portion of the grid disk starts on the first available outermost offset in the inner half.

For example, if cell disk, `CD_01_cell01` is completely empty and has 100 GB of space, and a grid disk, `data_CD_01_cell01`, is created and sized to 50 GB on the cell disk, then the cell disk would have the following layout:

```
- Outer portion of data_CD_01_cell01 - 25GB
- Free space - 25GB
------------ Middle Point ------------------
- Inner portion of data_CD_cell01 - 25GB
- Free space - 25GB
```

See Also

Oracle Exadata System Software User's Guide for information about grid disks

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12.7.6 Data Mining Scoring Offload

Oracle Exadata System Software now offloads data mining model scoring. This makes the deployment of your data warehouse on Oracle Exadata Storage Servers a better and more performant data analysis platform. All data mining scoring functions, such as `PREDICTION_PROBABILITY`, are offloaded to Oracle Exadata Storage Servers for processing. This accelerates warehouse analysis while it reduces database server CPU consumption and the I/O load between the Oracle Exadata Database Server and Oracle Exadata Storage Server.

12.7.7 Enhanced Manageability Features

Oracle Exadata Storage Server Software now includes the following manageability features:

- Automatic addition of replacement disk to the disk group: All the required Exadata operations to re-create the disk groups, and add the grid disks back to the original disk group are now performed automatically when a replacement disk is inserted after a physical disk failure.
- Automatic cell restart: Grid disks are automatically changed to online when a cell recovers from a failure, or after a restart.
- Support for OCR and voting disks on ASM disk groups: In Oracle Database 11*g* Release 2 (11.2), Oracle Cluster Registry (OCR) and voting disks are supported on ASM disk groups, and the iSCSI partitions are no longer needed.
- Support for up to four dual-port InfiniBand Host Channel Adapters in the database server. This feature enables larger Oracle Exadata Database Machine X2-8 Full Rack servers to be used as database servers using Oracle Exadata Storage Server Software.

12.8 What's New in Oracle Exadata Database Machine 11g Release 2 (11.2)

The following is new for Oracle Exadata System Software 11g Release 2 (11.2):

- Expanded Content in the Guide

12.8.1 Expanded Content in the Guide

This release of *Oracle Exadata Database Machine System Overview* includes maintenance procedures, cabling information, site planning checklists, and so on. This guide is the main reference book for Oracle Exadata Database Machine.

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Part II
Hardware Components

The Exadata Database Machine comes in many different configurations and has several different components.

- Hardware Components of Oracle Exadata Database Machine
  Oracle Exadata Database Machine consists of database servers, storage servers, and the network components to connect to your network.
- Hardware Components of the Exadata Storage Expansion Rack
  Oracle Exadata Storage Expansion Rack provides additional storage for Oracle Exadata Database Machine.

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Hardware Components of Oracle Exadata Database Machine

Oracle Exadata Database Machine consists of database servers, storage servers, and the network components to connect to your network.

Oracle Exadata Database Machine is available in flexible configurations that consist of a number of database and storage servers up to the capacity of the rack as defined using Oracle Exadata Configuration Assistant (OECA).

- Oracle Exadata Database Machine Hardware Components by Model
  These tables list the components included for each type of Oracle Exadata Database Machine model and configuration.
- Oracle Exadata Database Server Hardware Components
  Each Oracle Exadata Database Machine contains multiple database servers.
- Oracle Exadata Storage Server Hardware Components
  Each Oracle Exadata Database Machine contains multiple storage servers.
- Spares Kit Components for Oracle Exadata Database Machine

13.1 Oracle Exadata Database Machine Hardware Components by Model

These tables list the components included for each type of Oracle Exadata Database Machine model and configuration.

In the following tables, for raw capacity, 1 GB = 1 billion bytes. Capacity is calculated using normal space terminology of 1 TB = 1024 * 1024 * 1024 * 1024 bytes. Actual formatted capacity is less.

The following table describes the flexible configurations for various Exadata system models.

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Table 13-1 Oracle Exadata Database Machine Flexible Configurations

Model	Base Configuration	Flexible Configurations
Oracle Exadata Database Machine X11M	• 2 Exadata X11M database servers • 3 Exadata X11M storage servers • 2 RoCE Network Fabric Switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch	• Maximum of 19 servers (database and storage) in a rack • Minimum of 2 database servers, maximum of 15 database servers • Minimum of 3 storage servers, maximum of 17 storage servers • An extra RoCE Network Fabric Switch can be installed for combining racks. • Extra network cards can be installed if you require additional connectivity for client networks, or for separate networks. • A memory expansion kit can be installed to increase memory capacity for the database servers. Memory expansion kit is not available for the storage servers. • A disk expansion kit can be installed to increase local disk storage on the database server.
Oracle Exadata Database Machine X10M	• 2 Exadata X10M database servers • 3 Exadata X10M storage servers • 2 RoCE Network Fabric Switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 450.2 TB for Extreme Flash (EF), or 81.6 TB for High Capacity (HC) • Raw hard disk capacity: 792 TB for High Capacity (HC)	• Maximum of 19 servers (database and storage) in a rack • Minimum of 2 database servers, maximum of 15 database servers • Minimum of 3 High Capacity (HC) or Extreme Flash (EF) storage servers, can add 2 or more Extended (XT) servers or additional High Capacity (HC) or Extreme Flash (EF) storage servers for a maximum of 17 storage servers • An extra RoCE Network Fabric Switch can be installed for combining racks. • Extra network cards can be installed if you require additional connectivity for client networks, or for separate networks. • A memory expansion kit can be installed to increase memory capacity for the database servers. Memory expansion kit is not available for the storage servers. • A disk expansion kit can be used to upgrade disk storage of the database server, which increases the usable disk capacity of the database server, for use by Oracle Homes or other local disk requirements.

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Table 13-1 (Cont.) Oracle Exadata Database Machine Flexible Configurations

Model	Base Configuration	Flexible Configurations
Oracle Exadata Database Machine X9M-2	• 2 Exadata X9M-2 database servers • 3 Exadata X9M-2 storage servers • 2 RoCE Network Fabric Switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 153.6 TB for Extreme Flash (EF), or 76.8 TB for High Capacity (HC) • Raw hard disk capacity: 648 TB for High Capacity (HC) • Persistent memory capacity: 4.5 TB	• Maximum of 22 servers (database and storage) in a rack • Minimum of 2 database servers, maximum of 19 database servers • Minimum of 3 High Capacity (HC) or Extreme Flash (EF) storage servers, can add 2 or more Extended (XT) servers or additional High Capacity (HC) or Extreme Flash (EF) storage servers for a maximum of 18 storage servers • An extra RoCE Network Fabric Switch can be installed for combining racks. • An extra network card can be installed if you require additional connectivity for client networks, or for a separate network. • A memory expansion kit can be installed to increase memory capacity for the database servers. Memory expansion kit is not available for the storage servers. • A disk expansion kit can be used to upgrade disk storage of the database server, which increases the usable disk capacity of the database server, for use by Oracle Homes or other local disk requirements.

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Table 13-1 (Cont.) Oracle Exadata Database Machine Flexible Configurations

Model	Base Configuration	Flexible Configurations
Oracle Exadata Database Machine X8M-2	• 2 Exadata X8M-2 database servers • 3 Exadata X8M-2 storage servers • 2 RoCE Network Fabric Switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 153.6 TB for Extreme Flash (EF), or 76.8 TB for High Capacity (HC) • Raw hard disk capacity: 504 TB for High Capacity (HC)	• Maximum of 22 servers (database and storage) in a rack • Minimum of 2 database servers, maximum of 19 database servers • Minimum of 3 High Capacity (HC) or Extreme Flash (EF) storage servers, can add 2 or more Extended (XT) servers or additional High Capacity (HC) or Extreme Flash (EF) storage servers for a maximum of 18 storage servers • An extra RoCE Network Fabric Switch can be installed for combining racks. • An extra network card can be installed if you require additional connectivity for client networks, or for a separate network. • A memory expansion kit can be installed to increase memory capacity for the database servers. Memory expansion kit is not available for the storage servers. • A disk expansion kit can be used to upgrade disk storage of the database server, which increases the usable disk capacity of the database server, for use by Oracle Homes or other local disk requirements.

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Table 13-1 (Cont.) Oracle Exadata Database Machine Flexible Configurations

Model	Base Configuration	Flexible Configurations
Oracle Exadata Database Machine X8-2	• 2 Exadata X8-2 database servers • 3 Exadata X8-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Nexus 9348 Ethernet switch • Raw flash capacity: 153.6 TB for Extreme Flash (EF), or 76.8 TB for High Capacity (HC) • Raw hard disk capacity: 504 TB for High Capacity (HC)	• Maximum of 22 servers (database and storage) in a rack • Minimum of 2 database servers, maximum of 19 database servers • Minimum of 3 High Capacity (HC) or Extreme Flash (EF) storage servers, can add 2 or more Extended (XT) servers or additional High Capacity (HC) or Extreme Flash (EF) storage servers for a maximum of 18 storage servers • An extra InfiniBand leaf switch can be installed for combining racks. • An extra network card can be installed if you require additional connectivity for client networks, or for a separate network. • A memory expansion kit can be installed to increase memory capacity for the database or storage servers. Memory expansion kit is not available for the Extended (XT) storage servers. • A disk expansion kit can be used to upgrade disk storage of the database server, which increases the usable disk capacity of the database server, for use by Oracle Homes or other local disk requirements.

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Table 13-1 (Cont.) Oracle Exadata Database Machine Flexible Configurations

Model	Base Configuration	Flexible Configurations
Oracle Exadata Database Machine X7-2	• 2 Exadata X7-2 database servers • 3 Exadata X7-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Nexus 93108-1G or 9348 Ethernet switch • Raw flash capacity: 153.6 TB for Extreme Flash (EF), or 76.8 TB for High Capacity (HC) • Raw hard disk capacity: 360 TB for High Capacity (HC)	• Maximum of 22 servers (database and storage) in a rack • Minimum of 2 database servers, maximum of 19 database servers • Minimum of 3 High Capacity (HC) or Extreme Flash (EF) storage servers, maximum of 18 storage servers • An extra InfiniBand leaf switch can be installed for combining racks. • An extra network card can be installed if you require additional connectivity for client networks, or for a separate network. • A memory expansion kit can be installed to increase memory capacity for the database or storage servers. • A disk expansion kit can be used to upgrade disk storage of the database server, which increases the usable disk capacity of the database server, for use by Oracle Homes or other local disk requirements.
Oracle Exadata Database Machine X6-2	• 2 Exadata X6-2 database servers • 3 Exadata X6-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 76.8 TB for Extreme Flash (EF), or 38.4 TB for High Capacity (HC) • Raw hard disk capacity: 288 TB for High Capacity (HC)	• Maximum of 22 servers (database and storage) in a rack • Minimum of 2 database servers, maximum of 19 database servers • Minimum of 3 High Capacity (HC) or Extreme Flash (EF) storage servers, maximum of 18 storage servers • An extra InfiniBand leaf switch can be installed for combining racks. • An extra network card can be installed if you require additional connectivity for client networks, or for a separate network. • A memory expansion kit can be installed to increase memory capacity for the database or storage servers. • A disk expansion kit can be used to upgrade disk storage of the database server, which increases the usable disk capacity of the database server, for use by Oracle Homes or other local disk requirements.

The following table describes the fixed configurations (Full Rack, Half Rack, Quarter Rack, and Eighth Rack) for Oracle Exadata Database Machine.

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Table 13-2 Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X10M	Not applicable	Not applicable	Not applicable	• 2 Exadata X10M Eighth Rack database servers. Each server has 1 x 32-core processor with all 32 cores enabled • 3 Exadata X10M Eighth Rack storage servers. Each server has 1 x 32-core processor and contains the following storage: – 6 x 22 TB 7,200 RPM high capacity disks. – 2 PCI flash cards, each with 6.8 TB of raw flash storage. • 2 RoCE Network Fabric Switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 40.8 TB • Raw hard disk capacity: 396 TB

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X9M-2	Not applicable	Not applicable	Not applicable	• 2 Exadata X9M-2 database servers. Each server has 1 x 32-core processor with all 32 cores enabled • 3 Exadata X9M-2 storage servers. Each server has 2 x 16-core processors and contains the following storage: – 6 x 18 TB 7,200 RPM high capacity disks. – 2 PCI flash cards, each with 6.4 TB of raw flash storage. – 768 GB of persistent memory • 2 RoCE Network Fabric Switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 38.4 TB • Raw hard disk capacity: 324 TB • Persistent memory capacity: 2.3 TB

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X9M-8	• 2 Exadata X9M-8 database servers. An additional database server can be added. • 14 Exadata X9M-2 storage servers, either High Capacity or Extreme Flash • 2 RoCE Network Fabric Switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 716.8 TB for Extreme Flash (EF), or 358.4 TB for High Capacity (HC) • Raw hard disk capacity: 3024 TB for High Capacity (HC) • Persistent memory capacity: 21 TB	• 2 Exadata X9M-8 database servers. An additional database server can be added. • 3 Exadata X9M-2 storage servers, either High Capacity or Extreme Flash • 2 RoCE Network Fabric Switches. An extra switch can be installed for combining racks. • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 153.6 TB for Extreme Flash (EF), or 76.8 TB for High Capacity (HC) • Raw hard disk capacity: 648 TB for High Capacity (HC) • Persistent memory capacity: 4.5 TB	Not applicable	Not applicable

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X8M-2	Not applicable	Not applicable	Not applicable	• 2 Exadata X8M-2 database servers. Each server has 1 x 24-core processor with all 24 cores enabled. • 3 Exadata X8M-2 storage servers, either High Capacity or Extreme Flash. Each server has 2 x 16-core processors, each with 8 cores enabled. – High Capacity (HC) storage servers have 2 PCI flash cards, each with 6.4 TB (raw) Smart Flash Cache and 6 x 14 TB 7,200 RPM high capacity disks. – Extreme Flash (EF) storage servers have 4 PCI flash cards, each with 6.4 TB (raw) storage. • 2 RoCE Network Fabric Switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 76.8 TB for Extreme Flash (EF), or 38.4 TB for High Capacity (HC) • Raw hard disk capacity: 180 TB

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
				for High Capacity (HC)
Oracle Exadata Database Machine X8M-8	• 2 Exadata X8M-8 database servers. An additional database server can be added. • 14 Exadata X8M-2 storage servers, either High Capacity or Extreme Flash • 2 RoCE Network Fabric Switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 716.8 TB for Extreme Flash (EF), or 358.4 TB for High Capacity (HC) • Raw hard disk capacity: 2352 TB for High Capacity (HC)	• 2 Exadata X8M-8 database servers. An additional database server can be added. • 3 Exadata X8M-2 storage servers, either High Capacity or Extreme Flash • 2 RoCE Network Fabric Switches. An extra switch can be installed for combining racks. • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 Management Network Switch • Raw flash capacity: 153.3 TB for Extreme Flash (EF), or 76.8 TB for High Capacity (HC) • Raw hard disk capacity: 504 TB for High Capacity (HC)	Not applicable	Not applicable

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X8-2	Not applicable	Not applicable	Not applicable	• 2 Exadata X8-2 database servers. Each server has 1 x 24-core processor with all 24 cores enabled. • 3 Exadata X8-2 storage servers, either High Capacity or Extreme Flash. Each server has 2 x 16-core processors, each with 8 cores enabled. – High Capacity (HC) storage servers have 2 PCI flash cards, each with 6.4 TB (raw) Smart Flash Cache and 6 x 14 TB 7,200 RPM high capacity disks. – Extreme Flash (EF) storage servers have 4 PCI flash cards, each with 6.4 TB (raw) storage. • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Nexus 9348 Ethernet switch. • Raw flash capacity: 76.8 TB for Extreme Flash (EF), or 38.4 TB for High Capacity (HC)

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
				• Raw hard disk capacity: 180 TB for High Capacity (HC)
Oracle Exadata Database Machine X8-8	• 2 Exadata X8-8 database servers. An additional database server can be added. • 14 Exadata X8-2 storage servers, either High Capacity or Extreme Flash • 2 Sun Datacenter InfiniBand Switch 36 switches. • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Nexus 9348 Ethernet switch. • Raw flash capacity: 716.8 TB for Extreme Flash (EF), or 358.4 TB for High Capacity (HC) • Raw hard disk capacity: 2352 TB for High Capacity (HC)	• 2 Exadata X8-8 database servers. An additional database server can be added. • 3 Exadata X8-2 storage servers, either High Capacity or Extreme Flash • 2 Sun Datacenter InfiniBand Switch 36 switches. An extra InfiniBand leaf switch can be installed for combining racks. • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Nexus 9348 Ethernet switch • Raw flash capacity: 716.8 TB for Extreme Flash (EF), or 358.4 TB for High Capacity (HC) • Raw hard disk capacity: 2352 TB for High Capacity (HC)	Not applicable	Not applicable

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X7-2	• 8 database servers • 14 Exadata X7-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Nexus 93108-1G or 9348 Ethernet switch • Raw flash capacity: 716.8 TB for Extreme Flash (EF), or 358.4 TB for High Capacity (HC) • Raw hard disk capacity: 1680 TB for High Capacity (HC)	• 4 database servers • 7 Exadata X7-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Nexus 93108-1G or 9348 Ethernet switch • Raw flash capacity: 358.4 TB for Extreme Flash (EF), or 179.2 TB for High Capacity (HC) • Raw hard disk capacity: 840 TB for High Capacity (HC)	• 2 database servers • 3 Exadata X7-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Nexus 93108-1G or 9348 Ethernet switch • Raw flash capacity: 153.6 TB for Extreme Flash (EF), or 76.8 TB for High Capacity (HC) • Raw hard disk capacity: 360 TB for High Capacity (HC)	• 2 database servers. Each server has 1 x 24-core processor with all 24 cores enabled. • 3 Exadata X7-2 storage servers, either High Capacity or Extreme Flash. Each server has 2 x 10-core processors, each with 5 cores enabled. – High Capacity (HC) storage servers have 2 PCI flash cards, each with 6.4 TB (raw) Smart Flash Cache and 6 x 10 TB 7,200 RPM high capacity disks. – Extreme Flash (EF) storage servers have 8 PCI flash cards, 4 enabled, each with 3.2 TB (raw) storage. • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 x 48-port Cisco Nexus 93108-1G or 9348 Ethernet switch • Raw flash capacity: 76.8 TB for Extreme Flash (EF), or 38.4 TB

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
				for High Capacity (HC) • Raw hard disk capacity: 180 TB for High Capacity (HC)
Oracle Exadata Database Machine X7-8	• 2 database servers • 14 Exadata X7-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Nexus 93108-1G or 9348 Ethernet switch • Raw flash capacity: 716.8 TB for Extreme Flash (EF), or 358.4 TB for High Capacity (HC) • Raw hard disk capacity: 1680 TB for High Capacity (HC)	Not applicable	Not applicable	Not applicable

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X6-2	• 8 database servers • 14 Exadata X6-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 358.4 TB for Extreme Flash (EF), or 179.2 TB for High Capacity (HC) • Raw hard disk capacity: 1344 TB for High Capacity (HC)	• 4 database servers • 7 Exadata X6-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 179.2 TB for Extreme Flash (EF), or 89.6 TB for High Capacity (HC) • Raw hard disk capacity: 672 TB for High Capacity (HC)	• 2 database servers • 3 Exadata X6-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 76.8 TB for Extreme Flash (EF), or 38.4 TB for High Capacity (HC) • Raw hard disk capacity: 288 TB for High Capacity (HC)	• 2 database servers. Each server has 2 x 22-core processors, each with 11 cores enabled. • 3 Exadata X6-2 storage servers. Each server has 2 x 10-core processors, with 5 cores enabled. – High Capacity (HC) storage servers have 2 PCI flash cards, each with 3.2 TB (raw) Smart Flash Cache and 6 x 8 TB 7,200 RPM high capacity disks. – Extreme Flash (EF) storage servers have 8 PCI flash cards, 4 enabled, each with 3.2 TB (raw) storage. • 2 Sun Datacenter InfiniBand Switch 36 switches • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 38.4 TB for Extreme Flash (EF), or 19.2 TB for High Capacity (HC) • Raw hard disk capacity: 144 TB

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
				for High Capacity (HC)
Oracle Exadata Database Machine X5-2	• 8 database servers • 14 Exadata X5-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 179.2 TB for Extreme Flash (EF), or 89.6 TB for High Capacity (HC) • Raw hard disk capacity: 1344 TB for High Capacity (HC)	• 4 database servers • 7 Exadata X5-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 89.6 TB for Extreme Flash (EF), or 44.8 TB for High Capacity (HC) • Raw hard disk capacity: 672 TB for High Capacity (HC)	• 2 database servers • 3 Exadata X5-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 38.4 TB for Extreme Flash (EF), or 19.2 TB for High Capacity (HC) • Raw hard disk capacity: 288 TB for High Capacity (HC)	• 2 database servers. Each server has 2 x 18-core processors, each with 9 cores enabled • 3 Exadata X5-2 storage servers. Each server has: – 2 eight-core processors, each with 4 cores enabled – 4 PCI flash cards, 2 enabled, each with 1.6 TB (raw) Smart Flash Cache and 12 x 8 TB 7,200 RPM High Capacity (HC) disks, OR – 8 PCI flash drives, 4 enabled, each with 1.6 TB (raw) storage • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 19.2 TB for Extreme Flash (EF), or 9.6 TB for High Capacity (HC) • Raw hard disk capacity: 144 TB for High Capacity (HC) disks

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X5-8 Oracle Exadata Database Machine X6-8	• 2 database servers • 14 Exadata X5-2 storage servers (X6-2 for X6-8) • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 179.2 TB for Extreme Flash (EF), or 89.6 TB for High Capacity (HC) • Raw hard disk capacity: 1344 TB for High Capacity (HC)	• 2 database servers • 3 Exadata X5-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • Raw flash capacity: 38.4 TB for Extreme Flash (EF), or 19.2 TB for High Capacity (HC) • Raw hard disk capacity: 288 TB for High Capacity (HC)	Not applicable	Not applicable

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X4-2	• 8 database servers • 14 Exadata X4-2L storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 44.8 TB of raw flash capacity • 200 TB raw storage capacity for high performance disks, or 672 TB raw capacity for High Capacity (HC)	• 4 database servers • 7 Exadata X4-2L storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 22.4 TB of raw flash capacity • 100 TB raw storage capacity for high performance disks, or 386 TB raw capacity for High Capacity (HC)	• 2 database servers • 3 Exadata X4-2L storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 9.6 TB of raw flash capacity • 43.2 TB raw storage capacity for high performance disks, or 144 TB raw capacity for High Capacity (HC)	• 2 database servers • 3 Exadata X4-2L storage servers. Each server has: - 2 six-core processors - 12 x 1.2 TB 10,000 RPM High Performance disks, OR - 12 x 4 TB 7,200 RPM High Capacity disks • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 4.8 TB of raw flash capacity • 21.6 TB raw storage capacity for high performance disks, or 72 TB raw capacity for High Capacity (HC)

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X4-8 Full Rack	• 2 database servers • 14 Exadata X4-2L storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 44.8 TB of raw flash capacity • 200 TB raw storage capacity for high performance disks, or 672 TB raw capacity for High Capacity (HC)	Not applicable	Not applicable	Not applicable

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X3-2	• 8 database servers • 14 Exadata X3-2 storage servers • 3 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 22.4 TB of raw flash capacity • 100 TB raw storage capacity for high performance disks, or 504 TB raw capacity for High Capacity (HC)	• 4 database servers • 7 Exadata X3-2 storage servers • 3 Sun Datacenter InfiniBand Switch 36 (Oracle Exadata Database Machine Half Rack based on Sun Fire X4170 Oracle Database Servers includes two Sun Datacenter InfiniBand Switch 36 switches.) • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 11.2 TB of raw flash capacity • 50 TB raw storage capacity for high performance disks, or 252 TB raw capacity for High Capacity (HC)	• 2 database servers • 3 Exadata X3-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 4.8 TB of raw flash capacity • 21.6 TB raw storage capacity for high performance disks, or 108 TB raw capacity for High Capacity (HC)	• 2 database servers • 3 Exadata X3-2 storage servers - 2 six-core processors, each with 3 cores enabled - 12 PCI flash cards (6 cards enabled) with 2.4 TB Exadata Smart Flash Cache - 18 x 600 GB 15,000 RPM High Performance disks, OR 18 x 3 TB 7,200 RPM High Capacity disks (6 disks per storage server enabled) • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 2.4 TB of raw flash capacity • 10.8 TB raw storage capacity for high performance disks, or 54 TB raw capacity for High Capacity (HC)

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X3-8 Full Rack with Exadata X4-2L storage servers	• 2 database servers • 14 Exadata X4-2L storage servers • 2 Sun Datacenter InfiniBand Switch 36 • 2 redundant 24 kVA PDUs (3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 44.8 TB of raw flash capacity • 200 TB raw storage capacity for high performance disks, or 672 TB raw capacity for High Capacity (HC)	Not applicable	Not applicable	Not applicable

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X3-8 Full Rack with Exadata X3-2 storage servers	• 2 database servers • 14 Exadata X3-2 storage servers • 3 Sun Datacenter InfiniBand Switch 36 • 2 redundant 24 kVA PDUs (3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 22.4 TB of raw flash capacity • 100 TB raw storage capacity for high performance disks, or 504 TB raw capacity for High Capacity (HC)	Not applicable	Not applicable	Not applicable

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Table 13-2 (Cont.) Components of Oracle Exadata Database Machine in Fixed Configurations

Edition	Oracle Exadata Database Machine Full Rack	Oracle Exadata Database Machine Half Rack	Oracle Exadata Database Machine Quarter Rack	Oracle Exadata Database Machine Eighth Rack
Oracle Exadata Database Machine X2-2	• 8 database servers • 14 Exadata X2-2 storage servers • 3 Sun Datacenter InfiniBand Switch 36 • Keyboard, video, and mouse (KVM) hardware • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948, model number WS-C4948-S Ethernet switch • 5.3 TB of raw flash capacity	• 4 database servers • 7 Exadata X2-2 storage servers • 3 Sun Datacenter InfiniBand Switch 36 (Oracle Exadata Database Machine Half Rack based on Sun Fire X4170 Oracle Database Servers includes two Sun Datacenter InfiniBand Switch 36 switches.) • Keyboard, video, and mouse (KVM) hardware • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948, model number WS-C4948-S Ethernet switch • 2.6 TB of raw flash capacity	• 2 database servers • 3 Exadata X2-2 storage servers • 2 Sun Datacenter InfiniBand Switch 36 • Keyboard, video, and mouse (KVM) hardware • 2 redundant 15 kVA PDUs (1-phase or 3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948, model number WS-C4948-S Ethernet switch • 1.1 TB of raw flash capacity	Not applicable
Oracle Exadata Database Machine X2-8 Full Rack	• 2 database servers • 14 Exadata X2-2 storage servers • 3 Sun Datacenter InfiniBand Switch 36 • 2 redundant 24 kVA PDUs (3-phase, high-voltage or low-voltage) • 1 48-port Cisco Catalyst 4948, model number WS-C4948-S Ethernet switch • 5.3 TB of raw flash capacity	Not applicable	Not applicable	Not applicable

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13.2 Oracle Exadata Database Server Hardware Components

Each Oracle Exadata Database Machine contains multiple database servers.

The following sections describe the database server components for each type of Oracle Exadata Database Machine:

- Oracle Exadata Database Server X11M Hardware Components
- Oracle Exadata Database Server X11M-Z Hardware Components
- Oracle Exadata X10M Database Server Hardware Components
- Oracle Exadata X10M Eighth Rack Database Server Hardware Components
- Database Server Components of Oracle Exadata X9M-2
- Database Server Components of Oracle Exadata X9M-8
- Database Server Components of Oracle Exadata X8M-2
- Database Server Components of Oracle Exadata X8M-8
- Database Server Components of Oracle Exadata Database Machine X8-2
- Database Server Components of Oracle Exadata Database Machine X8-8
- Database Server Components of Oracle Exadata Database Machine X7-2
- Database Server Components of Oracle Exadata Database Machine X7-8
- Database Server Components of Oracle Exadata Database Machine X6-2
- Database Server Components of Oracle Exadata Database Machine X5-2
- Database Server Components of Oracle Exadata Database Machine X5-8 and X6-8
- Database Server Components of Oracle Exadata Database Machine X4-2
- Database Server Components of Oracle Exadata Database Machine X4-8 Full Rack
- Database Server Components of Oracle Exadata Database Machine X3-2
- Database Server Components of Oracle Exadata Database Machine X3-8 Full Rack
- Database Server Components of Oracle Exadata Database Machine X2-2
- Database Server Components of Oracle Exadata Database Machine X2-8 Full Rack

13.2.1 Oracle Exadata Database Server X11M Hardware Components

Each Oracle Exadata X11M database server includes the following components:

- CPU: 2 x 96-core AMD EPYC™ 9J25 processors, 2.6 GHz (up to 4.5 GHz)
- RAM: 6400MT/s DDR5 DIMMs. 512 GB (16 x 32 GB DIMMs), 1536 GB (24 x 64 GB DIMMs), 2304 GB (24 x 96 GB DIMMs), or 3072 GB (24 x 128 GB DIMMs)
- System storage: 2 x 3.84 TB NVMe storage devices, expandable to 4 devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric adapter; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

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- Client and additional network connectivity:
  - Two factory-installed CX6-LX network adapters. Each contains 2 x SFP+/SFP28 ports (10/25 GbE)
  - Up to 3 optional network adapters. Each adapter can be any of the following:
    - CX6-LX with 2 x SFP+/SFP28 ports (10/25 GbE)
    - CX6-DX with 2 x QSFP28 ports (100GbE). Each QSFP28 port can support one 10 GbE or 25 GbE link with appropriate breakout cables.
    - Quad 10G RJ45 Ethernet with 4 x 10GBASE-T ports (10 GbE)

13.2.2 Oracle Exadata Database Server X11M-Z Hardware Components

Each Oracle Exadata X11M-Z database server includes the following components:

- CPU: 1 x 32-core AMD EPYC™ 9J15 processor, 2.95 GHz (up to 4.4 GHz)
- RAM: 6400MT/s DDR5 DIMMs. 768 GB (12 x 64 GB DIMMs) or 1152 GB (12 x 96 GB DIMMs)
- System storage: 2 x 3.84 TB NVMe storage devices, expandable to 4 devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric adapter; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port
- Client and additional network connectivity:
  - Two factory-installed CX6-LX network adapters. Each contains 2 x SFP+/SFP28 ports (10/25 GbE)
  - One additional field-installed network adapter containing any of the following:
    - CX6-LX with 2 x SFP+/SFP28 ports (10/25 GbE)
    - CX6-DX with 2 x QSFP28 ports (100GbE). Each QSFP28 port can support one 10 GbE or 25 GbE link with appropriate breakout cables.
    - Quad 10G RJ45 Ethernet with 4 x 10GBASE-T ports (10 GbE)
  - Optionally, one or both of the factory-installed CX6-LX network adapters can be replaced by field-installed Quad 10G RJ45 Ethernet network adapters, with each adapter containing 4 x 10GBASE-T ports (10 GbE).

13.2.3 Oracle Exadata X10M Database Server Hardware Components

Each Oracle Exadata X10M database server includes the following components:

- CPU: 2 x 96-core AMD EPYC™ 9J14 processors, 2.6 GHz (up to 3.7 GHz)
- RAM: 512 GB (16 x 32 GB DIMMs), 1536 GB (24 x 64 GB DIMMs), 2304 GB (24 x 96 GB DIMMs), or 3072 GB (24 x 128 GB DIMMs)
- System storage: 2 x 3.84 TB PCIe 4.0 NVMe storage devices, expandable to 4 devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port

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- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port
- Client and additional network connectivity:
  - Two factory-installed CX6-LX network cards. Each card contains 2 x SFP+/SFP28 ports (10/25 GbE)
  - Up to 3 optional network cards. Each card can be any of the following:
    * CX6-LX with 2 x SFP+/SFP28 ports (10/25 GbE)
    * CX6-DX with 2 x QSFP28 ports (100GbE). Each QSFP28 port can support one 10 GbE or 25 GbE link with appropriate breakout cables.
    * Fortpond RJ45 Ethernet with 4 x 10GBASE-T ports (10 GbE)

13.2.4 Oracle Exadata X10M Eighth Rack Database Server Hardware Components

Each Oracle Exadata X10M Eighth Rack database server includes the following components:

- CPU: 1 x 32-core AMD EPYC™ 9334 processor, 2.7 GHz (up to 3.9 GHz)
- RAM: 384 GB RAM (12 x 32 GB DIMMs), 768 GB (12 x 64 GB DIMMs), or 1152 GB (12 x 96 GB DIMMs)
- System storage: 2 x 3.84 TB PCIe 4.0 NVMe storage devices, expandable to 4 devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port
- Client and additional network connectivity:
  - Two factory-installed CX6-LX network cards. Each card contains 2 x SFP+/SFP28 ports (10/25 GbE)
  - One additional field-installed network card containing any of the following:
    * CX6-LX with 2 x SFP+/SFP28 ports (10/25 GbE)
    * CX6-DX with 2 x QSFP28 ports (100GbE). Each QSFP28 port can support one 10 GbE or 25 GbE link with appropriate breakout cables.
    * Fortpond RJ45 Ethernet with 4 x 10GBASE-T ports (10 GbE)
  - Optionally, one or both of the factory-installed CX6-LX network cards can be replaced by field-installed Fortpond RJ45 Ethernet network cards, with each card containing 4 x 10GBASE-T ports (10 GbE).

13.2.5 Database Server Components of Oracle Exadata X9M-2

Each Oracle Exadata X9M-2 database server includes the following components:

- CPU - 32-core Intel Xeon 8358 processors (2.6 GHz):
  - Flexible configuration: 2 CPUs
  - Eighth Rack: 1 CPU
- RAM:

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  - Flexible configuration: 512 GB RAM (16 x 32 GB DIMMs), expandable to 1 TB (16 x 64 GB DIMMs), 1.5 TB (16 x 32 GB and 16 x 64 GB DIMMs), or 2 TB (32 x 64 GB DIMMs) with memory expansion kit
  - Eighth Rack: 384 GB RAM (12 x 32 GB DIMMs), expandable to 1 TB (16 x 64 GB DIMMs) with memory expansion kit
- System storage: 2 x 3.84 TB PCIe 4.0 NVMe storage drives, expandable to 4 drives
- RDMA Network Fabric: 1 x dual-port CX5 RDMA Network Fabric card; PCIe 4.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port
- Client and additional network connectivity:
  - Flexible configuration options:
    * Two factory-installed network cards. Each card contains 2 x SFP+/SFP28 ports (10/25 GbE) or 4 x 10GBASE-T ports (10 GbE)
    * One optional field-installed network card containing 2 x SFP+/SFP28 ports (10/25 GbE) or 4 x 10GBASE-T ports (10 GbE) or 2 x QSFP28 ports (100GbE). Each QSFP28 port can support one 10 GbE or 25 GbE link with appropriate breakout cables.
  - Eighth Rack: Two factory-installed network cards only. Each card contains 2 x SFP+/SFP28 ports (10/25 GbE) or 4 x 10GBASE-T ports (10 GbE)

13.2.6 Database Server Components of Oracle Exadata X9M-8

Each Oracle Exadata X9M-8 database server includes the following components:

- CPU: 8 x 24-core Intel Xeon Platinum 8268 Processors (2.9GHz)
- RAM: 3 TB (48 x 64 GB DIMMs), expandable to a maximum of 6 TB
- System storage: 2 x 6.4 TB flash accelerator PCIe cards (Hot-Pluggable)
- RDMA Network Fabric: 4 x dual-port QSFP28 100 Gb/s PCIe 3.0 RDMA Network Fabric cards - all ports active
- Network connectivity:
  - 8 x 10GBASE-T ports (1/10 GbE) - 1 port used for the administration network
  - 8 x SFP+/SFP28 ports (10/25 GbE)
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port
- Redundant hot-swappable power supplies and fans

13.2.7 Database Server Components of Oracle Exadata X8M-2

Oracle Exadata X8M-2 database servers include the following components:

- 2 x 24-core Intel Xeon Platinum 8260 Processors (2.4 GHz)
- 384 GB RAM (12 x 32 GB DIMMs), expandable to 1.5 TB (24 x 64 GB DIMMs) with memory expansion kit
- 4 x 1.2 TB boot drive/hard disks, hot swappable, expandable to 8 drives

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- Disk controller HBA with 2 GB cache (no batteries)
- RDMA Network Fabric: 1 x dual-port QSFP28 100 Gb/s PCIe 3.0 RDMA Network Fabric card - both ports active
- Client network: 2 x SFP+/SFP28 ports (10/25 GbE) or 2 x 10GBASE-T ports (10 GbE)
- Backup/optional networks: 2 x SFP+/SFP28 ports (10/25 GbE) or 4 x 10GBASE-T ports (10 GbE)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

13.2.8 Database Server Components of Oracle Exadata X8M-8

Oracle Exadata X8M-8 database servers include the following components:

- 8 x 24-core Intel(R) Xeon(R) Platinum 8268 Processors (2.9GHz)
- 3 TB (48 x 64 GB DIMMs) RAM
- 2 x 6.4 TB flash accelerator PCIe cards (Hot-Pluggable)
- RDMA Network Fabric: 4 x dual-port QSFP28 100 Gb/s PCIe 3.0 RDMA Network Fabric cards - all ports active
- 8 x 10GBASE-T ports (10 GbE) - 1 port used for the administration network
- 8 x SFP+/SFP28 ports (10/25 GbE)
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port
- Redundant hot swappable power supplies and fans

13.2.9 Database Server Components of Oracle Exadata Database Machine X8-2

Oracle Exadata Database Machine X8-2 database servers include the following components:

- 2 x 24-core Intel Xeon Platinum 8260 Processors (2.4 GHz)
- 384 GB RAM (12 x 32 GB DIMMs), expandable to 768 GB (12 x 64 GB DIMMs) or 1.5 TB (24 x 64 GB DIMMs) with memory expansion kit
- 4 x 1.2 TB boot drive/hard disks, hot swappable, expandable to 8 drives
- Disk controller HBA with 2 GB cache (no batteries)
- RDMA Network Fabric: 2 x InfiniBand 4X QDR (40 Gb/s) ports (PCIe 3.0) - both ports active
- Client network: 2 x SFP+/SFP28 ports (10/25 GbE) or 2 x 10GBASE-T ports (10 GbE)
- Backup/optional networks: 2 x SFP+/SFP28 ports (10/25 GbE) or 4 x 10GBASE-T ports (10 GbE)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

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13.2.10 Database Server Components of Oracle Exadata Database Machine X8-8

Oracle Exadata Database Machine X8-8 database servers include the following components:

- 8 x 24-core Intel(R) Xeon(R) Platinum 8268 Processors (2.9GHz)
- 3 TB (48 x 64 GB DIMMs) RAM, expandable to 6 TB (96 x 64 GB DIMMs) with memory expansion kit
- 2 x 6.4 TB flash accelerator PCIe cards (Hot-Pluggable)
- RDMA Network Fabric: 8 x InfiniBand 4X QDR (40 Gb/s) ports (PCIe 3.0) - all ports active
- 8 x 10GBASE-T ports (10 GbE) - 1 port used for the administration network
- 8 x SFP+/SFP28 ports (10/25 GbE)
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port
- Redundant hot swappable power supplies and fans

13.2.11 Database Server Components of Oracle Exadata Database Machine X7-2

Oracle Exadata Database Machine X7-2 database servers include the following components:

- 2 x 24-core Intel Xeon Platinum 8160 Processors (2.10GHz)
- 384 GB RAM, expandable to 768 GB (12 x 64 GB) or 1.5 TB (24 x 64GB) with memory expansion kit
- 4 x 600 GB 10K RPM SAS disks, hot swappable, expandable to 8 drives
- Disk controller HBA with 2 GB cache (no batteries)
- 2 x InfiniBand 4X QDR (40 Gbps) ports (PCIe 3.0), both ports active
- 2 x 10 GbE Base-T Ethernet ports or 2 x 10GbE/25GbE Ethernet SFP28 Ports
- 2 x 10GbE/25GbE Ethernet SFP28 Ports
- 1 x 10/100/1000 BASE-T Ethernet port for Integrated Lights Out Manager (ILOM) for remote management

13.2.12 Database Server Components of Oracle Exadata Database Machine X7-8

Oracle Exadata Database Machine X7-8 database servers include the following components:

- 8 x 24-core Intel(R) Xeon(R) Platinum 8168 Processors (2.70GHz)
- 3TB (48 x 64 GB) RAM, expandable to 6 TB (96 x 64 GB) with memory expansion kit
- 8 x InfiniBand 4X QDR (40 Gbps) ports (PCIe 3.0) - all ports active
- 8 x 10 GbE Base-T Ethernet ports (8 embedded ports based on the Intel 722 1/10GbE Controller)

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- 8 x 10GbE/25GbE Ethernet SFP28 Ports (4 Dual-port 10/25 GbE PCIe 3.0 network card based on the Broadcom BCM57414 10Gb/25Gb Ethernet Controller technology)
- 1 Ethernet port for Integrated Lights Out Manager (ILOM) for remote management
- Redundant hot swappable power supplies and fans

13.2.13 Database Server Components of Oracle Exadata Database Machine X6-2

Oracle Exadata Database Machine X6-2 database servers include the following components:

- 2 x 22-core Intel Xeon E5-2699 v4 processors (2.2 GHz)
- 256 GB (8 x 32 GB) RAM expandable to 512 GB (16 x 32 GB) or 768 GB (24 x 32 GB) with memory expansion kit
- 4 x 600 GB 10K RPM SAS disks, hot swappable, expandable to 8x
- Disk controller HBA with 1 GB cache (no more batteries)
- 2 x InfiniBand 4X QDR (40 Gbps) ports (PCIe 3.0), both ports active
- 4 x 1 GbE/10 GbE Base-T Ethernet ports
- 2 x 10 GbE Ethernet SFP+ ports (1 dual-port 10 GbE PCIe 2.0 network card based on the Intel 82599 10 GbE controller technology)
- 1 Ethernet port for Integrated Lights Out Manager (ILOM) for remote management

13.2.14 Database Server Components of Oracle Exadata Database Machine X5-2

Oracle Exadata Database Machine X5-2 database servers include the following components:

- 2 Eighteen-Core Intel Xeon E5-2699 v3 processors (2.3 GHz)
- 256 GB (8 x 32 GB) RAM expandable to 768 GB with memory expansion kit
- 4 x 600 GB 10K RPM SAS disks
- Disk controller HBA with 1 GB supercap-backed write cache
- 2 InfiniBand 4X QDR (40 Gb/s) ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA))
- 4 x 1 GbE/10GbE Base-T Ethernet ports
- 2 x 10 GbE Ethernet SFP+ ports (1 dual-port 10GbE PCIe 2.0 network card based on the Intel 82599 10 GbE controller technology)
- 1 Ethernet port for Integrated Lights Out Manager (ILOM) for remote management

13.2.15 Database Server Components of Oracle Exadata Database Machine X5-8 and X6-8

Oracle Exadata Database Machine X5-8 and X6-8 database servers include the following components:

- 8 Eighteen-Core Intel Xeon E7-8895 v3 processors (2.6 GHz)
- 2 TB (64 x 32 GB) RAM, expandable to 6 TB (192 x 32 GB) with memory expansion kit

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- 8 x 600 GB 10K RPM SAS disks (hot swappable)
- Disk controller HBA with 1 GB cache
- 8 x InfiniBand 4X QDR (40 Gbps) ports (PCIe 3.0) - all ports active
- 10 x 1 GbE Base-T Ethernet ports (2 Quad-port PCIe 2.0 network card, and 2 embedded ports based on the Intel I350 1 GbE Controller technology)
- 8 x 10 GbE Ethernet SFP+ ports (4 Dual-port 10 GbE PCIe 2.0 network card based on the Intel 82599 10 GbE Controller technology)
- 1 Ethernet port for Integrated Lights Out Manager (ILOM) for remote management
- Redundant hot swappable power supplies and fans

13.2.16 Database Server Components of Oracle Exadata Database Machine X4-2

Oracle Exadata Database Machine X4-2 database servers include the following components:

- 2 Twelve-Core Intel Xeon E5-2697 v2 processors (2.7 GHz)
- 256 GB (16 x 16 GB) RAM expandable to 512 GB with memory expansion kit
- 4 x 600 GB 10K RPM SAS disks
- Disk controller HBA with 512 MB battery-backed write cache, and swappable battery backup unit (BBU)
- 2 InfiniBand 4X QDR (40 Gb/s) ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA))
- 4 x 1 GbE/10GbE Base-T Ethernet ports
- 2 x 10 GbE Ethernet SFP+ ports (1 dual-port 10GbE PCIe 2.0 network card based on the Intel 82599 10 GbE controller technology)
- 1 Ethernet port for Integrated Lights Out Manager (ILOM) for remote management

13.2.17 Database Server Components of Oracle Exadata Database Machine X4-8 Full Rack

Oracle Exadata Database Machine X4-8 Full Rack database servers include the following components:

- 8 Fifteen-Core Intel Xeon E5-8895 v2 processors (2.8 GHz)
- 2 TB (64 x 32 GB) RAM expandable to 4 TB or 6 TB with memory expansion kit
- 7 x 600 GB 10K RPM SAS disks
- Disk controller HBA with 512 MB battery-backed write cache, and swappable battery backup unit (BBU)
- 8 InfiniBand 4X QDR (40 Gb/s) ports
- 10 x 1 GbE Base-T Ethernet ports
- 8 x 10 GbE Ethernet SFP+ ports (4 dual-port 10GbE PCIe 2.0 network card based on the Intel 82599 10 GbE controller technology)
- 1 Ethernet port for Integrated Lights Out Manager (ILOM) for remote management

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13.2.18 Database Server Components of Oracle Exadata Database Machine X3-2

Oracle Exadata Database Machine X3-2 database servers include the following components:

- 2 Eight-Core Intel Xeon E5-2690 processors (2.9 GHz)
- 256 GB (16 x 16 GB) RAM expandable to 512 GB with memory expansion kit
- 4 x 300 GB 10K RPM SAS disks
- Disk controller HBA with 512 MB battery-backed write cache
- 2 InfiniBand 4X QDR (40 Gb/s) ports (1 dual-port PCIe 2.0 Host Channel Adapter (HCA))
- 4 x 1 GbE/10GbE Base-T Ethernet ports
- 2 x 10 GbE Ethernet SFP+ ports (1 dual-port 10GbE PCIe 2.0 network card based on the Intel 82599 10 GbE controller technology)
- 1 Ethernet port for ILOM for remote management

13.2.19 Database Server Components of Oracle Exadata Database Machine X3-8 Full Rack

Oracle Exadata Database Machine X3-8 Full Rack database servers include the following components:

- 8 Ten-core Intel Xeon E7-8870 Processors (2.40 GHz)
- 2 TB RAM (128 x 16 GB)
- 8 x 300GB 10K RPM SAS Disks
- Disk Controller HBA with 512MB Battery-backed cache
- 8 x InfiniBand QDR (40 Gb/s) Ports
- 2 Network Express Modules (NEM) providing the following:
  - 8 x 10 Gb Ethernet network ports using SFP+ connectors (based on Intel 82599 10 GbE controller)
  - 8 x 1 Gb Ethernet network ports
- 1 Ethernet port for Sun Integrated Lights Out Manager (ILOM) for remote management

13.2.20 Database Server Components of Oracle Exadata Database Machine X2-2

Components of Sun Fire X4170 Oracle Database Servers

- 2 Quad-Core Intel Xeon E5540 processors (2.53 GHz)
- 72 GB RAM expandable to 144 GB with memory expansion kit
- 4 x 146 GB 10K RPM SAS disks
- Disk controller HBA with 512 MB battery-backed write cache
- Dual-port 4X QDR (40 Gb/s) InfiniBand Host Channel Adapter (HCA)

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- 4 embedded Gigabit Ethernet ports
- 1 Ethernet port for Sun Integrated Lights Out Manager (ILOM) for remote management

Components of Sun Fire X4170 M2 Oracle Database Servers

- 2 Six-Core Intel Xeon X5675 processors (3.06 GHz)
- 96 GB RAM expandable to 288 GB with memory expansion kit
- 4 x 300 GB 10 K RPM SAS disks
- Disk controller HBA with 512 MB battery-backed write cache
- Dual-port 4X QDR (40 Gb/s) InfiniBand Host Channel Adapter (HCA)
- 4 embedded Gigabit Ethernet ports
- 1 Ethernet port for Sun Integrated Lights Out Manager (ILOM) for remote management
- 1 dual-port 10 GbE PCIe 2.0 network card with Intel 82599 10 GbE controller

Note

- Sun Fire X4170 M2 Oracle Database Servers ship from the factory with 96 GB of memory with 12 of the 18 DIMM slots populated with 8 GB DIMMs. The optional X2-2 Memory Expansion Kit can be used to populate the remaining 6 empty slots with 16 GB DIMMs to bring the total memory to 192 GB (12 x 8 GB and 6 x 16 GB), or replace the existing 8 GB DIMMs with 16 GB DIMMs and add memory to bring the total memory to 288 GB (18 x 16 GB).

  The memory expansion kit is primarily for consolidation workloads where many databases are run on each database server. In this scenario, the CPU usage is often low while the memory usage is very high.

  However, there is a downside to populating all the memory slots as the frequency of the memory DIMMs drop to 800 MHz from 1333 MHz. The performance effect of the slower memory appears as increased CPU utilization. The average measured increase in CPU utilization is typically between 5% and 10%. The increase varies greatly by workload. In test workloads, several workloads had almost zero increase, while one workload had as high as a 20% increase.

13.2.21 Database Server Components of Oracle Exadata Database Machine X2-8 Full Rack

Components of Sun Fire X4800 Oracle Database Servers

- 8 Eight-core Intel Xeon X7560 Processors (2.26 GHz)
- 1 TB RAM
- 8 x 300GB 10K RPM SAS Disks
- Disk Controller HBA with 512MB Battery-backed cache
- 4 dual-port 4X QDR InfiniBand PCIe 2.0 Express Modules (EM)
- 2 Network Express Modules (NEM) providing the following:
  - 8 x 10 Gb Ethernet network ports using SFP+ connectors (based on Intel 82599 10 GbE controller)

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  - 8 x 1 Gb Ethernet network ports
- 1 Ethernet port for Sun Integrated Lights Out Manager (ILOM) for remote management

Components of Sun Server X2-8 Oracle Database Server

- 8 Ten-core Intel Xeon E7-8870 Processors (2.40 GHz)
- 2 TB RAM (128 x 16 GB)
- 8 x 300GB 10K RPM SAS Disks
- Disk Controller HBA with 512MB Battery-backed cache
- 4 dual-port 4X QDR InfiniBand PCIe 2.0 Express Modules (EM)
- 2 Network Express Modules (NEM) providing the following:
  - 8 x 10 Gb Ethernet network ports using SFP+ connectors (based on Intel 82599 10 GbE controller)
  - 8 x 1 Gb Ethernet network ports
- 1 Ethernet port for Sun Integrated Lights Out Manager (ILOM) for remote management

13.3 Oracle Exadata Storage Server Hardware Components

Each Oracle Exadata Database Machine contains multiple storage servers.

The following sections describe the hardware components for each type of Oracle Exadata Storage Server:

- Exadata Storage Server X11M Extreme Flash Hardware Components
  Each Oracle Exadata Storage Server X11M Extreme Flash (EF) server includes the following components:
- Exadata Storage Server X11M High Capacity Hardware Components
  Each Oracle Exadata Storage Server X11M High Capacity (HC) server includes the following components:
- Exadata Storage Server X11M-Z High Capacity Hardware Components
  Each Oracle Exadata Storage Server X11M-Z High Capacity (HC) server includes the following components:
- Exadata Storage Server X11M Extended Hardware Components
  Each Oracle Exadata Storage Server X11M Extended (XT) server includes the following components:
- Exadata Storage Server X11 Extreme Flash Hardware Components
  Each Oracle Exadata Storage Server X11 Extreme Flash (EF) server includes the following components:
- Exadata Storage Server X11 High Capacity Hardware Components
  Each Oracle Exadata Storage Server X11 High Capacity (HC) server includes the following components:
- Exadata Storage Server X11-Z High Capacity Hardware Components
  Each Oracle Exadata Storage Server X11-Z High Capacity (HC) server includes the following components:
- Exadata Storage Server X10M Extreme Flash Hardware Components
  Each Oracle Exadata Storage Server X10M Extreme Flash (EF) server includes the following components:

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- Exadata Storage Server X10M High Capacity Hardware Components
  Each Oracle Exadata Storage Server X10M High Capacity (HC) server includes the following components:
- Exadata Storage Server X10M Extended Hardware Components
  Each Oracle Exadata Storage Server X10M Extended (XT) server includes the following components:
- Exadata Storage Server X10M Eighth Rack High Capacity Hardware Components
  Each Oracle Exadata Storage Server X10M Eighth Rack High Capacity (HC) server includes the following components:
- Extreme Flash Exadata Storage Server X9M-2 Hardware Components
  Each Oracle Exadata Storage Server X9M-2 Extreme Flash (EF) server includes the following components:
- High Capacity Exadata Storage Server X9M-2 Hardware Components
  Each Oracle Exadata Storage Server X9M-2 High Capacity (HC) server includes the following components:
- Extended Exadata Storage Server X9M-2 Hardware Components
  Each Oracle Exadata Storage Server X9M-2 Extended (XT) server includes the following components:
- Extreme Flash Exadata Storage Server X8M-2 and X8-2 Hardware Components
  Oracle Exadata Storage Server X8-2 and X8M-2 Extreme Flash servers include the following components:
- High Capacity Exadata Storage Server X8-2 and X8M-2 Hardware Components
  Oracle Exadata Storage Server X8-2 and X8M-2 High Capacity servers include the following components:
- Extended Exadata Storage Server X8-2 and X8M-2 Hardware Components
  Exadata Extended (XT) Storage Server and X8M-2 Extended (XT) servers include the following components:
- Extreme Flash Exadata Storage Server X7-2 Hardware Components
  Oracle Exadata Storage Server X7-2 Extreme Flash servers include the following components:
- High Capacity Exadata Storage Server X7-2 Hardware Components
  Oracle Exadata Storage Server X7-2 High Capacity servers include the following components:
- Extreme Flash Exadata Storage Server X6-2 Hardware Components
  Oracle Exadata Storage Server X6-2 Extreme Flash servers include the following components:
- High Capacity Exadata Storage Server X6-2 Hardware Components
  Oracle Exadata Storage Server X6-2 High Capacity servers include the following components:
- Extreme Flash Exadata Storage Server X5-2 Hardware Components
  Oracle Exadata Storage Server X5-2 Extreme Flash servers include the following components:
- High Capacity Exadata Storage Server X5-2 Hardware Components
  Oracle Exadata Storage Server X5-2 High Capacity servers include the following components:
- Exadata Storage Server X4-2L Hardware Components
  Oracle Exadata Storage Server X4-2L servers include the following components:

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- Exadata Storage Server X3-2L Hardware Components
  Oracle Exadata Storage Server X3-2L servers include the following components:
- Exadata Storage Server with Sun Fire X4270 M2 Servers Hardware Components
  Oracle Exadata Storage Server with Sun Fire X4270 M2 Servers include the following components:
- Exadata Storage Server with Sun Fire X4275 Servers Hardware Components
  Oracle Exadata Storage Server with Sun Fire X4275 Servers include the following components:

13.3.1 Exadata Storage Server X11M Extreme Flash Hardware Components

Each Oracle Exadata Storage Server X11M Extreme Flash (EF) server includes the following components:

- CPU: 2 x 32-core AMD EPYC™ 9J15 processors, 2.95 GHz (up to 4.4 GHz)
- RAM: 1536 GB (24 x 64 GB 6400MT/s DDR5 DIMMs) including XRMEM cache
- Flash storage:
  - 4 x 30.72 TB capacity-optimized flash devices (for primary data storage)
  - 4 x 6.8 TB performance-optimized flash devices (primarily for high-performance low-latency caching using Exadata Smart Flash Cache and Exadata Smart Flash Log)
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X11M EF storage server requires Oracle Exadata System Software release 25.1.0 or later.

13.3.2 Exadata Storage Server X11M High Capacity Hardware Components

Each Oracle Exadata Storage Server X11M High Capacity (HC) server includes the following components:

- CPU: 2 x 32-core AMD EPYC™ 9J15 processors, 2.95 GHz (up to 4.4 GHz)
- RAM: 1536 GB (24 x 64 GB 6400MT/s DDR5 DIMMs) including XRMEM cache
- Disk storage: 12 x 22 TB hard disk drives (HDD)
- Disk controller Host Bus Adapter (HBA)
- Flash storage: 4 x 6.8 TB performance-optimized flash devices (primarily for high-performance low-latency caching using Exadata Smart Flash Cache and Exadata Smart Flash Log)
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port

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- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X11M HC storage server requires Oracle Exadata System Software release 25.1.0 or later.

13.3.3 Exadata Storage Server X11M-Z High Capacity Hardware Components

Each Oracle Exadata Storage Server X11M-Z High Capacity (HC) server includes the following components:

- CPU: 1 x 32-core AMD EPYC™ 9J15 processor, 2.95 GHz (up to 4.4 GHz)
- RAM: 768 GB (12 x 64 GB 6400MT/s DDR5 DIMMs) including XRMEM cache
- Disk storage: 6 x 22 TB hard disk drives (HDD)
- Disk controller Host Bus Adapter (HBA)
- Flash storage: 2 x 6.8 TB performance-optimized flash devices (primarily for high-performance low-latency caching using Exadata Smart Flash Cache and Exadata Smart Flash Log)
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X11M-Z HC storage server requires Oracle Exadata System Software release 25.1.0 or later.

13.3.4 Exadata Storage Server X11M Extended Hardware Components

Each Oracle Exadata Storage Server X11M Extended (XT) server includes the following components:

- CPU: 1 x 32-core AMD EPYC 9J15 processor, 2.95 GHz (up to 4.4 GHz)
- RAM: 256 GB (8 x 32 GB 6400MT/s DDR5 DIMMs)
- Disk storage: 12 x 22 TB hard disk drives (HDD)
- Disk controller Host Bus Adapter (HBA)
- Flash storage: 2 x 6.8 TB performance-optimized flash devices (primarily for high-performance low-latency caching using Exadata Smart Flash Cache and Exadata Smart Flash Log)
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X11M XT storage server requires Oracle Exadata System Software release 25.2.0 or later.

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13.3.5 Exadata Storage Server X11 Extreme Flash Hardware Components

Each Oracle Exadata Storage Server X11 Extreme Flash (EF) server includes the following components:

- CPU: 2 x 32-core AMD EPYC™ 9J15 processors, 2.95 GHz (up to 4.4 GHz)
- RAM: 256 GB (8 x 32 GB 6400MT/s DDR5 DIMMs), XRMEM cache not included
- Flash storage:
  - 4 x 30.72 TB capacity-optimized flash devices (for primary data storage)
  - 4 x 6.8 TB performance-optimized flash devices (primarily for high-performance low-latency caching using Exadata Smart Flash Cache and Exadata Smart Flash Log)
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X11 EF storage server requires Oracle Exadata System Software release 26.1.0 or later, 25.2.10 (May 2026) or later, or 25.1.17 (May 2026) or later. You can upgrade the storage server to add XRMEM cache by installing a memory expansion kit.

13.3.6 Exadata Storage Server X11 High Capacity Hardware Components

Each Oracle Exadata Storage Server X11 High Capacity (HC) server includes the following components:

- CPU: 2 x 32-core AMD EPYC™ 9J15 processors, 2.95 GHz (up to 4.4 GHz)
- RAM: 256 GB (8 x 32 GB 6400MT/s DDR5 DIMMs), XRMEM cache not included
- Disk storage: 12 x 22 TB hard disk drives (HDD)
- Disk controller Host Bus Adapter (HBA)
- Flash storage: 4 x 6.8 TB performance-optimized flash devices (primarily for high-performance low-latency caching using Exadata Smart Flash Cache and Exadata Smart Flash Log)
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X11 HC storage server requires Oracle Exadata System Software release 26.1.0 or later, 25.2.10 (May 2026) or later, or 25.1.17 (May 2026) or later. You can upgrade the storage server to add XRMEM cache by installing a memory expansion kit.

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13.3.7 Exadata Storage Server X11-Z High Capacity Hardware Components

Each Oracle Exadata Storage Server X11-Z High Capacity (HC) server includes the following components:

- CPU: 1 x 32-core AMD EPYC™ 9J15 processor, 2.95 GHz (up to 4.4 GHz)
- RAM: 192 GB (6 x 32 GB 6400MT/s DDR5 DIMMs), XRMEM cache not included
- Disk storage: 6 x 22 TB hard disk drives (HDD)
- Disk controller Host Bus Adapter (HBA)
- Flash storage: 2 x 6.8 TB performance-optimized flash devices (primarily for high-performance low-latency caching using Exadata Smart Flash Cache and Exadata Smart Flash Log)
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X11-Z HC storage server requires Oracle Exadata System Software release 26.1.0 or later, 25.2.10 (May 2026) or later, or 25.1.17 (May 2026) or later. You can upgrade the storage server to add XRMEM cache by installing a memory expansion kit.

13.3.8 Exadata Storage Server X10M Extreme Flash Hardware Components

Each Oracle Exadata Storage Server X10M Extreme Flash (EF) server includes the following components:

- CPU: 2 x 32-core AMD EPYC™ 9334 processors, 2.7 GHz (up to 3.9 GHz)
- RAM: 1536 GB (24 x 64 GB DIMMs) including XRMEM cache
- Flash storage:
  - 4 x 30.72 TB capacity-optimized flash devices (for primary data storage)
  - 4 x 6.8 TB performance-optimized flash devices (primarily for high-performance low-latency caching using Exadata Smart Flash Cache and Exadata Smart Flash Log)
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X10M EF storage server requires Oracle Exadata System Software release 23.1.0 or later.

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13.3.9 Exadata Storage Server X10M High Capacity Hardware Components

Each Oracle Exadata Storage Server X10M High Capacity (HC) server includes the following components:

- CPU: 2 x 32-core AMD EPYC™ 9334 processors, 2.7 GHz (up to 3.9 GHz)
- RAM: 1536 GB (24 x 64 GB DIMMs) including XRMEM cache
- Disk storage: 12 x 22 TB hard disk drives (HDD)
- Disk controller Host Bus Adapter (HBA)
- Flash storage: 4 x 6.8 TB performance-optimized flash devices
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X10M HC storage server requires Oracle Exadata System Software release 23.1.0 or later.

13.3.10 Exadata Storage Server X10M Extended Hardware Components

Each Oracle Exadata Storage Server X10M Extended (XT) server includes the following components:

- CPU: 1 x 32-core AMD EPYC™ 9334 processor, 2.7 GHz (up to 3.9 GHz)
- RAM: 128 GB (4 x 32 GB DIMMs)
- Disk storage: 12 x 22 TB hard disk drives (HDD)
- Disk controller Host Bus Adapter (HBA)
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X10M XT storage server requires Oracle Exadata System Software release 23.1.0 or later.

13.3.11 Exadata Storage Server X10M Eighth Rack High Capacity Hardware Components

Each Oracle Exadata Storage Server X10M Eighth Rack High Capacity (HC) server includes the following components:

- CPU: 1 x 32-core AMD EPYC™ 9334 processor, 2.7 GHz (up to 3.9 GHz)
- RAM: 768 GB (12 x 64 GB DIMMs) including XRMEM cache

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- Disk storage: 6 x 22 TB hard disk drives (HDD)
- Disk controller Host Bus Adapter (HBA)
- Flash storage: 2 x 6.8 TB performance-optimized flash devices
- System storage: 2 x 480 GB NVMe devices
- RDMA Network Fabric: 1 x dual-port CX7 RDMA Network Fabric card; PCIe 5.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X10M Eighth Rack HC storage server requires Oracle Exadata System Software release 23.1.0 or later.

13.3.12 Extreme Flash Exadata Storage Server X9M-2 Hardware Components

Each Oracle Exadata Storage Server X9M-2 Extreme Flash (EF) server includes the following components:

- CPU: 2 x 16-core Intel Xeon 8352Y processors (2.2 GHz)
- RAM: 256 GB (16 x 16 GB DDR4 3200 MT/s DIMMs)
- Flash storage: 8 x 6.4 TB NVMe flash devices (PCIe 4.0)
- Persistent memory: 12 x 128 GB modules (Intel Optane Persistent Memory 200 Series)
- System storage: 2 x 240 GB M.2 devices
- RDMA Network Fabric: 1 x dual-port CX5 RDMA Network Fabric card; PCIe 4.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X9M-2 EF storage server requires Oracle Exadata System Software release 21.2.0 or later.

13.3.13 High Capacity Exadata Storage Server X9M-2 Hardware Components

Each Oracle Exadata Storage Server X9M-2 High Capacity (HC) server includes the following components:

- CPU: 2 x 16-core Intel Xeon 8352Y processors (2.2 GHz), but only half of the CPU cores are enabled on Eighth Rack configurations
- RAM: 256 GB (16 x 16 GB DDR4 3200 MT/s DIMMs)
- Disk storage: 12 x 18 TB hard disk drives (HDD), but only 6 HDD on Eighth Rack configurations
- Disk controller Host Bus Adapter (HBA) with 2 GB cache
- Flash storage: 4 x 6.4 TB NVMe flash devices (PCIe 4.0), but only 2 flash devices on Eighth Rack configurations

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- Persistent memory: 12 x 128 GB modules (Intel Optane Persistent Memory 200 Series), but only 6 modules on Eighth Rack configurations
- System storage: 2 x 240 GB M.2 devices
- RDMA Network Fabric: 1 x dual-port CX5 RDMA Network Fabric card; PCIe 4.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X9M-2 HC storage server requires Oracle Exadata System Software release 21.2.0 or later.

13.3.14 Extended Exadata Storage Server X9M-2 Hardware Components

Each Oracle Exadata Storage Server X9M-2 Extended (XT) server includes the following components:

- CPU: 1 x 16-core Intel Xeon 8352Y processor (2.2 GHz)
- RAM: 96 GB (6 x 16 GB DDR4 3200 MT/s DIMMs)
- Disk storage: 12 x 18 TB hard disk drives (HDD)
- Disk controller Host Bus Adapter (HBA) with 2 GB cache
- System storage: 2 x 240 GB M.2 devices
- RDMA Network Fabric: 1 x dual-port CX5 RDMA Network Fabric card; PCIe 4.0, 2 x 100 Gb/s ports active-active (200 Gb/s combined throughput)
- Administration network: 1 x 1 GbE Base-T Ethernet port
- Integrated Lights Out Manager (ILOM) port for remote management: 1 x 1 GbE Base-T Ethernet port

The X9M-2 XT storage server requires Oracle Exadata System Software release 21.2.0 or later.

13.3.15 Extreme Flash Exadata Storage Server X8M-2 and X8-2 Hardware Components

Oracle Exadata Storage Server X8-2 and X8M-2 Extreme Flash servers include the following components:

- 2x 16-core Intel Xeon 5218 Processors (2.3GHz)
- 192 GB RAM (12 x 16 GB DIMMs) – full 6 channels
- **X8M-2 only**: 12 x 128 GB Intel Optane™ DC Persistent Memory modules
- 8 x 6.4 TB flash accelerator PCIe cards
- 2 x 240 GB M.2 devices for system partitions (partitioned as 150 GB devices)
- **X8M-2 only:** 1 dual-port (PCIe 3.0), both ports active, 100Gb/s RDMA Network Fabric Card
- **X8-2 only:** 2 x InfiniBand 4X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA)), all ports active
- 1 Ethernet port for ILOM for remote management

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The X8-2 EF server requires Oracle Exadata System Software release 19.2.0 or later. The X8M-2 EF server requires Oracle Exadata System Software release 19.3.0 or later.

13.3.16 High Capacity Exadata Storage Server X8-2 and X8M-2 Hardware Components

Oracle Exadata Storage Server X8-2 and X8M-2 High Capacity servers include the following components:

- 2x 16-core Intel Xeon 5218 Processors (2.3GHz)
- 192 GB RAM (12 x 16 GB DIMMs) – full 6 channels
- **X8M-2 only**: 12 x 128 GB Intel Optane™ DC Persistent Memory modules
- 12 x 14 TB High Capacity SAS disks, but only 6 drives on Eighth Rack configurations
- 2 x 240 GB M.2 devices for system partitions (partitioned to appear as 150 GB devices)
- 4 x 6.4 TB flash accelerator PCIe cards
- Disk controller HBA with 2 GB cache
- **X8M-2 only:** 1 dual-port (PCIe 3.0), both ports active, 100Gb/s RDMA Network Fabric Card
- **X8-2 only:** 2 x InfiniBand 4X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA)), all ports active
- 1 Ethernet port for ILOM for remote management

The X8-2 HC server requires Oracle Exadata System Software release 19.2.0 or later. The X8M-2 HC server requires Oracle Exadata System Software release 19.3.0 or later.

13.3.17 Extended Exadata Storage Server X8-2 and X8M-2 Hardware Components

Exadata Extended (XT) Storage Server and X8M-2 Extended (XT) servers include the following components:

- 1x 16-core Intel Xeon 5218 Processor (2.3GHz)
- 96 GB RAM (6 x 16 GB DIMMs) – full 6 channels
- 12 x 14 TB High Capacity SAS disks
- 2 x 240 GB M.2 devices for system partitions
- Disk controller HBA with 2 GB cache
- **X8M-2 only:** 1 dual-port (PCIe 3.0), both ports active, 100Gb/s RDMA Network Fabric Card
- **X8-2 only:** 2 x InfiniBand 4X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA)), all ports active
- 1 Ethernet port for ILOM for remote management

The X8-2 XT server requires Oracle Exadata System Software release 19.2.0 or later. The X8M-2 XT server requires Oracle Exadata System Software release 19.3.0 or later.

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13.3.18 Extreme Flash Exadata Storage Server X7-2 Hardware Components

Oracle Exadata Storage Server X7-2 Extreme Flash servers include the following components:

- 2x Intel Xeon Silver 4114 Processors (2.20GHz)
- 192 GB RAM (12 x 16 GB) – full 6 channels
- 8 x 6.4 TB flash accelerator PCIe cards
- 2 x 150 GB M.2 devices for system partitions
- 2 x InfiniBand 4X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA)) - all ports active
- 1 Ethernet port for ILOM for remote management

Requires Oracle Exadata System Software release 18.1.0 or later.

13.3.19 High Capacity Exadata Storage Server X7-2 Hardware Components

Oracle Exadata Storage Server X7-2 High Capacity servers include the following components:

- 2x Intel Xeon Silver 4114 Processors (2.20GHz)
- 192 GB RAM (12 x 16 GB) – full 6 channels
- 12 x 10 TB High Capacity SAS disks
- 2 x 150 GB M.2 devices for system partitions
- 4 x 6.4 TB flash accelerator PCIe cards
- Disk controller HBA with 2 GB cache
- 2 x InfiniBand 4X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA)) - all ports active
- 1 Ethernet port for ILOM for remote management

Requires Oracle Exadata System Software release 18.1.0 or later.

13.3.20 Extreme Flash Exadata Storage Server X6-2 Hardware Components

Oracle Exadata Storage Server X6-2 Extreme Flash servers include the following components:

- 2 x 10-Core Intel Xeon CPU E5-2630 v4 (2.2 GHz)
- 128 GB RAM (8 x 16 GB)
- 8 x 3.2 TB 2.5-inch flash accelerator F320 PCIe drives
- 2 x InfiniBand 4X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA)) - all ports active
- 4 embedded Gigabit Ethernet ports
- 1 Ethernet port for ILOM for remote management

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13.3.21 High Capacity Exadata Storage Server X6-2 Hardware Components

Oracle Exadata Storage Server X6-2 High Capacity servers include the following components:

- 2 x 10-Core Intel Xeon CPU E5-2630 v4 (2.2 GHz)
- 128 GB RAM (8 x 16 GB)
- 12 x 8 TB 7.2 K RPM High Capacity SAS disks (in earlier releases, the high capacity disks were 4 TB)
- 4 x 3.2 TB flash accelerator F320 PCIe card
- Disk controller HBA with 1 GB cache
- 2 x InfiniBand 4X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA)) - all ports active
- 4 embedded Gigabit Ethernet ports
- 1 Ethernet port for ILOM for remote management

13.3.22 Extreme Flash Exadata Storage Server X5-2 Hardware Components

Oracle Exadata Storage Server X5-2 Extreme Flash servers include the following components:

- 2 Eight-Core Intel Xeon CPU E5-2630 v3 (2.40GHz)
- 64 GB RAM (8x 8 GB)
- 8 x 1.6 TB NVMe PCIe 3.0 SSD Extreme Flash disks
- 2 InfiniBand 4 X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA))
- 4 embedded Gigabit Ethernet ports
- 1 Ethernet port for ILOM for remote management

13.3.23 High Capacity Exadata Storage Server X5-2 Hardware Components

Oracle Exadata Storage Server X5-2 High Capacity servers include the following components:

- 2 Eight-Core Intel Xeon CPU E5-2630 v3 (2.40GHz)
- 96 GB RAM (4x 8 GB and 4x 16 GB)
- 12 x 8 TB 7.2 K RPM High Capacity SAS disks (in earlier releases, the high capacity disks were 4 TB)
- 4 x 1.6 TB flash accelerator F160 PCIe cards
- Disk controller HBA with 1 GB supercap-backed write cache
- 2 InfiniBand 4 X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA))
- 4 embedded Gigabit Ethernet ports
- 1 Ethernet port for ILOM for remote management

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13.3.24 Exadata Storage Server X4-2L Hardware Components

Oracle Exadata Storage Server X4-2L servers include the following components:

- 2 Six-Core Intel Xeon E5-2630 v2 processors (2.6 GHz)
- 96 GB RAM (4 x 8 GB, and 4 x 16 GB))
- 12 x 1.2 TB 10 K RPM High Performance SAS disks or 12 x 4 TB 7.2 K RPM High Capacity SAS disks
- 4 x 800 GB Sun Flash Accelerator F80 PCIe Cards
- Disk controller HBA with 512 MB battery-backed write cache, and swappable BBU
- 2 InfiniBand 4 X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 3.0 Host Channel Adapter (HCA))
- 4 embedded Gigabit Ethernet ports
- 1 Ethernet port for ILOM for remote management

13.3.25 Exadata Storage Server X3-2L Hardware Components

Oracle Exadata Storage Server X3-2L servers include the following components:

- 2 Six-Core Intel Xeon E5-2630L processors (2 GHz)
- 64 GB RAM (8 x 8 GB)
- 12 x 600 GB 15 K RPM High Performance SAS disks or 12 x 3 TB 7.2 K RPM High Capacity SAS disks
- 4 x 400 GB Sun Flash Accelerator F40 PCIe Cards
- Disk controller HBA with 512 MB battery-backed write cache
- 2 InfiniBand 4 X QDR (40 Gb/s) InfiniBand ports (1 dual-port PCIe 2.0 Host Channel Adapter (HCA))
- 4 embedded Gigabit Ethernet ports
- 1 Ethernet port for ILOM for remote management

13.3.26 Exadata Storage Server with Sun Fire X4270 M2 Servers Hardware Components

Oracle Exadata Storage Server with Sun Fire X4270 M2 Servers include the following components:

- 2 Six-Core Intel Xeon L5640 processors (2.26 GHz)
- 24 GB RAM
- 12 x 600 GB 15 K RPM High Performance SAS disks or 12 x 3 TB 7.2 K RPM High Capacity SAS disks (in earlier releases, the high capacity disks were 2 TB)
- 4 x 96 GB Sun Flash Accelerator F20 PCIe Cards
- Disk controller HBA with 512 MB battery-backed write cache
- Dual-port 4X QDR (40 Gb/s) InfiniBand Host Channel Adapter (HCA)
- 1 embedded Gigabit Ethernet port

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- 1 Ethernet port for ILOM for remote management

13.3.27 Exadata Storage Server with Sun Fire X4275 Servers Hardware Components

Oracle Exadata Storage Server with Sun Fire X4275 Servers include the following components:

- 2 Quad-Core Intel Xeon E5540 processors (2.53 GHz)
- 24 GB RAM
- 12 x 600 GB 15 K RPM High Performance SAS disks or 12 x 2 TB 7.2 K RPM SATA disks
- 4 x 96 GB Sun Flash Accelerator F20 PCIe Cards
- Disk controller HBA with 512 MB battery-backed write cache
- Dual-port 4X QDR (40 Gb/s) InfiniBand Host Channel Adapter (HCA)
- 1 embedded Gigabit Ethernet port
- 1 Ethernet port for ILOM for remote management

13.4 Spares Kit Components for Oracle Exadata Database Machine

Table 13-3 Spare Kit Components for Exadata Database Machine by Model

System	Spare Kit Contents
Oracle Exadata Database Machine X11M	**Note:** No spares kit is included with Oracle Exadata Database Machine X11M. Spare hard disk drives and flash devices may be purchased separately.
Oracle Exadata Database Machine X10M	**Note:** No spares kit is included with Oracle Exadata Database Machine X10M. Spare hard disk drives and flash devices may be purchased separately.
Oracle Exadata Database Machine X9M-2 and X9M-8	• 1 x 18 TB disk for High Capacity storage servers only • 1 x 6.4 TB NVMe PCI Flash card
Oracle Exadata Database Machine X8M-2, X8M-8, X8-2, and X8-8 Full Rack, Half Rack, Quarter Rack, and Eighth Rack	• 1 x 14 TB SAS disk for High Capacity storage servers only • 1 x Flash Accelerator F640 or F640v2 PCIe card
Oracle Exadata Database Machine X7-2 and X7-8 Full Rack, Half Rack, Quarter Rack, and Eighth Rack	• 1 x 10 TB 7.2 K RPM SAS disk for High Capacity storage servers only • 1 x Flash Accelerator F640 PCIe card
Oracle Exadata Database Machine X6-2 Full Rack, Half Rack, Quarter Rack, and Eighth Rack	• 1 x 8 TB 7.2 K RPM High Capacity SAS disk • 1 x flash accelerator F320 PCIe card for high capacity storage servers only

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Table 13-3 (Cont.) Spare Kit Components for Exadata Database Machine by Model

System	Spare Kit Contents
Oracle Exadata Database Machine X5-2 Full Rack, Half Rack, Quarter Rack, and Eighth Rack	• 1 x 8 TB 7.2 K RPM High Capacity SAS disk • 1 x flash accelerator F160 PCIe card for high capacity storage servers only • 1 x 1.6 TB solid-state drive for extreme flash storage servers only
Oracle Exadata Database Machine X5-8 and X6-8	• 1 x 8 TB 7.2 K RPM High Capacity SAS disk • 1 x flash accelerator F160 PCIe card for high capacity storage servers only
Oracle Exadata Database Machine X4-2 Full Rack, Half Rack, Quarter Rack, and Eighth Rack	• 1 x 1.2 TB 10 K RPM High Performance SAS disks or 1 x 4 TB 7.2 K RPM High Capacity SAS disks • 1 x 800 GB Exadata Smart Flash Cache card
Oracle Exadata Database Machine X4-8	• 1 x 1.6 TB NVMe PCIe 3.0 High Performance or 1 x 4 TB 7.2 K RPM High Capacity SAS disks • 1 x flash accelerator F160 PCIe card for high capacity storage servers only
Oracle Exadata Database Machine X3-2 Full Rack	• 2 x 600 GB 15 K RPM High Performance SAS disks or 2 x 3 TB 7.2 K RPM High Capacity SAS disks • 2 x 400 GB Exadata Smart Flash Cache cards • 6 x 3 m, and 10 x 5 m InfiniBand cables
Oracle Exadata Database Machine X3-2 Half Rack	• 1 x 600 GB 15 K RPM High Performance SAS disks or 1 x 3 TB 7.2 K RPM High Capacity SAS disks • 1 x 400 GB Exadata Smart Flash Cache card • 6 x 3 m, and 10 x 5 m InfiniBand cables
Oracle Exadata Database Machine X3-2 Quarter Rack and Eighth Rack	• 1 x 600 GB 15 K RPM High Performance SAS disks or 1 x 3 TB 7.2 K RPM High Capacity SAS disks • 1 x 400 GB Exadata Smart Flash Cache card • 4 x 5 m InfiniBand cables
Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X4-2L Servers	• 1 x 1.2 TB 10 K RPM High Performance SAS disks or 1 x 4 TB 7.2 K RPM High Capacity SAS disks • 1 x 400 GB Exadata Smart Flash Cache card
Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X3-2 Servers	• 2 x 600 GB 15 K RPM High Performance SAS disks or 2 x 3 TB 7.2 K RPM High Capacity SAS disks • 2 x 400 GB Exadata Smart Flash Cache cards • 6 x 3 m, and 10 x 5 m InfiniBand cables

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Table 13-3 (Cont.) Spare Kit Components for Exadata Database Machine by Model

System	Spare Kit Contents
Oracle Exadata Database Machine X2-2 and Oracle Exadata Database Machine X2-8 Full Rack	• 2 x 600 GB 15 K RPM High Performance SAS disks or 2 x 3 TB 7.2 K RPM High Capacity SAS disks • 2 x 96 GB Exadata Smart Flash Cache cards • 6 x 3 m, and 10 x 5 m InfiniBand cables **Note** The Oracle Exadata Database Machine X2-2 (with X4170 and X4275 servers) models have 2 TB High Capacity SATA drives.
Oracle Exadata Database Machine X2-2 and Oracle Exadata Database Machine X2-8 Half Rack	• 1 x 600 GB 15 K RPM High Performance SAS disks or 1 x 3 TB 7.2 K RPM High Capacity SAS disks • 1 x 96 GB Exadata Smart Flash Cache card • 6 x 3 m, and 10 x 5 m InfiniBand cables **Note** The Oracle Exadata Database Machine X2-2 (with X4170 and X4275 servers) models have 2 TB High Capacity SATA drives.
Oracle Exadata Database Machine X2-2 and Oracle Exadata Database Machine X2-8 Quarter Rack	• 1 x 600 GB 15 K RPM High Performance SAS disks or 1 x 3 TB 7.2 K RPM High Capacity SAS disks • 1 x 96 GB Exadata Smart Flash Cache card • 4 x 5 m InfiniBand cables **Note** The Oracle Exadata Database Machine X2-2 (with X4170 and X4275 servers) models have 2 TB High Capacity SATA drives.

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Hardware Components of the Exadata Storage Expansion Rack

Oracle Exadata Storage Expansion Rack provides additional storage for Oracle Exadata Database Machine.

The additional storage can be used for backups, historical data, and unstructured data. Oracle Exadata Storage Expansion Racks can be used to add space to Oracle Exadata Database Machine as follows:

- Add new Oracle Exadata Storage Servers and grid disks to a new Oracle Automatic Storage Management (Oracle ASM) disk group.
- Extend existing disk groups by adding grid disks in Oracle Exadata Storage Expansion Rack.
- Split Oracle Exadata Storage Expansion Rack among multiple Oracle Exadata Database Machines.

The following sections describe the components of Oracle Exadata Storage Expansion Racks:

- Components of Oracle Exadata Storage Expansion Rack X11M
- Components of Oracle Exadata Storage Expansion Rack X10M
- Components of Oracle Exadata Storage Expansion Rack X9M-2
- Components of Oracle Exadata Storage Expansion Rack X8M-2
- Components of Oracle Exadata Storage Expansion Rack X8-2
- Components of Oracle Exadata Storage Expansion Rack X7-2
- Components of Oracle Exadata Storage Expansion Rack X6-2
- Components of Oracle Exadata Storage Expansion Rack X5-2
- Components of Oracle Exadata Storage Expansion Rack X4-2
- Components of Oracle Exadata Storage Expansion Rack X3-2
- Components of Oracle Exadata Storage Expansion Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers
- Spares Kit Components for Oracle Exadata Storage Expansion Rack

14.1 Components of Oracle Exadata Storage Expansion Rack X11M

Oracle Exadata Storage Expansion Rack X11M includes the following components:

- Storage: Between 4 and 19 X11M Exadata Storage Servers.

  Raw storage capacity:

  - With High Capacity (HC) storage:

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        - 4 HC X11M storage servers: 1056 TB of raw disk capacity and 108.8 TB of raw flash capacity.
        - 19 HC X11M storage servers: 5016 TB of raw disk capacity and 516.8 TB of raw flash capacity.
    - With Extreme Flash (EF) storage:
        - 4 EF X11M storage servers: 600.3 TB of raw flash capacity.
        - 19 EF X11M storage servers: 2851.5 TB of raw flash capacity.
- RDMA Network Fabric: 3 x RoCE Network Fabric Switches
- Power Distribution Units (PDUs): 2 x PDUs (single phase or three phase, high voltage or low voltage)
- Network Connectivity: 1 x Management Network Switch

> **Note**
>
> In the list above, raw capacity is expressed using standard disk drive terminology, with 1 TB = 1,000,000,000,000 bytes. Usable capacity is less.

14.2 Components of Oracle Exadata Storage Expansion Rack X10M

Oracle Exadata Storage Expansion Rack X10M includes the following components:

- Storage: Between 4 and 19 Exadata Storage Servers X10M.

  A base Oracle Exadata Storage Expansion Rack contains 4 High Capacity (HC) or 4 Extreme Flash (EF) storage servers. For a HC base rack, additional HC or Extended (XT) storage servers may be added to a total of 19 storage servers. For an EF base rack, additional EF or XT storage servers may be added to a total of 19 storage servers.

  Raw storage capacity:

    - With HC storage servers:
        - 4 HC storage servers: 1056 TB of raw disk capacity and 108.8 TB of raw flash capacity.
        - 19 HC storage servers: 5016 TB of raw disk capacity and 516.8 TB of raw flash capacity.
    - With EF storage servers:
        - 4 EF storage servers: 600.3 TB of raw flash capacity.
        - 19 EF storage servers: 2851.5 TB of raw flash capacity.
    - With XT storage servers: up to 3960 TB of raw disk capacity, in addition to either 4 HC or 4 EF storage servers.
- RDMA Network Fabric: 3 x RoCE Network Fabric Switches
- Power Distribution Units (PDUs): 2 x PDUs (single phase or three phase, high voltage or low voltage)
- Network Connectivity: 1 x Management Network Switch

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> **Note**
>
> In the list above, raw capacity is expressed using standard disk drive terminology, with 1 TB = 1,000,000,000,000 bytes. Usable capacity is less.

14.3 Components of Oracle Exadata Storage Expansion Rack X9M-2

Oracle Exadata Storage Expansion Rack X9M-2 includes the following components:

- Storage: Between 4 and 19 Exadata Storage Servers X9M-2.

  A base Oracle Exadata Storage Expansion Rack contains 4 High Capacity (HC) or 4 Extreme Flash (EF) storage servers. For a HC base rack, additional HC or Extended (XT) storage servers may be added to a total of 19 storage servers. For an EF base rack, additional EF or XT storage servers may be added to a total of 19 storage servers.

  Raw storage capacity:

  - With HC storage servers:
    - 4 HC storage servers: 864 TB of raw disk capacity and 102.4 TB of raw flash capacity.
    - 19 HC storage servers: 4104 TB of raw disk capacity and 486.4 TB of raw flash capacity.
  - With EF storage servers:
    - 4 EF storage servers: 204.8 TB of raw flash capacity.
    - 19 EF storage servers: 972.8 TB of raw flash capacity.
  - With XT storage servers: up to 3240 TB of raw disk capacity, in addition to either 4 HC or 4 EF storage servers.
- RDMA Network Fabric: 3 x RoCE Network Fabric Switches
- Power Distribution Units (PDUs): 2 x 15 kVA (single phase or three phase, high voltage or low voltage)
- Network Connectivity: 1 x Management Network Switch

> **Note**
>
> In the list above, raw capacity is expressed using standard disk drive terminology, with 1 TB = 1,000,000,000,000 bytes. Usable capacity is less.

14.4 Components of Oracle Exadata Storage Expansion Rack X8M-2

The Oracle Exadata Storage Expansion Rack X8M-2 includes the following components:

- At least 4 Exadata Storage Server X8M-2 servers with:
  - 6.4 TB Flash Accelerator F640 or F640v2 PCIe cards

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  - (High Capacity (HC) Storage Servers only) 14 TB 7.2 K RPM High Capacity SAS disks
- 3 x RoCE Network Fabric Switches
- 2 redundant 15 kVA PDU (single phase or three phase, high voltage or low voltage)
- 1 x Management Network Switch
- 102.4 TB of raw flash capacity for HC storage servers or 204.8 TB of raw flash capacity for Extreme Flash (EF) storage servers
- 672 TB of raw capacity disks for high capacity storage servers only

(In the list above, for raw capacity, 1 GB = 1 billion bytes. Capacity is calculated using normal space terminology of 1 TB = 1024 * 1024 * 1024 * 1024 bytes. Actual formatted capacity is less.)

14.5 Components of Oracle Exadata Storage Expansion Rack X8-2

The Oracle Exadata Storage Expansion Rack X8-2 includes the following components:

- 4 Exadata Storage Server X8-2 servers with 6.4 TB Flash Accelerator F640 or F640v2 PCIe cards, and, for High Capacity (HC) Storage Servers only, 14 TB 7.2 K RPM High Capacity SAS disks
- 3 Sun Datacenter InfiniBand Switch 36
- 2 redundant 15 kVA PDU (single phase or three phase, high voltage or low voltage)
- 1x 48-port Cisco Nexus 9348 (Cisco Nexus9000 C9348GC-FXP chassis) Ethernet switch
- 102.4 TB of raw flash capacity for HC storage servers or 204.8 TB of raw flash capacity for Extreme Flash (EF) storage servers
- 672 TB of raw capacity disks for high capacity storage servers only

(In the list above, for raw capacity, 1 GB = 1 billion bytes. Capacity is calculated using normal space terminology of 1 TB = 1024 * 1024 * 1024 * 1024 bytes. Actual formatted capacity is less.)

14.6 Components of Oracle Exadata Storage Expansion Rack X7-2

The Oracle Exadata Storage Expansion Rack X7-2 includes the following components:

- 4 Exadata Storage Server X7-2 Servers with 6.4 TB Flash Accelerator F640 PCIe cards or 10 TB 7.2 K RPM High Capacity SAS disks
- 3 Sun Datacenter InfiniBand Switch 36
- 2 redundant 15 kVA PDU (single phase or three phase, high voltage or low voltage)
- 1x 48-port Cisco Nexus 93108-1G (Cisco Nexus9000 C93108TC-EX chassis) or 9348 (Cisco Nexus9000 C9348GC-FXP chassis) Ethernet switch
- 102.4 TB of raw flash capacity for HC storage servers or 204.8 TB of raw flash capacity for Extreme Flash (EF) storage servers
- 480 TB of raw capacity disks for high capacity storage servers only

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(In the list above, for raw capacity, 1 GB = 1 billion bytes. Capacity is calculated using normal space terminology of 1 TB = 1024 * 1024 * 1024 * 1024 bytes. Actual formatted capacity is less.)

14.7 Components of Oracle Exadata Storage Expansion Rack X6-2

Oracle Exadata Storage Expansion Rack X6-2 is available as a quarter rack. It includes the following components:

- 4 Exadata Storage Server X6-2 Servers with 3.2 TB NVMe PCIe 3.0 High Performance SSD or 8 TB 7.2 K RPM High Capacity SAS disks
- 3 Sun Datacenter InfiniBand Switch 36
- 2 redundant 15 kVA PDU (single phase or three phase, high voltage or low voltage)
- 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch
- 12.8 TB of raw flash capacity for high capacity storage servers only
- 102.4 TB of raw capacity for extreme flash drives, or 384 TB of raw capacity for high capacity disks

(In the list above, for raw capacity, 1 GB = 1 billion bytes. Capacity is calculated using normal space terminology of 1 TB = 1024 * 1024 * 1024 * 1024 bytes. Actual formatted capacity is less.)

14.8 Components of Oracle Exadata Storage Expansion Rack X5-2

Oracle Exadata Storage Expansion Rack X5-2 is available as a quarter rack. It includes the following components:

- 4 Exadata Storage Server X5-2 Servers with 1.6 TB NVMe PCIe 3.0 High Performance SSD or 8 TB 7.2 K RPM High Capacity SAS disks (in earlier releases, the high capacity disks were 4 TB)
- 3 Sun Datacenter InfiniBand Switch 36
- 2 redundant 15 kVA PDU (single phase or three phase, high voltage or low voltage)
- 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch
- 12.8 TB of raw flash capacity for high capacity storage servers only
- 51.2 TB (expandable to 76.8 TB) raw storage capacity for high performance disks, or 192 TB raw capacity for high capacity disks

(In the list above, for raw capacity, 1 GB = 1 billion bytes. Capacity is calculated using normal space terminology of 1 TB = 1024 * 1024 * 1024 * 1024 bytes. Actual formatted capacity is less.)

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14.9 Components of Oracle Exadata Storage Expansion Rack X4-2

Oracle Exadata Storage Expansion Rack X4-2 is available as a full rack, half rack or quarter rack. Table 14-1 lists the components included in each type of Oracle Exadata Storage Expansion Rack X4-2.

In the table below, for raw capacity, 1 GB = 1 billion bytes. Capacity is calculated using normal space terminology of 1 TB = 1024 * 1024 * 1024 * 1024 bytes. Actual formatted capacity is less.

Table 14-1 Components of Oracle Exadata Storage Expansion Rack X4-2

Rack	Components
Oracle Exadata Storage Expansion X4-2 Full Rack	• 18 Exadata Storage Server X4-2L Servers with 1.2 TB 10 K RPM High Performance SAS disks or 4 TB 7.2 K RPM High Capacity SAS disks • 3 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDU (single phase or three phase, high voltage or low voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 57.6 TB of raw flash capacity • 258 TB raw storage capacity for high performance disks, or 864 TB raw capacity for high capacity disks
Oracle Exadata Storage Expansion X4-2 Half Rack	• 9 Exadata Storage Server X4-2L Servers with 1.2 TB 10 K RPM High Performance SAS disks or 4 TB 7.2 K RPM High Capacity SAS disks • 3 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (single phase or three phase, high voltage or low voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 28.8 TB of raw flash capacity • 129 TB raw storage capacity for high performance disks, or 432 TB raw capacity for high capacity disks
Oracle Exadata Storage Expansion X4-2 Quarter Rack	• 4 Exadata Storage Server X4-2L Servers with 1.2 TB 10 K RPM High Performance SAS disks or 4 TB 7.2 K RPM High Capacity SAS disks • 3 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (single phase or three phase, high voltage or low voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 12.8 TB of raw flash capacity • 57 TB raw storage capacity for high performance disks, or 192 TB raw capacity for high capacity disks

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14.10 Components of Oracle Exadata Storage Expansion Rack X3-2

Oracle Exadata Storage Expansion Rack X3-2 is available as a full rack, half rack or quarter rack. Table 14-2 lists the components included in each type of Oracle Exadata Storage Expansion Rack X3-2.

In the table below, for raw capacity, 1 GB = 1 billion bytes. Capacity is calculated using normal space terminology of 1 TB = 1024 * 1024 * 1024 * 1024 bytes. Actual formatted capacity is less.

Table 14-2 Components of Spares Kit for Oracle Exadata Database Machine X3-2

Rack	Components
Oracle Exadata Storage Expansion X3-2 Full Rack	• 18 Exadata Storage Server X3-2 Servers with 600 GB 15 K RPM High Performance SAS disks or 3 TB 7.2 K RPM High Capacity SAS disks • 3 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDU (single phase or three phase, high voltage or low voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 28.8 TB of raw flash capacity • 128 TB raw storage capacity for high performance disks, or 648 TB raw capacity for high capacity disks
Oracle Exadata Storage Expansion X3-2 Half Rack	• 9 Exadata Storage Server X3-2 Servers with 600 GB 15 K RPM High Performance SAS disks or 3 TB 7.2 K RPM High Capacity SAS disks • 3 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (single phase or three phase, high voltage or low voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 14.4 TB of raw flash capacity • 64 TB raw storage capacity for high performance disks, or 324 TB raw capacity for high capacity disks
Oracle Exadata Storage Expansion X3-2 Quarter Rack	• 4 Exadata Storage Server X3-2 Servers with 600 GB 15 K RPM High Performance SAS disks or 3 TB 7.2 K RPM High Capacity SAS disks • 3 Sun Datacenter InfiniBand Switch 36 • 2 redundant 15 kVA PDUs (single phase or three phase, high voltage or low voltage) • 1 48-port Cisco Catalyst 4948E-F, model number WS-C4948E-F-S Ethernet switch • 6.4 TB of raw flash capacity • 28 TB raw storage capacity for high performance disks, or 144 TB raw capacity for high capacity disks

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14.11 Components of Oracle Exadata Storage Expansion Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

Oracle Exadata Storage Expansion Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers is available as a full rack, half rack or quarter rack. Table 14-3 lists the components included in each type of Oracle Exadata Storage Expansion Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 14-3 Components of Oracle Exadata Storage Expansion Racks with Exadata Storage Server with Sun Fire X4270 M2 Servers

Rack	Components
Oracle Exadata Storage Expansion Full Rack	• 18 Exadata Storage Server with Sun Fire X4270 M2 Servers with 600 GB 15 K RPM High Performance SAS disks or 3 TB 7.2 K RPM High Capacity SAS disks (in earlier releases, the high capacity disks were 2 TB) • 3 Sun Datacenter InfiniBand Switch 36 • 6.75 TB high speed flash • Keyboard, video, and mouse (KVM) hardware • 2 redundant 15 kVA PDU (single phase or three phase, high voltage or low voltage) • 1 48-port Cisco Catalyst 4948, model number WS-C4948-S Ethernet switch
Oracle Exadata Storage Expansion Half Rack	• 9 Exadata Storage Server with Sun Fire X4270 M2 Servers with 600 GB 15 K RPM High Performance SAS disks or 3 TB 7.2 K RPM High Capacity SAS disks (in earlier releases, the high capacity disks were 2 TB) • 3 Sun Datacenter InfiniBand Switch 36 • 3.4 TB high speed flash • Keyboard, video, and mouse (KVM) hardware • 2 redundant 15 kVA PDUs (single phase or three phase, high voltage or low voltage) • 1 48-port Cisco Catalyst 4948, model number WS-C4948-S Ethernet switch
Oracle Exadata Storage Expansion Quarter Rack	• 4 Exadata Storage Server with Sun Fire X4270 M2 Servers with 600 GB 15 K RPM High Performance SAS disks or 3 TB 7.2 K RPM High Capacity SAS disks (in earlier releases, the high capacity disks were 2 TB) • 3 Sun Datacenter InfiniBand Switch 36 • 1.5 TB high speed flash • Keyboard, video, and mouse (KVM) hardware • 2 redundant 15 kVA PDUs (single phase or three phase, high voltage or low voltage) • 1 48-port Cisco Catalyst 4948, model number WS-C4948-S Ethernet switch

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14.12 Spares Kit Components for Oracle Exadata Storage Expansion Rack

Table 14-4 Spares Kit Contents by Exadata Storage Server Model

Engineered System	Spare Kit Contents
Oracle Exadata Storage Expansion Rack X11M	**Note:** No spares kit is included with Oracle Exadata Storage Expansion Rack X11M. Spare hard disk drives and flash devices may be purchased separately.
Oracle Exadata Storage Expansion Rack X10M	**Note:** No spares kit is included with Oracle Exadata Storage Expansion Rack X10M. Spare hard disk drives and flash devices may be purchased separately.
Oracle Exadata Storage Expansion Rack X9M-2	• 1 x 18 TB disk for High Capacity storage servers only • 1 x 6.4 TB NVMe PCI Flash card
Oracle Exadata Storage Expansion Rack X8-2 and X8M-2	• 1x 14 TB 7.2K RPM High Capacity SAS disk • 1x Flash Accelerator F640 or F640v2 PCIe card
Oracle Exadata Storage Expansion Rack X7-2	• 1x 10 TB 7.2K RPM High Capacity SAS disk • 1x Flash Accelerator F640 PCIe card
Oracle Exadata Storage Expansion Rack X6-2 Full Rack, Half Rack, and Quarter Rack	• 1 x 3.2 TB NVMe PCIe 3.0 High Performance SSD or 1 x 8 TB 7.2 K RPM High Capacity SAS disks • 1 x flash accelerator F320 PCIe card for high capacity storage servers only
Oracle Exadata Storage Expansion Rack X5-2 Full Rack, Half Rack, and Quarter Rack	• 1 x 1.6 TB NVMe PCIe 3.0 High Performance SSD or 1 x 8 TB 7.2 K RPM High Capacity SAS disks • 1 x flash accelerator F160 PCIe card for high capacity storage servers only
Oracle Exadata Storage Expansion Rack X4-2 Full Rack, Half Rack, and Quarter Rack	• 1 x 1.2 TB 10 K RPM High Performance SAS disks or 1 x 4 TB 7.2 K RPM High Capacity SAS disks • 1 x 800 GB Exadata Smart Flash Cache card
Oracle Exadata Storage Expansion Rack X3-2 Full Rack	• 2 x 600 GB 15 K RPM High Performance SAS disks or 2 x 3 TB 7.2 K RPM High Capacity SAS disks • 2 x 400 GB Exadata Smart Flash Cache cards • 6 x 3 m, and 10 x 5 m InfiniBand cables
Oracle Exadata Storage Expansion Rack X3-2 Half Rack	• 1 x 600 GB 15 K RPM High Performance SAS disks or 1 x 3 TB 7.2 K RPM High Capacity SAS disks • 1 x 400 GB Exadata Smart Flash Cache card • 6 x 3 m, and 10 x 5 m InfiniBand cables
Oracle Exadata Storage Expansion Rack X3-2 Quarter Rack	• 1 x 600 GB 15 K RPM High Performance SAS disks or 1 x 3 TB 7.2 K RPM High Capacity SAS disks • 1 x 400 GB Exadata Smart Flash Cache card • 4 x 5 m InfiniBand cables

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Table 14-4 (Cont.) Spares Kit Contents by Exadata Storage Server Model

Engineered System	Spare Kit Contents
Oracle Exadata Storage Expansion Rack with Oracle Exadata Storage Server with Sun Fire X4270 M2 Servers Full Rack	• 2 x 600 GB 15 K RPM High Performance SAS disks or 2 x 3 TB 7.2 K RPM High Capacity SAS disks • 2 x 96 GB Exadata Smart Flash Cache cards • 6 x 3 m, and 10 x 5 m InfiniBand cables
Oracle Exadata Storage Expansion Rack with Oracle Exadata Storage Server with Sun Fire X4270 M2 Servers Half Rack	• 1 x 600 GB 15 K RPM High Performance SAS disks or 1 x 3 TB 7.2 K RPM High Capacity SAS disks • 1 x 96 GB Exadata Smart Flash Cache cards • 6 x 3 m, and 10 x 5 m InfiniBand cables
Oracle Exadata Storage Expansion Rack with Oracle Exadata Storage Server with Sun Fire X4270 M2 Servers Quarter Rack	• 1 x 600 GB 15 K RPM High Performance SAS disks or 1 x 3 TB 7.2 K RPM High Capacity SAS disks • 1 x 96 GB Exadata Smart Flash Cache cards • 4 x 5m InfiniBand cables

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Part III

Cabling Information for Oracle Exadata Database Machine

Oracle Exadata Database Machine has different cabling tables depending on the hardware model.

- Cabling Tables for Oracle Exadata Database Machine X11M and X10M
  This section describes the cable connections for Oracle Exadata Database Machine X11M and X10M.
- Cabling Tables for Oracle Exadata X9M
  This section shows the cable layouts for Oracle Exadata X9M-2 and X9M-8.
- Cabling Tables for Oracle Exadata X8M
  These tables show the cable layouts for Oracle Exadata X8M-2 and X8M-8.
- Cabling Tables for Oracle Exadata Database Machine X8-2, X8-8, X7-2, and X7-8
- Cabling Tables for Oracle Exadata Database Machine X6-2, X6-8, X5-2, and X5-8
  The tables in this chapter show the cable layouts for Oracle Exadata Database Machine X6-2, X6-8, X5-2, and X5-8.
- Cabling Tables for Oracle Exadata Database Machine X4-2 and Oracle Exadata Database Machine X4-8 Full Rack
  The tables in this chapter show the cable layouts for Oracle Exadata Database Machine X4-2, and Oracle Exadata Database Machine X4-8 Full Rack.
- Cabling Tables for Oracle Exadata Database Machine X3-2 and Oracle Exadata Database Machine X3-8 Full Rack
  The tables in this chapter show the cable layouts for Oracle Exadata Database Machine X3-2 and Oracle Exadata Database Machine X3-8 Full Rack.
- Cabling Tables for Oracle Exadata Database Machine X2-2 and Oracle Exadata Database Machine X2-8 Full Rack
  The tables in this chapter show the cable layouts for Oracle Exadata Database Machine X2-2 and Oracle Exadata Database Machine X2-8 Full Rack.
- Cabling Tables for Oracle Exadata Storage Expansion Rack X11M and X10M
  This section shows the cable layouts for Oracle Exadata Storage Expansion Rack X11M and X10M.
- Cabling Tables for Oracle Exadata Storage Expansion Rack X9M-2
  This section shows the cable layouts for Oracle Exadata Storage Expansion Rack X9M-2.
- Cabling Tables for Oracle Exadata Storage Expansion Rack X8M and Earlier

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Cabling Tables for Oracle Exadata Database Machine X11M and X10M

This section describes the cable connections for Oracle Exadata Database Machine X11M and X10M.

- Rack Layout
  This topic shows the rack layout for Oracle Exadata Database Machine X11M and X10M.
- Administration Network Ethernet Port Cabling
  This topic describes the administration network cabling in Oracle Exadata Database Machine X11M and X10M.
- RDMA Network Fabric Cabling for Oracle Exadata Database Machine X11M and X10M
  This topic contains RDMA Network Fabric cabling details for Oracle Exadata Database Machine X11M and X10M.
- PDU Cabling for Oracle Exadata X11M and X10M

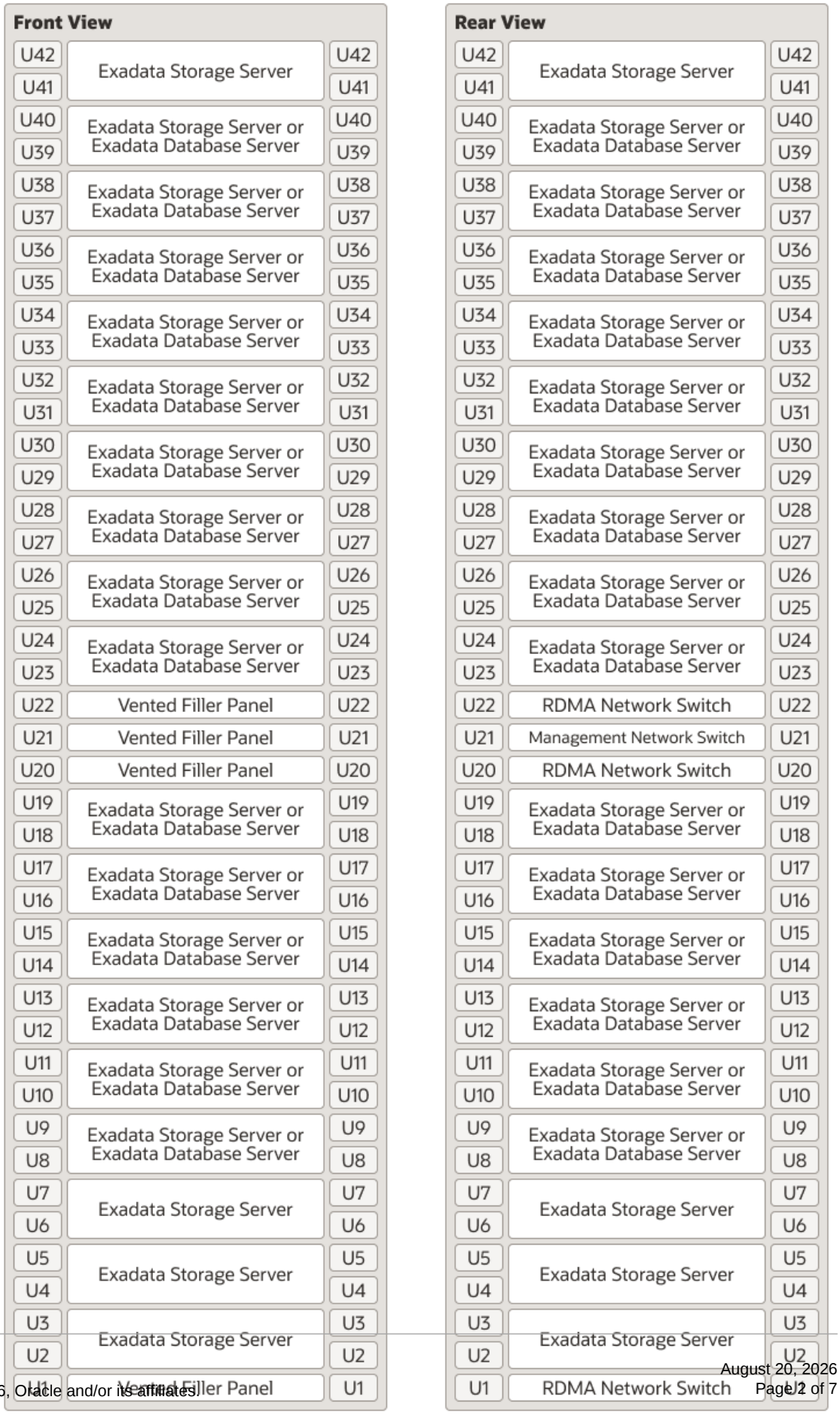
15.1 Rack Layout

This topic shows the rack layout for Oracle Exadata Database Machine X11M and X10M.

The following diagram shows the component positioning in a fully populated Oracle Exadata Database Machine X11M or X10M rack.

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Figure 15-1 Rack Layout for Oracle Exadata Database Machine X11M and X10M



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> **Note**
>
> - The Exadata Storage Servers and Exadata Database Servers are oriented so that all cabling is rear-facing.
> - The network switches are oriented with rear-facing network ports.
> - The RDMA network switch at U1 is optional, and only required for interconnecting multiple Exadata racks.

15.2 Administration Network Ethernet Port Cabling

This topic describes the administration network cabling in Oracle Exadata Database Machine X11M and X10M.

The Management Network Switch is located in rack unit 21 (U21) on Oracle Exadata Database Machine X11M and X10M racks. Each component in the rack connects to the Management Network Switch as described in the following table.

In the following table, U*N* denotes the rack unit location, where U42 is at the top of the rack and U1 is at the bottom of the rack.

Table 15-1 Administration Network Cabling for Oracle Exadata Database Machine X11M or X10M

From Rack Unit	Equipment Type	Network Port	To Management Network Switch Port
U41	Storage Server	NET 0	15
U41	Storage Server	NET MGT (ILOM)	16
U39	Storage Server or Database Server	NET 0	1
U39	Storage Server or Database Server	NET MGT (ILOM)	2
U37	Storage Server or Database Server	NET 0	3
U37	Storage Server or Database Server	NET MGT (ILOM)	4
U35	Storage Server or Database Server	NET 0	5
U35	Storage Server or Database Server	NET MGT (ILOM)	6
U33	Storage Server or Database Server	NET 0	7
U33	Storage Server or Database Server	NET MGT (ILOM)	8
U31	Storage Server or Database Server	NET 0	9
U31	Storage Server or Database Server	NET MGT (ILOM)	10
U29	Storage Server or Database Server	NET 0	11

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Table 15-1 (Cont.) Administration Network Cabling for Oracle Exadata Database Machine X11M or X10M

From Rack Unit	Equipment Type	Network Port	To Management Network Switch Port
U29	Storage Server or Database Server	NET MGT (ILOM)	12
U27	Storage Server or Database Server	NET 0	13
U27	Storage Server or Database Server	NET MGT (ILOM)	14
U25	Storage Server or Database Server	NET 0	17
U25	Storage Server or Database Server	NET MGT (ILOM)	18
U23	Storage Server or Database Server	NET 0	21
U23	Storage Server or Database Server	NET MGT (ILOM)	22
U22	RDMA Network Fabric Leaf Switch	NET MGT 0	45
U20	RDMA Network Fabric Leaf Switch	NET MGT 0	46
U18	Storage Server or Database Server	NET 0	25
U18	Storage Server or Database Server	NET MGT (ILOM)	26
U16	Storage Server or Database Server	NET 0	29
U16	Storage Server or Database Server	NET MGT (ILOM)	30
U14	Storage Server or Database Server	NET 0	31
U14	Storage Server or Database Server	NET MGT (ILOM)	32
U12	Storage Server or Database Server	NET 0	33
U12	Storage Server or Database Server	NET MGT (ILOM)	34
U10	Storage Server or Database Server	NET 0	35
U10	Storage Server or Database Server	NET MGT (ILOM)	36
U8	Storage Server or Database Server	NET 0	37
U8	Storage Server or Database Server	NET MGT (ILOM)	38
U6	Storage Server	NET 0	39

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Table 15-1 (Cont.) Administration Network Cabling for Oracle Exadata Database Machine X11M or X10M

From Rack Unit	Equipment Type	Network Port	To Management Network Switch Port
U6	Storage Server	NET MGT (ILOM)	40
U4	Storage Server	NET 0	41
U4	Storage Server	NET MGT (ILOM)	42
U2	Storage Server	NET 0	43
U2	Storage Server	NET MGT (ILOM)	44
U1	RDMA Network Spine Switch	NET MGT 0	47
PDU-A	Power Distribution Unit (PDU)	NET MGT	19
PDU-B	Power Distribution Unit (PDU)	NET MGT	23

15.3 RDMA Network Fabric Cabling for Oracle Exadata Database Machine X11M and X10M

This topic contains RDMA Network Fabric cabling details for Oracle Exadata Database Machine X11M and X10M.

The RDMA Network Fabric leaf switches are located in rack units 20 and 22 for Oracle Exadata Database Machine X11M and X10M.

The following table describes the connections between the servers and the RDMA Network Fabric leaf switches in an Oracle Exadata Database Machine X11M or X10M rack that is fully populated with database servers and storage servers. All connections in this table use QSFP28 100G cables that are 3 meters long.

In the following tables, U*N* denotes the rack unit location, where U42 is at the top of the rack and U1 is at the bottom of the rack.

Table 15-2 RDMA Network Fabric Cabling for Oracle Exadata Database Machine X11M or X10M Servers and Leaf Switches

From Server in Rack Unit	Server Port	To RDMA Network Fabric Switch in Rack Unit	RDMA Network Fabric Switch Port
U41	PCIe Slot 5, Port 2	U22	15
U41	PCIe Slot 5, Port 1	U20	15
U39	PCIe Slot 5, Port 2	U22	08
U39	PCIe Slot 5, Port 1	U20	08
U37	PCIe Slot 5, Port 2	U22	09
U37	PCIe Slot 5, Port 1	U20	09
U35	PCIe Slot 5, Port 2	U22	10
U35	PCIe Slot 5, Port 1	U20	10

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Table 15-2 (Cont.) RDMA Network Fabric Cabling for Oracle Exadata Database Machine X11M or X10M Servers and Leaf Switches

From Server in Rack Unit	Server Port	To RDMA Network Fabric Switch in Rack Unit	RDMA Network Fabric Switch Port
U33	PCIe Slot 5, Port 2	U22	11
U33	PCIe Slot 5, Port 1	U20	11
U31	PCIe Slot 5, Port 2	U22	12
U31	PCIe Slot 5, Port 1	U20	12
U29	PCIe Slot 5, Port 2	U22	13
U29	PCIe Slot 5, Port 1	U20	13
U27	PCIe Slot 5, Port 2	U22	14
U27	PCIe Slot 5, Port 1	U20	14
U25	PCIe Slot 5, Port 2	U22	16
U25	PCIe Slot 5, Port 1	U20	16
U23	PCIe Slot 5, Port 2	U22	18
U23	PCIe Slot 5, Port 1	U20	18
U18	PCIe Slot 5, Port 2	U22	20
U18	PCIe Slot 5, Port 1	U20	20
U16	PCIe Slot 5, Port 2	U22	22
U16	PCIe Slot 5, Port 1	U20	22
U14	PCIe Slot 5, Port 2	U22	23
U14	PCIe Slot 5, Port 1	U20	23
U12	PCIe Slot 5, Port 2	U22	24
U12	PCIe Slot 5, Port 1	U20	24
U10	PCIe Slot 5, Port 2	U22	25
U10	PCIe Slot 5, Port 1	U20	25
U8	PCIe Slot 5, Port 2	U22	26
U8	PCIe Slot 5, Port 1	U20	26
U6	PCIe Slot 5, Port 2	U22	27
U6	PCIe Slot 5, Port 1	U20	27
U4	PCIe Slot 5, Port 2	U22	28
U4	PCIe Slot 5, Port 1	U20	28
U2	PCIe Slot 5, Port 2	U22	29
U2	PCIe Slot 5, Port 1	U20	29

The following table describes the inter-switch connections between the RDMA Network Fabric leaf switches in an Oracle Exadata Database Machine X10M rack. All connections in this table use QSFP28 100G cables that are 1 meter long.

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Table 15-3 RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata Database Machine X11M or X10M

From RDMA Network Fabric Switch in Rack Unit	Port	To RDMA Network Fabric Switch in Rack Unit	Port
U20	04	U22	04
U20	05	U22	05
U20	06	U22	06
U20	07	U22	07
U20	30	U22	30
U20	31	U22	31
U20	32	U22	32
U20	33	U22	33

15.4 PDU Cabling for Oracle Exadata X11M and X10M

Oracle Exadata X11M and X10M feature various database server hardware configurations with differing power requirements. Consequently, the PDU cabling in each Exadata rack may vary depending on the specific system configuration.

To view recommended PDU cabling details for your Exadata system configuration, use Oracle Exadata Configuration Assistant (OECA).

Related Topics

- Oracle Exadata Configuration Assistant (OECA) Downloads

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16

Cabling Tables for Oracle Exadata X9M

This section shows the cable layouts for Oracle Exadata X9M-2 and X9M-8.

- Rack Layout
  This topic shows the rack layout for Oracle Exadata X9M-2 and X9M-8.
- Integrated Lights Out Manager (ILOM) Cabling
  This topic contains the tables for the ILOM network cabling in Oracle Exadata X9M.
- Administrative Ethernet Port Cabling
  This topic describes the administrative network cabling in Oracle Exadata X9M.
- Single Phase Power Distribution Unit Cabling
  The following describes the cabling routes from each single-phase power distribution unit (PDU) to the component power supplies in Oracle Exadata X9M-2 and X9M-8.
- Three-Phase Power Distribution Unit Cabling
  The following describes the cabling routes from each three-phase power distribution unit (PDU) to the component power supplies in Oracle Exadata X9M-2 and X9M-8.
- RDMA Network Fabric Network Cabling
  The following describes RDMA Network Fabric cabling for Oracle Exadata X9M-2 and X9M-8.

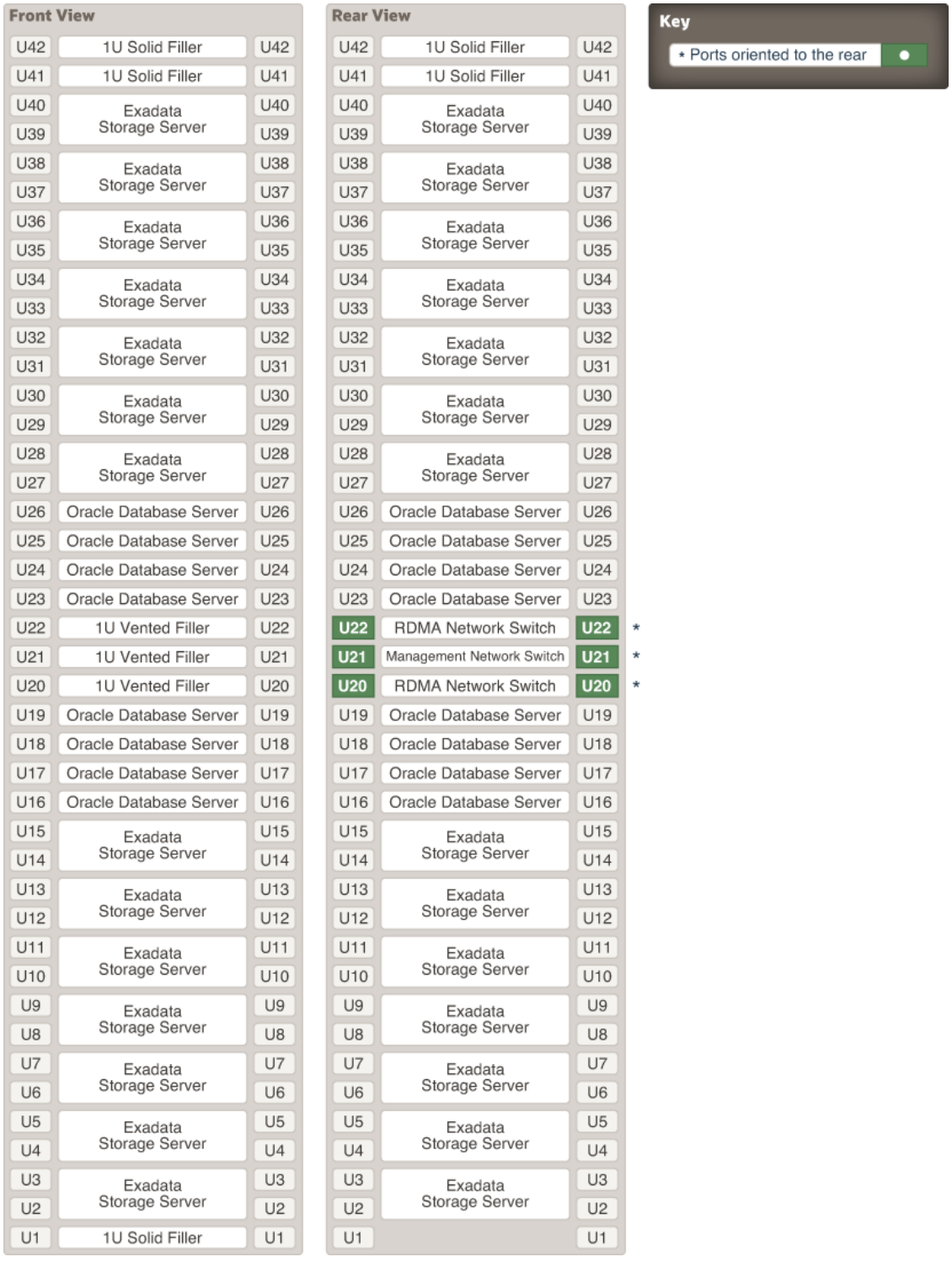
16.1 Rack Layout

This topic shows the rack layout for Oracle Exadata X9M-2 and X9M-8.

The following image shows the front and rear views of the component positioning in Oracle Exadata X9M-2 Full Rack. The front view is shown on the left, and the rear view is shown on the right.

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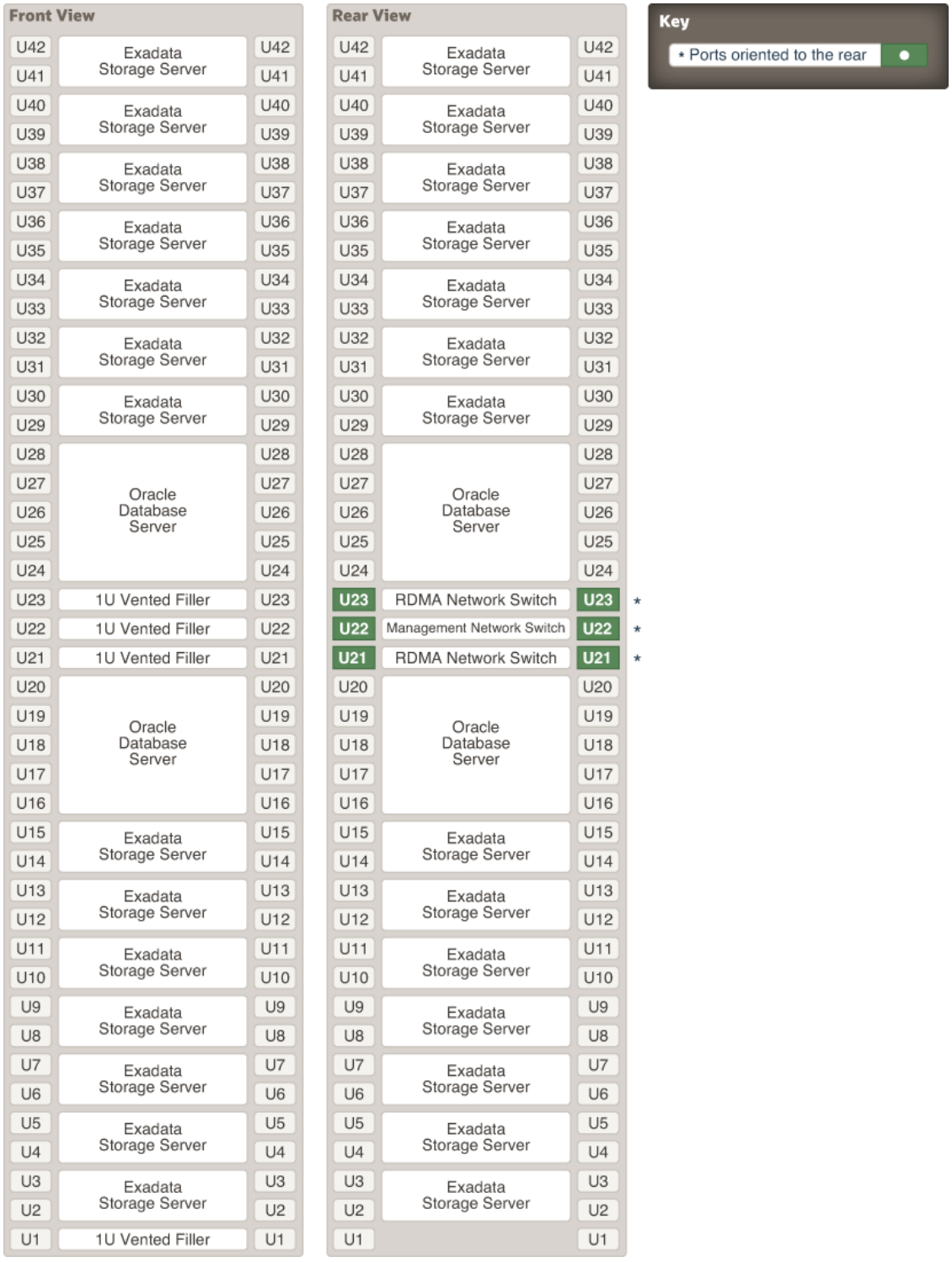
Figure 16-1 Rack Layout of Oracle Exadata X9M-2 Full Rack



The following image shows the front and rear views of the component positioning in Oracle Exadata X9M-8.

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Figure 16-2 Rack Layout of Oracle Exadata X9M-8



16.2 Integrated Lights Out Manager (ILOM) Cabling

This topic contains the tables for the ILOM network cabling in Oracle Exadata X9M.

The following tables are in this section:

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- Table 16-1 ILOM Cabling for Oracle Exadata X9M-2 Full Rack
- Table 16-2 ILOM Cabling for Oracle Exadata X9M-8 Full Rack

In the following tables, U*n* denotes the unit height in the rack, where *n* is the number, such as U20. The cables used for ILOM are red in color.

The following table shows the cable connections from the ILOM port (NET MGT) on the servers to the Management Network Switch:

Table 16-1 ILOM Cabling for Oracle Exadata X9M-2 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U39	Storage Server	2
U37	Storage Server	4
U35	Storage Server	6
U33	Storage Server	8
U31	Storage Server	10
U29	Storage Server	12
U27	Storage Server	14
U26	Database server	16
U25	Database server	18
U24	Database server	20
U23	Database server	22
U22 (NET MGT 0)	Leaf switch	45
U20 (NET MGT 0)	Leaf switch	46
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44

The following table shows the cable connections from the ILOM port on the servers to the Management Network Switch:

Table 16-2 ILOM Cabling for Oracle Exadata X9M-8 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U41	Storage Server	2

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Table 16-2 (Cont.) ILOM Cabling for Oracle Exadata X9M-8 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U39	Storage Server	4
U37	Storage Server	6
U35	Storage Server	8
U33	Storage Server	10
U31	Storage Server	12
U29	Storage Server	14
U24	Database server	16
U16	Database server	18
U14	Storage Server	20
U12	Storage Server	22
U10	Storage Server	24
U8	Storage Server	26
U6	Storage Server	28
U4	Storage Server	30
U2	Storage Server	32

16.3 Administrative Ethernet Port Cabling

This topic describes the administrative network cabling in Oracle Exadata X9M.

The Management Network Switch is located in rack unit 21 on Oracle Exadata X9M-2 racks and in rack unit 22 on Oracle Exadata X9M-8 racks.

In the following tables, U*n* denotes the unit height in the rack, where *n* is the number, such as U20. The cables used for the Management Network Switch are blue in color. The following tables are in this section:

- Table 16-3 Administrative Network Cabling for Oracle Exadata X9M-2 Full Rack
- Table 16-4 Administrative Network Cabling for Oracle Exadata X9M-8 Full Rack

Table 16-3 Administrative Network Cabling for Oracle Exadata X9M-2 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U39	Storage Server	1
U37	Storage Server	3
U35	Storage Server	5
U33	Storage Server	7
U31	Storage Server	9
U29	Storage Server	11
U27	Storage Server	13

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Table 16-3 (Cont.) Administrative Network Cabling for Oracle Exadata X9M-2 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U26	Database server	15
U25	Database server	17
U24	Database server	19
U23	Database server	21
U22	RDMA Network Fabric Switch	45
U20	RDMA Network Fabric Switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Storage Server	31
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
U1	RDMA Network Fabric Switch Note that the spine switch is not included by default on Oracle Exadata X9M-2 racks, but port 47 is still reserved on the Management Network Switch for the spine RDMA Network Fabric switch.	47

Table 16-4 Administrative Network Cabling for Oracle Exadata X9M-8 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U41	Storage Server	1
U39	Storage Server	3
U37	Storage Server	5
U35	Storage Server	7
U33	Storage Server	9
U31	Storage Server	11
U29	Storage Server	13
U24	Database server	15
U23	RDMA Network Fabric Switch	33
U21	RDMA Network Fabric Switch	34

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Table 16-4 (Cont.) Administrative Network Cabling for Oracle Exadata X9M-8 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U16	Database server	17
U14	Storage Server	19
U12	Storage Server	21
U10	Storage Server	23
U8	Storage Server	25
U6	Storage Server	27
U4	Storage Server	29
U2	Storage Server	31
U1	RDMA Network Fabric Switch Note that the spine switch is not included by default on Oracle Exadata X9M-8 racks, but port 47 is still reserved on the Management Network Switch for the spine RDMA Network Fabric switch.	35

16.4 Single Phase Power Distribution Unit Cabling

The following describes the cabling routes from each single-phase power distribution unit (PDU) to the component power supplies in Oracle Exadata X9M-2 and X9M-8.

- Single Phase PDU Cabling for Oracle Exadata X9M-2 Full Rack
  Single phase cabling for the Oracle Exadata X9M-2 Full Rack routes from each power distribution unit (PDU) to the power supplies on each server or switch.
- Single Phase PDU Cabling for Oracle Exadata X9M-8 Full Rack
  Single phase cabling for the Oracle Exadata X9M-8 Full Rack routes from each power distribution unit (PDU) to the power supplies on each server or switch.

16.4.1 Single Phase PDU Cabling for Oracle Exadata X9M-2 Full Rack

Single phase cabling for the Oracle Exadata X9M-2 Full Rack routes from each power distribution unit (PDU) to the power supplies on each server or switch.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 16-5 Single Phase PDU Cabling for Oracle Exadata X9M-2 Full Rack

Rack Slot	PSU 0 to PDU-A Outlet	PSU 1 to PDU-B Outlet	Cable Length
U42	G5-6	G0-0	3 meters
U41	G4-6	G1-0	3 meters
U40	G4-2	G1-4	3 meters

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Table 16-5 (Cont.) Single Phase PDU Cabling for Oracle Exadata X9M-2 Full Rack

Rack Slot	PSU 0 to PDU-A Outlet	PSU 1 to PDU-B Outlet	Cable Length
U39	G4-4	G1-2	3 meters
U37	G1-5	G4-1	3 meters
U35	G3-1	G2-5	3 meters
U33	G1-3	G4-3	3 meters
U31	G3-3	G2-3	3 meters
U29	G4-0	G1-6	3 meters
U27	G5-2	G0-4	3 meters
U26	G0-6	G5-0	3 meters
U25	G3-0	G2-6	3 meters
U24	G4-1	G1-5	3 meters
U23	G5-0	G0-6	3 meters
U22	G1-6	G4-0	3 meters
U21	G0-4	G5-2	3 meters
U20	G0-3	G5-3	3 meters
U19	G3-2	G2-4	3 meters
U18	G2-5	G3-1	3 meters
U17	G1-2	G4-4	3 meters
U16	G1-4	G4-2	3 meters
U14	G5-3	G0-3	3 meters
U12	G5-4	G0-2	3 meters
U10	G2-3	G3-3	3 meters
U08	G2-4	G3-2	3 meters
U06	G2-6	G3-0	3 meters
U04	G0-2	G5-4	3 meters
U02	G0-5	G5-1	3 meters
U01	G4-3	G1-3	3 meters

16.4.2 Single Phase PDU Cabling for Oracle Exadata X9M-8 Full Rack

Single phase cabling for the Oracle Exadata X9M-8 Full Rack routes from each power distribution unit (PDU) to the power supplies on each server or switch.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections in the table below list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 16-6 Single Phase PDU Cabling for Oracle Exadata X9M-8 Full Rack

Rack Slot	PSU to PDU-A	PDU-A Outlet	PSU to PDU-B	PDU-B Outlet	Cable Length
U41	PS0	G3-5	PS1	G2-1	3 meters
U39	PS0	G4-6	PS1	G1-0	3 meters
U37	PS0	G5-2	PS1	G0-4	3 meters
U35	PS0	G5-0	PS1	G0-6	3 meters

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Table 16-6 (Cont.) Single Phase PDU Cabling for Oracle Exadata X9M-8 Full Rack

Rack Slot	PSU to PDU-A	PDU-A Outlet	PSU to PDU-B	PDU-B Outlet	Cable Length
U33	PS0	G2-5	PS1	G3-1	3 meters
U31	PS0	G4-3	PS1	G1-3	3 meters
U29	PS0	G3-6	PS1	G2-0	3 meters
U24	PS2	G2-7	PS3	G3-7	2 meters
U24	PS0	G0-7	PS1	G5-7	2 meters
U23	PS2	G3-1	PS1	G2-5	2 meters
U22	PS2	G2-6	PS1	G3-0	2 meters
U21	PS2	G1-6	PS1	G4-0	2 meters
U16	PS2	G1-7	PS3	G4-7	2 meters
U16	PS0	G3-7	PS1	G2-7	2 meters
U14	PS0	G5-1	PS1	G0-5	3 meters
U12	PS0	G4-1	PS1	G1-5	3 meters
U10 (with 2 DB servers)	PS0	G4-4	PS1	G1-2	3 meters
U10 (with 3 DB servers)	PS2	G4-7	PS3	G1-7	2 meters
U10 (with 3 DB servers)	PS0	G5-7	PS1	G0-7	2 meters
U08	PS0	G0-6	PS1	G5-0	3 meters
U06	PS0	G1-1	PS1	G4-5	3 meters
U04	PS0	G1-0	PS1	G4-6	3 meters
U02	PS0	G0-1	PS1	G5-5	3 meters
U01	PS2	G4-0	PS1	G1-6	3 meters

16.5 Three-Phase Power Distribution Unit Cabling

The following describes the cabling routes from each three-phase power distribution unit (PDU) to the component power supplies in Oracle Exadata X9M-2 and X9M-8.

- Three-Phase PDU Cabling for Oracle Exadata X9M-2 Full Rack
  Three-phase cabling for the Oracle Exadata X9M-2 Full Rack routes from each power distribution unit (PDU) to the power supplies on each server or switch.
- Three Phase PDU Cabling for Oracle Exadata X9M-8 Full Rack
  Three-phase cabling for the Oracle Exadata X9M-8 Full Rack routes from each power distribution unit (PDU) to the power supplies on each server or switch.

16.5.1 Three-Phase PDU Cabling for Oracle Exadata X9M-2 Full Rack

Three-phase cabling for the Oracle Exadata X9M-2 Full Rack routes from each power distribution unit (PDU) to the power supplies on each server or switch.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

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Table 16-7 Three Phase PDU Cabling for Oracle Exadata X9M-2 Full Rack

Rack Slot	PSU 0 to PDU-A Outlet	PSU 1 to PDU-B Outlet	Cable Length
U42	G5-4	G2-2	3 meters
U41	G5-2	G2-4	3 meters
U40	G5-1	G2-5	3 meters
U39	G4-6	G1-0	3 meters
U37	G4-1	G1-5	3 meters
U35	G4-5	G1-1	3 meters
U33	G5-5	G2-1	3 meters
U31	G4-2	G1-4	3 meters
U29	G5-3	G2-3	3 meters
U27	G3-2	G0-4	3 meters
U26	G5-0	G2-6	3 meters
U25	G3-0	G0-6	3 meters
U24	G3-1	G0-5	3 meters
U23	G3-5	G0-1	3 meters
U22	G1-6	G4-0	3 meters
U21	G2-6	G5-0	3 meters
U20	G1-5	G4-1	3 meters
U19	G1-1	G4-5	3 meters
U18	G1-4	G4-2	3 meters
U17	G2-1	G5-5	3 meters
U16	G1-3	G4-3	3 meters
U14	G0-5	G3-1	3 meters
U12	G2-5	G5-1	3 meters
U10	G0-3	G3-3	3 meters
U08	G2-3	G5-3	3 meters
U06	G2-4	G5-2	3 meters
U04	G0-6	G3-0	3 meters
U02	G0-0	G3-6	3 meters
U01	G1-0	G4-6	3 meters

16.5.2 Three Phase PDU Cabling for Oracle Exadata X9M-8 Full Rack

Three-phase cabling for the Oracle Exadata X9M-8 Full Rack routes from each power distribution unit (PDU) to the power supplies on each server or switch.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 16-8 Three Phase PDU Cabling for Oracle Exadata X9M-8 Full Rack

Rack Slot	PSU to PDU-A	PDU-A Outlet	PSU to PDU-B	PDU-B Outlet	Cable Length
U41	PS0	G5-5	PS1	G2-1	3 meters

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Table 16-8 (Cont.) Three Phase PDU Cabling for Oracle Exadata X9M-8 Full Rack

Rack Slot	PSU to PDU-A	PDU-A Outlet	PSU to PDU-B	PDU-B Outlet	Cable Length
U39	PS0	G5-4	PS1	G2-2	3 meters
U37	PS0	G5-2	PS1	G2-4	3 meters
U35	PS0	G2-4	PS1	G5-2	3 meters
U33	PS0	G3-6	PS1	G0-0	3 meters
U31	PS0	G4-6	PS1	G1-0	3 meters
U29	PS0	G4-4	PS1	G1-2	3 meters
U24	PS2	G3-7	PS3	G0-7	2 meters
U24	PS0	G4-7	PS1	G1-7	2 meters
U23	PS2	G3-1	PS1	G0-5	2 meters
U22	PS2	G3-0	PS1	G0-6	2 meters
U21	PS2	G2-5	PS1	G5-1	2 meters
U16	PS2	G2-7	PS3	G5-7	2 meters
U16	PS0	G1-7	PS1	G4-7	2 meters
U14	PS0	G2-6	PS1	G5-0	3 meters
U12	PS0	G1-0	PS1	G4-6	3 meters
U10 (with 2 DB servers)	PS0	G0-6	PS1	G3-0	3 meters
U10 (with 3 DB servers)	PS2	G5-7	PS3	G2-7	2 meters
U10 (with 3 DB servers)	PS0	G0-7	PS1	G3-7	2 meters
U08	PS0	G0-5	PS1	G3-1	3 meters
U06	PS0	G1-1	PS1	G4-5	3 meters
U04	PS0	G0-2	PS1	G3-4	3 meters
U02	PS0	G0-1	PS1	G3-5	3 meters
U01	PS2	G0-0	PS1	G3-6	3 meters

16.6 RDMA Network Fabric Network Cabling

The following describes RDMA Network Fabric cabling for Oracle Exadata X9M-2 and X9M-8.

- RDMA Network Fabric Cabling for Oracle Exadata X9M-2
  This topic contains RDMA Network Fabric cabling details for Oracle Exadata X9M-2.
- RDMA Network Fabric Cabling for Oracle Exadata X9M-8
  This topic contains RDMA Network Fabric cabling details for Oracle Exadata X9M-8.

16.6.1 RDMA Network Fabric Cabling for Oracle Exadata X9M-2

This topic contains RDMA Network Fabric cabling details for Oracle Exadata X9M-2.

The RDMA Network Fabric switches are located in rack units 20 and 22 for Oracle Exadata X9M-2.

In the following tables, U*n* denotes the slot in the rack, where *n* is the number, such as U20. P*n* denotes the RDMA Network Fabric port *n*, where *n* is port number, such as P1. The cables used for the RDMA Network Fabric switch are black in color.

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> **Note**
>
> Not all the slots shown in the tables below will be used in a single configuration. Match the rack component with the appropriate slot in the tables below to determine how to cable that particular component.

The following tables are in this section:

- Table 16-9 RDMA Network Fabric for Oracle Exadata Database Machine X9M-2 Database Servers
- Table 16-10 RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-2 Storage Servers
- Table 16-11 RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata Database Machine X9M-2

The following table lists the location, ports and cables for the RDMA Network Fabric connections for database servers in an Oracle Exadata X9M-2 rack.

Table 16-9 RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-2 Database Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U39	System Board QSFP28 Port 2	U22	08	3 meters
U39	System Board QSFP28 Port 1	U20	08	3 meters
U37	System Board QSFP28 Port 2	U22	09	3 meters
U37	System Board QSFP28 Port 1	U20	09	3 meters
U35	System Board QSFP28 Port 2	U22	10	3 meters
U35	System Board QSFP28 Port 1	U20	10	3 meters
U33	System Board QSFP28 Port 2	U22	11	3 meters
U33	System Board QSFP28 Port 1	U20	11	3 meters
U31	System Board QSFP28 Port 2	U22	12	3 meters
U31	System Board QSFP28 Port 1	U20	12	3 meters
U29	System Board QSFP28 Port 2	U22	13	3 meters
U29	System Board QSFP28 Port 1	U20	13	3 meters
U27	System Board QSFP28 Port 2	U22	14	3 meters

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Table 16-9 (Cont.) RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-2 Database Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U27	System Board QSFP28 Port 1	U20	14	3 meters
U26	System Board QSFP28 Port 2	U22	15	3 meters
U26	System Board QSFP28 Port 1	U20	15	3 meters
U25	System Board QSFP28 Port 2	U22	16	3 meters
U25	System Board QSFP28 Port 1	U20	16	3 meters
U24	System Board QSFP28 Port 2	U22	17	3 meters
U24	System Board QSFP28 Port 1	U20	17	3 meters
U23	System Board QSFP28 Port 2	U22	18	3 meters
U23	System Board QSFP28 Port 1	U20	18	3 meters
U19	System Board QSFP28 Port 2	U22	19	3 meters
U19	System Board QSFP28 Port 1	U20	19	3 meters
U18	System Board QSFP28 Port 2	U22	20	3 meters
U18	System Board QSFP28 Port 1	U20	20	3 meters
U17	System Board QSFP28 Port 2	U22	21	3 meters
U17	System Board QSFP28 Port 1	U20	21	3 meters
U16	System Board QSFP28 Port 2	U22	22	3 meters
U16	System Board QSFP28 Port 1	U20	22	3 meters
U14	System Board QSFP28 Port 2	U22	23	3 meters
U14	System Board QSFP28 Port 1	U20	23	3 meters
U12	System Board QSFP28 Port 2	U22	24	3 meters
U12	System Board QSFP28 Port 1	U20	24	3 meters
U10	System Board QSFP28 Port 2	U22	25	3 meters

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Table 16-9 (Cont.) RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-2 Database Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U10	System Board QSFP28 Port 1	U20	25	3 meters
U08	System Board QSFP28 Port 2	U22	26	3 meters
U08	System Board QSFP28 Port 1	U20	26	3 meters

The following table lists the location, ports and cables for the RDMA Network Fabric connections for storage servers in an Oracle Exadata X9M-2 rack.

> **Note**
>
> On Exadata X9M-2 High Capacity (HC) and Extreme Flash (EF) storage servers, the RDMA Network Fabric ports are located at PCIe slot 3. On Extreme (XT) storage servers, the RDMA Network Fabric ports are located at PCIe slot 10.

Table 16-10 RDMA Network Fabric for Oracle Exadata Database Machine X9M-2 Storage Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U41	PCIe QSFP28 Port 2	U22	15	3 meters
U41	PCIe QSFP28 Port 1	U20	15	3 meters
U39	PCIe QSFP28 Port 2	U22	08	3 meters
U39	PCIe QSFP28 Port 1	U20	08	3 meters
U37	PCIe QSFP28 Port 2	U22	09	3 meters
U37	PCIe QSFP28 Port 1	U20	09	3 meters
U35	PCIe QSFP28 Port 2	U22	10	3 meters
U35	PCIe QSFP28 Port 1	U20	10	3 meters
U33	PCIe QSFP28 Port 2	U22	11	3 meters
U33	PCIe QSFP28 Port 1	U20	11	3 meters
U31	PCIe QSFP28 Port 2	U22	12	3 meters
U31	PCIe QSFP28 Port 1	U20	12	3 meters
U29	PCIe QSFP28 Port 2	U22	13	3 meters
U29	PCIe QSFP28 Port 1	U20	13	3 meters
U27	PCIe QSFP28 Port 2	U22	14	3 meters
U27	PCIe QSFP28 Port 1	U20	14	3 meters
U25	PCIe QSFP28 Port 2	U22	16	3 meters
U25	PCIe QSFP28 Port 1	U20	16	3 meters
U23	PCIe QSFP28 Port 2	U22	18	3 meters

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Table 16-10 (Cont.) RDMA Network Fabric for Oracle Exadata Database Machine X9M-2 Storage Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U23	PCIe QSFP28 Port 1	U20	18	3 meters
U18	PCIe QSFP28 Port 2	U22	20	3 meters
U18	PCIe QSFP28 Port 1	U20	20	3 meters
U14	PCIe QSFP28 Port 2	U22	23	3 meters
U14	PCIe QSFP28 Port 1	U20	23	3 meters
U12	PCIe QSFP28 Port 2	U22	24	3 meters
U12	PCIe QSFP28 Port 1	U20	24	3 meters
U10	PCIe QSFP28 Port 2	U22	25	3 meters
U10	PCIe QSFP28 Port 1	U20	25	3 meters
U08	PCIe QSFP28 Port 2	U22	26	3 meters
U08	PCIe QSFP28 Port 1	U20	26	3 meters
U06	PCIe QSFP28 Port 2	U22	27	3 meters
U06	PCIe QSFP28 Port 1	U20	27	3 meters
U04	PCIe QSFP28 Port 2	U22	28	3 meters
U04	PCIe QSFP28 Port 1	U20	28	3 meters
U02	PCIe QSFP28 Port 2	U22	29	3 meters
U02	PCIe QSFP28 Port 1	U20	29	3 meters

The following table lists the location, ports and cables for the RDMA Network Fabric connections for the leaf switches in an Oracle Exadata X9M-2 rack.

Table 16-11 RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata Database Machine X9M-2

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U20	04	U22	04	1 meter
U20	05	U22	05	1 meter
U20	06	U22	06	1 meter
U20	07	U22	07	1 meter
U20	30	U22	30	1 meter
U20	31	U22	31	1 meter
U20	32	U22	32	1 meter
U20	33	U22	33	1 meter

16.6.2 RDMA Network Fabric Cabling for Oracle Exadata X9M-8

This topic contains RDMA Network Fabric cabling details for Oracle Exadata X9M-8.

The RDMA Network Fabric switches are located in rack units 21 and 23 for Oracle Exadata X9M-8.

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In the following tables, U*n* denotes the slot in the rack, where *n* is the number, such as U23. P*n* denotes the RDMA Network Fabric port *n*, where *n* is port number, such as P1. The cables used for the RDMA Network Fabric switch are black in color.

> **Note**
>
> Not all the slots shown in the tables below will be used in a single configuration. Match the rack component with the appropriate slot in the tables below to determine how to cable that particular component.

The following tables are in this section:

- Table 16-12 RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-8 Database Servers
- Table 16-13 RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-8 Storage Servers
- Table 16-14 RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata Database Machine X9M-8

The following table lists the rack location, ports and cables for the RDMA Network Fabric connections for database servers in an Oracle Exadata X9M-8 rack.

Table 16-12 RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-8 Database Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U24	PCIe 5, P2	U23	15	3 meters
U24	PCIe 5, P1	U21	15	3 meters
U24	PCIe 7, P2	U23	16	3 meters
U24	PCIe 7, P1	U21	16	3 meters
U24	PCIe 9, P2	U23	17	3 meters
U24	PCIe 9, P1	U21	17	3 meters
U24	PCIe 11, P2	U23	18	3 meters
U24	PCIe 11, P1	U21	18	3 meters
U16	PCIe 5, P2	U23	19	3 meters
U16	PCIe 5, P1	U21	19	3 meters
U16	PCIe 7, P2	U23	20	3 meters
U16	PCIe 7, P1	U21	20	3 meters
U16	PCIe 9, P2	U23	21	3 meters
U16	PCIe 9, P1	U21	21	3 meters
U16	PCIe 11, P2	U23	22	3 meters
U16	PCIe 11, P1	U21	22	3 meters
U10	PCIe 5, P2	U23	23	3 meters
U10	PCIe 5, P1	U21	23	3 meters
U10	PCIe 7, P2	U23	24	3 meters

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Table 16-12 (Cont.) RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-8 Database Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U10	PCIe 7, P1	U21	24	3 meters
U10	PCIe 9, P2	U23	25	3 meters
U10	PCIe 9, P1	U21	25	3 meters
U10	PCIe 11, P2	U23	30 or 8 **Note:** Port 30 is the target only in a configuration with 3 database servers and 11 storage servers. Otherwise, port 8 is the target.	3 meters
U10	PCIe 11, P1	U21	30 or 8 **Note:** Port 30 is the target only in a configuration with 3 database servers and 11 storage servers. Otherwise, port 8 is the target.	3 meters

The following table lists the location, ports and cables for the RDMA Network Fabric connections for storage servers in an Oracle Exadata X9M-8 rack.

> **Note**
>
> On Exadata X9M-2 High Capacity (HC) and Extreme Flash (EF) storage servers, the RDMA Network Fabric ports are located at PCIe slot 3. On Extreme (XT) storage servers, the RDMA Network Fabric ports are located at PCIe slot 10.

Table 16-13 RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-8 Storage Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U41	PCIe QSFP28 Port 2	U23	08	3 meters
U41	PCIe QSFP28 Port 1	U21	08	3 meters
U39	PCIe QSFP28 Port 2	U23	09	3 meters
U39	PCIe QSFP28 Port 1	U21	09	3 meters
U37	PCIe QSFP28 Port 2	U23	10	3 meters
U37	PCIe QSFP28 Port 1	U21	10	3 meters
U35	PCIe QSFP28 Port 2	U23	11	3 meters
U35	PCIe QSFP28 Port 1	U21	11	3 meters

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Table 16-13 (Cont.) RDMA Network Fabric Cabling for Oracle Exadata Database Machine X9M-8 Storage Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U33	PCIe QSFP28 Port 2	U23	12	3 meters
U33	PCIe QSFP28 Port 1	U21	12	3 meters
U31	PCIe QSFP28 Port 2	U23	13	3 meters
U31	PCIe QSFP28 Port 1	U21	13	3 meters
U29	PCIe QSFP28 Port 2	U23	14	3 meters
U29	PCIe QSFP28 Port 1	U21	14	3 meters
U14	PCIe QSFP28 Port 2	U23	23	3 meters
U14	PCIe QSFP28 Port 1	U21	23	3 meters
U12	PCIe QSFP28 Port 2	U23	24	3 meters
U12	PCIe QSFP28 Port 1	U21	24	3 meters
U10	PCIe QSFP28 Port 2	U23	25	3 meters
U10	PCIe QSFP28 Port 1	U21	25	3 meters
U08	PCIe QSFP28 Port 2	U23	26	3 meters
U08	PCIe QSFP28 Port 1	U21	26	3 meters
U06	PCIe QSFP28 Port 2	U23	27	3 meters
U06	PCIe QSFP28 Port 1	U21	27	3 meters
U04	PCIe QSFP28 Port 2	U23	28	3 meters
U04	PCIe QSFP28 Port 1	U21	28	3 meters
U02	PCIe QSFP28 Port 2	U23	29	3 meters
U02	PCIe QSFP28 Port 1	U21	29	3 meters

The following table lists the location, ports and cables for the RDMA Network Fabric connections for the leaf switches in an Oracle Exadata X9M-8 rack.

Table 16-14 RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata Database Machine X9M-8

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U21	04	U23	04	1 meter
U21	05	U23	05	1 meter
U21	06	U23	06	1 meter
U21	07	U23	07	1 meter
U21	30 or 34 **Note:** Port 34 is used only in a configuration with 3 database servers and 11 storage servers. Otherwise, port 30 is used.	U23	30 or 34 **Note:** Port 34 is used only in a configuration with 3 database servers and 11 storage servers. Otherwise, port 30 is used.	1 meter
U21	31	U23	31	1 meter

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Table 16-14 (Cont.) RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata Database Machine X9M-8

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U21	32	U23	32	1 meter
U21	33	U23	33	1 meter

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Cabling Tables for Oracle Exadata X8M

These tables show the cable layouts for Oracle Exadata X8M-2 and X8M-8.

> **Note**
>
> For ease of reading, the name "Oracle Exadata Rack" is used when information refers to both Oracle Exadata and Oracle Exadata Storage Expansion Rack.

- Rack Layout Diagrams
  The diagrams in this topic show the rack layout for Oracle Exadata X8M-2 and X8M-8.
- Integrated Lights Out Manager (ILOM) Cabling Tables
  This topic contains the tables for the ILOM network cabling.
- Administrative Ethernet Port Cabling Tables
  This topic contains the tables for the administrative network cabling.
- Single Phase Power Distribution Unit Cabling Tables
  These tables show the cabling routes from each single-phase power distribution unit (PDU) to the power supplies configured in an Oracle Exadata Database Machine X8M-2 and X8M-8.
- Three-Phase Power Distribution Unit Cabling Tables
  This section contains the tables for a three-phase power distribution unit (PDU) in Oracle Exadata X8M-2 and X8M-8.
- RDMA Network Fabric Network Cabling Tables
  This section contains the tables for RDMA Network Fabric network cabling for Oracle Exadata X8M-2 and X8M-8 racks.

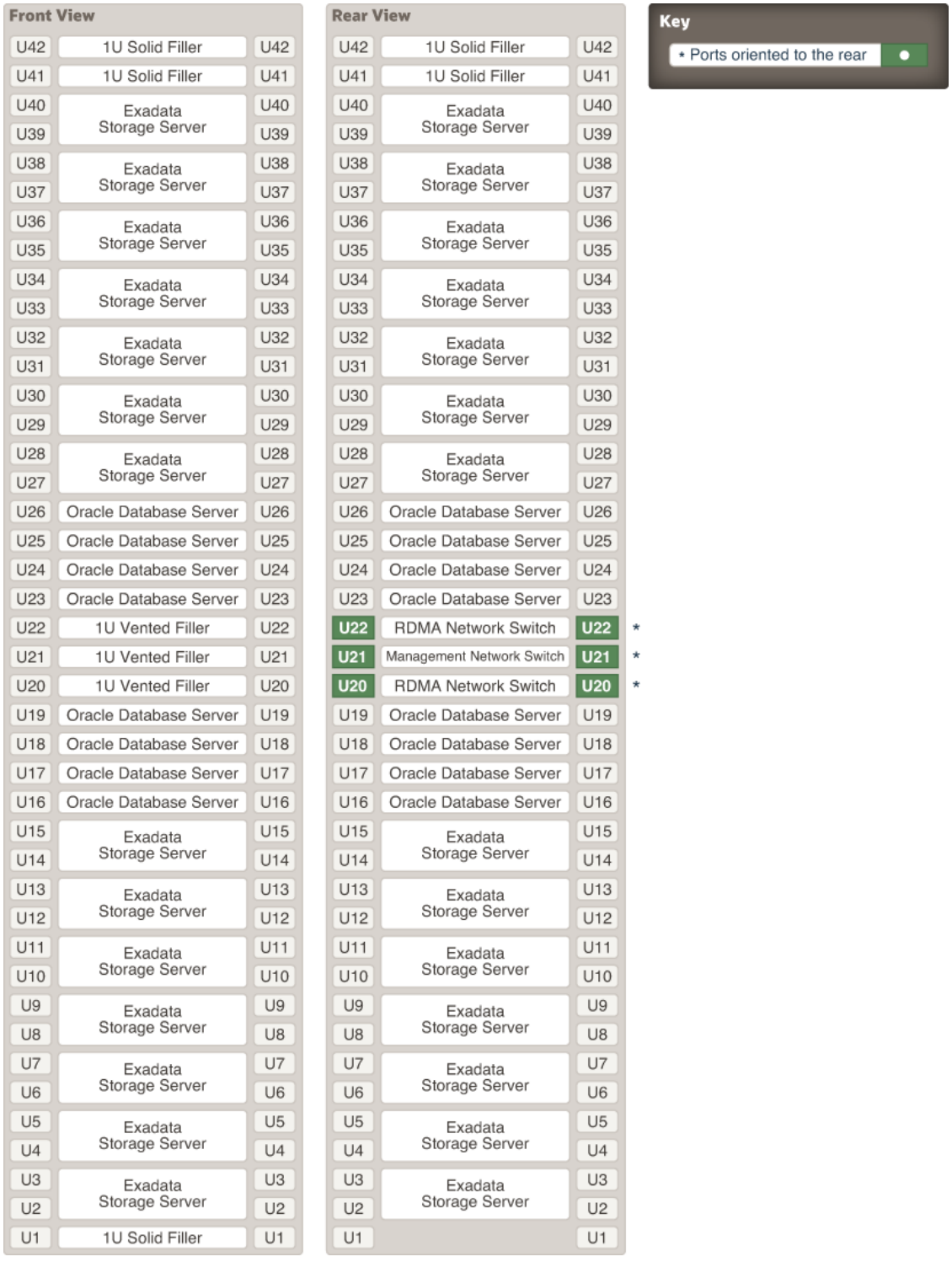
17.1 Rack Layout Diagrams

The diagrams in this topic show the rack layout for Oracle Exadata X8M-2 and X8M-8.

The following image shows the front and rear views of the component positioning in Oracle Exadata X8M-2 Full Rack. The front view is shown on the left, and the rear view is shown on the right.

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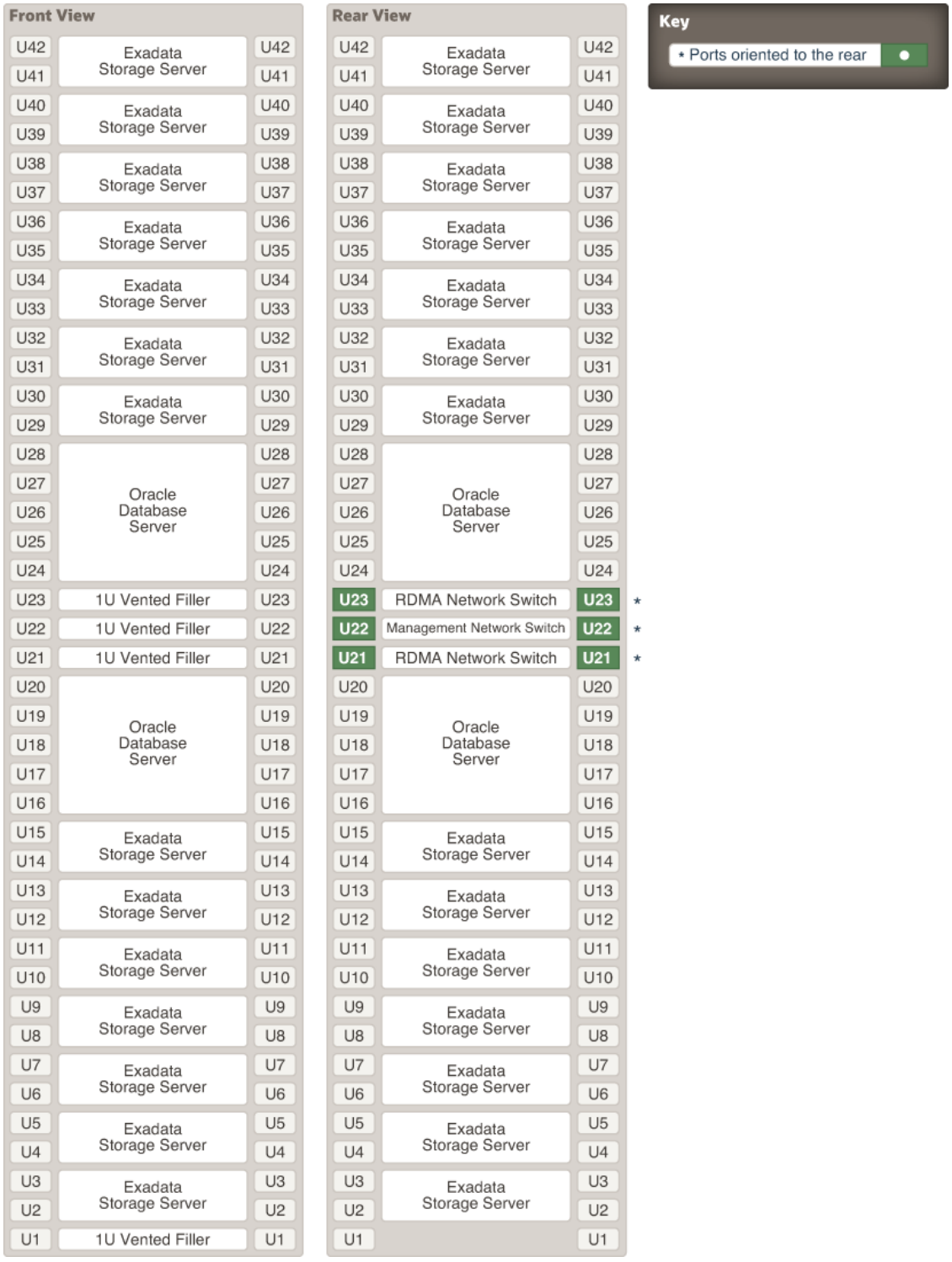
Figure 17-1 Rack Layout of Oracle Exadata X8M-2 Full Rack



The following image shows the front and rear views of the component positioning in Oracle Exadata X8M-8.

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Figure 17-2 Rack Layout of Oracle Exadata X8M-8



17.2 Integrated Lights Out Manager (ILOM) Cabling Tables

This topic contains the tables for the ILOM network cabling.

The following tables are in this section:

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- Table 17-1 ILOM Cabling for Oracle Exadata X8M-2 Full Rack
- Table 17-2 ILOM Cabling for Oracle Exadata X8M-8 Full Rack

In the following tables, U*n* denotes the unit height in the rack, where *n* is the number, such as U20. The cables used for ILOM are red in color.

The following table shows the cable connections from the ILOM port (NET MGT) on the servers to the Management Network Switch:

Table 17-1 ILOM Cabling for Oracle Exadata X8M-2 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U39	Storage Server	2
U37	Storage Server	4
U35	Storage Server	6
U33	Storage Server	8
U31	Storage Server	10
U29	Storage Server	12
U27	Storage Server	14
U26	Database server	16
U25	Database server	18
U24	Database server	20
U23	Database server	22
U22 (NET MGT 0)	Leaf switch	45
U20 (NET MGT 0)	Leaf switch	46
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44

The following table shows the cable connections from the ILOM port on the servers to the Management Network Switch:

Table 17-2 ILOM Cabling for Oracle Exadata X8M-8 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U41	Storage Server	2

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Table 17-2 (Cont.) ILOM Cabling for Oracle Exadata X8M-8 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U39	Storage Server	4
U37	Storage Server	6
U35	Storage Server	8
U33	Storage Server	10
U31	Storage Server	12
U29	Storage Server	14
U24	Database server	16
U16	Database server	18
U14	Storage Server	20
U12	Storage Server	22
U10	Storage Server	24
U8	Storage Server	26
U6	Storage Server	28
U4	Storage Server	30
U2	Storage Server	32

17.3 Administrative Ethernet Port Cabling Tables

This topic contains the tables for the administrative network cabling.

The Management Network Switch is located in rack unit 21 on Oracle Exadata X8M-2 racks and in rack unit 22 on Oracle Exadata X8M-8 racks.

In the following tables, U*n* denotes the unit height in the rack, where *n* is the number, such as U20. The cables used for the Management Network Switch are blue in color. The following tables are in this section:

- Table 17-3 Administrative Network Cabling for Oracle Exadata X8M-2 Full Rack
- Table 17-4 Administrative Network Cabling for Oracle Exadata X8M-8 Full Rack

The following table shows the cable connections from the Admin port in the rack components to the Management Network Switch:

Table 17-3 Administrative Network Cabling for Oracle Exadata X8M-2 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U39	Storage Server	1
U37	Storage Server	3
U35	Storage Server	5
U33	Storage Server	7
U31	Storage Server	9

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Table 17-3 (Cont.) Administrative Network Cabling for Oracle Exadata X8M-2 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U29	Storage Server	11
U27	Storage Server	13
U26	Database server	15
U25	Database server	17
U24	Database server	19
U23	Database server	21
U22	RDMA Network Fabric Switch	45
U20	RDMA Network Fabric Switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Storage Server	31
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
U1	RDMA Network Fabric Switch Note that the spine switch is not included by default on Oracle Exadata X8M-2 racks, but port 47 is still reserved on the Management Network Switch for the spine RDMA Network Fabric switch.	47

The following table shows the cable connections from the Admin port in the rack components to the Management Network Switch:

Table 17-4 Administrative Network Cabling for Oracle Exadata X8M-8 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U41	Storage Server	1
U39	Storage Server	3
U37	Storage Server	5
U35	Storage Server	7
U33	Storage Server	9
U31	Storage Server	11

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Table 17-4 (Cont.) Administrative Network Cabling for Oracle Exadata X8M-8 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U29	Storage Server	13
U24	Database server	15
U23	RDMA Network Fabric Switch	33
U21	RDMA Network Fabric Switch	34
U16	Database server	17
U14	Storage Server	19
U12	Storage Server	21
U10	Storage Server	23
U8	Storage Server	25
U6	Storage Server	27
U4	Storage Server	29
U2	Storage Server	31
U1	RDMA Network Fabric Switch Note that the spine switch is not included by default on Oracle Exadata X8M-8 racks, but port 47 is still reserved on the Management Network Switch for the spine RDMA Network Fabric switch.	35

17.4 Single Phase Power Distribution Unit Cabling Tables

These tables show the cabling routes from each single-phase power distribution unit (PDU) to the power supplies configured in an Oracle Exadata Database Machine X8M-2 and X8M-8.

- Single Phase PDU Cabling for Oracle Exadata Database Machine X8M-2 Full Rack
  Single phase cabling for the Oracle Exadata Database Machine X8M-2 Full Rack routes from each power distribution unit (PDU) to the power supplies.
- Single Phase PDU Cabling for Oracle Exadata Database Machine X8M-8 Full Rack
  Single phase cabling for the Oracle Exadata Database Machine X8M-8 Full Rack routes from each power distribution unit (PDU) to the power supplies.

17.4.1 Single Phase PDU Cabling for Oracle Exadata Database Machine X8M-2 Full Rack

Single phase cabling for the Oracle Exadata Database Machine X8M-2 Full Rack routes from each power distribution unit (PDU) to the power supplies.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

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Table 17-5 Single Phase PDU Cabling for Oracle Exadata Database Machine X8M-2 Full Rack

Rack Unit	PS	PDU-A	PDU-B/PS1	Cable Length
U42	PS0	G5-3	G0-3	2 meters
U41	PS0	G5-5	G0-1	2 meters
U40	PS0	G5-6	G0-0	2 meters
U39	PS0	G3-6	G2-0	2 meters
U37	PS0	G3-0	G2-6	2 meters
U35	PS0	G5-4	G0-2	2 meters
U33	PS0	G4-1	G1-5	2 meters
U31	PS0	G5-2	G0-4	2 meters
U29	PS0	G5-1	G0-5	2 meters
U27	PS0	G4-3	G1-3	2 meters
U26	PS0	G4-6	G1-0	2 meters
U25	PS0	G4-5	G1-1	2 meters
U24	PS0	G4-2	G1-4	2 meters
U23	PS0	G4-0	G1-6	2 meters
U22	PS2	G1-6	G4-0	2 meters
U21	PS2	G1-5	G4-1	2 meters
U20	PS2	G1-2	G4-4	2 meters
U19	PS0	G3-2	G2-4	2 meters
U18	PS0	G2-6	G3-0	2 meters
U17	PS0	G0-6	G5-0	2 meters
U16	PS0	G0-3	G5-3	2 meters
U14	PS0	G2-3	G3-3	2 meters
U12	PS0	G2-4	G3-2	2 meters
U10	PS0	G2-0	G3-6	2 meters
U8	PS0	G2-5	G3-1	2 meters
U6	PS0	G0-0	G5-6	2 meters
U4	PS0	G0-1	G5-5	2 meters
U2	PS0	G1-0	G4-6	2 meters
U1	PS2	G3-5	G2-1	3 meters

17.4.2 Single Phase PDU Cabling for Oracle Exadata Database Machine X8M-8 Full Rack

Single phase cabling for the Oracle Exadata Database Machine X8M-8 Full Rack routes from each power distribution unit (PDU) to the power supplies.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in

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groups of four. The PDU connections in the table below list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 17-6 Single Phase PDU Cabling for Oracle Exadata Database Machine X8M-8 Full Rack

Rack Unit	PS	PDU-A	PDU-B/PSU 1	Cable Length
U41	PS0	G3-5	G2-1	2 meters
U39	PS0	G5-4	G0-2	2 meters
U37	PS0	G5-2	G0-4	2 meters
U35	PS0	G5-0	G0-6	2 meters
U33	PS0	G3-4	G2-2	2 meters
U31	PS0	G4-3	G1-3	2 meters
U29	PS0	G3-6	G2-0	2 meters
U24	PS0	G2-7 (PS2)	G3-7 (PS3)	1 meter
U24	PS0	G4-7	G1-7	1 meter
U23	PS2	G3-1	G2-5	2 meters
U22	PS2	G2-6	G3-0	2 meters
U21	PS2	G1-6	G4-0	2 meters
U16	PS0	G1-7 (PS2)	G4-7 (PS3)	1 meter
U16	PS0	G3-7	G2-7	1 meter
U14 (only 2 DB servers)	PS0	G2-0	G3-6	2 meters
U12 (only 2 DB servers)	PS0	G1-3	G4-3	2 meters
U10 (only 2 DB servers)	PS0	G1-0	G4-6	2 meters
U10 (3 DB servers)	PS0	G0-7 (PS2)	G5-7 (PS3)	1 meter
U10 (3 DB servers)	PS0	G5-7	G0-7	2 meters
U8	PS0	G0-6	G5-0	2 meters
U6	PS0	G0-4	G5-2	2 meters
U4	PS0	G0-3	G5-3	2 meters
U2	PS0	G0-1	G5-5	2 meters
U1	PS2	G4-0	G1-6	3 meters

17.5 Three-Phase Power Distribution Unit Cabling Tables

This section contains the tables for a three-phase power distribution unit (PDU) in Oracle Exadata X8M-2 and X8M-8.

- Three-Phase PDU Cabling for Oracle Exadata Database Machine X8M-2 Full Rack
  Three-phase cabling for the Oracle Exadata Database Machine X8M-2 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.
- Three Phase PDU Cabling for Oracle Exadata Database Machine X8M-8 Full Rack
  Three-phase cabling for the Oracle Exadata Database Machine X8M-8 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.

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17.5.1 Three-Phase PDU Cabling for Oracle Exadata Database Machine X8M-2 Full Rack

Three-phase cabling for the Oracle Exadata Database Machine X8M-2 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 17-7 Three Phase PDU Cabling for Oracle Exadata Database Machine X8M-2 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G5-4	G2-2	2 meters
U41	G5-2	G2-4	2 meters
U40	G5-1	G2-5	2 meters
U39	G5-6	G2-0	2 meters
U37	G3-5	G0-1	2 meters
U35	G3-0	G0-6	2 meters
U33	G5-5	G2-1	2 meters
U31	G5-3	G2-3	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-2	G0-4	2 meters
U26	G5-0	G2-6	2 meters
U25	G4-5	G1-1	2 meters
U24	G3-1	G0-5	2 meters
U23	G4-1	G1-5	2 meters
U22	G1-6	G4-0	2 meters
U21	G2-6	G5-0	2 meters
U20	G1-5	G4-1	2 meters
U19	G1-1	G4-5	2 meters
U18	G1-4	G4-2	2 meters
U17	G2-1	G5-5	2 meters
U16	G2-3	G5-3	2 meters
U14	G0-5	G3-1	2 meters
U12	G2-5	G5-1	2 meters
U10	G0-3	G3-3	2 meters
U8	G1-3	G4-3	2 meters
U6	G2-4	G5-2	2 meters
U4	G0-6	G3-0	2 meters
U2	G0-0	G3-6	2 meters
U1	G1-0	G4-6	3 meters

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17.5.2 Three Phase PDU Cabling for Oracle Exadata Database Machine X8M-8 Full Rack

Three-phase cabling for the Oracle Exadata Database Machine X8M-8 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 17-8 Three Phase PDU Cabling for Oracle Exadata Database Machine X8M-8 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U41	G5-5	G2-1	2 meters
U39	G5-4	G2-2	2 meters
U37	G5-2	G2-4	2 meters
U35	G5-1	G2-5	2 meters
U33	G5-0	G2-6	2 meters
U31	G4-6	G1-0	2 meters
U29	G4-4	G1-2	2 meters
U24	G3-7 (PS2)	G0-7 (PS3)	2 meters
U24	G4-7	G1-7	2 meters
U23	G3-1	G0-5	2 meters
U22	G3-0	G0-6	2 meters
U21	G2-5	G5-1	2 meters
U16	G2-7 (PS2)	G5-7 (PS3)	2 meters
U16	G1-7	G4-7	2 meters
U14 (only 2 DB servers)	G1-3	G4-3	2 meters
U12 (only 2 DB servers)	G1-0	G4-6	2 meters
U10 (only 2 DB servers)	G0-6	G3-0	2 meters
U10 (3 DB servers)	G5-7 (PS2)	G2-7 (PS3)	1 meter
U10 (3 DB servers)	G0-7	G3-7	1 meter
U8	G0-5	G3-1	2 meters
U6	G0-4	G3-2	2 meters
U4	G0-2	G3-4	2 meters
U2	G0-1	G3-5	2 meters
U1	G0-0	G3-6	3 meters

17.6 RDMA Network Fabric Network Cabling Tables

This section contains the tables for RDMA Network Fabric network cabling for Oracle Exadata X8M-2 and X8M-8 racks.

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- RDMA Network Fabric Network Cabling Tables for X8M-2 Racks
  This topic contains the tables for RDMA Network Fabric network cabling for Oracle Exadata X8M-2 racks.
- RDMA Network Fabric Network Cabling Tables for X8M-8 Racks
  This topic contains the tables for RDMA Network Fabric network cabling for Oracle Exadata X8M-8 racks.

17.6.1 RDMA Network Fabric Network Cabling Tables for X8M-2 Racks

This topic contains the tables for RDMA Network Fabric network cabling for Oracle Exadata X8M-2 racks.

The RoCE Network Fabric switches are located in rack units 20 and 22 for Oracle Exadata X8M-2.

You can use the following tables for both flexible and fixed configurations. This first table contains RDMA Network Fabric cabling information for the database servers, each of which occupies 1RU. The second table covers the storage servers, each of which occupies 2RU. The last table contains the inter-switch cabling between the leaf switches.

> **Note**
>
> Not all the slots shown in the tables below will be used in a single configuration. Match the rack component with the appropriate slot in the tables below to determine how to cable that particular component.

In the following tables, U*n* denotes the slot in the rack, where *n* is the number, such as U20. P*n* denotes the RDMA Network Fabric port *n*, where *n* is port number, such as P1. The cables used for the RDMA Network Fabric switch are black in color. The following tables are in this section:

- Table 17-9 RDMA Network Fabric Network Cabling for Oracle Exadata X8M-2 Database Servers
- Table 17-10 RDMA Network Fabric Network Cabling for Oracle Exadata X8M-2 Storage Servers
- Table 17-11 RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata X8M-2

The following table lists the location, ports and cables for the RDMA Network Fabric connections for database servers in an Oracle Exadata X8M-2 rack.

Table 17-9 RDMA Network Fabric Network Cabling for Oracle Exadata Database Machine X8M-2 Database Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U39	PCIe 2, P2	U22	08	3 meters
U39	PCIe 2, P1	U20	08	3 meters
U37	PCIe 2, P2	U22	09	3 meters
U37	PCIe 2, P1	U20	09	3 meters
U35	PCIe 2, P2	U22	10	3 meters
U35	PCIe 2, P1	U20	10	3 meters

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Table 17-9 (Cont.) RDMA Network Fabric Network Cabling for Oracle Exadata Database Machine X8M-2 Database Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U33	PCIe 2, P2	U22	11	3 meters
U33	PCIe 2, P1	U20	11	3 meters
U31	PCIe 2, P2	U22	12	3 meters
U31	PCIe 2, P1	U20	12	3 meters
U29	PCIe 2, P2	U22	13	3 meters
U29	PCIe 2, P1	U20	13	3 meters
U27	PCIe 2, P2	U22	14	3 meters
U27	PCIe 2, P1	U20	14	3 meters
U26	PCIe 2, P2	U22	15	3 meters
U26	PCIe 2, P1	U20	15	3 meters
U25	PCIe 2, P2	U22	16	3 meters
U25	PCIe 2, P1	U20	16	3 meters
U24	PCIe 2, P2	U22	17	3 meters
U24	PCIe 2, P1	U20	17	3 meters
U23	PCIe 2, P2	U22	18	3 meters
U23	PCIe 2, P1	U20	18	3 meters
U19	PCIe 2, P2	U22	19	3 meters
U19	PCIe 2, P1	U20	19	3 meters
U18	PCIe 2, P2	U22	20	3 meters
U18	PCIe 2, P1	U20	20	3 meters
U17	PCIe 2, P2	U22	21	3 meters
U17	PCIe 2, P1	U20	21	3 meters
U16	PCIe 2, P2	U22	22	3 meters
U16	PCIe 2, P1	U20	22	3 meters
U14	PCIe 2, P2	U22	23	3 meters
U14	PCIe 2, P1	U20	23	3 meters
U12	PCIe 2, P2	U22	24	3 meters
U12	PCIe 2, P1	U20	24	3 meters
U10	PCIe 2, P2	U22	25	3 meters
U10	PCIe 2, P1	U20	25	3 meters
U08	PCIe 2, P2	U22	26	3 meters
U08	PCIe 2, P1	U20	26	3 meters

The following table lists the location, ports and cables for the RDMA Network Fabric connections for storage servers in an Oracle Exadata X8M-2 rack.

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Table 17-10 RDMA Network Fabric Network Cabling for Oracle Exadata Database Machine X8M-2 Storage Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U41	PCIe 1, P2	U22	15	3 meters
U41	PCIe 1, P1	U20	15	3 meters
U39	PCIe 1, P2	U22	08	3 meters
U39	PCIe 1, P1	U20	08	3 meters
U37	PCIe 1, P2	U22	09	3 meters
U37	PCIe 1, P1	U20	09	3 meters
U35	PCIe 1, P2	U22	10	3 meters
U35	PCIe 1, P1	U20	10	3 meters
U33	PCIe 1, P2	U22	11	3 meters
U33	PCIe 1, P1	U20	11	3 meters
U31	PCIe 1, P2	U22	12	3 meters
U31	PCIe 1, P1	U20	12	3 meters
U29	PCIe 1, P2	U22	13	3 meters
U29	PCIe 1, P1	U20	13	3 meters
U27	PCIe 1, P2	U22	14	3 meters
U27	PCIe 1, P1	U20	14	3 meters
U25	PCIe 1, P2	U22	16	3 meters
U25	PCIe 1, P1	U20	16	3 meters
U23	PCIe 1, P2	U22	18	3 meters
U23	PCIe 1, P1	U20	18	3 meters
U18	PCIe 1, P2	U22	20	3 meters
U18	PCIe 1, P1	U20	20	3 meters
U14	PCIe 1, P2	U22	23	3 meters
U14	PCIe 1, P1	U20	23	3 meters
U12	PCIe 1, P2	U22	24	3 meters
U12	PCIe 1, P1	U20	24	3 meters
U10	PCIe 1, P2	U22	25	3 meters
U10	PCIe 1, P1	U20	25	3 meters
U08	PCIe 1, P2	U22	26	3 meters
U08	PCIe 1, P1	U20	26	3 meters
U06	PCIe 1, P2	U22	27	3 meters
U06	PCIe 1, P1	U20	27	3 meters
U04	PCIe 1, P2	U22	28	3 meters
U04	PCIe 1, P1	U20	28	3 meters
U02	PCIe 1, P2	U22	29	3 meters
U02	PCIe 1, P1	U20	29	3 meters

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The following table lists the location, ports and cables for the RDMA Network Fabric connections for the leaf switches in an Oracle Exadata X8M-2 rack.

Table 17-11 RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata Database Machine X8M-2

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U20	04	U22	04	1 meter
U20	05	U22	05	1 meter
U20	06	U22	06	1 meter
U20	07	U22	07	1 meter
U20	30	U22	30	1 meter
U20	31	U22	31	1 meter
U20	32	U22	32	1 meter
U20	33	U22	33	1 meter

17.6.2 RDMA Network Fabric Network Cabling Tables for X8M-8 Racks

This topic contains the tables for RDMA Network Fabric network cabling for Oracle Exadata X8M-8 racks.

The RoCE Network Fabric switches are located in rack units 21 and 23 for Oracle Exadata X8M-8.

The following tables can be used for both flexible and fixed configurations. There are three sets of tables for each Exadata hardware model. One table is for storage servers, which have a 2-slot height (2RU). Another table is for the database servers, which require 5RU. The last table for each hardware model is for the inter-switch cabling, which provides the cabling information for the leaf switches.

> **Note**
>
> Not all the slots shown in the tables below will be used in a single configuration. Match the rack component with the appropriate slot in the tables below to determine how to cable that particular component.

In the following tables, U*n* denotes the slot in the rack, where *n* is the number, such as U23. P*n* denotes the RDMA Network Fabric port *n*, where *n* is port number, such as P1. The cables used for the RDMA Network Fabric switch are black in color. The following tables are in this section:

- Table 17-12 RDMA Network Fabric Network Cabling for Oracle Exadata X8M-8 Database Servers
- Table 17-13 RDMA Network Fabric Network Cabling for Oracle Exadata X8M-8 Storage Servers
- Table 17-14 RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata X8M-8

The following table lists the rack location, ports and cables for the RDMA Network Fabric connections for database servers in an Oracle Exadata X8M-8 rack.

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Table 17-12 RDMA Network Fabric Network Cabling for Oracle Exadata Database Machine X8M-8 Database Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U24	PCIe 5, P2	U23	15	3 meters
U24	PCIe 5, P1	U21	15	3 meters
U24	PCIe 7, P2	U23	16	3 meters
U24	PCIe 7, P1	U21	16	3 meters
U24	PCIe 9, P2	U23	17	3 meters
U24	PCIe 9, P1	U21	17	3 meters
U24	PCIe 11, P2	U23	18	3 meters
U24	PCIe 11, P1	U21	18	3 meters
U16	PCIe 5, P2	U23	19	3 meters
U16	PCIe 5, P1	U21	19	3 meters
U16	PCIe 7, P2	U23	20	3 meters
U16	PCIe 7, P1	U21	20	3 meters
U16	PCIe 9, P2	U23	21	3 meters
U16	PCIe 9, P1	U21	21	3 meters
U16	PCIe 11, P2	U23	22	3 meters
U16	PCIe 11, P1	U21	22	3 meters
U10	PCIe 5, P2	U23	23	3 meters
U10	PCIe 5, P1	U21	23	3 meters
U10	PCIe 7, P2	U23	24	3 meters
U10	PCIe 7, P1	U21	24	3 meters
U10	PCIe 9, P2	U23	25	3 meters
U10	PCIe 9, P1	U21	25	3 meters
U10	PCIe 11, P2	U23	30 or 8 **Note:** Port 30 is the target only in a configuration with 3 database servers and 11 storage servers. Otherwise, port 8 is the target.	3 meters
U10	PCIe 11, P1	U21	30 or 8 **Note:** Port 30 is the target only in a configuration with 3 database servers and 11 storage servers. Otherwise, port 8 is the target.	3 meters

The following table lists the location, ports and cables for the RDMA Network Fabric connections for storage servers in an Oracle Exadata X8M-8 rack.

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Table 17-13 RDMA Network Fabric Network Cabling for Oracle Exadata Database Machine X8M-8 Storage Servers

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U41	PCIe 1, P2	U23	08	3 meters
U41	PCIe 1, P1	U21	08	3 meters
U39	PCIe 1, P2	U23	09	3 meters
U39	PCIe 1, P1	U21	09	3 meters
U37	PCIe 1, P2	U23	10	3 meters
U37	PCIe 1, P1	U21	10	3 meters
U35	PCIe 1, P2	U23	11	3 meters
U35	PCIe 1, P1	U21	11	3 meters
U33	PCIe 1, P2	U23	12	3 meters
U33	PCIe 1, P1	U21	12	3 meters
U31	PCIe 1, P2	U23	13	3 meters
U31	PCIe 1, P1	U21	13	3 meters
U29	PCIe 1, P2	U23	14	3 meters
U29	PCIe 1, P1	U21	14	3 meters
U14	PCIe 1, P2	U23	23	3 meters
U14	PCIe 1, P1	U21	23	3 meters
U12	PCIe 1, P2	U23	24	3 meters
U12	PCIe 1, P1	U21	24	3 meters
U10	PCIe 1, P2	U23	25	3 meters
U10	PCIe 1, P1	U21	25	3 meters
U08	PCIe 1, P2	U23	26	3 meters
U08	PCIe 1, P1	U21	26	3 meters
U06	PCIe 1, P2	U23	27	3 meters
U06	PCIe 1, P1	U21	27	3 meters
U04	PCIe 1, P2	U23	28	3 meters
U04	PCIe 1, P1	U21	28	3 meters
U02	PCIe 1, P2	U23	29	3 meters
U02	PCIe 1, P1	U21	29	3 meters

The following table lists the location, ports and cables for the RDMA Network Fabric connections for the leaf switches in an Oracle Exadata X8M-8 rack.

Table 17-14 RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata Database Machine X8M-8

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U21	04	U23	04	1 meter
U21	05	U23	05	1 meter

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Table 17-14 (Cont.) RDMA Network Fabric Inter-Switch Cabling for Oracle Exadata Database Machine X8M-8

From Rack Unit	Port	To RDMA Network Fabric Switch	Port	Description
U21	06	U23	06	1 meter
U21	07	U23	07	1 meter
U21	30 or 34 **Note:** Port 34 is used only in a configuration with 3 database servers and 11 storage servers. Otherwise, port 30 is used.	U23	30 or 34 **Note:** Port 34 is used only in a configuration with 3 database servers and 11 storage servers. Otherwise, port 30 is used.	1 meter
U21	31	U23	31	1 meter
U21	32	U23	32	1 meter
U21	33	U23	33	1 meter

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Cabling Tables for Oracle Exadata Database Machine X8-2, X8-8, X7-2, and X7-8

The tables in this chapter show the cable layouts for Oracle Exadata Database Machine X8-2, X8-8, X7-2, and X7-8.

> **Note**
>
> For ease of reading, the name "Oracle Exadata Rack" is used when information refers to both Oracle Exadata Database Machine and Oracle Exadata Storage Expansion Rack.

- Rack Layout Diagrams
  The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X8-2, X8-8, X7-2, and X7-8.
- Sun Integrated Lights Out Manager Cabling Tables
  This topic contains the tables for the Sun Integrated Lights Out Manager (ILOM) network cabling.
- Administrative Gigabit Ethernet Port Cabling Tables
  This topic contains the tables for the administrative Gigabit Ethernet network cabling.
- Single Phase Power Distribution Unit Cabling Tables
  This section contains the tables for a single phase power distribution unit (PDU) in an Oracle Exadata Database Machine X8-2, X8-8, X7-2, or X7-8.
- Three-Phase Power Distribution Unit Cabling Tables
  This section contains the tables for a three-phase power distribution unit (PDU) in an Oracle Exadata Database Machine X8-8, X8-2, X7-2, and X7-8.
- InfiniBand Network Cabling Tables
  This topic contains the tables for InfiniBand network cabling for Oracle Exadata Database Machine X8 and X7 racks.

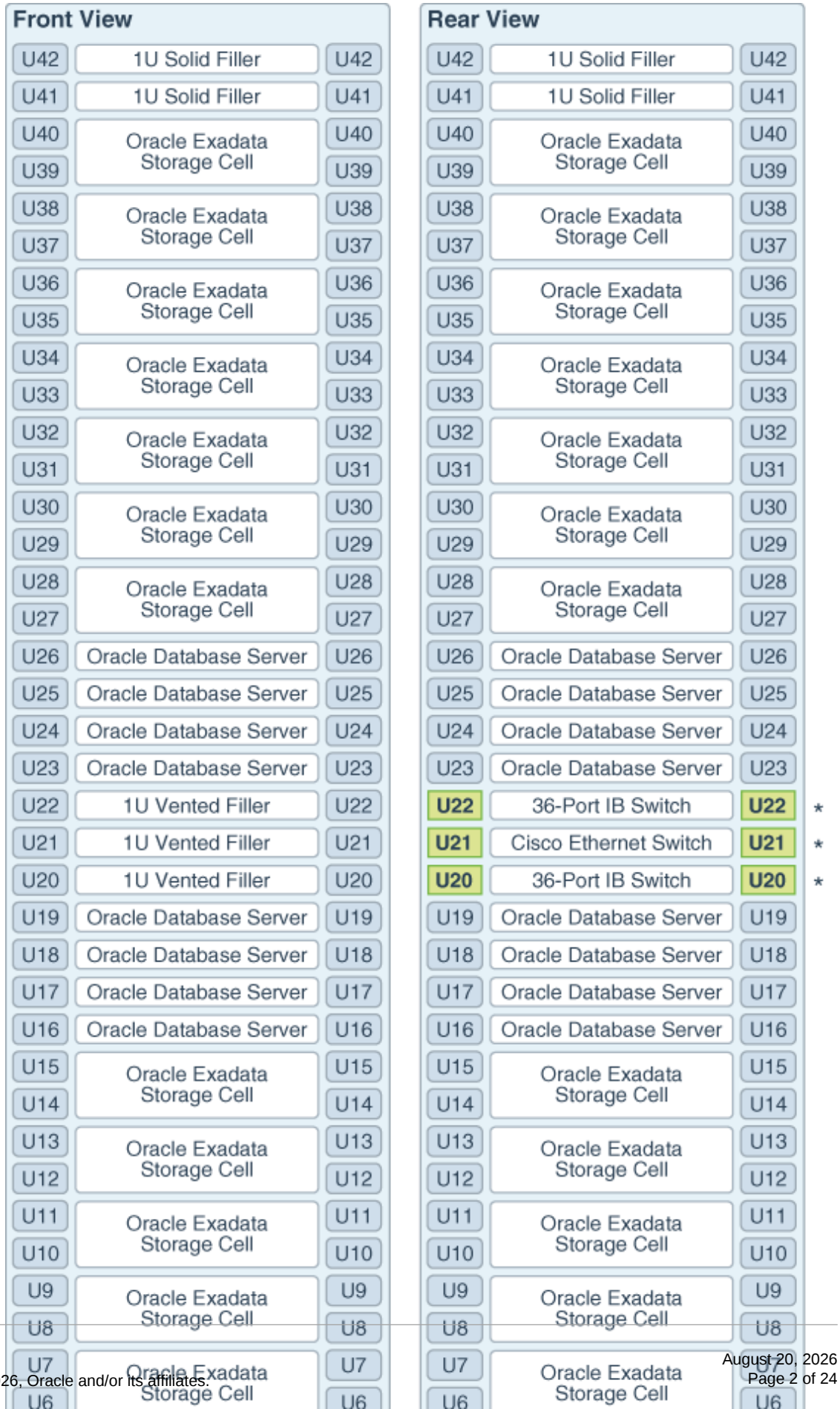
18.1 Rack Layout Diagrams

The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X8-2, X8-8, X7-2, and X7-8.

The following image shows the front and rear views of Oracle Exadata Database Machine X8-2 and X7-2 Full Rack. The front view is shown on the left, and the rear view is shown on the right.

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Figure 18-1 Rack Layout of Oracle Exadata Database Machine X8-2 and X7-2 Full Rack

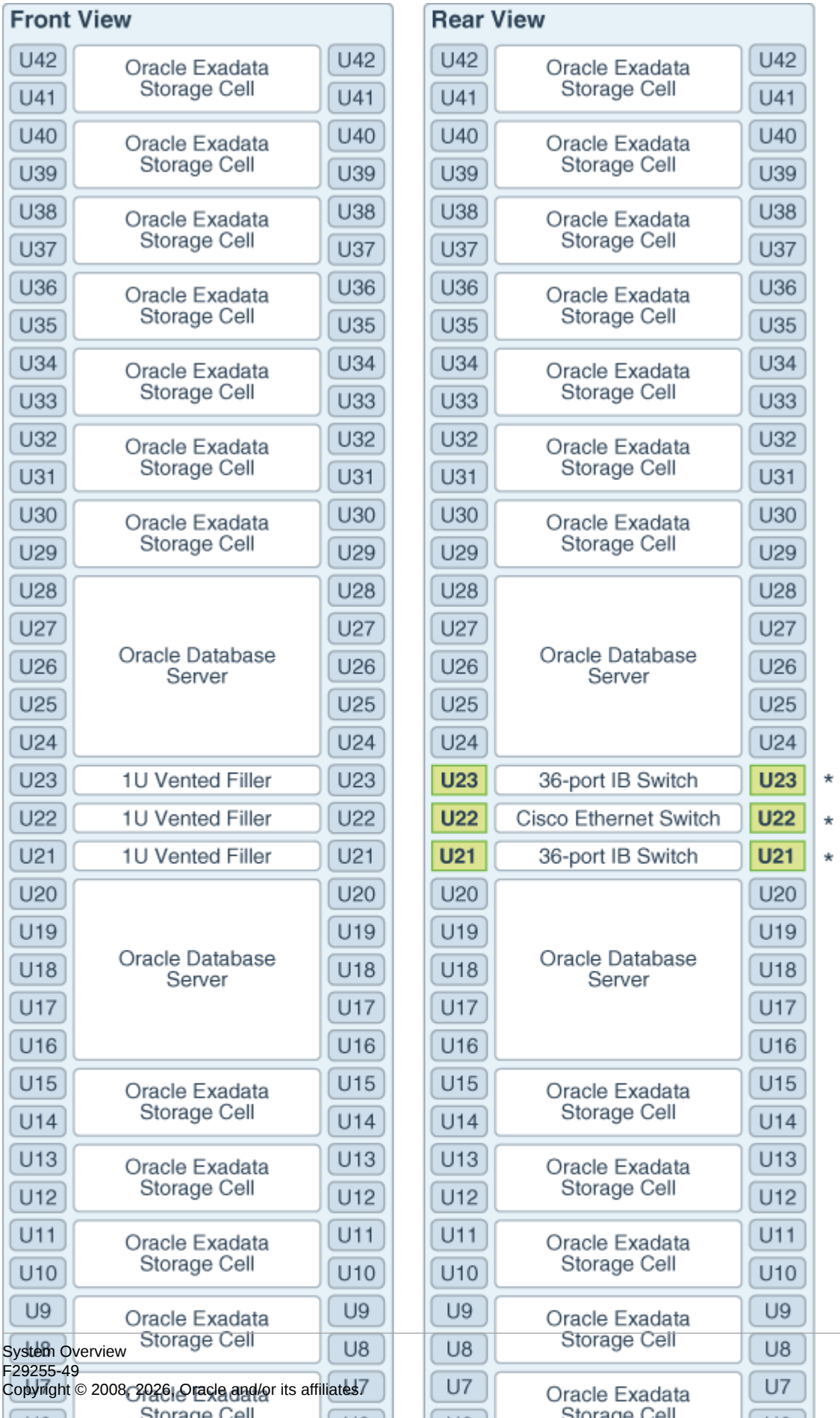


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The following image shows the front and rear views of Oracle Exadata Database Machine X8-8 and X7-8.

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Figure 18-2 Rack Layout of Oracle Exadata Database Machine X8-8 and X7-8



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18.2 Sun Integrated Lights Out Manager Cabling Tables

This topic contains the tables for the Sun Integrated Lights Out Manager (ILOM) network cabling.

The following tables are in this section:

- Table 18-1 ILOM Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack
- Table 18-2 ILOM Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

In the following tables, U*n* denotes the unit height in the rack, where *n* is the number, such as U20. The cables used for Integrated Lights Out Manager (ILOM) are red in color.

Table 18-1 ILOM Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U39	Exadata Storage Server	2
U37	Exadata Storage Server	4
U35	Exadata Storage Server	6
U33	Exadata Storage Server	8
U31	Exadata Storage Server	10
U29	Exadata Storage Server	12
U27	Exadata Storage Server	14
U26	Database server	16
U25	Database server	18
U24	Database server	20
U23	Database server	22
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Exadata Storage Server	32
U12	Exadata Storage Server	34
U10	Exadata Storage Server	36
U8	Exadata Storage Server	38
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X8-8 and X7-8 Full Rack:

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Table 18-2 ILOM Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	2
U39	Exadata Storage Server	4
U37	Exadata Storage Server	6
U35	Exadata Storage Server	8
U33	Exadata Storage Server	10
U31	Exadata Storage Server	12
U29	Exadata Storage Server	14
U24	Database server	16
U16	Database server	18
U14	Exadata Storage Server	20
U12	Exadata Storage Server	22
U10	Exadata Storage Server	24
U8	Exadata Storage Server	26
U6	Exadata Storage Server	28
U4	Exadata Storage Server	30
U2	Exadata Storage Server	32

18.3 Administrative Gigabit Ethernet Port Cabling Tables

This topic contains the tables for the administrative Gigabit Ethernet network cabling.

The Gigabit Ethernet switch is located in rack unit 21 on Oracle Exadata Database Machine X8-2, X8-8, X7-2, and X7-8 racks.

In the following tables, U*n* denotes the unit height in the rack, where *n* is the number, such as U20. The cables used for the Gigabit Ethernet switch are blue in color. The following tables are in this section:

- Table 18-3 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack
- Table 18-4 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

Table 18-3 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U39	Exadata Storage Server	1
U37	Exadata Storage Server	3
U35	Exadata Storage Server	5
U33	Exadata Storage Server	7
U31	Exadata Storage Server	9

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Table 18-3 (Cont.) Gigabit Ethernet Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U29	Exadata Storage Server	11
U27	Exadata Storage Server	13
U26	Database server	15
U25	Database server	17
U24	Database server	19
U23	Database server	21
U22	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Exadata Storage Server	31
U12	Exadata Storage Server	33
U10	Exadata Storage Server	35
U8	Exadata Storage Server	37
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43
U1	Sun Datacenter InfiniBand Switch 36 switch Note that the spine switch is no longer included by default on Exadata X4-2 and newer models, but port 47 is still reserved on the Cisco switch for the spine InfiniBand switch.	47

The following table shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X8-8 and X7-8 Full Rack:

Table 18-4 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	1
U39	Exadata Storage Server	3
U37	Exadata Storage Server	5
U35	Exadata Storage Server	7

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Table 18-4 (Cont.) Gigabit Ethernet Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U33	Exadata Storage Server	9
U31	Exadata Storage Server	11
U29	Exadata Storage Server	13
U24	Database server	15
U23	Sun Datacenter InfiniBand Switch 36	33
U21	Sun Datacenter InfiniBand Switch 36	34
U16	Database server	17
U14	Exadata Storage Server	19
U12	Exadata Storage Server	21
U10	Exadata Storage Server	23
U8	Exadata Storage Server	25
U6	Exadata Storage Server	27
U4	Exadata Storage Server	29
U2	Exadata Storage Server	31
U1	Sun Datacenter InfiniBand Switch 36 Note that the spine switch is no longer included by default on Exadata X4-2 and newer models, but port 47 is still reserved on the Cisco switch for the spine InfiniBand switch.	35

18.4 Single Phase Power Distribution Unit Cabling Tables

This section contains the tables for a single phase power distribution unit (PDU) in an Oracle Exadata Database Machine X8-2, X8-8, X7-2, or X7-8.

- Single Phase PDU Cabling for Oracle Exadata Database Machine X8-2 Full Rack
  Single phase cabling for the Oracle Exadata Database Machine X8-2 Full Rack routes from each power distribution unit (PDU) to the power supplies.
- Single Phase PDU Cabling for Oracle Exadata Database Machine X8-8 Full Rack
  Single phase cabling for the Oracle Exadata Database Machine X8-8 Full Rack routes from each power distribution unit (PDU) to the power supplies.
- Single Phase PDU Cabling for Oracle Exadata Database Machine X7-2 Full Rack
  Single phase cabling for the Exadata Database Machine X7-2 Full Rack routes from each power distribution unit (PDU) to the power supplies.
- Single Phase PDU Cabling for Oracle Exadata Database Machine X7-8 Full Rack
  Single phase cabling for the Oracle Exadata Database Machine X7-8 Full Rack routes from each power distribution unit (PDU) to the power supplies.

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18.4.1 Single Phase PDU Cabling for Oracle Exadata Database Machine X8-2 Full Rack

Single phase cabling for the Oracle Exadata Database Machine X8-2 Full Rack routes from each power distribution unit (PDU) to the power supplies.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter CMA. The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 18-5 Single Phase PDU Cabling for Oracle Exadata Database Machine X8-2 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G3-5	G2-1	2 meters
U41	G5-5	G0-1	2 meters
U40	G3-3	G2-3	2 meters
U39	G5-4	G0-2	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-2	G0-4	2 meters
U33	G4-4	G1-2	2 meters
U31	G4-3	G1-3	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-0	G2-6	2 meters
U26	G5-1	G0-5	2 meters
U25	G5-0	G0-6	2 meters
U24	G4-1	G1-5	2 meters
U23	G3-6	G2-0	2 meters
U22	G1-2	G4-4	2 meters
U21	G0-5	G5-1	2 meters
U20	G0-4	G5-2	2 meters
U19	G2-4	G3-2	2 meters
U18	G1-1	G4-5	2 meters
U17	G0-3	G5-3	2 meters
U16	G0-2	G5-4	2 meters
U14	G2-3	G3-3	2 meters
U12	G2-2	G3-4	2 meters
U10	G2-1	G3-5	2 meters
U8	G2-0	G3-6	2 meters
U6	G1-0	G4-6	2 meters
U4	G0-1	G5-5	2 meters
U2	G0-0	G5-6	2 meters

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Table 18-5 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X8-2 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U1	G4-0	G1-6	3 meters

18.4.2 Single Phase PDU Cabling for Oracle Exadata Database Machine X8-8 Full Rack

Single phase cabling for the Oracle Exadata Database Machine X8-8 Full Rack routes from each power distribution unit (PDU) to the power supplies.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter CMA. The cables are bundled in groups of four. The PDU connections in the table below list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 18-6 Single Phase PDU Cabling for Oracle Exadata Database Machine X8-8 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U41	G3-5	G2-1	2 meters
U39	G5-4	G0-2	2 meters
U37	G5-2	G0-4	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-3	G1-3	2 meters
U29	G3-6	G2-0	2 meters
U24	G2-7 (PS2)	G3-7 (PS3)	2 meters
U24	G4-7	G1-7	2 meters
U23	G3-1	G2-5	2 meters
U22	G2-6	G3-0	2 meters
U21	G3-0	G2-6	2 meters
U16	G1-7 (PS2)	G4-7 (PS3)	2 meters
U16	G3-7	G2-7	2 meters
U14 (only 2 DB servers)	G2-0	G3-6	2 meters
U12 (only 2 DB servers)	G1-3	G4-3	2 meters
U10 (only 2 DB servers)	G1-0	G4-6	2 meters
U10 (3 DB servers)	G0-7 (PS2)	G5-7 (PS3)	2 meters
U10 (3 DB servers)	G5-7	G0-7	2 meters
U8	G0-6	G5-0	2 meters
U6	G0-4	G5-2	2 meters
U4	G0-3	G5-3	2 meters
U2	G0-1	G5-5	2 meters

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Table 18-6 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X8-8 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U1	G0-0	G5-6	3 meters

18.4.3 Single Phase PDU Cabling for Oracle Exadata Database Machine X7-2 Full Rack

Single phase cabling for the Exadata Database Machine X7-2 Full Rack routes from each power distribution unit (PDU) to the power supplies.

The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

Table 18-7 Single Phase PDU Cabling for Oracle Exadata Database Machine X7-2 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G5-5	G0-1	2 meters
U41	G3-6	G2-0	2 meters
U40	G5-2	G0-4	2 meters
U39	G5-6	G0-0	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-1	G0-5	2 meters
U33	G5-0	G0-6	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-3	G1-3	2 meters
U27	G3-5	G2-1	2 meters
U26	G4-5	G1-1	2 meters
U25	G4-2	G1-4	2 meters
U24	G4-1	G1-5	2 meters
U23	G2-5	G3-1	2 meters
U22	G1-4	G4-2	2 meters
U21	G1-3	G4-3	2 meters
U20	G1-5	G4-1	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G1-6	G4-0	2 meters
U16	G1-2	G4-4	2 meters
U14	G2-4	G3-2	2 meters
U12	G2-1	G3-5	2 meters
U10	G2-0	G3-6	2 meters

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Table 18-7 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X7-2 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G4-0	G1-6	3 meters

18.4.4 Single Phase PDU Cabling for Oracle Exadata Database Machine X7-8 Full Rack

Single phase cabling for the Oracle Exadata Database Machine X7-8 Full Rack routes from each power distribution unit (PDU) to the power supplies.

The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

Table 18-8 Single Phase PDU Cabling for Oracle Exadata Database Machine X7-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-6	G0-0	2 meters
U39	G5-4	G0-2	2 meters
U37	G5-2	G0-4	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-3	G1-3	2 meters
U29	G3-6	G2-0	2 meters
U24	G4-7 (C19) (ACO)	G1-7 (C19) (AC1)	1 meter
U24	G2-7 (C19) (AC2)	G3-7 (C19) (AC3)	1 meter
U23	G3-1	G2-5	2 meters
U22	G2-6 (PS-2)	G3-0 (PS-1)	2 meters
U21	G3-0	G2-6	2 meters
U16	G3-7 (C19) (AC0)	G2-7 (C19) (AC1)	1 meter
U16	G1-7 (C19) (AC2)	G4-7 (C19) (AC3)	1 meter
U14	G2-0	G3-6	2 meters
U12	G1-3	G4-3	2 meters
U10	G1-0	G4-6	2 meters
U8	G0-6	G5-0	2 meters
U6	G0-4	G5-2	2 meters
U4	G0-3	G5-3	2 meters

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Table 18-8 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X7-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U2	G0-1	G5-5	2 meters
U1	G0-0	G5-6	2 meters

18.5 Three-Phase Power Distribution Unit Cabling Tables

This section contains the tables for a three-phase power distribution unit (PDU) in an Oracle Exadata Database Machine X8-8, X8-2, X7-2, and X7-8.

- Three-Phase PDU Cabling for Oracle Exadata Database Machine X8-2 Full Rack
  Three-phase cabling for the Oracle Exadata Database Machine X8-2 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.
- Three Phase PDU Cabling for Oracle Exadata Database Machine X8-8 Full Rack
  Three-phase cabling for the Oracle Exadata Database Machine X8-8 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.
- Three-Phase PDU Cabling for Oracle Exadata Database Machine X7-2 Full Rack
  Three-phase cabling for the Oracle Exadata Database Machine X7-2 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.
- Three Phase PDU Cabling for Oracle Exadata Database Machine X7-8 Full Rack
  Three-phase cabling for the Exadata Database Machine X7-2 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.

18.5.1 Three-Phase PDU Cabling for Oracle Exadata Database Machine X8-2 Full Rack

Three-phase cabling for the Oracle Exadata Database Machine X8-2 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter CMA. The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 18-9 Three Phase PDU Cabling for Oracle Exadata Database Machine X8-2 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G5-6	G2-0	2 meters
U41	G5-3	G2-3	2 meters
U40	G3-5	G0-1	2 meters
U39	G4-3	G1-3	2 meters
U37	G5-2	G2-4	2 meters
U35	G3-2	G0-4	2 meters
U33	G4-2	G1-4	2 meters

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Table 18-9 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X8-2 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U31	G5-1	G2-5	2 meters
U29	G3-6	G0-0	2 meters
U27	G4-1	G1-5	2 meters
U26	G3-1	G0-5	2 meters
U25	G4-0	G1-6	2 meters
U24	G3-0	G0-6	2 meters
U23	G2-6	G5-0	2 meters
U22	G1-5	G4-1	2 meters
U21	G2-4	G5-2	2 meters
U20	G1-4	G4-2	2 meters
U19	G0-6	G3-0	2 meters
U18	G2-3	G5-3	2 meters
U17	G0-2	G3-4	2 meters
U16	G0-1	G3-5	2 meters
U14	G1-3	G4-3	2 meters
U12	G1-2	G4-4	2 meters
U10	G1-1	G4-5	2 meters
U8	G2-2	G5-4	2 meters
U6	G0-0	G3-6	2 meters
U4	G2-1	G5-5	2 meters
U2	G2-0	G5-6	2 meters
U1	G1-0	G4-6	3 meters

18.5.2 Three Phase PDU Cabling for Oracle Exadata Database Machine X8-8 Full Rack

Three-phase cabling for the Oracle Exadata Database Machine X8-8 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter CMA. The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 18-10 Three Phase PDU Cabling for Oracle Exadata Database Machine X8-8 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U41	G5-5	G2-1	2 meters
U39	G5-4	G2-2	2 meters

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Table 18-10 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X8-8 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U37	G5-2	G2-4	2 meters
U35	G5-1	G2-5	2 meters
U33	G5-0	G2-6	2 meters
U31	G4-6	G1-0	2 meters
U29	G4-4	G1-2	2 meters
U24	G3-7 (PS2)	G0-7 (PS3)	2 meters
U24	G4-7	G1-7	2 meters
U23	G3-1	G0-5	2 meters
U22	G3-0	G0-6	2 meters
U21	G2-5	G5-1	2 meters
U16	G2-7 (PS2)	G5-7 (PS3)	2 meters
U16	G1-7	G4-7	2 meters
U14 (only 2 DB servers)	G1-3	G4-3	2 meters
U12 (only 2 DB servers)	G1-0	G4-6	2 meters
U10 (only 2 DB servers)	G0-6	G3-0	2 meters
U10 (3 DB servers)	G5-7 (PS2)	G2-7 (PS3)	2 meters
U10 (3 DB servers)	G0-7	G3-7	2 meters
U8	G0-5	G3-1	2 meters
U6	G0-4	G3-2	2 meters
U4	G0-2	G3-4	2 meters
U2	G0-1	G3-5	2 meters
U1	G0-0	G3-6	3 meters

18.5.3 Three-Phase PDU Cabling for Oracle Exadata Database Machine X7-2 Full Rack

Three-phase cabling for the Oracle Exadata Database Machine X7-2 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter CMA. The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

Table 18-11 Three Phase PDU Cabling for Oracle Exadata Database Machine X7-2 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G5-4	G2-2	2 meters
U41	G5-6	G2-0	2 meters

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Table 18-11 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X7-2 Full Rack

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U40	G4-6	G1-0	2 meters
U39	G4-5	G1-1	2 meters
U37	G3-5	G0-1	2 meters
U35	G5-5	G2-1	2 meters
U33	G4-3	G1-3	2 meters
U31	G3-1	G0-5	2 meters
U29	G4-0	G1-6	2 meters
U27	G5-3	G2-3	2 meters
U26	G5-1	G2-5	2 meters
U25	G3-3	G0-3	2 meters
U24	G4-4	G1-2	2 meters
U23	G3-2	G0-4	2 meters
U22	G2-6	G5-0	2 meters
U21	G1-0	G4-6	2 meters
U20	G0-0	G3-6	2 meters
U19	G2-5	G5-1	2 meters
U18	G0-6	G3-0	2 meters
U17	G1-6	G4-0	2 meters
U16	G2-1	G5-5	2 meters
U14	G1-4	G4-2	2 meters
U12	G2-3	G5-3	2 meters
U10	G2-0	G5-6	2 meters
U8	G1-2	G4-4	2 meters
U6	G1-1	G4-5	2 meters
U4	G0-2	G3-4	2 meters
U2	G0-1	G3-5	2 meters
U1	G2-2	G5-4	3 meters

18.5.4 Three Phase PDU Cabling for Oracle Exadata Database Machine X7-8 Full Rack

Three-phase cabling for the Exadata Database Machine X7-2 Full Rack routes from each power distribution unit (PDU) to the power supplies configured in each rack.

The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

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Table 18-12 Three Phase PDU Cabling for Oracle Exadata Database Machine X7-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-5	G2-1	2 meters
U39	G5-4	G2-2	2 meters
U37	G5-2	G2-4	2 meters
U35	G5-1	G2-5	2 meters
U33	G5-0	G2-6	2 meters
U31	G4-6	G1-0	2 meters
U29	G4-4	G1-2	2 meters
U24	AC0 to G4-7 (C19)	AC1 to G1-7 (C19)	1 meter
U24	AC2 to G3-7 (C19)	AC3 to G0-7 (C19)	1 meter
U23	G3-1	G0-5	2 meters
U22	G3-0	G0-6	2 meters
U21	G2-5	G5-1	2 meters
U16	AC0 to G1-7 (C19)	AC1 to G4-7 (C19)	1 meter
U16	AC2 to G2-7 (C19)	AC3 to G5-7 (C19)	1 meter
U14	G1-3	G4-3	2 meters
U12	G1-0	G4-6	2 meters
U10	G0-6	G3-0	2 meters
U8	G0-5	G3-1	2 meters
U6	G0-4	G3-2	2 meters
U4	G0-2	G3-4	2 meters
U2	G0-1	G3-5	2 meters
U1	G0-0	G3-6	2 meters

18.6 InfiniBand Network Cabling Tables

This topic contains the tables for InfiniBand network cabling for Oracle Exadata Database Machine X8 and X7 racks.

The Sun Datacenter InfiniBand Switch 36 switches are located in rack units 20 and 22. If present, the optional spine switch is located in rack unit 1.

In the following tables, U*n* denotes the unit height in the rack, where *n* is the number, such as U20. P*n* denotes the InfiniBand port *n*, where *n* is port number, such as P1. The cables used for the InfiniBand switch are black in color. The following tables are in this section:

- Table 18-13 InfiniBand Network Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack
- Table 18-14 InfiniBand Network Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack.

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Table 18-13 InfiniBand Network Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	0A	U39	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U22	0B	U37	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U22	1A	U35	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U22	1B	U33	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U22	2A	U31	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U22	2B	U29	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U22	3B	U27	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U22	3A	U26	Oracle Exadata Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U22	4A	U25	Oracle Exadata Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U22	4B	U24	Oracle Exadata Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U22	5A	U23	Oracle Exadata Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U22	12B	U19	Oracle Exadata Database Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U22	13A	U18	Oracle Exadata Database Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U22	13B	U17	Oracle Exadata Database Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U22	14B	U16	Oracle Exadata Database Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U22	14A	U14	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U22	15A	U12	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U22	15B	U10	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable

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Table 18-13 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	16A	U8	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U20	0A	U39	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U20	0B	U37	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U20	1A	U35	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U20	1B	U33	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U20	2A	U31	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U20	2B	U29	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U20	3B	U27	Oracle Exadata Storage Server	PCIe 7, P2	3 meter QDR InfiniBand cable
U20	3A	U26	Oracle Exadata Database Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U20	4A	U25	Oracle Exadata Database Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U20	4B	U24	Oracle Exadata Database Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U20	5A	U23	Oracle Exadata Database Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U20	12B	U19	Oracle Exadata Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	13A	U18	Oracle Exadata Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	13B	U17	Oracle Exadata Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable

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Table 18-13 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	14B	U16	Oracle Exadata Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14A	U14	Oracle Exadata Storage Server	PCIe 7, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 7, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable

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Table 18-13 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X8-2 and X7-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U1 — when added as an optional configuration	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack.

Table 18-14 InfiniBand Network Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	0A	U41	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	0B	U39	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	1A	U37	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	1B	U35	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	2A	U33	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	2B	U31	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	3B	U29	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	3A	U24	Oracle Exadata Database Server	12 PCIe3 P1	2 meter QDR InfiniBand cable
U23	4A	U24	Oracle Exadata Database Server	10 PCIe3 P1	2 meter QDR InfiniBand cable
U23	4B	U24	Oracle Exadata Database Server	8 PCIe3 P1	2 meter QDR InfiniBand cable

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Table 18-14 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	5A	U24	Oracle Exadata Database Server	6 PCIe3 P1	2 meter QDR InfiniBand cable
U23	13A	U16	Oracle Exadata Database Server	10 PCIe3 P2	2 meter QDR InfiniBand cable
U23	13B	U16	Oracle Exadata Database Server	8 PCIe3 P2	2 meter QDR InfiniBand cable
U23	14B	U16	Oracle Exadata Database Server	6 PCIe3 P2	2 meter QDR InfiniBand cable
U23	12B	U16	Oracle Exadata Database Server	12 PCIe3 P2	2 meter QDR InfiniBand cable
U23	14A	U14	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	15A	U12	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	15B	U10	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	16A	U8	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	16B	U6	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	17A	U4	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	17B	U2	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	0A	U41	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	0B	U39	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	1A	U37	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	1B	U35	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	2A	U33	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	2B	U31	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	3B	U29	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable

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Table 18-14 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	3A	U24	Oracle Exadata Database Server	12 PCIe3 P2	2 meter QDR InfiniBand cable
U21	4A	U24	Oracle Exadata Database Server	10 PCIe3 P2	2 meter QDR InfiniBand cable
U21	4B	U24	Oracle Exadata Database Server	8 PCIe3 P2	2 meter QDR InfiniBand cable
U21	5A	U24	Oracle Exadata Database Server	6 PCIe3 P2	2 meter QDR InfiniBand cable
U21	12B	U16	Oracle Exadata Database Server	12 PCIe3 P1	2 meter QDR InfiniBand cable
U21	13A	U16	Oracle Exadata Database Server	10 PCIe3 P1	2 meter QDR InfiniBand cable
U21	13B	U16	Oracle Exadata Database Server	8 PCIe3 P1	2 meter QDR InfiniBand cable
U21	14B	U16	Oracle Exadata Database Server	6 PCIe3 P1	2 meter QDR InfiniBand cable
U21	14A	U14	Oracle Exadata Storage Server	3 PCIe3 P1	2 meter QDR InfiniBand cable
U21	15A	U12	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	15B	U10	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	16A	U8	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	16B	U6	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	17A	U4	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	17B	U2	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	9B	U23	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable

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Table 18-14 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X8-8 and X7-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	10B	U23	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U21	11B	U23	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U21	8A	U23	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U21	9A	U23	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U21	10A	U23	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U21	11A	U23	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1 — when added as an optional configuration	1B	U21	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U23	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

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Cabling Tables for Oracle Exadata Database Machine X6-2, X6-8, X5-2, and X5-8

The tables in this chapter show the cable layouts for Oracle Exadata Database Machine X6-2, X6-8, X5-2, and X5-8.

- Rack Layout Diagrams
  The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X6-2, X6-8, X5-2, and X5-8.
- Sun Integrated Lights Out Manager Cabling Tables
- Administrative Gigabit Ethernet Port Cabling Tables
  This section contains the tables for the administrative Gigabit Ethernet network cabling.
- Single Phase Power Distribution Unit Cabling Tables
- Three Phase Power Distribution Unit Cabling Tables
  This section contains the tables for three phase cabling from each power distribution unit (PDU) to the power supplies configured in each rack.
- InfiniBand Network Cabling Tables
  This topic contains the tables for the InfiniBand network cabling for Oracle Exadata Database Machine X5 and X6 racks.

19.1 Rack Layout Diagrams

The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X6-2, X6-8, X5-2, and X5-8.

> **Note**
>
> For ease of reading, the name "Oracle Exadata Rack" is used when information refers to both Oracle Exadata Database Machine and Oracle Exadata Storage Expansion Rack.

The following abbreviations are used in the tables:

Abbreviation	Description
R*n*	Rack *n*, where *n* is the number of the rack, such as R1.
U*n*	Unit height in rack, where *n* is the number, such as U20.
P*n*	InfiniBand port *n*, where n is port number, such as P8A.

The cables used in Oracle Exadata Database Machine are color-coded as follows:

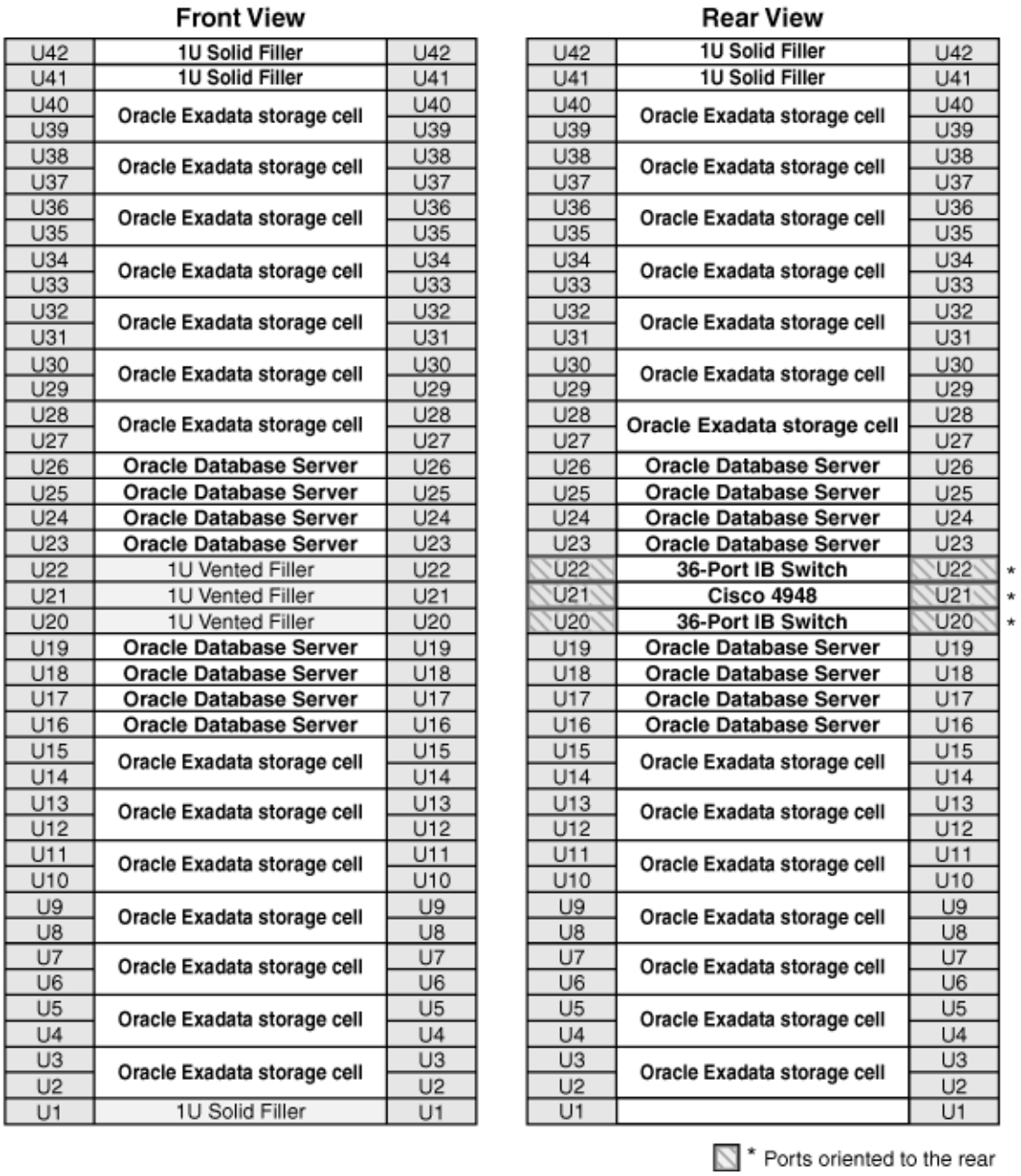
- Black: InfiniBand cables, or AC power jumper cables

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- Red: Integrated Lights Out Manager (ILOM) cables
- Blue: Gigabit Ethernet cables

The following figure shows the front and rear views of Oracle Exadata Database Machine X5-2 and X6-2 Full Rack. The front is shown on the left, and the rear is shown on the right.

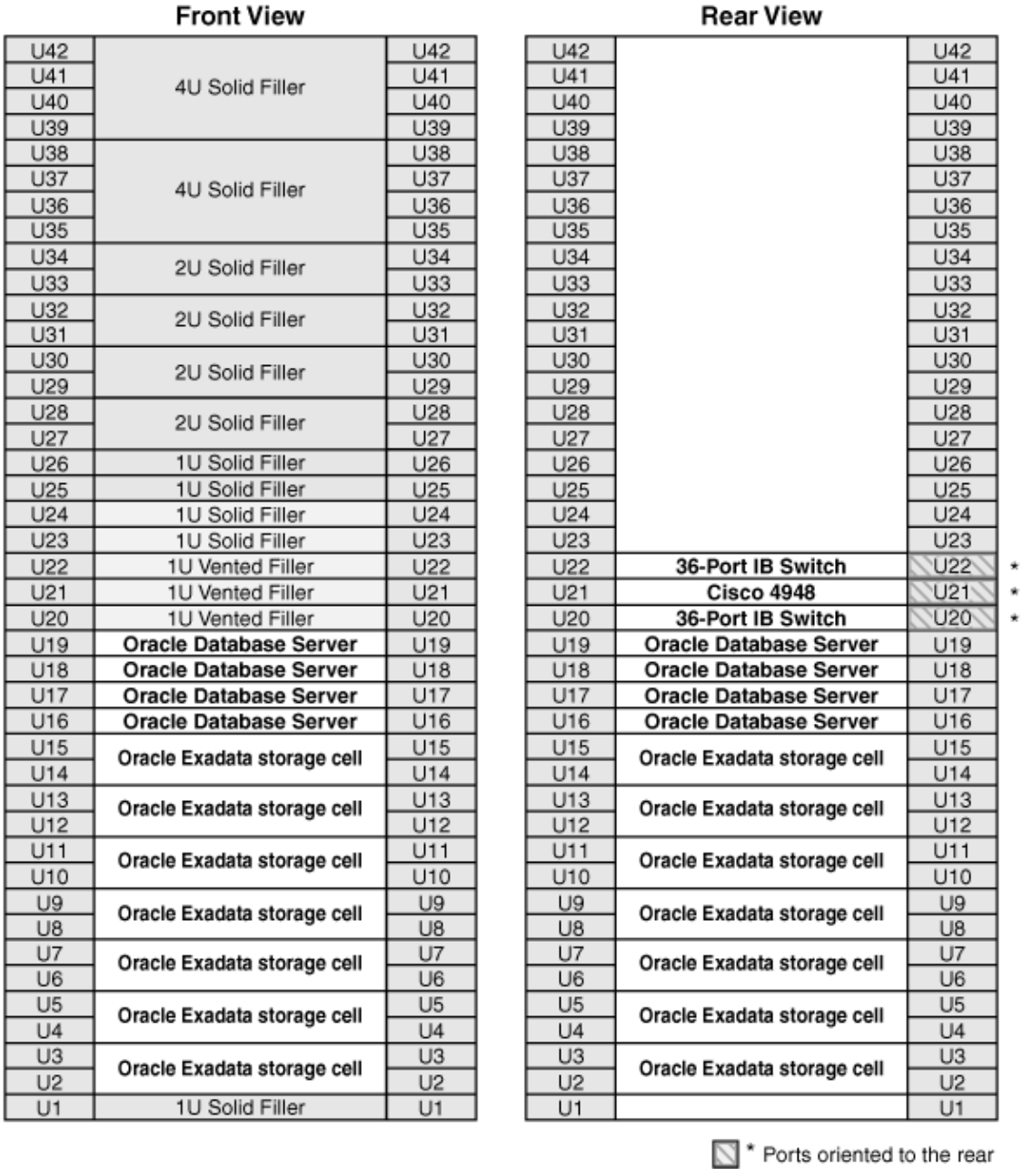
Figure 19-1 Rack Layout of Oracle Exadata Database Machine X6-2 and X5-2 Full Rack



The following figure shows the front and rear views of Oracle Exadata Database Machine X6-2 and X5-2 Half Rack.

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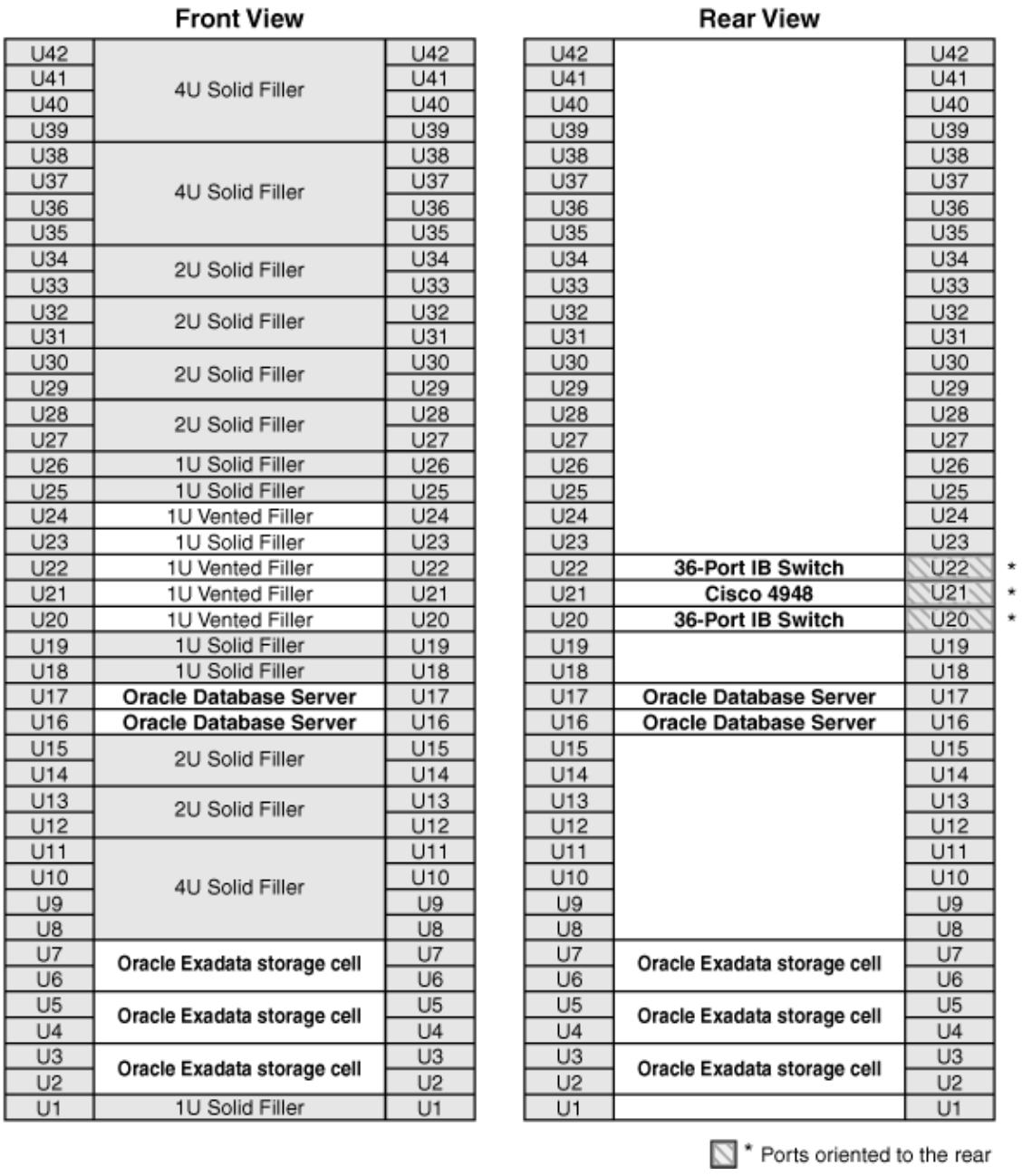
Figure 19-2 Rack Layout for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack



The following figure shows the front and rear views of Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack, and Oracle Exadata Database Machine X6-2 and X5-2 Eighth Rack.

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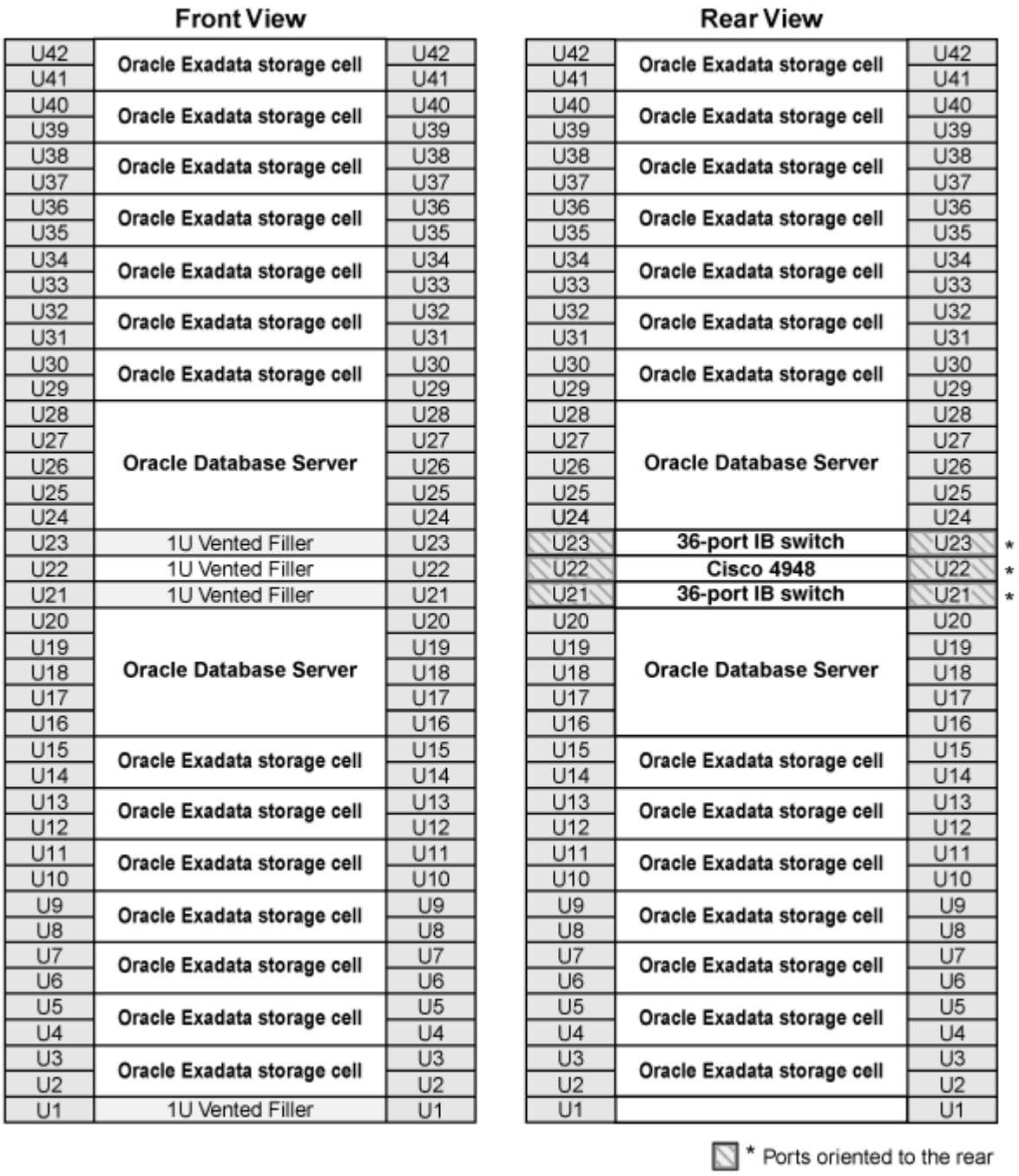
Figure 19-3 Rack Layout of Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack, and Oracle Exadata Database Machine X6-2 and X5-2 Eighth Rack



The following figure shows the front and rear views of Oracle Exadata Database Machine X5-8 and X6-8.

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Figure 19-4 Rack Layout of Oracle Exadata Database Machine X5-8 and X6-8



19.2 Sun Integrated Lights Out Manager Cabling Tables

The following tables are in this section:

- Table 19-1 ILOM Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack
- Table 19-2 ILOM Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack
- Table 19-3 ILOM Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack

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- Table 19-4 ILOM Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X6-2 and X5-2 Full Rack:

Table 19-1 ILOM Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U39	Exadata Storage Server	2
U37	Exadata Storage Server	4
U35	Exadata Storage Server	6
U33	Exadata Storage Server	8
U31	Exadata Storage Server	10
U29	Exadata Storage Server	12
U27	Exadata Storage Server	14
U26	Database server	16
U25	Database server	18
U24	Database server	20
U23	Database server	22
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Exadata Storage Server	32
U12	Exadata Storage Server	34
U10	Exadata Storage Server	36
U8	Exadata Storage Server	38
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X6-2 and X5-2 Half Rack:

Table 19-2 ILOM Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Exadata Storage Server	32
U12	Exadata Storage Server	34

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Table 19-2 (Cont.) ILOM Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U10	Exadata Storage Server	36
U8	Exadata Storage Server	38
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack:

Table 19-3 ILOM Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U17	Database server	28
U16	Database server	30
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X5-8 and X6-8 Full Rack:

Table 19-4 ILOM Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	2
U39	Exadata Storage Server	4
U37	Exadata Storage Server	6
U35	Exadata Storage Server	8
U33	Exadata Storage Server	10
U31	Exadata Storage Server	12
U29	Exadata Storage Server	14
U24	Database server	16
U16	Database server	18
U14	Exadata Storage Server	20
U12	Exadata Storage Server	22
U10	Exadata Storage Server	24
U8	Exadata Storage Server	26
U6	Exadata Storage Server	28
U4	Exadata Storage Server	30

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Table 19-4 (Cont.) ILOM Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U2	Exadata Storage Server	32

19.3 Administrative Gigabit Ethernet Port Cabling Tables

This section contains the tables for the administrative Gigabit Ethernet network cabling.

The Gigabit Ethernet switch is located in rack unit 21 on Oracle Exadata Database Machine X6-2 and X5-2 racks.

The following tables are in this section:

- Table 19-5 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack
- Table 19-6 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack
- Table 19-7 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack
- Table 19-8 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

The following table shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X6-2 and X5-2 Full Rack:

Table 19-5 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U39	Exadata Storage Server	1
U37	Exadata Storage Server	3
U35	Exadata Storage Server	5
U33	Exadata Storage Server	7
U31	Exadata Storage Server	9
U29	Exadata Storage Server	11
U27	Exadata Storage Server	13
U26	Database server	15
U25	Database server	17
U24	Database server	19
U23	Database server	21
U22	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U19	Database server	23

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Table 19-5 (Cont.) Gigabit Ethernet Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Exadata Storage Server	31
U12	Exadata Storage Server	33
U10	Exadata Storage Server	35
U8	Exadata Storage Server	37
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43
U1	Sun Datacenter InfiniBand Switch 36 switch Note that the spine switch is no longer included by default on Exadata X4-2 and newer models, but port 47 is still reserved on Cisco 4948 for the spine InfiniBand switch.	47

The following table shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X6-2 and X5-2 Half Rack:

Table 19-6 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U22	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Exadata Storage Server	31
U12	Exadata Storage Server	33
U10	Exadata Storage Server	35
U8	Exadata Storage Server	37
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43

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Table 19-6 (Cont.) Gigabit Ethernet Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U1	Sun Datacenter InfiniBand Switch 36 switch Note that the spine switch is no longer included by default on Exadata X4-2 and newer models, but port 47 is still reserved on Cisco 4948 for the spine InfiniBand switch.	47

The following table shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack:

Table 19-7 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U22	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U17	Database server	27
U16	Database server	29
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43

The following table shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X5-8 and X6-8 Full Rack:

Table 19-8 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	1
U39	Exadata Storage Server	3
U37	Exadata Storage Server	5
U35	Exadata Storage Server	7
U33	Exadata Storage Server	9
U31	Exadata Storage Server	11
U29	Exadata Storage Server	13
U24	Database server	15
U23	Sun Datacenter InfiniBand Switch 36	33

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Table 19-8 (Cont.) Gigabit Ethernet Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U21	Sun Datacenter InfiniBand Switch 36	34
U16	Database server	17
U14	Exadata Storage Server	19
U12	Exadata Storage Server	21
U10	Exadata Storage Server	23
U8	Exadata Storage Server	25
U6	Exadata Storage Server	27
U4	Exadata Storage Server	29
U2	Exadata Storage Server	31

19.4 Single Phase Power Distribution Unit Cabling Tables

This section contains the tables for single phase cabling from each power distribution unit (PDU) to the power supplies configured in each rack. The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

The following tables are in this section:

- Table 19-9 Single Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack
- Table 19-10 Single Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack
- Table 19-11 Single Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack
- Table 19-12 Single Phase PDU Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X6-2 and X5-2 Full Rack.

Table 19-9 Single Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U42	G3-6	G2-0	2 meters
U41	G4-5	G1-1	2 meters
U40	G5-4	G0-2	2 meters
U39	G5-6	G0-0	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-1	G0-5	2 meters
U33	G5-0	G0-6	2 meters

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Table 19-9 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U31	G4-4	G1-2	2 meters
U29	G4-3	G1-3	2 meters
U27	G4-2	G1-4	2 meters
U26	G4-1	G1-5	2 meters
U25	G3-5	G2-1	2 meters
U24	G4-0	G1-6	2 meters
U23	G3-3	G2-3	2 meters
U22	G3-1	G2-5	2 meters
U21	G3-0 (Cisco PS-2)	G2-6 (Cisco PS-1)	2 meters
U20	G1-5	G4-1	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X6-2 and X5-2 Half Rack.

Table 19-10 Single Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0 (Cisco PS-2)	G2-6 (Cisco PS-1)	2 meters
U20	G1-5	G4-1	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters

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Table 19-10 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack.

Table 19-11 Single Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0 (Cisco PS-2)	G2-6 (Cisco PS-1)	2 meters
U20	G1-5	G4-1	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X5-8 and X6-8 Full Rack.

Table 19-12 Single Phase PDU Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-6	G0-0	2 meters
U39	G5-4	G0-2	2 meters
U37	G5-2	G0-4	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-3	G1-3	2 meters
U29	G3-6	G2-0	2 meters
U24	G4-7 (C19) (ACO)	G1-7 (C19) (AC1)	1 meter
U24	G2-7 (C19) (AC2)	G3-7 (C19) (AC3)	1 meter
U23	G3-1	G2-5	2 meters

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Table 19-12 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G2-6 (PS-2)	G3-0 (PS-1)	2 meters
U21	G3-0	G2-6	2 meters
U16	G3-7 (C19) (AC0)	G2-7 (C19) (AC1)	1 meter
U16	G1-7 (C19) (AC2)	G4-7 (C19) (AC3)	1 meter
U14	G2-0	G3-6	2 meters
U12	G1-3	G4-3	2 meters
U10	G1-0	G4-6	2 meters
U8	G0-6	G5-0	2 meters
U6	G0-4	G5-2	2 meters
U4	G0-3	G5-3	2 meters
U2	G0-1	G5-5	2 meters
U1	G0-0	G5-6	2 meters

19.5 Three Phase Power Distribution Unit Cabling Tables

This section contains the tables for three phase cabling from each power distribution unit (PDU) to the power supplies configured in each rack.

The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

The following tables are in this section:

- Table 19-13 Three Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack
- Table 19-14 Three Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack
- Table 19-15 Three Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack
- Table 19-16 Three Phase PDU Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X6-2 and X5-2 Full Rack.

Table 19-13 Three Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U42	G5-4	G2-2	2 meters
U41	G5-5	G2-1	2 meters
U40	G3-6	G0-0	2 meters
U39	G5-6	G2-0	2 meters

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Table 19-13 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U37	G5-3	G2-3	2 meters
U35	G5-0	G2-6	2 meters
U33	G5-2	G2-4	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G4-1	G1-5	2 meters
U26	G5-1	G2-5	2 meters
U25	G3-5	G0-1	2 meters
U24	G3-4	G0-2	2 meters
U23	G3-3	G0-3	2 meters
U22	G3-2	G0-4	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U19	G2-3	G5-3	2 meters
U18	G2-2	G5-4	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G1-5	G4-1	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U0	G0-0	G3-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X6-2 and X5-2 Half Rack.

Table 19-14 Three Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-2	G0-4	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U19	G2-3	G5-3	2 meters
U18	G2-2	G5-4	2 meters

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Table 19-14 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G1-5	G4-1	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack.

Table 19-15 Three Phase PDU Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-2	G0-4	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X5-8 and X6-8 Full Rack.

Table 19-16 Three Phase PDU Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-5	G2-1	2 meters
U39	G5-4	G2-2	2 meters
U37	G5-2	G2-4	2 meters
U35	G5-1	G2-5	2 meters
U33	G5-0	G2-6	2 meters
U31	G4-6	G1-0	2 meters
U29	G4-4	G1-2	2 meters

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Table 19-16 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U24	AC0 to G4-7 (C19)	AC1 to G1-7 (C19)	1 meter
U24	AC2 to G3-7 (C19)	AC3 to G0-7 (C19)	1 meter
U23	G3-1	G0-5	2 meters
U22	G3-0	G0-6	2 meters
U21	G2-5	G5-1	2 meters
U16	AC0 to G1-7 (C19)	AC1 to G4-7 (C19)	1 meter
U16	AC2 to G2-7 (C19)	AC3 to G5-7 (C19)	1 meter
U14	G1-3	G4-3	2 meters
U12	G1-0	G4-6	2 meters
U10	G0-6	G3-0	2 meters
U8	G0-5	G3-1	2 meters
U6	G0-4	G3-2	2 meters
U4	G0-2	G3-4	2 meters
U2	G0-1	G3-5	2 meters
U1	G0-0	G3-6	2 meters

19.6 InfiniBand Network Cabling Tables

This topic contains the tables for the InfiniBand network cabling for Oracle Exadata Database Machine X5 and X6 racks.

In two-socket systems, the Sun Datacenter InfiniBand Switch 36 switches are located in rack units 20 and 22. In eight-socket systems, the Sun Datacenter InfiniBand Switch 36 switches are located in rack units 21 and 23. If present, the optional spine switch is located in rack unit 1.

The following tables are in this topic:

- Table 19-17 InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and Oracle Exadata Database Machine X5-2 Full Rack
- Table 19-18 InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack
- Table 19-19 InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack
- Table 19-20 InfiniBand Network Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack.

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Table 19-17 InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	0A	U39	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	0B	U37	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	1A	U35	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	1B	U33	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	2A	U31	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	2B	U29	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	3B	U27	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	3A	U26	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	4A	U25	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	4B	U24	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	5A	U23	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	12B	U19	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13A	U18	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13B	U17	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14B	U16	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14A	U14	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15A	U12	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15B	U10	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 19-17 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	16A	U8	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0A	U39	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0B	U37	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1A	U35	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1B	U33	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2A	U31	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2B	U29	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3B	U27	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3A	U26	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	4A	U25	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	4B	U24	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	5A	U23	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	12B	U19	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13A	U18	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13B	U17	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable

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Table 19-17 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	14B	U16	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14A	U14	Oracle Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable

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Table 19-17 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U1 — when added as an optional configuration	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack.

Table 19-18 InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	12B	U19	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13A	U18	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13B	U17	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14B	U16	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14A	U14	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15A	U12	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15B	U10	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16A	U8	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 19-18 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	17B	U2	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	12B	U19	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13A	U18	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13B	U17	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14B	U16	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14A	U14	Oracle Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable

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Table 19-18 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1 — when added as an optional configuration	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X6-2 and Oracle Exadata Database Machine X5-2 Quarter Rack.

> **Note**
>
> The same rules and restrictions for Oracle Exadata Database Machine X5-2 and Oracle Exadata Database Machine X6-2 Quarter Rack apply to Oracle Exadata Database Machine X5-2 and Oracle Exadata Database Machine X6-2 Eighth Rack.

Table 19-19 InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	13B	U17	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14B	U16	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 19-19 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	17A	U4	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	13B	U17	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14B	U16	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable

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Table 19-19 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X6-2 and X5-2 Quarter Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U1 — when added as an optional configuration	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack.

Table 19-20 InfiniBand Network Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	0A	U41	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	0B	U39	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	1A	U37	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	1B	U35	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	2A	U33	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	2B	U31	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	3B	U29	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	3A	U24	Oracle Exadata Database Server	12 PCIe3 P1	2 meter QDR InfiniBand cable
U23	4A	U24	Oracle Exadata Database Server	10 PCIe3 P1	2 meter QDR InfiniBand cable
U23	4B	U24	Oracle Exadata Database Server	8 PCIe3 P1	2 meter QDR InfiniBand cable

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Table 19-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	5A	U24	Oracle Exadata Database Server	6 PCIe3 P1	2 meter QDR InfiniBand cable
U23	13A	U16	Oracle Exadata Database Server	10 PCIe3 P2	2 meter QDR InfiniBand cable
U23	13B	U16	Oracle Exadata Database Server	8 PCIe3 P2	2 meter QDR InfiniBand cable
U23	14B	U16	Oracle Exadata Database Server	6 PCIe3 P2	2 meter QDR InfiniBand cable
U23	12B	U16	Oracle Exadata Database Server	12 PCIe3 P2	2 meter QDR InfiniBand cable
U23	14A	U14	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	15A	U12	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	15B	U10	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	16A	U8	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	16B	U6	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	17A	U4	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	17B	U2	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	0A	U41	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	0B	U39	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	1A	U37	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	1B	U35	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	2A	U33	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	2B	U31	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	3B	U29	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable

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Table 19-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	3A	U24	Oracle Exadata Database Server	12 PCIe3 P2	2 meter QDR InfiniBand cable
U21	4A	U24	Oracle Exadata Database Server	10 PCIe3 P2	2 meter QDR InfiniBand cable
U21	4B	U24	Oracle Exadata Database Server	8 PCIe3 P2	2 meter QDR InfiniBand cable
U21	5A	U24	Oracle Exadata Database Server	6 PCIe3 P2	2 meter QDR InfiniBand cable
U21	12B	U16	Oracle Exadata Database Server	12 PCIe3 P1	2 meter QDR InfiniBand cable
U21	13A	U16	Oracle Exadata Database Server	10 PCIe3 P1	2 meter QDR InfiniBand cable
U21	13B	U16	Oracle Exadata Database Server	8 PCIe3 P1	2 meter QDR InfiniBand cable
U21	14B	U16	Oracle Exadata Database Server	6 PCIe3 P1	2 meter QDR InfiniBand cable
U21	14A	U14	Oracle Exadata Storage Server	3 PCIe3 P1	2 meter QDR InfiniBand cable
U21	15A	U12	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	15B	U10	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	16A	U8	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	16B	U6	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	17A	U4	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	17B	U2	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	9B	U23	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable

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Table 19-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X5-8 and X6-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	10B	U23	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U21	11B	U23	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U21	8A	U23	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U21	9A	U23	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U21	10A	U23	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U21	11A	U23	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1 — when added as an optional configuration	1B	U21	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U23	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

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Cabling Tables for Oracle Exadata Database Machine X4-2 and Oracle Exadata Database Machine X4-8 Full Rack

The tables in this chapter show the cable layouts for Oracle Exadata Database Machine X4-2, and Oracle Exadata Database Machine X4-8 Full Rack.

- Rack Layout Diagrams
  The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X4-2 and Oracle Exadata Database Machine X4-8.
- Sun Integrated Lights Out Manager Cabling Tables
- Administrative Gigabit Ethernet Port Cabling Tables
- Single Phase Power Distribution Unit Cabling Tables
- Three Phase Power Distribution Unit Cabling Tables
- InfiniBand Network Cabling Tables
  This topic contains the tables for the InfiniBand network cabling for Oracle Exadata Database Machine X4 racks.

20.1 Rack Layout Diagrams

The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X4-2 and Oracle Exadata Database Machine X4-8.

> **Note**
>
> For ease of reading, the name "Oracle Exadata Rack" is used when information refers to both Oracle Exadata Database Machine X4-2 and Oracle Exadata Storage Expansion Rack.

The following abbreviations are used in the tables:

Abbreviation	Description
R*n*	Rack *n*, where *n* is the number of the rack, such as R1.
U*n*	Unit height in rack, where *n* is the number, such as U20.
P*n*	InfiniBand port *n*, where n is port number, such as P8A.

The cables used in Oracle Exadata Database Machine are color-coded as follows:

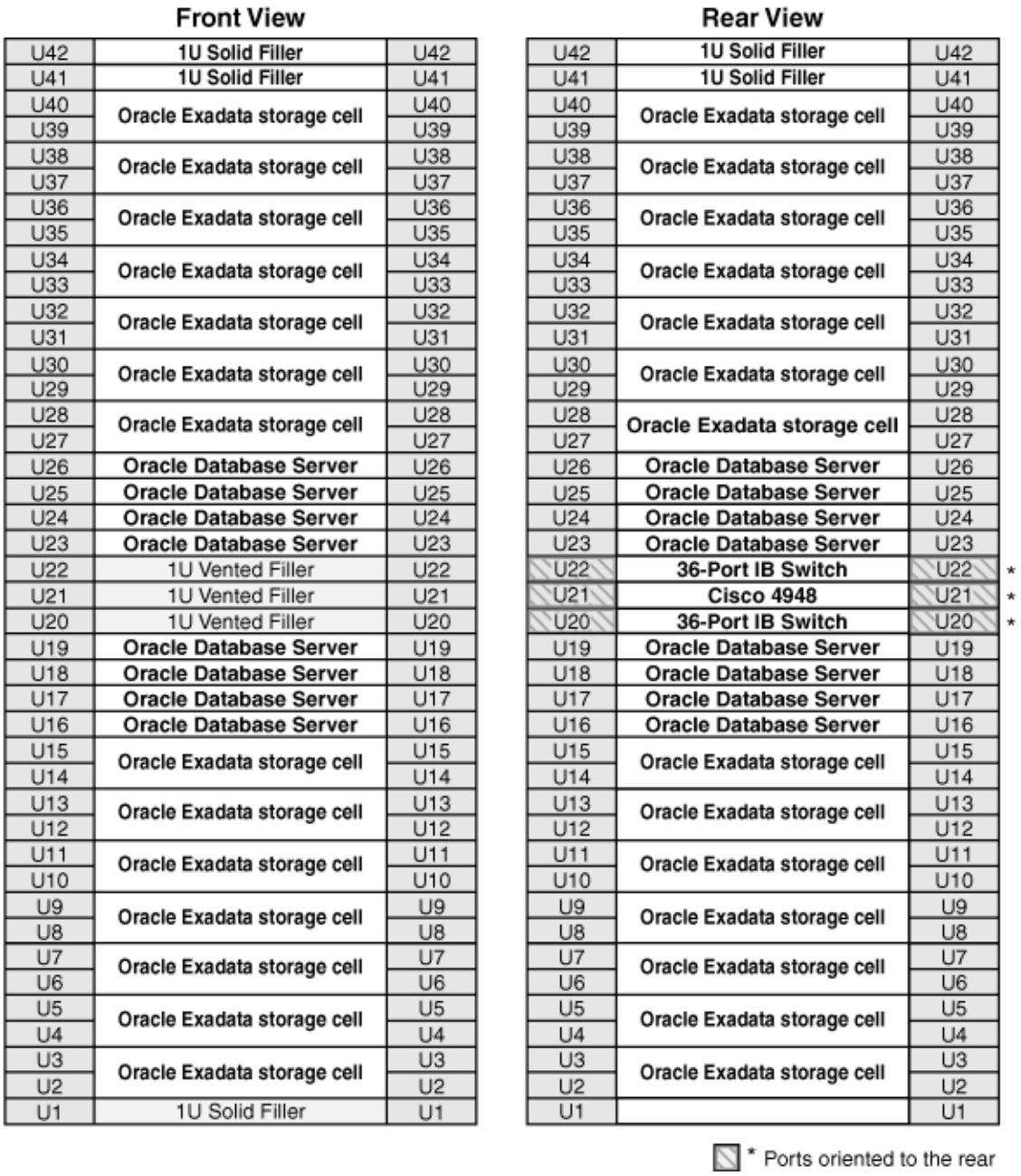
- Black: InfiniBand cables, or AC power jumper cables

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- Red: Integrated Lights Out Manager (ILOM) cables
- Blue: Gigabit Ethernet cables

The following diagram shows the front and rear views of Oracle Exadata Database Machine X4-2 Full Rack. The front is shown on the left, and the rear is shown on the right.

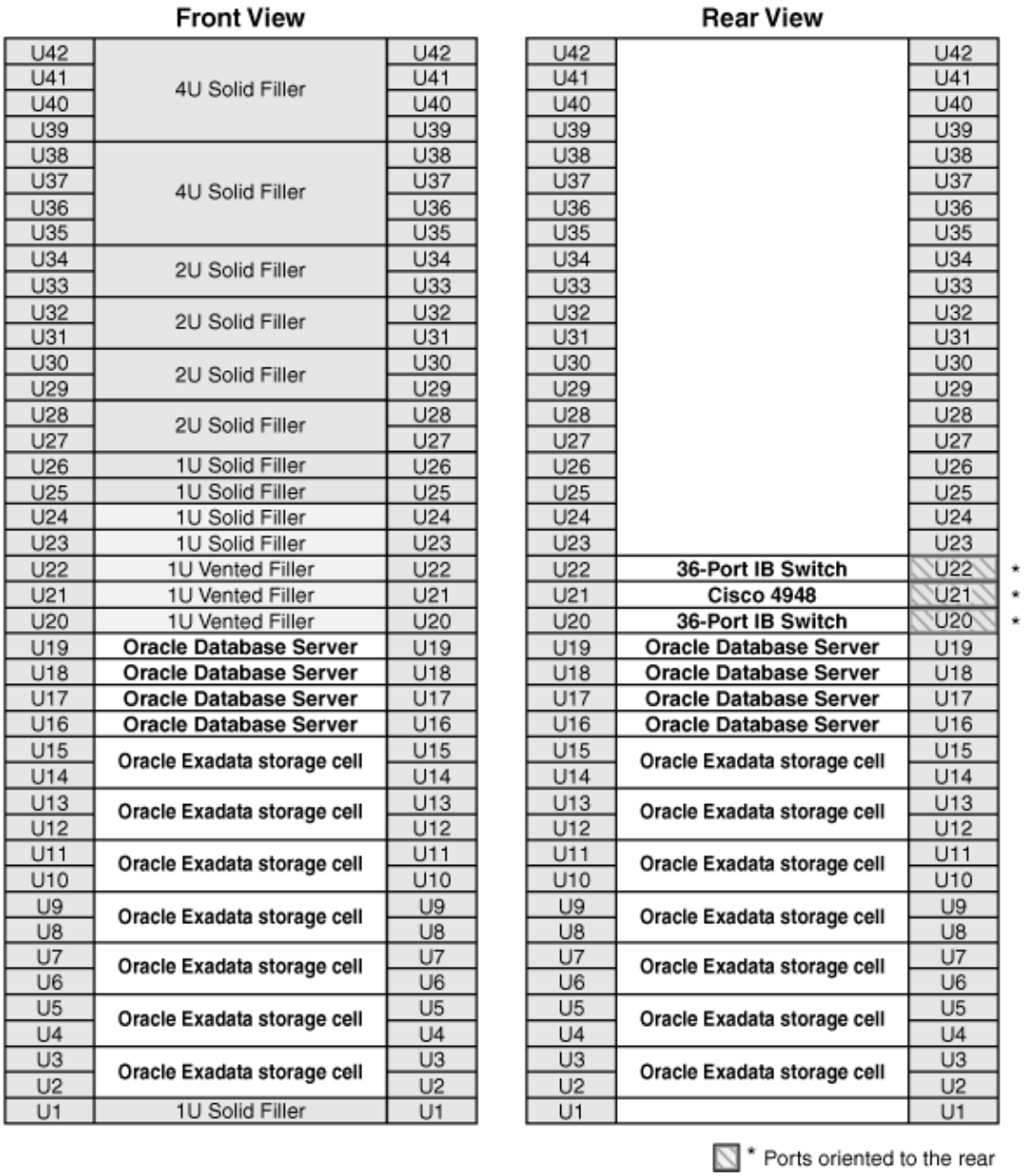
Figure 20-1 Rack Layout of Oracle Exadata Database Machine X4-2 Full Rack



The next diagram shows the front and rear views of Oracle Exadata Database Machine X4-2 Half Rack.

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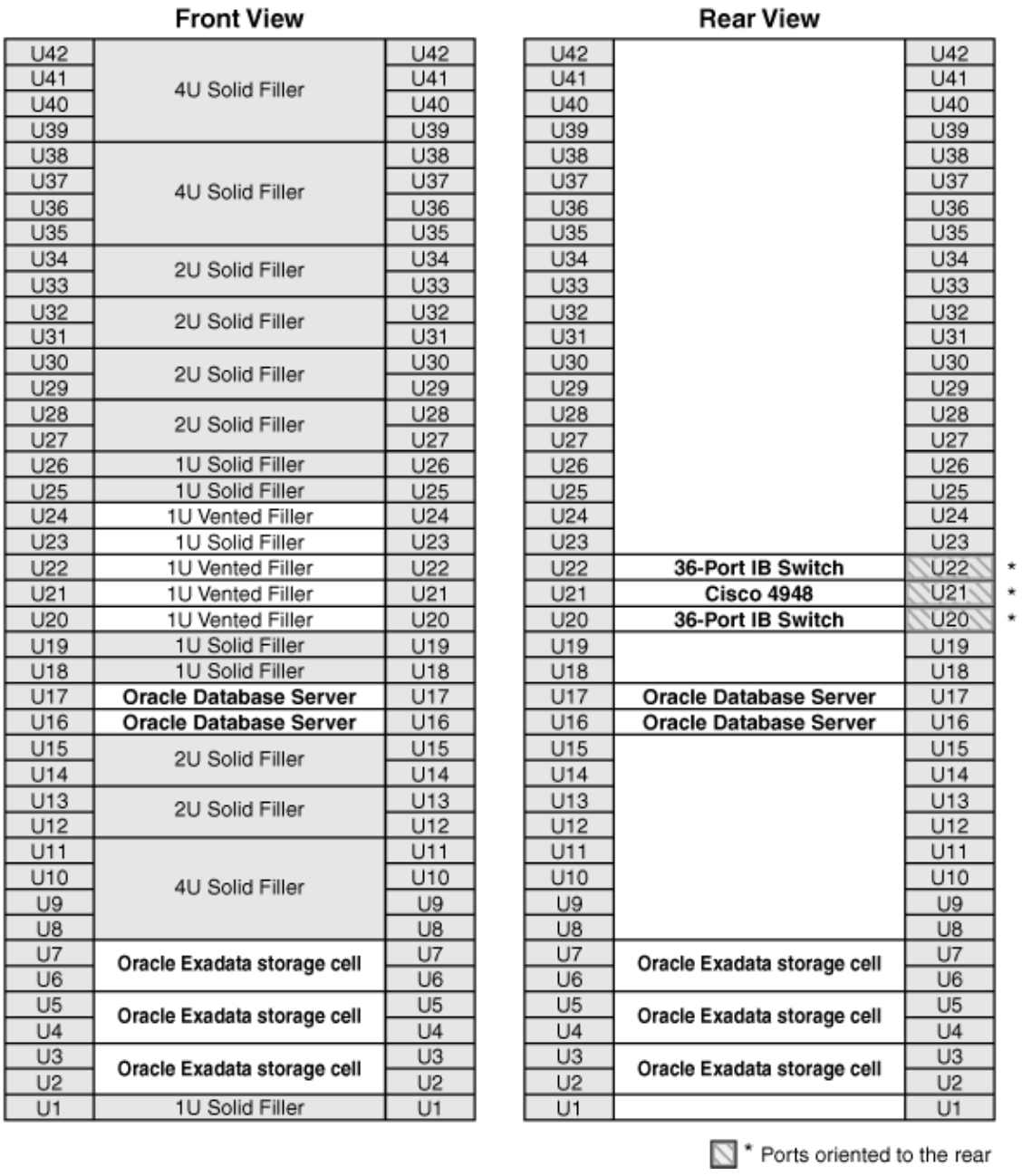
Figure 20-2 Rack Layout for Oracle Exadata Database Machine X4-2 Half Rack



The next diagram shows the front and rear views of Oracle Exadata Database Machine X4-2 Quarter Rack, and Oracle Exadata Database Machine X4-2 Eighth Rack.

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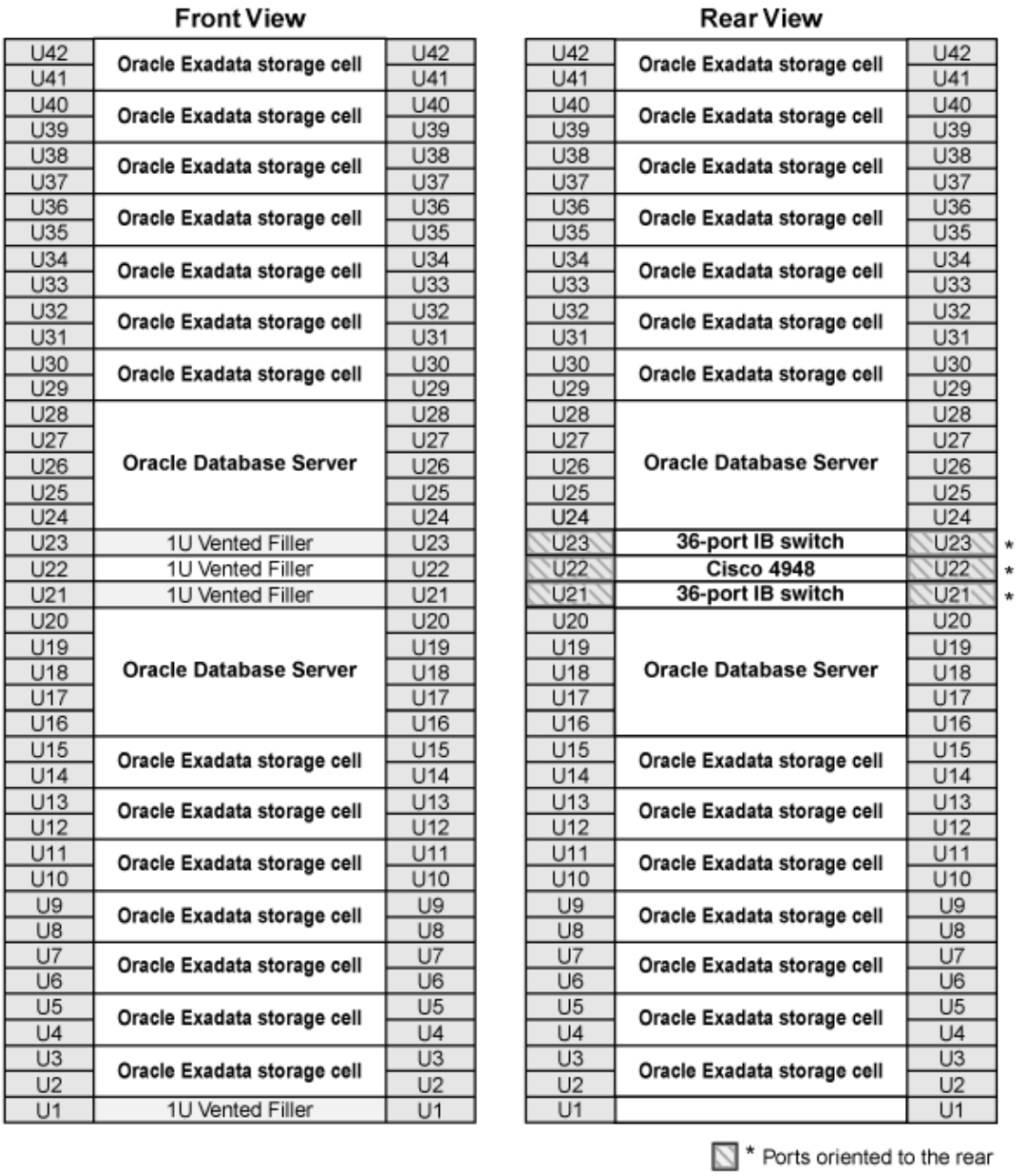
Figure 20-3 Rack Layout of Oracle Exadata Database Machine X4-2 Quarter Rack, and Oracle Exadata Database Machine X4-2 Eighth Rack



The next diagram shows the front and rear views of Oracle Exadata Database Machine X4-8 Full Rack.

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Figure 20-4 Rack Layout of Oracle Exadata Database Machine X4-8 Full Rack



20.2 Sun Integrated Lights Out Manager Cabling Tables

This section contains the tables for the Sun Integrated Lights Out Manager (ILOM) network cabling. The ILOM port on the servers is labeled NET MGT, and connects to the Gigabit Ethernet port located in rack unit 21 on Oracle Exadata Database Machine X4-2 racks. The ILOM port connects to the Gigabit Ethernet port located in rack unit 22 on Oracle Exadata Database Machine X4-8 Full Rack racks.

The following tables are in this section:

- Table 20-1

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- Table 20-2
- Table 20-3
- Table 20-4

Table 20-1 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X4-2 Full Rack:

Table 20-1 ILOM Cabling for Oracle Exadata Database Machine X4-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U39	Exadata Storage Server	2
U37	Exadata Storage Server	4
U35	Exadata Storage Server	6
U33	Exadata Storage Server	8
U31	Exadata Storage Server	10
U29	Exadata Storage Server	12
U27	Exadata Storage Server	14
U26	Database server	16
U25	Database server	18
U24	Database server	20
U23	Database server	22
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Exadata Storage Server	32
U12	Exadata Storage Server	34
U10	Exadata Storage Server	36
U8	Exadata Storage Server	38
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

Table 20-2 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X4-2 Half Rack:

Table 20-2 ILOM Cabling for Oracle Exadata Database Machine X4-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Exadata Storage Server	32

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Table 20-2 (Cont.) ILOM Cabling for Oracle Exadata Database Machine X4-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U12	Exadata Storage Server	34
U10	Exadata Storage Server	36
U8	Exadata Storage Server	38
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

Table 20-3 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X4-2 Quarter Rack:

Table 20-3 ILOM Cabling for Oracle Exadata Database Machine X4-2 Quarter Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U17	Database server	28
U16	Database server	30
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

Table 20-4 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X4-8 Full Rack:

Table 20-4 ILOM Cabling for Oracle Exadata Database Machine X4-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	2
U39	Exadata Storage Server	4
U37	Exadata Storage Server	6
U35	Exadata Storage Server	8
U33	Exadata Storage Server	10
U31	Exadata Storage Server	12
U29	Exadata Storage Server	14
U24	Database server	16
U16	Database server	18
U14	Exadata Storage Server	20
U12	Exadata Storage Server	22
U10	Exadata Storage Server	24
U8	Exadata Storage Server	26
U6	Exadata Storage Server	28
U4	Exadata Storage Server	30

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Table 20-4 (Cont.) ILOM Cabling for Oracle Exadata Database Machine X4-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U2	Exadata Storage Server	32

20.3 Administrative Gigabit Ethernet Port Cabling Tables

This section contains the tables for the administrative Gigabit Ethernet network cabling. The Gigabit Ethernet switch is located in rack unit 21 on Oracle Exadata Database Machine X4-2 racks.

The following tables are in this section:

- Table 20-5
- Table 20-6
- Table 20-7
- Table 20-8

Table 20-5 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X4-2 Full Rack:

Table 20-5 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X4-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U39	Exadata Storage Server	1
U37	Exadata Storage Server	3
U35	Exadata Storage Server	5
U33	Exadata Storage Server	7
U31	Exadata Storage Server	9
U29	Exadata Storage Server	11
U27	Exadata Storage Server	13
U26	Database server	15
U25	Database server	17
U24	Database server	19
U23	Database server	21
U22	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Exadata Storage Server	31

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Table 20-5 (Cont.) Gigabit Ethernet Cabling for Oracle Exadata Database Machine X4-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U12	Exadata Storage Server	33
U10	Exadata Storage Server	35
U8	Exadata Storage Server	37
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43
U1	Sun Datacenter InfiniBand Switch 36 switch Note that the spine switch is no longer included by default on Exadata X4-2 and newer models, but port 47 is still reserved on Cisco 4948 for the spine InfiniBand switch.	47

Table 20-6 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X4-2 Half Rack:

Table 20-6 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X4-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U22	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Exadata Storage Server	31
U12	Exadata Storage Server	33
U10	Exadata Storage Server	35
U8	Exadata Storage Server	37
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43

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Table 20-6 (Cont.) Gigabit Ethernet Cabling for Oracle Exadata Database Machine X4-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U1	Sun Datacenter InfiniBand Switch 36 switch Note that the spine switch is no longer included by default on Exadata X4-2 and newer models, but port 47 is still reserved on Cisco 4948 for the spine InfiniBand switch.	47

Table 20-7 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X4-2 Quarter Rack:

Table 20-7 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X4-2 Quarter Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U22	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U17	Database server	27
U16	Database server	29
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43

Table 20-8 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X4-8 Full Rack:

Table 20-8 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X4-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	1
U39	Exadata Storage Server	3
U37	Exadata Storage Server	5
U35	Exadata Storage Server	7
U33	Exadata Storage Server	9
U31	Exadata Storage Server	11
U29	Exadata Storage Server	13
U24	Database server	15
U23	Sun Datacenter InfiniBand Switch 36	33

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Table 20-8 (Cont.) Gigabit Ethernet Cabling for Oracle Exadata Database Machine X4-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U21	Sun Datacenter InfiniBand Switch 36	34
U16	Database server	17
U14	Exadata Storage Server	19
U12	Exadata Storage Server	21
U10	Exadata Storage Server	23
U8	Exadata Storage Server	25
U6	Exadata Storage Server	27
U4	Exadata Storage Server	29
U2	Exadata Storage Server	31

20.4 Single Phase Power Distribution Unit Cabling Tables

This section contains the tables for single phase cabling from each power distribution unit (PDU) to the power supplies configured in each rack. The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

The following tables are in this section:

- Table 20-9
- Table 20-10
- Table 20-11
- Table 20-12

Table 20-9 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X4-2 Full Rack.

Table 20-9 Single Phase PDU Cabling for Oracle Exadata Database Machine X4-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U39	G5-6	G0-0	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-6	G2-0	2 meters
U26	G4-0	G1-6	2 meters
U25	G3-5	G2-1	2 meters
U24	G3-4	G2-2	2 meters

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Table 20-9 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X4-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U23	G3-3	G2-3	2 meters
U22	G3-1	G2-5	2 meters
U21	G3-0 (Cisco PS-2)	G2-6 (Cisco PS-1)	2 meters
U20	G2-4	G3-2	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters

Table 20-10 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X4-2 Half Rack.

Table 20-10 Single Phase PDU Cabling for Oracle Exadata Database Machine X4-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0 (Cisco PS-2)	G2-6 (Cisco PS-1)	2 meters
U20	G2-4	G3-2	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters

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Table 20-11 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X4-2 Quarter Rack.

Table 20-11 Single Phase PDU Cabling for Oracle Exadata Database Machine X4-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0 (Cisco PS-2)	G2-6 (Cisco PS-1)	2 meters
U20	G2-4	G3-2	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters

Table 20-12 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X4-8 Full Rack.

Table 20-12 Single Phase PDU Cabling for Oracle Exadata Database Machine X4-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-6	G0-0	2 meters
U39	G5-4	G0-2	2 meters
U37	G5-2	G0-4	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-3	G1-3	2 meters
U29	G3-6	G2-0	2 meters
U24	G4-7 (C19) (ACO)	G1-7 (C19) (AC1)	1 meter
U24	G2-7 (C19) (AC2)	G3-7 (C19) (AC3)	1 meter
U23	G3-1	G2-5	2 meters
U22	G2-6 (PS-2)	G3-0 (PS-1)	2 meters
U21	G3-0	G2-6	2 meters
U16	G3-7 (C19) (AC0)	G2-7 (C19) (AC1)	1 meter
U16	G1-7 (C19) (AC2)	G4-7 (C19) (AC3)	1 meter
U14	G2-0	G3-6	2 meters
U12	G1-3	G4-3	2 meters
U10	G1-0	G4-6	2 meters
U8	G0-6	G5-0	2 meters
U6	G0-4	G5-2	2 meters
U4	G0-3	G5-3	2 meters
U2	G0-1	G5-5	2 meters

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Table 20-12 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X4-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U1	G0-0	G5-6	2 meters

20.5 Three Phase Power Distribution Unit Cabling Tables

This section contains the tables for three phase cabling from each power distribution unit (PDU) to the power supplies configured in each rack. The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

The following tables are in this section:

- Table 20-13
- Table 20-14
- Table 20-15
- Table 20-16

Table 20-13 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X4-2 Full Rack.

Table 20-13 Three Phase PDU Cabling for Oracle Exadata Database Machine X4-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U39	G5-6	G2-0	2 meters
U37	G5-3	G2-3	2 meters
U35	G5-0	G2-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-6	G0-0	2 meters
U26	G4-0	G1-6	2 meters
U25	G3-5	G0-1	2 meters
U24	G3-4	G0-2	2 meters
U23	G3-3	G0-3	2 meters
U22	G3-1	G0-5	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U19	G2-3	G5-3	2 meters
U18	G2-2	G5-4	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters

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Table 20-13 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X4-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters

Table 20-14 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X4-2 Half Rack.

Table 20-14 Three Phase PDU Cabling for Oracle Exadata Database Machine X4-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G0-5	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U19	G2-3	G5-3	2 meters
U18	G2-2	G5-4	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters

Table 20-15 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X4-2 Quarter Rack.

Table 20-15 Three Phase PDU Cabling for Oracle Exadata Database Machine X4-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G0-5	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U17	G2-1	G5-5	2 meters

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Table 20-15 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X4-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U16	G1-6	G4-0	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters

Table 20-16 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X4-8 Full Rack.

Table 20-16 Three Phase PDU Cabling for Oracle Exadata Database Machine X4-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-5	G2-1	2 meters
U39	G5-4	G2-2	2 meters
U37	G5-2	G2-4	2 meters
U35	G5-1	G2-5	2 meters
U33	G5-0	G2-6	2 meters
U31	G4-6	G1-0	2 meters
U29	G4-4	G1-2	2 meters
U24	AC0 to G4-7 (C19)	AC1 to G1-7 (C19)	1 meter
U24	AC2 to G3-7 (C19)	AC3 to G0-7 (C19)	1 meter
U23	G3-1	G0-5	2 meters
U22	G3-0	G0-6	2 meters
U21	G2-5	G5-1	2 meters
U16	AC0 to G1-7 (C19)	AC1 to G4-7 (C19)	1 meter
U16	AC2 to G2-7 (C19)	AC3 to G5-7 (C19)	1 meter
U14	G1-3	G4-3	2 meters
U12	G1-0	G4-6	2 meters
U10	G0-6	G3-0	2 meters
U8	G0-5	G3-1	2 meters
U6	G0-4	G3-2	2 meters
U4	G0-2	G3-4	2 meters
U2	G0-1	G3-5	2 meters
U1	G0-0	G3-6	2 meters

20.6 InfiniBand Network Cabling Tables

This topic contains the tables for the InfiniBand network cabling for Oracle Exadata Database Machine X4 racks.

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In Oracle Exadata Database Machine X4-2, the Sun Datacenter InfiniBand Switch 36 switches are located in rack slots 20 and 22. In Oracle Exadata Database Machine X4-8, the Sun Datacenter InfiniBand Switch 36 switches are located in rack units 21 and 23. If present, the optional spine switch is located in rack unit 1.

The following tables are in this section:

- Table 20-17 InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Full Rack
- Table 20-18 InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Half Rack
- Table 20-19 InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Quarter Rack and Oracle Exadata Database Machine X4-2 Eighth Rack
- Table 20-20 InfiniBand Network Cabling for Oracle Exadata Database Machine X4-8 Full Rack

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X4-2 Full Rack.

Table 20-17 InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	0A	U39	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	0B	U37	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	1A	U35	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	1B	U33	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	2A	U31	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	2B	U29	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	3B	U27	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	3A	U26	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	4A	U25	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	4B	U24	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	5A	U23	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable

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Table 20-17 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	12B	U19	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13A	U18	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13B	U17	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14B	U16	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14A	U14	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15A	U12	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15B	U10	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16A	U8	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0A	U39	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0B	U37	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1A	U35	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1B	U33	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2A	U31	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2B	U29	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3B	U27	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3A	U26	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable

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Table 20-17 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	4A	U25	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	4B	U24	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	5A	U23	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	12B	U19	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13A	U18	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13B	U17	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14B	U16	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14A	U14	Oracle Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable

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Table 20-17 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1 — when added as an optional configuration	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X4-2 Half Rack.

Table 20-18 InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	12B	U19	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13A	U18	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable

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Table 20-18 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	13B	U17	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14B	U16	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14A	U14	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15A	U12	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15B	U10	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16A	U8	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	12B	U19	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13A	U18	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13B	U17	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14B	U16	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14A	U14	Oracle Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable

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Table 20-18 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	17A	U4	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1 — when added as an optional configuration	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X4-2 Quarter Rack and Oracle Exadata Database Machine X4-2 Eighth Rack.

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> **Note**
>
> The same rules and restrictions apply to Oracle Exadata Database Machine X4-2 Eighth Rack as for Oracle Exadata Database Machine X4-2 Quarter Rack.

Table 20-19 InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Quarter Rack and Oracle Exadata Database Machine X4-2 Eighth Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	13B	U17	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14B	U16	Oracle Exadata Database Server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	13B	U17	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14B	U16	Oracle Exadata Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable

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Table 20-19 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X4-2 Quarter Rack and Oracle Exadata Database Machine X4-2 Eighth Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1 — when added as an optional configuration	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X4-8 Full Rack.

Table 20-20 InfiniBand Network Cabling for Oracle Exadata Database Machine X4-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	0A	U41	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	0B	U39	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	1A	U37	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	1B	U35	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	2A	U33	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	2B	U31	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U23	3B	U29	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable

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Table 20-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X4-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	3A	U24	Oracle Exadata Database Server	12 PCIe3 P1	2 meter QDR InfiniBand cable
U23	4A	U24	Oracle Exadata Database Server	10 PCIe3 P1	2 meter QDR InfiniBand cable
U23	4B	U24	Oracle Exadata Database Server	8 PCIe3 P1	2 meter QDR InfiniBand cable
U23	5A	U24	Oracle Exadata Database Server	6 PCIe3 P1	2 meter QDR InfiniBand cable
U23	13A	U16	Oracle Exadata Database Server	10 PCIe3 P2	2 meter QDR InfiniBand cable
U23	13B	U16	Oracle Exadata Database Server	8 PCIe3 P2	2 meter QDR InfiniBand cable
U23	14B	U16	Oracle Exadata Database Server	6 PCIe3 P2	2 meter QDR InfiniBand cable
U23	12B	U16	Oracle Exadata Database Server	12 PCIe3 P2	2 meter QDR InfiniBand cable
U23	14A	U14	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	15A	U12	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	15B	U10	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	16A	U8	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	16B	U6	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	17A	U4	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U23	17B	U2	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	0A	U41	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	0B	U39	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	1A	U37	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable

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Table 20-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X4-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	1B	U35	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	2A	U33	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	2B	U31	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	3B	U29	Oracle Exadata Storage Server	3 PCIe3 P2	3 meter QDR InfiniBand cable
U21	3A	U24	Oracle Exadata Database Server	12 PCIe3 P2	2 meter QDR InfiniBand cable
U21	4A	U24	Oracle Exadata Database Server	10 PCIe3 P2	2 meter QDR InfiniBand cable
U21	4B	U24	Oracle Exadata Database Server	8 PCIe3 P2	2 meter QDR InfiniBand cable
U21	5A	U24	Oracle Exadata Database Server	6 PCIe3 P2	2 meter QDR InfiniBand cable
U21	12B	U16	Oracle Exadata Database Server	12 PCIe3 P1	2 meter QDR InfiniBand cable
U21	13A	U16	Oracle Exadata Database Server	10 PCIe3 P1	2 meter QDR InfiniBand cable
U21	13B	U16	Oracle Exadata Database Server	8 PCIe3 P1	2 meter QDR InfiniBand cable
U21	14B	U16	Oracle Exadata Database Server	6 PCIe3 P1	2 meter QDR InfiniBand cable
U21	14A	U14	Oracle Exadata Storage Server	3 PCIe3 P1	2 meter QDR InfiniBand cable
U21	15A	U12	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	15B	U10	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	16A	U8	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	16B	U6	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	17A	U4	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable

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Table 20-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X4-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	17B	U2	Oracle Exadata Storage Server	3 PCIe3 P1	3 meter QDR InfiniBand cable
U21	9B	U23	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U21	10B	U23	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U21	11B	U23	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U21	8A	U23	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U21	9A	U23	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U21	10A	U23	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U21	11A	U23	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1 — when added as an optional configuration	1B	U21	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1 — when added as an optional configuration	0B	U23	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

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Cabling Tables for Oracle Exadata Database Machine X3-2 and Oracle Exadata Database Machine X3-8 Full Rack

The tables in this chapter show the cable layouts for Oracle Exadata Database Machine X3-2 and Oracle Exadata Database Machine X3-8 Full Rack.

- Rack Layout Diagrams
  The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X3-2 and Oracle Exadata Database Machine X3-8.
- Sun Integrated Lights Out Manager Cabling Tables
- Administrative Gigabit Ethernet Port Cabling Tables
- Single Phase Power Distribution Unit Cabling Tables
- Three Phase Power Distribution Unit Cabling Tables
- InfiniBand Network Cabling Tables

21.1 Rack Layout Diagrams

The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X3-2 and Oracle Exadata Database Machine X3-8.

> **Note**
>
> For ease of reading, the name "Oracle Exadata Rack" is used when information refers to both Oracle Exadata Database Machine X3-2 and Oracle Exadata Storage Expansion Rack X3-2.

The following abbreviations are used in the tables:

Abbreviation	Description
R*n*	Rack *n*, where *n* is the number of the rack, such as R1.
U*n*	Unit height in rack, where *n* is the number, such as U20.
P*n*	InfiniBand port *n*, where *n* is port number, such as P8A.

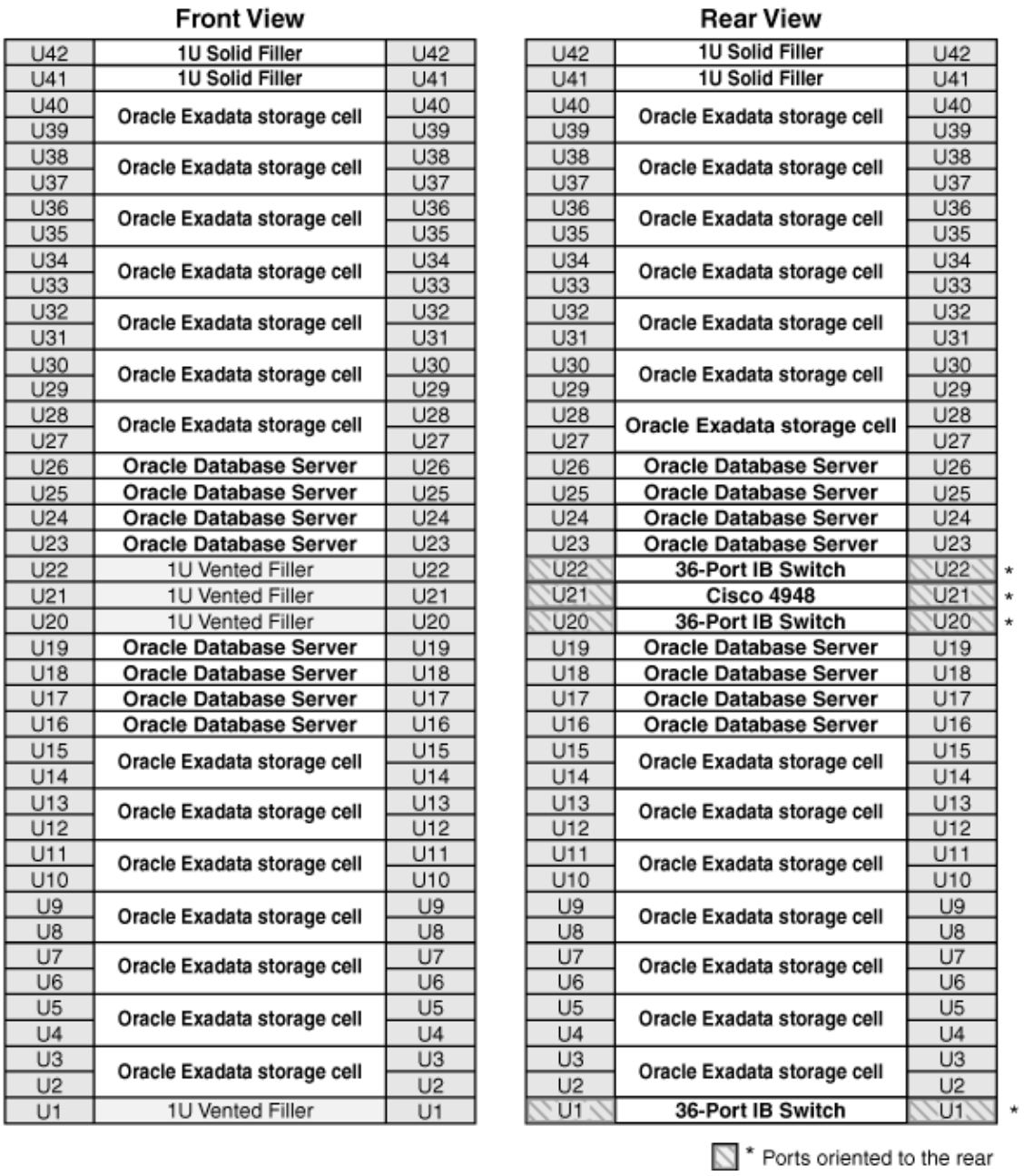
The cables used in Oracle Exadata Database Machine are color-coded as follows:

- Black: InfiniBand cables, or AC power jumper cables
- Red: Integrated Lights Out Manager (ILOM) cables
- Blue: Gigabit Ethernet cables

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The following diagram shows the front and rear views of Oracle Exadata Database Machine X3-2 Full Rack. The front is shown on the left, and the rear is shown on the right.

Figure 21-1 Rack Layout of Oracle Exadata Database Machine X3-2 Full Rack

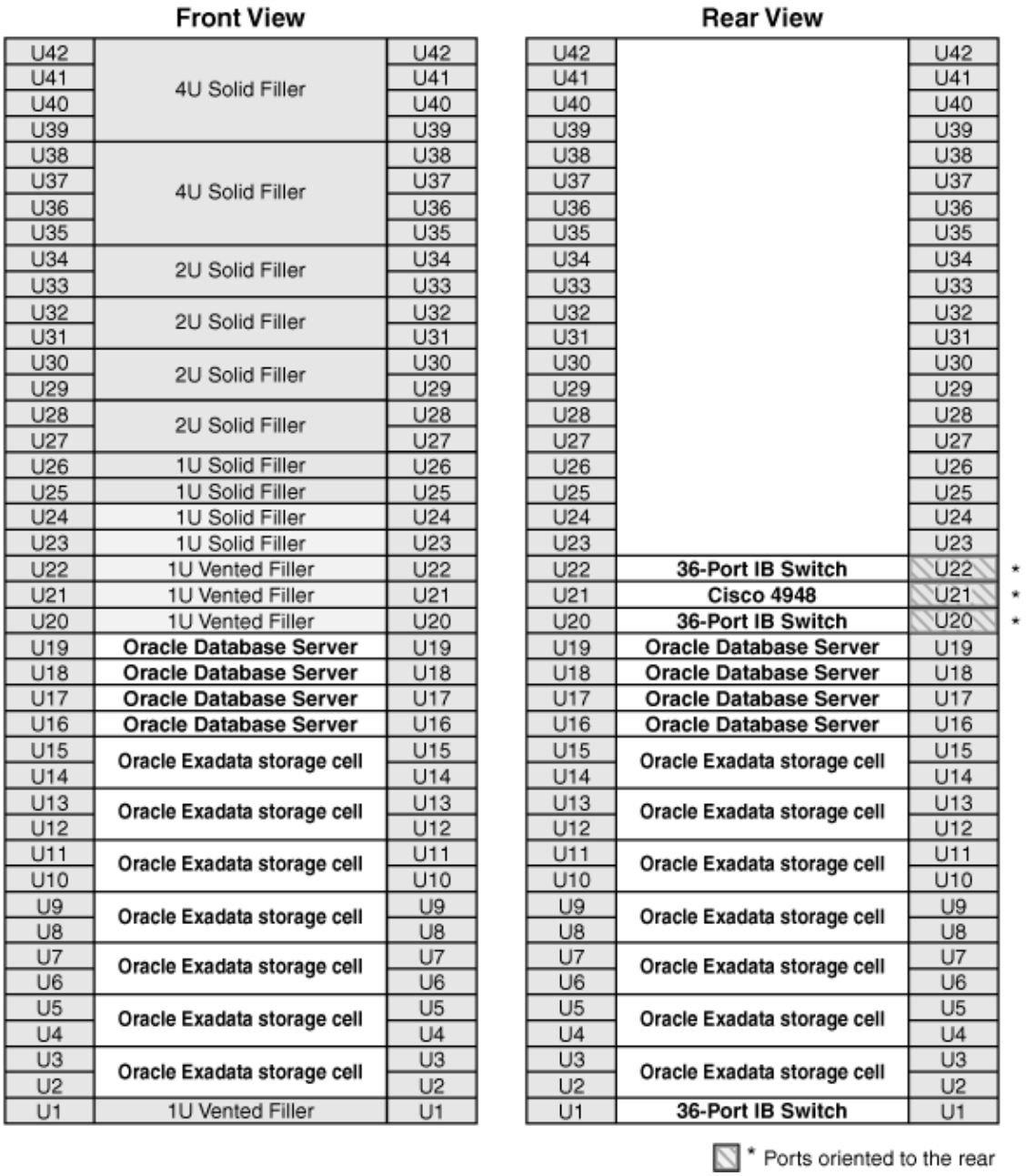


The next diagram shows the front and rear views of Oracle Exadata Database Machine X3-2 Half Rack.

> **Note**
>
> The Sun Datacenter InfiniBand Switch 36 switch in rack position U1 is included in Oracle Exadata Database Machine X3-2 Half Racks.

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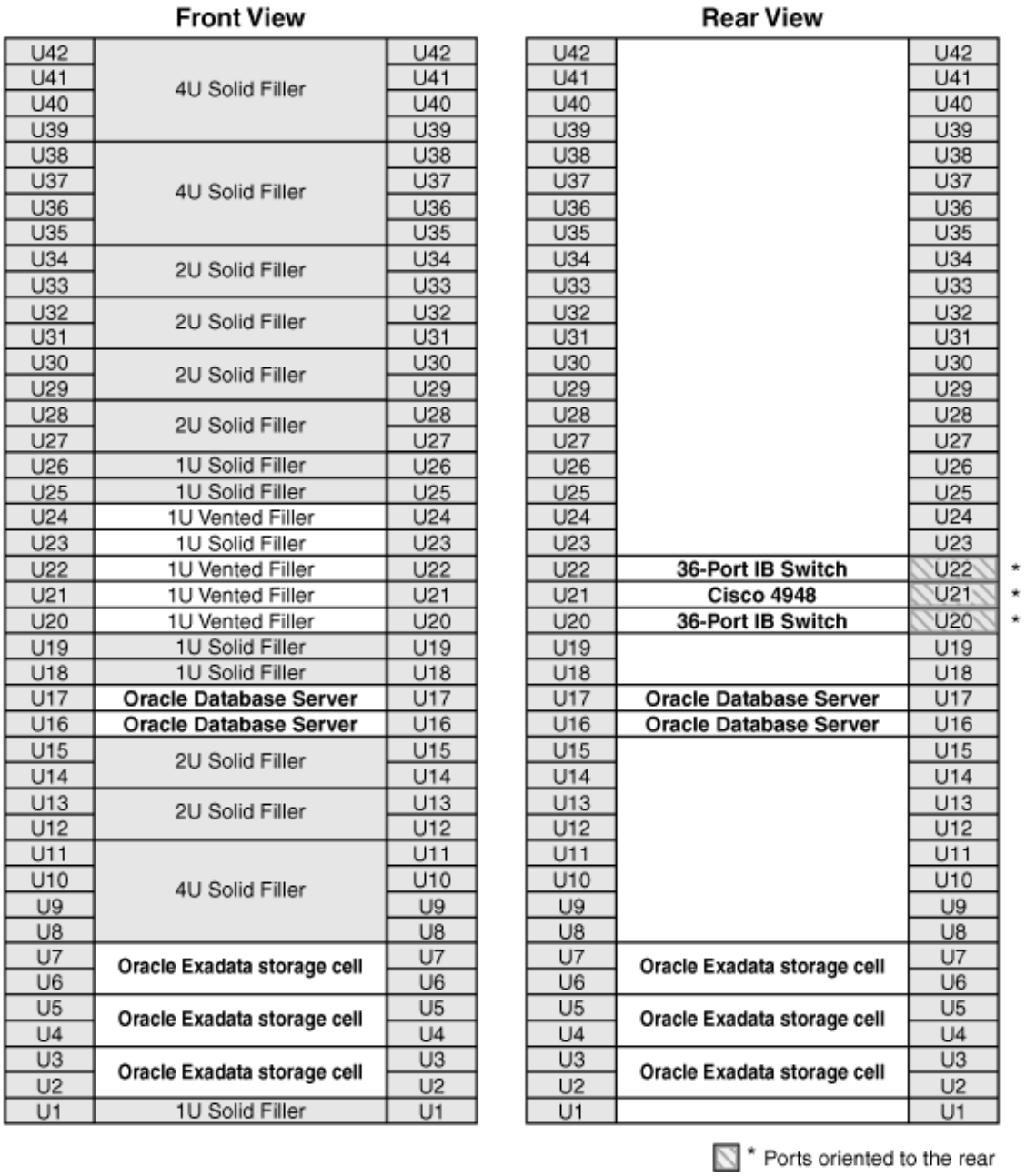
Figure 21-2 Rack Layout for Oracle Exadata Database Machine X3-2 Half Rack



The next diagram shows the front and rear views of Oracle Exadata Database Machine X3-2 Quarter Rack.

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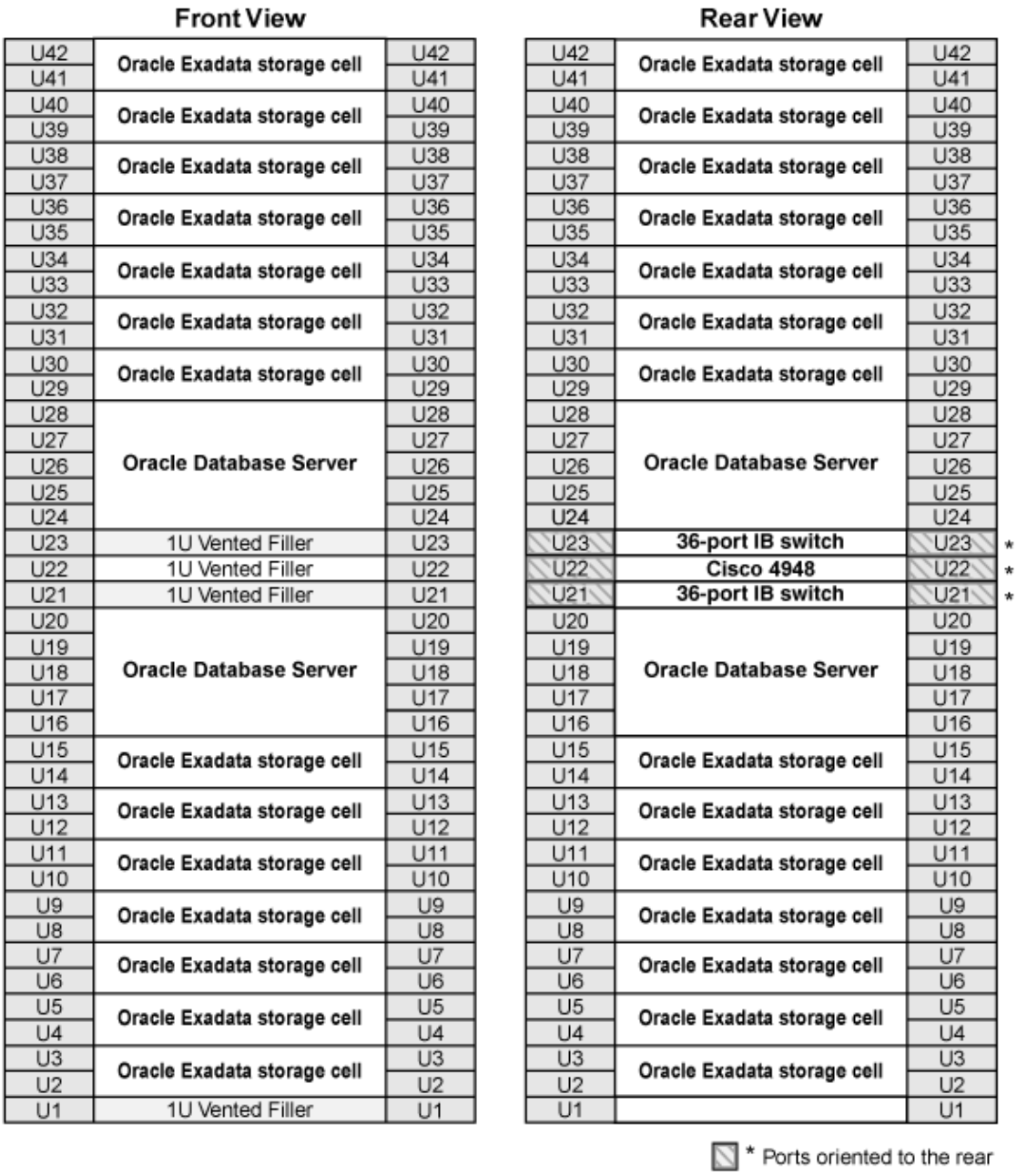
Figure 21-3 Rack Layout of Oracle Exadata Database Machine X3-2 Quarter Rack



The next diagram shows the front and rear views of Oracle Exadata Database Machine X3-8 Full Rack.

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Figure 21-4 Rack Layout of Oracle Exadata Database Machine X3-8 Full Rack



> **Note**
>
> Oracle Exadata Database Machine X3-8 Full Racks with Exadata Storage Server X3-2 Servers include a Sun Datacenter InfiniBand Switch 36 switch in rack unit 1.

21.2 Sun Integrated Lights Out Manager Cabling Tables

This section contains the tables for the Sun Integrated Lights Out Manager (ILOM) network cabling. The ILOM port on the servers is labeled NET MGT, and connects to the Gigabit

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Ethernet port located in rack unit 21 on Oracle Exadata Database Machine X2-2 racks. The ILOM port connects to the Gigabit Ethernet port located in rack unit 22 on Oracle Exadata Database Machine X2-8 Full Rack racks.

The following tables are in this section:

- Table 21-1
- Table 21-2
- Table 21-3
- Table 21-4

Table 21-1 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X3-2 Full Rack:

Table 21-1 ILOM Cabling for Oracle Exadata Database Machine X3-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U39	Exadata Storage Server	2
U37	Exadata Storage Server	4
U35	Exadata Storage Server	6
U33	Exadata Storage Server	8
U31	Exadata Storage Server	10
U29	Exadata Storage Server	12
U27	Exadata Storage Server	14
U26	Database server	16
U25	Database server	18
U24	Database server	20
U23	Database server	22
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Exadata Storage Server	32
U12	Exadata Storage Server	34
U10	Exadata Storage Server	36
U8	Exadata Storage Server	38
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

Table 21-2 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X3-2 Half Rack:

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Table 21-2 ILOM Cabling for Oracle Exadata Database Machine X3-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Exadata Storage Server	32
U12	Exadata Storage Server	34
U10	Exadata Storage Server	36
U8	Exadata Storage Server	38
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

Table 21-3 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X3-2 Quarter Rack:

Table 21-3 ILOM Cabling for Oracle Exadata Database Machine X3-2 Quarter Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U17	Database server	28
U16	Database server	30
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

Table 21-4 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X3-8 Full Rack:

Table 21-4 ILOM Cabling for Oracle Exadata Database Machine X3-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	2
U39	Exadata Storage Server	4
U37	Exadata Storage Server	6
U35	Exadata Storage Server	8
U33	Exadata Storage Server	10
U31	Exadata Storage Server	12
U29	Exadata Storage Server	14
U24	Database server	16
U16	Database server	18
U14	Exadata Storage Server	20

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Table 21-4 (Cont.) ILOM Cabling for Oracle Exadata Database Machine X3-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U12	Exadata Storage Server	22
U10	Exadata Storage Server	24
U8	Exadata Storage Server	26
U6	Exadata Storage Server	28
U4	Exadata Storage Server	30
U2	Exadata Storage Server	32

21.3 Administrative Gigabit Ethernet Port Cabling Tables

This section contains the tables for the administrative Gigabit Ethernet network cabling. The Gigabit Ethernet switch is located in rack unit 21 on Oracle Exadata Database Machine X3-2 racks. The Gigabit Ethernet switch is located in rack unit 22 on Oracle Exadata Database Machine X3-8 Full Rack racks.

The following tables are in this section:

- Table 21-5
- Table 21-6
- Table 21-7
- Table 21-8

Table 21-5 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X3-2 Full Rack:

Table 21-5 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X3-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U39	Exadata Storage Server	1
U37	Exadata Storage Server	3
U35	Exadata Storage Server	5
U33	Exadata Storage Server	7
U31	Exadata Storage Server	9
U29	Exadata Storage Server	11
U27	Exadata Storage Server	13
U26	Database server	15
U25	Database server	17
U24	Database server	19
U23	Database server	21
U22	Sun Datacenter InfiniBand Switch 36 switch	45

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Table 21-5 (Cont.) Gigabit Ethernet Cabling for Oracle Exadata Database Machine X3-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Exadata Storage Server	31
U12	Exadata Storage Server	33
U10	Exadata Storage Server	35
U8	Exadata Storage Server	37
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43
U1	Sun Datacenter InfiniBand Switch 36 switch	47

Table 21-6 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X3-2 Half Rack:

Table 21-6 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X3-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U22	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Exadata Storage Server	31
U12	Exadata Storage Server	33
U10	Exadata Storage Server	35
U8	Exadata Storage Server	37
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43
U1	Sun Datacenter InfiniBand Switch 36 switch	47

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Table 21-7 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X3-2 Quarter Rack:

Table 21-7 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X3-2 Quarter Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U22	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U17	Database server	27
U16	Database server	29
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43

Table 21-8 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X3-8 Full Rack:

Table 21-8 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X3-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	1
U39	Exadata Storage Server	3
U37	Exadata Storage Server	5
U35	Exadata Storage Server	7
U33	Exadata Storage Server	9
U31	Exadata Storage Server	11
U29	Exadata Storage Server	13
U24	Database server	15
U23	Sun Datacenter InfiniBand Switch 36	33
U21	Sun Datacenter InfiniBand Switch 36	34
U16	Database server	17
U14	Exadata Storage Server	19
U12	Exadata Storage Server	21
U10	Exadata Storage Server	23
U8	Exadata Storage Server	25
U6	Exadata Storage Server	27
U4	Exadata Storage Server	29
U2	Exadata Storage Server	31

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> **Note**
>
> Oracle Exadata Database Machine X3-8 Full Racks with Exadata Storage Server X3-2 Servers include a Sun Datacenter InfiniBand Switch 36 switch in rack unit 1, and use port 35 for the Gigabit Ethernet port.

21.4 Single Phase Power Distribution Unit Cabling Tables

This section contains the tables for single phase cabling from each power distribution unit (PDU) to the power supplies configured in each rack. The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

The following tables are in this section:

- Table 21-9
- Table 21-10
- Table 21-11
- Table 21-12

Table 21-9 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X3-2 Full Rack.

Table 21-9 Single Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U39	G5-6	G0-0	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-6	G2-0	2 meters
U26	G4-0	G1-6	2 meters
U25	G3-5	G2-1	2 meters
U24	G3-4	G2-2	2 meters
U23	G3-3	G2-3	2 meters
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters

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Table 21-9 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

Table 21-10 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X3-2 Half Rack.

Table 21-10 Single Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

Table 21-11 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X3-2 Quarter Rack.

Table 21-11 Single Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters

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Table 21-11 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U20	G2-4	G3-2	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

Table 21-12 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X3-8 Full Rack.

Table 21-12 Single Phase PDU Cabling for Oracle Exadata Database Machine X3-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-6	G0-0	2 meters
U39	G5-4	G0-2	2 meters
U37	G5-2	G0-4	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-3	G1-3	2 meters
U29	G3-6	G2-0	2 meters
U24	G4-0	G1-6	1 meter
U24	G2-1	G3-5	1 meter
U23	G3-1	G2-5	2 meters
U22	G2-6	G3-0	2 meters
U21	G3-0	G2-6	2 meters
U16	G3-5	G2-1	1 meter
U16	G1-6	G4-0	1 meter
U14	G2-0	G3-6	2 meters
U12	G1-3	G4-3	2 meters
U10	G1-0	G4-6	2 meters
U8	G0-6	G5-0	2 meters
U6	G0-4	G5-2	2 meters
U4	G0-3	G5-3	2 meters
U2	G0-1	G5-5	2 meters
U1	G0-0	G5-6	2 meters

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21.5 Three Phase Power Distribution Unit Cabling Tables

This section contains the tables for three phase cabling from each power distribution unit (PDU) to the power supplies configured in each rack. The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

The following tables are in this section:

- Table 21-13
- Table 21-14
- Table 21-15
- Table 21-16

Table 21-13 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X3-2 Full Rack.

Table 21-13 Three Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U39	G5-6	G2-0	2 meters
U37	G5-3	G2-3	2 meters
U35	G5-0	G2-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-6	G0-0	2 meters
U26	G4-0	G1-6	2 meters
U25	G3-5	G0-1	2 meters
U24	G3-4	G0-2	2 meters
U23	G3-3	G0-3	2 meters
U22	G3-1	G0-5	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U19	G2-3	G5-3	2 meters
U18	G2-2	G5-4	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters

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Table 21-13 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

Table 21-14 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X3-2 Half Rack.

Table 21-14 Three Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G0-5	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U19	G2-3	G5-3	2 meters
U18	G2-2	G5-4	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

Table 21-15 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X3-2 Quarter Rack.

Table 21-15 Three Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G0-5	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters

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Table 21-15 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X3-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

Table 21-16 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X3-8 Full Rack.

Table 21-16 Three Phase PDU Cabling for Oracle Exadata Database Machine X3-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-5	G2-1	2 meters
U39	G5-4	G2-2	2 meters
U37	G5-2	G2-4	2 meters
U35	G5-1	G2-5	2 meters
U33	G5-0	G2-6	2 meters
U31	G4-6	G1-0	2 meters
U29	G4-4	G1-2	2 meters
U24	G4-1	G1-5	1 meter
U24	G3-6	G0-0	1 meter
U23	G3-3	G0-3	2 meters
U22	G3-0	G0-6	2 meters
U21	G2-5	G5-1	2 meters
U16	G2-1	G5-5	2 meters
U16	G1-6	G4-0	1 meter
U14	G1-3	G4-3	2 meters
U12	G1-0	G4-6	2 meters
U10	G0-6	G3-0	2 meters
U8	G0-5	G3-1	2 meters
U6	G0-4	G3-2	2 meters
U4	G0-2	G3-4	2 meters
U2	G0-1	G3-5	2 meters
U1	G0-0	G3-6	2 meters

21.6 InfiniBand Network Cabling Tables

This section contains the tables for the InfiniBand network cabling. The Sun Datacenter InfiniBand Switch 36 switches are located in located in rack unit 1, 20 and 22.

The following tables are in this section:

- Table 21-17

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- Table 21-18
- Table 21-19
- Table 21-20
- Table 21-21

Table 21-17 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X3-2 Full Rack.

Table 21-17 InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	0A	U39	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	0B	U37	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	1A	U35	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	1B	U33	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	2A	U31	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	2B	U29	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	3A	U27	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	3B	U26	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	4A	U25	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	4B	U24	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	5A	U23	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U22	12B	U19	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13A	U18	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13B	U17	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14A	U16	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14B	U14	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15A	U12	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 21-17 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	15B	U10	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16A	U8	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0A	U39	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0B	U37	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1A	U35	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1B	U33	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2A	U31	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2B	U29	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3A	U27	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3B	U26	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	4A	U25	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	4B	U24	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	5A	U23	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U20	12B	U19	Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13A	U18	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13B	U17	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14A	U16	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14B	U14	Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable

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Table 21-17 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	15A	U12	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	8B	U1	Sun Datacenter InfiniBand Switch 36 switch	0B	3 meter QDR InfiniBand cable
U20	8B	U1	Sun Datacenter InfiniBand Switch 36 switch	1B	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable

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Table 21-17 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

Table 21-18 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X3-2 Half Rack.

> **Note**
>
> The Sun Datacenter InfiniBand Switch 36 switch in rack position U1 is included in Oracle Exadata Database Machine X3-2 Half Racks.

Table 21-18 InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	12B	U19	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13A	U18	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	13B	U17	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14A	U16	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	14B	U14	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15A	U12	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15B	U10	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 21-18 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	16A	U8	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	12B	U19	Database Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13A	U18	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	13B	U17	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14A	U16	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14B	U14	Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable

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Table 21-18 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

Table 21-19 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X3-2 Quarter Rack and Oracle Exadata Database Machine X3-2 Eighth Rack.

> **Note**
>
> The same rules and restrictions apply to Oracle Exadata Database Machine X3-2 Eighth Rack as for Oracle Exadata Database Machine X3-2 Quarter Rack.

Table 21-19 InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Quarter Rack and Oracle Exadata Database Machine X3-2 Eighth Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	13B	U17	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable

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Table 21-19 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Quarter Rack and Oracle Exadata Database Machine X3-2 Eighth Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	14A	U16	Database server	PCIe 3, P2	2 meter QDR InfiniBand cable
U22	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	13B	U17	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	14A	U16	Database server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable

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Table 21-19 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-2 Quarter Rack and Oracle Exadata Database Machine X3-2 Eighth Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable

Table 21-20 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X4-2L Servers.

Table 21-20 InfiniBand Network Cabling for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X4-2L Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	0A	U41	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	0B	U39	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	1A	U37	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	1B	U35	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	2A	U33	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	2B	U31	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	3A	U29	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	3B	U24	Database server	EM-3.0 P-O	2 meter QDR InfiniBand cable
U23	4A	U24	Database server	EM-2.0 P-O	2 meter QDR InfiniBand cable
U23	4B	U24	Database server	EM-1.0 P-O	2 meter QDR InfiniBand cable
U23	5A	U24	Database server	EM-0.0 P-O	2 meter QDR InfiniBand cable
U23	13A	U16	Database server	EM-2.0 P-1	2 meter QDR InfiniBand cable
U23	13B	U16	Database server	EM-1.0 P-1	2 meter QDR InfiniBand cable
U23	14A	U16	Database server	EM-0.0 P-1	2 meter QDR InfiniBand cable

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Table 21-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X4-2L Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	12B	U16	Database server	EM-3.0 P-1	2 meter QDR InfiniBand cable
U23	14B	U14	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	15A	U12	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	15B	U10	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	16A	U8	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	0A	U41	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	0B	U39	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	1A	U37	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	1B	U35	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	2A	U33	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	2B	U31	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	3A	U29	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	3B	U24	Database server	EM-3.0 P-1	2 meter QDR InfiniBand cable
U21	4A	U24	Database server	EM-2.0 P-1	2 meter QDR InfiniBand cable
U21	4B	U24	Database server	EM-1.0 P-1	2 meter QDR InfiniBand cable
U21	5A	U24	Database server	EM-0.0 P-1	2 meter QDR InfiniBand cable
U21	12B	U16	Database Server	EM-3.0 P-O	2 meter QDR InfiniBand cable
U21	13A	U16	Database server	EM-2.0 P-O	2 meter QDR InfiniBand cable

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Table 21-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X4-2L Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	13B	U16	Database server	EM-1.0 P-O	2 meter QDR InfiniBand cable
U21	14A	U16	Database server	EM-0.0 P-O	2 meter QDR InfiniBand cable
U21	14B	U14	Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U21	15A	U12	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	15B	U10	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	16A	U8	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	9B	U23	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U21	10B	U23	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U21	11B	U23	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U21	8A	U23	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U21	9A	U23	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U21	10A	U23	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable

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Table 21-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X4-2L Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	11A	U23	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable

Table 21-21 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X3-2 Servers.

Table 21-21 InfiniBand Network Cabling for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X3-2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	0A	U41	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	0B	U39	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	1A	U37	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	1B	U35	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	2A	U33	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	2B	U31	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	3A	U29	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	3B	U24	Database server	EM-3.0 P-O	2 meter QDR InfiniBand cable
U23	4A	U24	Database server	EM-2.0 P-O	2 meter QDR InfiniBand cable
U23	4B	U24	Database server	EM-1.0 P-O	2 meter QDR InfiniBand cable
U23	5A	U24	Database server	EM-0.0 P-O	2 meter QDR InfiniBand cable
U23	13A	U16	Database server	EM-2.0 P-1	2 meter QDR InfiniBand cable
U23	13B	U16	Database server	EM-1.0 P-1	2 meter QDR InfiniBand cable
U23	14A	U16	Database server	EM-0.0 P-1	2 meter QDR InfiniBand cable

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Table 21-21 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X3-2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	12B	U16	Database server	EM-3.0 P-1	2 meter QDR InfiniBand cable
U23	14B	U14	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	15A	U12	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	15B	U10	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	16A	U8	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	0A	U41	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	0B	U39	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	1A	U37	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	1B	U35	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	2A	U33	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	2B	U31	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	3A	U29	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	3B	U24	Database server	EM-3.0 P-1	2 meter QDR InfiniBand cable
U21	4A	U24	Database server	EM-2.0 P-1	2 meter QDR InfiniBand cable
U21	4B	U24	Database server	EM-1.0 P-1	2 meter QDR InfiniBand cable
U21	5A	U24	Database server	EM-0.0 P-1	2 meter QDR InfiniBand cable
U21	12B	U16	Database Server	EM-3.0 P-O	2 meter QDR InfiniBand cable
U21	13A	U16	Database server	EM-2.0 P-O	2 meter QDR InfiniBand cable

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Table 21-21 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X3-2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	13B	U16	Database server	EM-1.0 P-O	2 meter QDR InfiniBand cable
U21	14A	U16	Database server	EM-0.0 P-O	2 meter QDR InfiniBand cable
U21	14B	U14	Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U21	15A	U12	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	15B	U10	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	16A	U8	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	8B	U1	Sun Datacenter InfiniBand Switch 36 switch	0B	3 meter QDR InfiniBand cable
U21	8B	U1	Sun Datacenter InfiniBand Switch 36 switch	1B	3 meter QDR InfiniBand cable
U21	9B	U23	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U21	10B	U23	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U21	11B	U23	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U21	8A	U23	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable

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Table 21-21 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X3-8 Full Rack with Exadata Storage Server X3-2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	9A	U23	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U21	10A	U23	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U21	11A	U23	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1	1B	U21	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U23	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

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Cabling Tables for Oracle Exadata Database Machine X2-2 and Oracle Exadata Database Machine X2-8 Full Rack

The tables in this chapter show the cable layouts for Oracle Exadata Database Machine X2-2 and Oracle Exadata Database Machine X2-8 Full Rack.

- Rack Layout Diagrams
  The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X2-2 and Oracle Exadata Database Machine X2-8 Full Rack.
- Keyboard, Video and Mouse Network Cabling Tables
- Sun Integrated Lights Out Manager Cabling Tables
- Administrative Gigabit Ethernet Port Cabling Tables
- Single Phase Power Distribution Unit Cabling Tables
- Three Phase Power Distribution Unit Cabling Tables
- InfiniBand Network Cabling Tables

22.1 Rack Layout Diagrams

The diagrams in this topic show the rack layout for Oracle Exadata Database Machine X2-2 and Oracle Exadata Database Machine X2-8 Full Rack.

> **Note**
>
> For ease of reading, the name "Oracle Exadata Rack" is used when information refers to both Oracle Exadata Database Machine and Oracle Exadata Storage Expansion Rack.

The following abbreviations are used in the tables:

Abbreviation	Description
R*n*	Rack *n*, where *n* is the number of the rack, such as R1.
U*n*	Unit height in rack, where *n* is the number, such as U20.
P*n*	InfiniBand port *n*, where n is port number, such as P8A.

The cables used in Oracle Exadata Database Machine are color-coded as follows:

- Black: InfiniBand cables, or AC power jumper cables
- Red: Integrated Lights Out Manager (ILOM) cables

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- Blue: Gigabit Ethernet cables
- Orange: KVM switch cables (not used in Oracle Exadata Database Machine X2-8 Full Rack)

The following table shows the front and rear views of Oracle Exadata Database Machine X2-2 Full Rack. The front is shown on the left, and the rear is shown on the right.

Figure 22-1 Rack Layout of Oracle Exadata Database Machine X2-2 Full Rack

Front View			Rear View			
U42	Oracle Exadata storage cell	U42	U42	Oracle Exadata storage cell	U42	
U41		U41	U41		U41	
U40	Oracle Exadata storage cell	U40	U40	Oracle Exadata storage cell	U40	
U39		U39	U39		U39	
U38	Oracle Exadata storage cell	U38	U38	Oracle Exadata storage cell	U38	
U37		U37	U37		U37	
U36	Oracle Exadata storage cell	U36	U36	Oracle Exadata storage cell	U36	
U35		U35	U35		U35	
U34	Oracle Exadata storage cell	U34	U34	Oracle Exadata storage cell	U34	
U33		U33	U33		U33	
U32	Oracle Exadata storage cell	U32	U32	Oracle Exadata storage cell	U32	
U31		U31	U31		U31	
U30	Oracle Exadata storage cell	U30	U30	Oracle Exadata storage cell	U30	
U29		U29	U29		U29	
U28	**Oracle Database Server**	U28	U28	**Oracle Database Server**	U28	
U27	**Oracle Database Server**	U27	U27	**Oracle Database Server**	U27	
U26	**Oracle Database Server**	U26	U26	**Oracle Database Server**	U26	
U25	**Oracle Database Server**	U25	U25	**Oracle Database Server**	U25	
U24	1U Vented Filler	U24	U24	**36-Port IB Switch**	U24	*
U23	**KVM LCD**	U23	U23	**KVM LCD**	U23	
U22	1U Vented Filler	U22	U22	**KVM Switch**	U22	*
U21	1U Vented Filler	U21	U21	**Cisco 4948**	U21	*
U20	1U Vented Filler	U20	U20	**36-Port IB Switch**	U20	*
U19	**Oracle Database Server**	U19	U19	**Oracle Database Server**	U19	
U18	**Oracle Database Server**	U18	U18	**Oracle Database Server**	U18	
U17	**Oracle Database Server**	U17	U17	**Oracle Database Server**	U17	
U16	**Oracle Database Server**	U16	U16	**Oracle Database Server**	U16	
U15	Oracle Exadata storage cell	U15	U15	Oracle Exadata storage cell	U15	
U14		U14	U14		U14	
U13	Oracle Exadata storage cell	U13	U13	Oracle Exadata storage cell	U13	
U12		U12	U12		U12	
U11	Oracle Exadata storage cell	U11	U11	Oracle Exadata storage cell	U11	
U10		U10	U10		U10	
U9	Oracle Exadata storage cell	U9	U9	Oracle Exadata storage cell	U9	
U8		U8	U8		U8	
U7	Oracle Exadata storage cell	U7	U7	Oracle Exadata storage cell	U7	
U6		U6	U6		U6	
U5	Oracle Exadata storage cell	U5	U5	Oracle Exadata storage cell	U5	
U4		U4	U4		U4	
U3	Oracle Exadata storage cell	U3	U3	Oracle Exadata storage cell	U3	
U2		U2	U2		U2	
U1	1U Vented Filler	U1	U1	**36-Port IB Switch**	U1	*

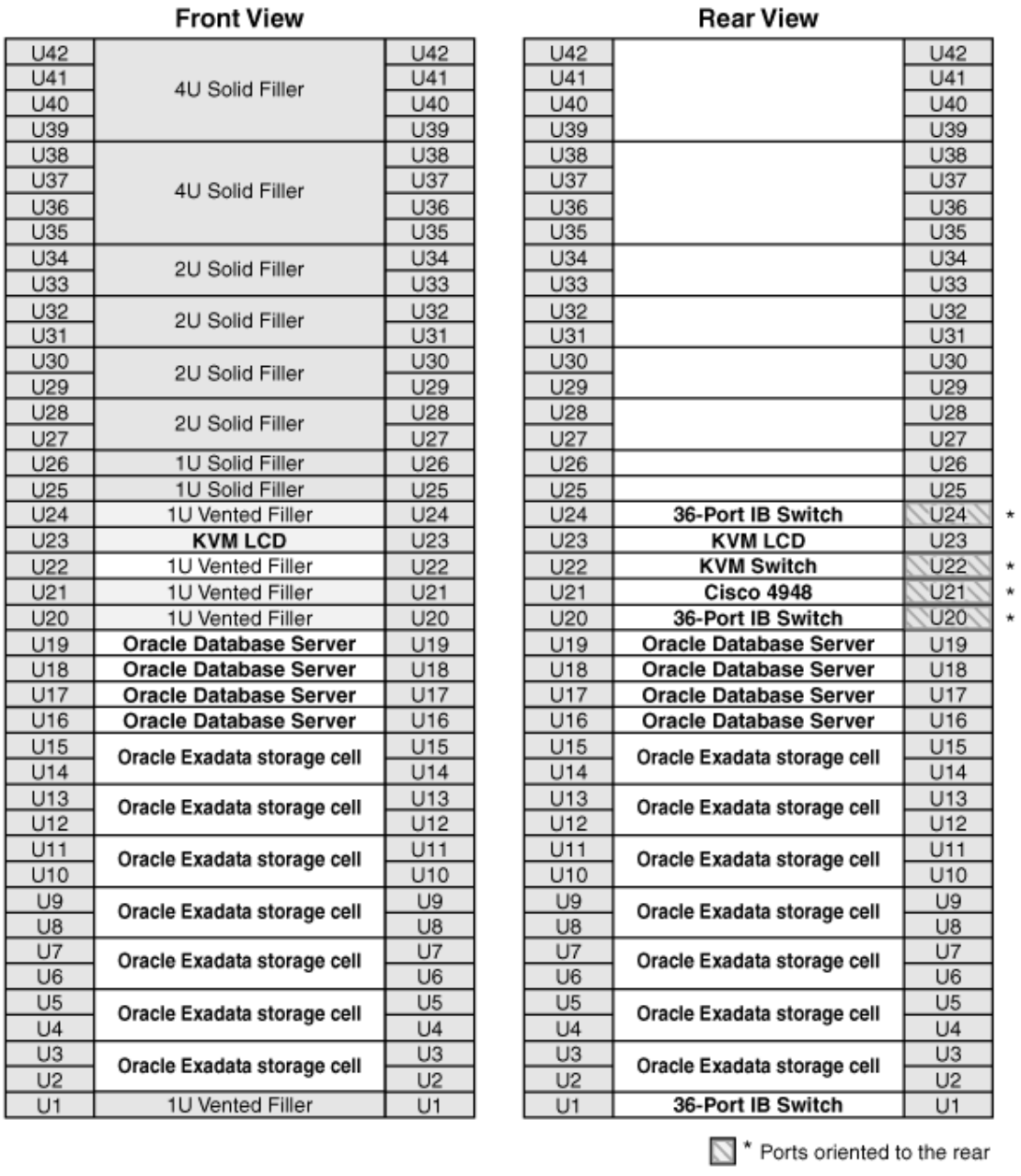
* Ports oriented to the rear

The following table shows the front and rear views of Oracle Exadata Database Machine X2-2 Half Rack.

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> **Note**
>
> The Sun Datacenter InfiniBand Switch 36 switch in rack position U1 is included in Oracle Exadata Database Machine X2-2 Half Racks with the Sun Fire X4170 M2 Oracle Database Servers.

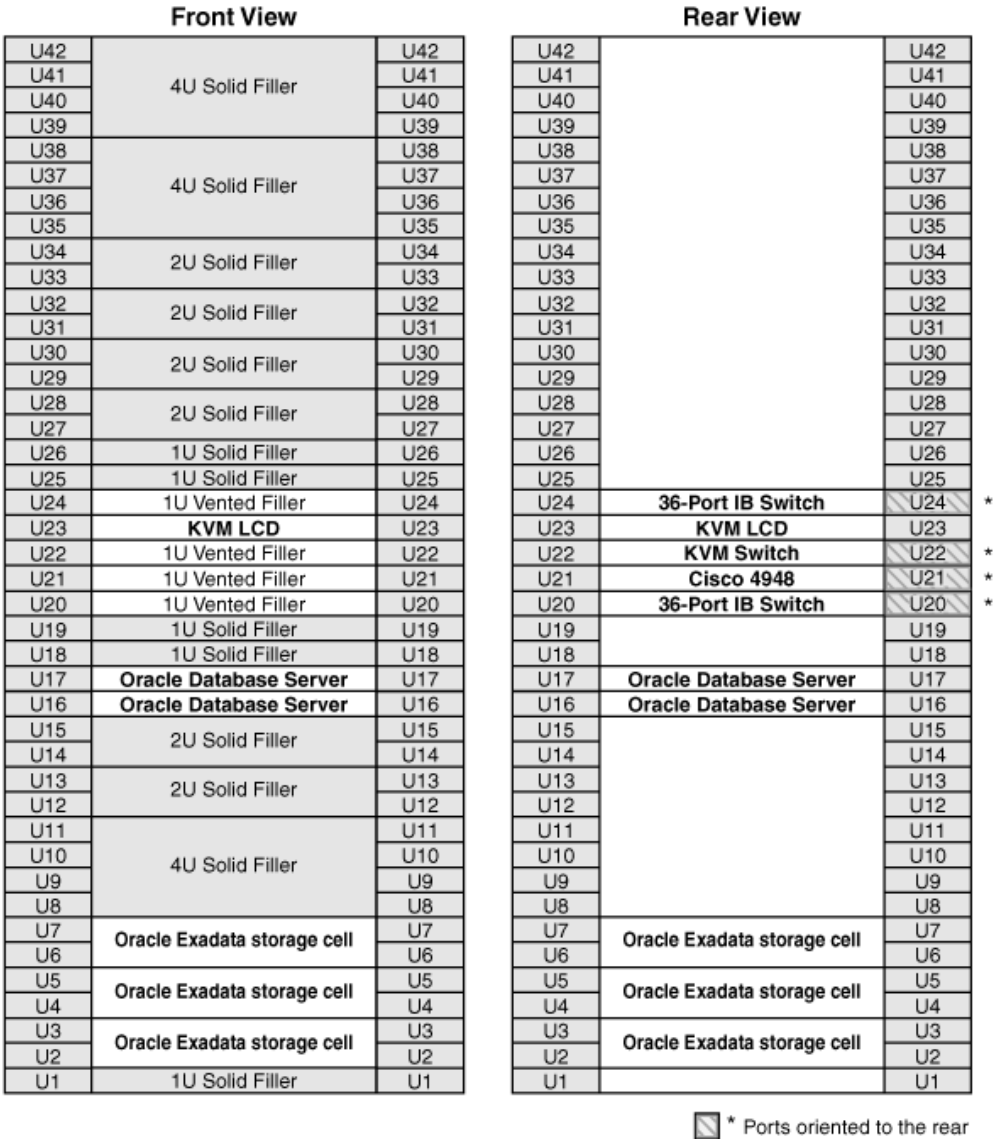
Figure 22-2 Rack Layout for Oracle Exadata Database Machine X2-2 Half Rack



The following table shows the front and rear views of Oracle Exadata Database Machine X2-2 Quarter Rack.

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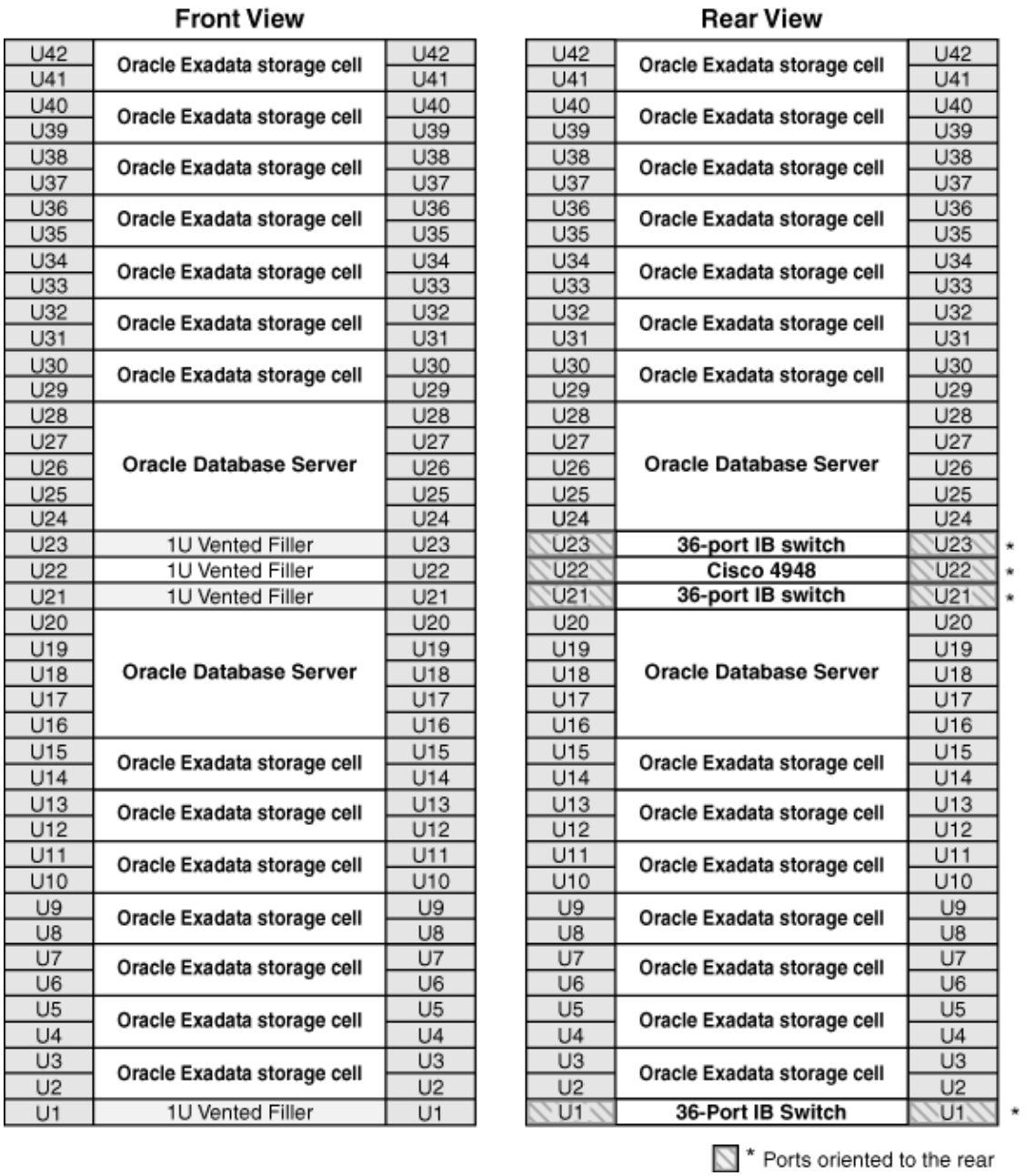
Figure 22-3 Rack Layout of Oracle Exadata Database Machine X2-2 Quarter Rack



The following table shows the front and rear views of Oracle Exadata Database Machine X2-8 Full Rack.

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Figure 22-4 Rack Layout of Oracle Exadata Database Machine X2-8 Full Rack



22.2 Keyboard, Video and Mouse Network Cabling Tables

This section contains the tables for the keyboard, video and mouse (KVM) network cabling. The KVM port on the servers is labeled "SER MGT" and connects to the KVM switch located in rack unit 22. The following tables are in this section:

- Table 22-1
- Table 22-2
- Table 22-3

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Table 22-1 shows the cable connections from the servers to the KVM switch in Oracle Exadata Database Machine X2-2 Full Rack:

Table 22-1 KVM Cabling for Oracle Exadata Database Machine X2-2 Full Rack

From Rack Unit	Type of Equipment	KVM Port
U41	Exadata Storage Server	1
U39	Exadata Storage Server	2
U37	Exadata Storage Server	3
U35	Exadata Storage Server	4
U33	Exadata Storage Server	5
U31	Exadata Storage Server	6
U29	Exadata Storage Server	7
U28	Database server	8
U27	Database server	9
U26	Database server	10
U25	Database server	11
U19	Database server	12
U18	Database server	13
U17	Database server	14
U16	Database server	15
U14	Exadata Storage Server	16
U12	Exadata Storage Server	17
U10	Exadata Storage Server	18
U8	Exadata Storage Server	19
U6	Exadata Storage Server	20
U4	Exadata Storage Server	21
U2	Exadata Storage Server	22

Table 22-2 shows the cable connections from the servers to the KVM switch in Oracle Exadata Database Machine X2-2 Half Rack:

Table 22-2 KVM Cabling for Oracle Exadata Database Machine X2-2 Half Rack

From Rack Unit	Type of Equipment	KVM Port
U19	Database server	12
U18	Database server	13
U17	Database server	14
U16	Database server	15
U14	Exadata Storage Server	16
U12	Exadata Storage Server	17
U10	Exadata Storage Server	18
U8	Exadata Storage Server	19

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Table 22-2 (Cont.) KVM Cabling for Oracle Exadata Database Machine X2-2 Half Rack

From Rack Unit	Type of Equipment	KVM Port
U6	Exadata Storage Server	20
U4	Exadata Storage Server	21
U2	Exadata Storage Server	22

Table 22-3 shows the cable connections from the servers to the KVM switch in Oracle Exadata Database Machine X2-2 Quarter Rack:

Table 22-3 KVM Cabling for Oracle Exadata Database Machine X2-2 Quarter Rack

From Rack Unit	Type of Equipment	KVM Port
U17	Database server	14
U16	Database server	15
U6	Exadata Storage Server	20
U4	Exadata Storage Server	21
U2	Exadata Storage Server	22

22.3 Sun Integrated Lights Out Manager Cabling Tables

This section contains the tables for the Sun Integrated Lights Out Manager (ILOM) network cabling. The ILOM port on the servers is labeled NET MGT, and connects to the Gigabit Ethernet port located in rack unit 21 on Oracle Exadata Database Machine X2-2 racks. The ILOM port connects to the Gigabit Ethernet port located in rack unit 22 on Oracle Exadata Database Machine X2-8 Full Rack racks.

The following tables are in this section:

- Table 22-4
- Table 22-5
- Table 22-6
- Table 22-7

Table 22-4 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X2-2 Full Rack:

Table 22-4 ILOM Cabling for Oracle Exadata Database Machine X2-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	2
U39	Exadata Storage Server	4
U37	Exadata Storage Server	6
U35	Exadata Storage Server	8
U33	Exadata Storage Server	10
U31	Exadata Storage Server	12

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Table 22-4 (Cont.) ILOM Cabling for Oracle Exadata Database Machine X2-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U29	Exadata Storage Server	14
U28	Database server	16
U27	Database server	18
U26	Database server	20
U25	Database server	22
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Exadata Storage Server	32
U12	Exadata Storage Server	34
U10	Exadata Storage Server	36
U8	Exadata Storage Server	38
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

Table 22-5 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X2-2 Half Rack:

Table 22-5 ILOM Cabling for Oracle Exadata Database Machine X2-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U19	Database server	24
U18	Database server	26
U17	Database server	28
U16	Database server	30
U14	Exadata Storage Server	32
U12	Exadata Storage Server	34
U10	Exadata Storage Server	36
U8	Exadata Storage Server	38
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

Table 22-6 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X2-2 Quarter Rack:

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Table 22-6 ILOM Cabling for Oracle Exadata Database Machine X2-2 Quarter Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U17	Database server	28
U16	Database server	30
U6	Exadata Storage Server	40
U4	Exadata Storage Server	42
U2	Exadata Storage Server	44

Table 22-7 shows the cable connections from the servers to the ILOM switch in Oracle Exadata Database Machine X2-8 Full Rack:

Table 22-7 ILOM Cabling for Oracle Exadata Database Machine X2-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	2
U39	Exadata Storage Server	4
U37	Exadata Storage Server	6
U35	Exadata Storage Server	8
U33	Exadata Storage Server	10
U31	Exadata Storage Server	12
U29	Exadata Storage Server	14
U24	Database server	16
U16	Database server	18
U14	Exadata Storage Server	20
U12	Exadata Storage Server	22
U10	Exadata Storage Server	24
U8	Exadata Storage Server	26
U6	Exadata Storage Server	28
U4	Exadata Storage Server	30
U2	Exadata Storage Server	32

22.4 Administrative Gigabit Ethernet Port Cabling Tables

This section contains the tables for the administrative Gigabit Ethernet network cabling. The Gigabit Ethernet switch is located in rack unit 21 on Oracle Exadata Database Machine X2-2 racks. The Gigabit Ethernet switch is located in rack unit 22 on Oracle Exadata Database Machine X2-8 Full Rack racks.

The following tables are in this section:

- Table 22-8
- Table 22-9
- Table 22-10

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- Table 22-11

Table 22-8 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X2-2 Full Rack:

Table 22-8 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X2-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	1
U39	Exadata Storage Server	3
U37	Exadata Storage Server	5
U35	Exadata Storage Server	7
U33	Exadata Storage Server	9
U31	Exadata Storage Server	11
U29	Exadata Storage Server	13
U28	Database server	15
U27	Database server	17
U26	Database server	19
U25	Database server	21
U24	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Exadata Storage Server	31
U12	Exadata Storage Server	33
U10	Exadata Storage Server	35
U8	Exadata Storage Server	37
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43
U1	Sun Datacenter InfiniBand Switch 36 switch	47

Table 22-9 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X2-2 Half Rack:

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Table 22-9 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X2-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U24	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U19	Database server	23
U18	Database server	25
U17	Database server	27
U16	Database server	29
U14	Exadata Storage Server	31
U12	Exadata Storage Server	33
U10	Exadata Storage Server	35
U8	Exadata Storage Server	37
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43
U1	Sun Datacenter InfiniBand Switch 36 switch	47

Table 22-10 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X2-2 Quarter Rack:

Table 22-10 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X2-2 Quarter Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U24	Sun Datacenter InfiniBand Switch 36 switch	45
U20	Sun Datacenter InfiniBand Switch 36 switch	46
U17	Database server	27
U16	Database server	29
U6	Exadata Storage Server	39
U4	Exadata Storage Server	41
U2	Exadata Storage Server	43

Table 22-11 shows the cable connections from the servers to the Gigabit Ethernet switch in Oracle Exadata Database Machine X2-8 Full Rack:

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Table 22-11 Gigabit Ethernet Cabling for Oracle Exadata Database Machine X2-8 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Exadata Storage Server	1
U39	Exadata Storage Server	3
U37	Exadata Storage Server	5
U35	Exadata Storage Server	7
U33	Exadata Storage Server	9
U31	Exadata Storage Server	11
U29	Exadata Storage Server	13
U24	Database server	15
U23	Sun Datacenter InfiniBand Switch 36	33
U21	Sun Datacenter InfiniBand Switch 36	34
U16	Database server	17
U14	Exadata Storage Server	19
U12	Exadata Storage Server	21
U10	Exadata Storage Server	23
U8	Exadata Storage Server	25
U6	Exadata Storage Server	27
U4	Exadata Storage Server	29
U2	Exadata Storage Server	31
U1	Sun Datacenter InfiniBand Switch 36	35

22.5 Single Phase Power Distribution Unit Cabling Tables

This section contains the tables for single phase cabling from each power distribution unit (PDU) to the power supplies configured in each rack. The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

The following tables are in this section:

- Table 22-12
- Table 22-13
- Table 22-14
- Table 22-15

Table 22-12 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X2-2 Full Rack.

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Table 22-12 Single Phase PDU Cabling for Oracle Exadata Database Machine X2-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-6	G0-0	2 meters
U39	G5-3	G0-3	2 meters
U37	G5-0	G0-6	2 meters
U35	G4-6	G1-0	2 meters
U33	G4-4	G1-2	2 meters
U31	G4-2	G1-4	2 meters
U29	G3-6	G2-0	2 meters
U28	G4-0	G1-6	2 meters
U27	G3-5	G2-1	2 meters
U26	G3-4	G2-2	2 meters
U25	G3-3	G2-3	2 meters
U24	G3-1	G2-5	1 meter
U23	N/A	G3-0	included
U22	G2-5	G3-1	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

Table 22-13 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X2-2 Half Rack.

Table 22-13 Single Phase PDU Cabling for Oracle Exadata Database Machine X2-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U24	G3-1	G2-5	1 meter
U23	N/A	G3-0	included

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Table 22-13 (Cont.) Single Phase PDU Cabling for Oracle Exadata Database Machine X2-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G2-5	G3-1	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

Table 22-14 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X2-2 Quarter Rack.

Table 22-14 Single Phase PDU Cabling for Oracle Exadata Database Machine X2-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U24	G3-1	G2-5	1 meter
U23	N/A	G3-0	included
U22	G2-5	G3-1	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U17	G2-1	G3-5	2 meters
U16	G1-6	G4-0	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

Table 22-15 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X2-8 Full Rack.

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Table 22-15 Single Phase PDU Cabling for Oracle Exadata Database Machine X2-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-6	G0-0	2 meters
U39	G5-4	G0-2	2 meters
U37	G5-2	G0-4	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-3	G1-3	2 meters
U29	G3-6	G2-0	2 meters
U24	G4-0	G1-6	1 meter
U24	G3-5	G2-1	1 meter
U23	G3-1	G2-5	2 meters
U22	G2-6	G3-0	2 meters
U21	G3-0	G2-6	2 meters
U16	G2-1	G3-5	1 meter
U16	G1-6	G4-0	1 meter
U14	G2-0	G3-6	2 meters
U12	G1-3	G4-3	2 meters
U10	G1-0	G4-6	2 meters
U8	G0-6	G5-0	2 meters
U6	G0-4	G5-2	2 meters
U4	G0-3	G5-3	2 meters
U2	G0-1	G5-5	2 meters
U1	G0-0	G5-6	2 meters

22.6 Three Phase Power Distribution Unit Cabling Tables

This section contains the tables for three phase cabling from each power distribution unit (PDU) to the power supplies configured in each rack. The cables are terminated to PDU-A on the left, and routed to the right to enter CMA, and are bundled in groups of four.

The following tables are in this section:

- Table 22-16
- Table 22-17
- Table 22-18
- Table 22-19

Table 22-16 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X2-2 Full Rack.

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Table 22-16 Three Phase PDU Cabling for Oracle Exadata Database Machine X2-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-6	G2-0	2 meters
U39	G5-3	G2-3	2 meters
U37	G5-0	G2-6	2 meters
U35	G4-6	G1-0	2 meters
U33	G4-4	G1-2	2 meters
U31	G4-2	G1-4	2 meters
U29	G3-6	G0-0	2 meters
U28	G4-0	G1-6	2 meters
U27	G3-5	G0-1	2 meters
U26	G3-4	G0-2	2 meters
U25	G3-3	G0-3	2 meters
U24	G3-1	G0-5	1 meter
U23	N/A	G5-0	included
U22	G2-5	G5-1	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U19	G2-3	G5-3	2 meters
U18	G2-2	G5-4	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

Table 22-17 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X2-2 Half Rack.

Table 22-17 Three Phase PDU Cabling for Oracle Exadata Database Machine X2-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U24	G3-1	G0-5	1 meter
U23	N/A	G5-0	included

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Table 22-17 (Cont.) Three Phase PDU Cabling for Oracle Exadata Database Machine X2-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G2-5	G5-1	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U19	G2-3	G5-3	2 meters
U18	G2-2	G5-4	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

Table 22-18 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X2-2 Quarter Rack.

Table 22-18 Three Phase PDU Cabling for Oracle Exadata Database Machine X2-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U24	G3-1	G0-5	1 meter
U23	N/A	G5-0	included
U22	G2-5	G5-1	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

Table 22-19 shows the cable connections from the PDUs to the rack units in Oracle Exadata Database Machine X2-8 Full Rack.

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Table 22-19 Three Phase PDU Cabling for Oracle Exadata Database Machine X2-8 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-5	G2-1	2 meters
U39	G5-4	G2-2	2 meters
U37	G5-2	G2-4	2 meters
U35	G5-1	G2-5	2 meters
U33	G5-0	G2-6	2 meters
U31	G4-6	G1-0	2 meters
U29	G4-4	G1-2	2 meters
U24	G4-1	G1-5	1 meter
U24	G3-6	G0-0	1 meter
U23	G3-3	G0-3	2 meters
U22	G3-0	G0-6	2 meters
U21	G2-5	G5-1	2 meters
U16	G2-1	G5-5	1 meter
U16	G1-6	G4-0	1 meter
U14	G1-3	G4-3	2 meters
U12	G1-0	G4-6	2 meters
U10	G0-6	G3-0	2 meters
U8	G0-5	G3-1	2 meters
U6	G0-4	G3-2	2 meters
U4	G0-2	G3-4	2 meters
U2	G0-1	G3-5	2 meters
U1	G0-0	G3-6	2 meters

22.7 InfiniBand Network Cabling Tables

This section contains the tables for the InfiniBand network cabling. The Sun Datacenter InfiniBand Switch 36 switches are located in located in rack unit 1, 20 and 24.

The following tables are in this section:

- Table 22-20
- Table 22-21
- Table 22-22
- Table 22-23

Table 22-20 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X2-2 Full Rack.

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Table 22-20 InfiniBand Network Cabling for Oracle Exadata Database Machine X2-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U24	0A	U41	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	0B	U39	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	1A	U37	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	1B	U35	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	2A	U33	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	2B	U31	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	3A	U29	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	3B	U28	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U24	4A	U27	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U24	4B	U26	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U24	5A	U25	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U24	12B	U19	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	13A	U18	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	13B	U17	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	14A	U16	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	14B	U14	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	15A	U12	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	15B	U10	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	16A	U8	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 22-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X2-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U24	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0A	U41	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0B	U39	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1A	U37	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1B	U35	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2A	U33	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2B	U31	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3A	U29	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3B	U28	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U20	4A	U27	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U20	4B	U26	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U20	5A	U25	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U20	12B	U19	Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	13A	U18	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	13B	U17	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14A	U16	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14B	U14	Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable

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Table 22-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X2-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	8B	U1	Sun Datacenter InfiniBand Switch 36 switch	0B	3 meter QDR InfiniBand cable
U20	8B	U1	Sun Datacenter InfiniBand Switch 36 switch	1B	3 meter QDR InfiniBand cable
U20	9B	U24	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U24	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U24	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U24	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U24	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U24	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U24	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

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Table 22-20 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X2-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U1	0B	U24	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

Table 22-21 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X2-2 Half Rack.

> **Note**
>
> The Sun Datacenter InfiniBand Switch 36 switch in rack position U1 is included in Oracle Exadata Database Machine X2-2 Half Racks with Sun Fire X4170 M2 Oracle Database Servers.

Table 22-21 InfiniBand Network Cabling for Oracle Exadata Database Machine X2-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U24	12B	U19	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	13A	U18	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	13B	U17	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	14A	U16	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	14B	U14	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	15A	U12	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	15B	U10	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	16A	U8	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 22-21 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X2-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U24	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	12B	U19	Database Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	13A	U18	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	13B	U17	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14A	U16	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14B	U14	Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U24	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U24	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U24	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U24	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U24	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable

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Table 22-21 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X2-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	10A	U24	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U24	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U24	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

Table 22-22 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X2-2 Quarter Rack.

Table 22-22 InfiniBand Network Cabling for Oracle Exadata Database Machine X2-2 Quarter Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U24	13B	U17	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	14A	U16	Database server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	13B	U17	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14A	U16	Database server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable

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Table 22-22 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X2-2 Quarter Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U24	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U20	10B	U24	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U20	11B	U24	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U20	8A	U24	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U20	9A	U24	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U20	10A	U24	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U20	11A	U24	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable

Table 22-23 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Database Machine X2-8 Full Rack.

Table 22-23 InfiniBand Network Cabling for Oracle Exadata Database Machine X2-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	0A	U41	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable

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Table 22-23 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X2-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U23	0B	U39	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	1A	U37	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	1B	U35	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	2A	U33	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	2B	U31	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	3A	U29	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	3B	U24	Database server	EM-3.0 P-O	2 meter QDR InfiniBand cable
U23	4A	U24	Database server	EM-2.0 P-O	2 meter QDR InfiniBand cable
U23	4B	U24	Database server	EM-1.0 P-O	2 meter QDR InfiniBand cable
U23	5A	U24	Database server	EM-0.0 P-O	2 meter QDR InfiniBand cable
U23	13A	U16	Database server	EM-2.0 P-1	2 meter QDR InfiniBand cable
U23	13B	U16	Database server	EM-1.0 P-1	2 meter QDR InfiniBand cable
U23	14A	U16	Database server	EM-0.0 P-1	2 meter QDR InfiniBand cable
U23	12B	U16	Database server	EM-3.0 P-1	2 meter QDR InfiniBand cable
U23	14B	U14	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	15A	U12	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	15B	U10	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	16A	U8	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U23	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 22-23 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X2-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	0A	U41	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	0B	U39	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	1A	U37	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	1B	U35	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	2A	U33	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	2B	U31	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	3A	U29	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U21	3B	U24	Database server	EM-3.0 P-1	2 meter QDR InfiniBand cable
U21	4A	U24	Database server	EM-2.0 P-1	2 meter QDR InfiniBand cable
U21	4B	U24	Database server	EM-1.0 P-1	2 meter QDR InfiniBand cable
U21	5A	U24	Database server	EM-0.0 P-1	2 meter QDR InfiniBand cable
U21	12B	U16	Database Server	EM-3.0 P-O	2 meter QDR InfiniBand cable
U21	13A	U16	Database server	EM-2.0 P-O	2 meter QDR InfiniBand cable
U21	13B	U16	Database server	EM-1.0 P-O	2 meter QDR InfiniBand cable
U21	14A	U16	Database server	EM-0.0 P-O	2 meter QDR InfiniBand cable
U21	14B	U14	Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U21	15A	U12	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	15B	U10	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	16A	U8	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U21	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable

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Table 22-23 (Cont.) InfiniBand Network Cabling for Oracle Exadata Database Machine X2-8 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U21	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U23	8B	U1	Sun Datacenter InfiniBand Switch 36 switch	0B	3 meter QDR InfiniBand cable
U21	8B	U1	Sun Datacenter InfiniBand Switch 36 switch	1B	3 meter QDR InfiniBand cable
U21	9B	U23	Sun Datacenter InfiniBand Switch 36 switch	9A	1 meter QDR InfiniBand cable
U21	10B	U23	Sun Datacenter InfiniBand Switch 36 switch	10A	1 meter QDR InfiniBand cable
U21	11B	U23	Sun Datacenter InfiniBand Switch 36 switch	11A	1 meter QDR InfiniBand cable
U21	8A	U23	Sun Datacenter InfiniBand Switch 36 switch	8A	1 meter QDR InfiniBand cable
U21	9A	U23	Sun Datacenter InfiniBand Switch 36 switch	9B	1 meter QDR InfiniBand cable
U21	10A	U23	Sun Datacenter InfiniBand Switch 36 switch	10B	1 meter QDR InfiniBand cable
U21	11A	U23	Sun Datacenter InfiniBand Switch 36 switch	11B	1 meter QDR InfiniBand cable
U1	1B	U21	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U23	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

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Cabling Tables for Oracle Exadata Storage Expansion Rack X11M and X10M

This section shows the cable layouts for Oracle Exadata Storage Expansion Rack X11M and X10M.

- Rack Layout
  This topic shows the rack layout for Oracle Exadata Storage Expansion Rack X11M and X10M.
- Integrated Lights Out Manager (ILOM) Cabling
  This topic shows the ILOM network cabling for Oracle Exadata Storage Expansion Rack X11M and X10M.
- Administration Network Cabling
  This topic shows the administration network cabling for Oracle Exadata Storage Expansion Rack X11M and X10M.
- Single Phase Power Distribution Unit Cabling
  This topic shows the cabling routes from each single-phase power distribution unit (PDU) to the power supplies configured in each Oracle Exadata Storage Expansion Rack X11M and X10M.
- Three Phase Power Distribution Unit Cabling
  This topic shows the cabling routes from each three-phase power distribution unit (PDU) to the power supplies configured in Oracle Exadata Storage Expansion Rack X11M and X10M.
- RDMA Network Fabric Cabling
  Use the following RDMA Network Fabric cabling information for Oracle Exadata Storage Expansion Rack X11M and X10M.

23.1 Rack Layout

This topic shows the rack layout for Oracle Exadata Storage Expansion Rack X11M and X10M.

The following diagram shows the component positioning in a fully populated Oracle Exadata Storage Expansion Rack X11M or X10M.

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Figure 23-1 Rack Layout for Oracle Exadata Storage Expansion Rack X11M and X10M



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> **Note**
>
> - The Exadata Storage Servers are oriented so that all cabling is rear-facing.
> - The network switches are oriented with rear-facing network ports.

23.2 Integrated Lights Out Manager (ILOM) Cabling

This topic shows the ILOM network cabling for Oracle Exadata Storage Expansion Rack X11M and X10M.

The ILOM port on the servers is labeled NET MGT, and connects to the Management Network Switch located in rack unit 21 on Oracle Exadata Storage Expansion Racks.

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion Rack X11M and X10M:

Table 23-1 ILOM Cabling for Oracle Exadata Storage Expansion Rack X11M and X10M

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Storage Server	16
U39	Storage Server	2
U37	Storage Server	4
U35	Storage Server	6
U33	Storage Server	8
U31	Storage Server	10
U29	Storage Server	12
U27	Storage Server	14
U25	Storage Server	18
U23	Storage Server	22
U18	Storage Server	26
U16	Storage Server	30
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44
PDU-A	PDU	19
PDU-B	PDU	20

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23.3 Administration Network Cabling

This topic shows the administration network cabling for Oracle Exadata Storage Expansion Rack X11M and X10M.

The port on the storage servers is labeled NET0, and connects to the Management Network Switch located in rack unit 21 on Oracle Exadata Storage Expansion Racks.

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Rack X11M and X10M

Table 23-2 Administration Network Cabling for Oracle Exadata Storage Expansion Rack X11M and X10M

From Rack Unit	Type of Equipment	Management Network Switch Port
U41	Storage Server	15
U39	Storage Server	1
U37	Storage Server	3
U35	Storage Server	5
U33	Storage Server	7
U31	Storage Server	9
U29	Storage Server	11
U27	Storage Server	13
U25	Storage Server	17
U23	Storage Server	21
U22	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46
U18	Storage Server	25
U16	Storage Server	29
U14	Storage Server	31
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
U1	RDMA Network Fabric spine switch	47

23.4 Single Phase Power Distribution Unit Cabling

This topic shows the cabling routes from each single-phase power distribution unit (PDU) to the power supplies configured in each Oracle Exadata Storage Expansion Rack X11M and X10M.

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The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X11M and X10M.

Table 23-3 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X11M and X10M

Rack Slot	PDU-A / PSU 0	PDU-B / PSU 1	Cable Length
U42	G5-6	G0-0	3 meters
U41	G4-6	G1-0	3 meters
U40	G4-2	G1-4	3 meters
U39	G4-4	G1-2	3 meters
U37	G1-5	G4-1	3 meters
U35	G3-1	G2-5	3 meters
U33	G1-3	G4-3	3 meters
U31	G3-3	G2-3	3 meters
U29	G4-0	G1-6	3 meters
U27	G5-2	G0-4	3 meters
U26	G0-6	G5-0	3 meters
U25	G3-0	G2-6	3 meters
U24	G4-1	G1-5	3 meters
U23	G5-0	G0-6	3 meters
U22	G1-6	G4-0	3 meters
U21	G0-4	G5-2	3 meters
U20	G0-3	G5-3	3 meters
U19	G3-2	G2-4	3 meters
U18	G2-5	G3-1	3 meters
U17	G1-2	G4-4	3 meters
U16	G1-4	G4-2	3 meters
U14	G5-3	G0-3	3 meters
U12	G5-4	G0-2	3 meters
U10	G2-3	G3-3	3 meters
U08	G2-4	G3-2	3 meters
U06	G2-6	G3-0	3 meters
U04	G0-2	G5-4	3 meters
U02	G0-5	G5-1	3 meters
U01	G4-3	G1-3	3 meters

23.5 Three Phase Power Distribution Unit Cabling

This topic shows the cabling routes from each three-phase power distribution unit (PDU) to the power supplies configured in Oracle Exadata Storage Expansion Rack X11M and X10M.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in

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groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X11M and X10M.

Table 23-4 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X11M and X10M

Rack Slot	PDU-A / PSU 0	PDU-B / PSU 1	Cable Length
U42	G5-4	G2-2	3 meters
U41	G5-2	G2-4	3 meters
U40	G5-1	G2-5	3 meters
U39	G4-6	G1-0	3 meters
U37	G4-1	G1-5	3 meters
U35	G4-5	G1-1	3 meters
U33	G5-5	G2-1	3 meters
U31	G4-2	G1-4	3 meters
U29	G5-3	G2-3	3 meters
U27	G3-2	G0-4	3 meters
U26	G5-0	G2-6	3 meters
U25	G3-0	G0-6	3 meters
U24	G3-1	G0-5	3 meters
U23	G3-5	G0-1	3 meters
U22	G1-6	G4-0	3 meters
U21	G2-6	G5-0	3 meters
U20	G1-5	G4-1	3 meters
U19	G1-1	G4-5	3 meters
U18	G1-4	G4-2	3 meters
U17	G2-1	G5-5	3 meters
U16	G1-3	G4-3	3 meters
U14	G0-5	G3-1	3 meters
U12	G2-5	G5-1	3 meters
U10	G0-3	G3-3	3 meters
U08	G2-3	G5-3	3 meters
U06	G2-4	G5-2	3 meters
U04	G0-6	G3-0	3 meters
U02	G0-0	G3-6	3 meters
U01	G1-0	G4-6	3 meters

23.6 RDMA Network Fabric Cabling

Use the following RDMA Network Fabric cabling information for Oracle Exadata Storage Expansion Rack X11M and X10M.

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Table 23-5 RDMA Network Fabric Cabling for Oracle Exadata Storage Expansion Rack X11M and X10M Full Rack

From Rack Unit	Port	To RDMA Network Fabric Switch Rack Unit	Port	Description
U41	PCIe Slot 5, Port 2	U22	15	3 meters
U41	PCIe Slot 5, Port 1	U20	15	3 meters
U39	PCIe Slot 5, Port 2	U22	08	3 meters
U39	PCIe Slot 5, Port 1	U20	08	3 meters
U37	PCIe Slot 5, Port 2	U22	09	3 meters
U37	PCIe Slot 5, Port 1	U20	09	3 meters
U35	PCIe Slot 5, Port 2	U22	10	3 meters
U35	PCIe Slot 5, Port 1	U20	10	3 meters
U33	PCIe Slot 5, Port 2	U22	11	3 meters
U33	PCIe Slot 5, Port 1	U20	11	3 meters
U31	PCIe Slot 5, Port 2	U22	12	3 meters
U31	PCIe Slot 5, Port 1	U20	12	3 meters
U29	PCIe Slot 5, Port 2	U22	13	3 meters
U29	PCIe Slot 5, Port 1	U20	13	3 meters
U27	PCIe Slot 5, Port 2	U22	14	3 meters
U27	PCIe Slot 5, Port 1	U20	14	3 meters
U25	PCIe Slot 5, Port 2	U22	16	3 meters
U25	PCIe Slot 5, Port 1	U20	16	3 meters
U23	PCIe Slot 5, Port 2	U22	18	3 meters
U23	PCIe Slot 5, Port 1	U20	18	3 meters
U18	PCIe Slot 5, Port 2	U22	20	3 meters
U18	PCIe Slot 5, Port 1	U20	20	3 meters
U14	PCIe Slot 5, Port 2	U22	23	3 meters
U14	PCIe Slot 5, Port 1	U20	23	3 meters
U12	PCIe Slot 5, Port 2	U22	24	3 meters
U12	PCIe Slot 5, Port 1	U20	24	3 meters
U10	PCIe Slot 5, Port 2	U22	25	3 meters
U10	PCIe Slot 5, Port 1	U20	25	3 meters
U08	PCIe Slot 5, Port 2	U22	26	3 meters
U08	PCIe Slot 5, Port 1	U20	26	3 meters
U06	PCIe Slot 5, Port 2	U22	27	3 meters
U06	PCIe Slot 5, Port 1	U20	27	3 meters
U04	PCIe Slot 5, Port 2	U22	28	3 meters
U04	PCIe Slot 5, Port 1	U20	28	3 meters
U02	PCIe Slot 5, Port 2	U22	29	3 meters

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Table 23-5 (Cont.) RDMA Network Fabric Cabling for Oracle Exadata Storage Expansion Rack X11M and X10M Full Rack

From Rack Unit	Port	To RDMA Network Fabric Switch Rack Unit	Port	Description
U02	PCIe Slot 5, Port 1	U20	29	3 meters

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Cabling Tables for Oracle Exadata Storage Expansion Rack X9M-2

This section shows the cable layouts for Oracle Exadata Storage Expansion Rack X9M-2.

- Rack Layout
  This topic shows the component placement within Oracle Exadata Storage Expansion Rack X9M-2.
- Integrated Lights Out Manager (ILOM) Cabling
  This topic shows the ILOM network cabling for Oracle Exadata Storage Expansion Rack X9M-2.
- Administrative Network Cabling
  This topic shows the Administrative network cabling for the Oracle Exadata Storage Expansion Rack X9M-2.
- Single Phase Power Distribution Unit Cabling
  This topic shows the cabling routes from each single-phase power distribution unit (PDU) to the power supplies configured in each Oracle Exadata Storage Expansion Rack X9M-2.
- Three Phase Power Distribution Unit Cabling
  This topic shows the cabling routes from each three-phase power distribution unit (PDU) to the power supplies configured in Oracle Exadata Storage Expansion Rack X9M-2.
- RDMA Network Fabric Cabling
  Use the following RDMA Network Fabric cabling information for Oracle Exadata Storage Expansion Rack X9M-2.

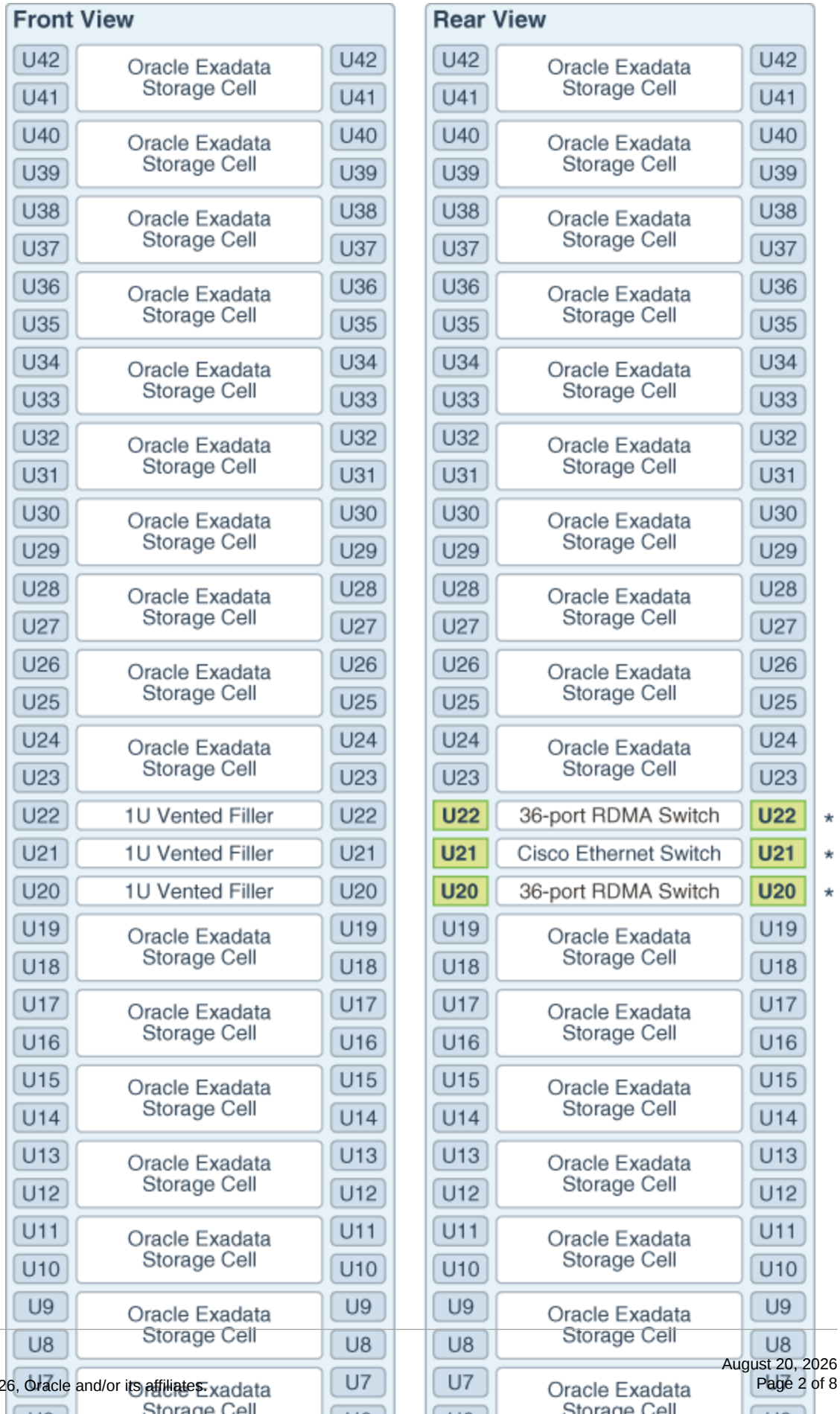
24.1 Rack Layout

This topic shows the component placement within Oracle Exadata Storage Expansion Rack X9M-2.

The following image shows the front and rear of Oracle Exadata Storage Expansion Rack X9M-2 configured with the maximum of 19 storage servers. The front is shown on the left, and the rear is shown on the right.

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Figure 24-1 Rack Layout of Oracle Exadata Storage Expansion Rack X9M-2



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24.2 Integrated Lights Out Manager (ILOM) Cabling

This topic shows the ILOM network cabling for Oracle Exadata Storage Expansion Rack X9M-2.

The ILOM port on the servers is labeled NET MGT, and connects to the Management Network Switch located in rack unit 21 on Oracle Exadata Storage Expansion Racks.

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion Rack X9M-2:

Table 24-1 ILOM Cabling for Oracle Exadata Storage Expansion Rack X9M-2

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Storage Server	16
U39	Storage Server	2
U37	Storage Server	4
U35	Storage Server	6
U33	Storage Server	8
U31	Storage Server	10
U29	Storage Server	12
U27	Storage Server	14
U25	Storage Server	18
U23	Storage Server	22
U18	Storage Server	26
U16	Storage Server	30
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44
PDU-A	PDU	19
PDU-B	PDU	20

24.3 Administrative Network Cabling

This topic shows the Administrative network cabling for the Oracle Exadata Storage Expansion Rack X9M-2.

The port on the storage servers is labeled NET0, and connects to the Management Network Switch located in rack unit 21 on Oracle Exadata Storage Expansion Racks.

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Rack X9M-2

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Table 24-2 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X9M-2

From Rack Unit	Type of Equipment	Management Network Switch Port
U41	Storage Server	15
U39	Storage Server	1
U37	Storage Server	3
U35	Storage Server	5
U33	Storage Server	7
U31	Storage Server	9
U29	Storage Server	11
U27	Storage Server	13
U25	Storage Server	17
U23	Storage Server	21
U22	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46
U18	Storage Server	25
U16	Storage Server	29
U14	Storage Server	31
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
U1	RDMA Network Fabric spine switch	47

24.4 Single Phase Power Distribution Unit Cabling

This topic shows the cabling routes from each single-phase power distribution unit (PDU) to the power supplies configured in each Oracle Exadata Storage Expansion Rack X9M-2.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X9M-2.

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Table 24-3 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X9M-2

Rack Slot	PDU-A / PSU 0	PDU-B / PSU 1	Cable Length
U42	G5-6	G0-0	3 meters
U41	G4-6	G1-0	3 meters
U40	G4-2	G1-4	3 meters
U39	G4-4	G1-2	3 meters
U37	G1-5	G4-1	3 meters
U35	G3-1	G2-5	3 meters
U33	G1-3	G4-3	3 meters
U31	G3-3	G2-3	3 meters
U29	G4-0	G1-6	3 meters
U27	G5-2	G0-4	3 meters
U26	G0-6	G5-0	3 meters
U25	G3-0	G2-6	3 meters
U24	G4-1	G1-5	3 meters
U23	G5-0	G0-6	3 meters
U22	G1-6	G4-0	3 meters
U21	G0-4	G5-2	3 meters
U20	G0-3	G5-3	3 meters
U19	G3-2	G2-4	3 meters
U18	G2-5	G3-1	3 meters
U17	G1-2	G4-4	3 meters
U16	G1-4	G4-2	3 meters
U14	G5-3	G0-3	3 meters
U12	G5-4	G0-2	3 meters
U10	G2-3	G3-3	3 meters
U08	G2-4	G3-2	3 meters
U06	G2-6	G3-0	3 meters
U04	G0-2	G5-4	3 meters
U02	G0-5	G5-1	3 meters
U01	G4-3	G1-3	3 meters

24.5 Three Phase Power Distribution Unit Cabling

This topic shows the cabling routes from each three-phase power distribution unit (PDU) to the power supplies configured in Oracle Exadata Storage Expansion Rack X9M-2.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X9M-2.

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Table 24-4 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X9M-2

Rack Slot	PDU-A / PSU 0	PDU-B / PSU 1	Cable Length
U42	G5-4	G2-2	3 meters
U41	G5-2	G2-4	3 meters
U40	G5-1	G2-5	3 meters
U39	G4-6	G1-0	3 meters
U37	G4-1	G1-5	3 meters
U35	G4-5	G1-1	3 meters
U33	G5-5	G2-1	3 meters
U31	G4-2	G1-4	3 meters
U29	G5-3	G2-3	3 meters
U27	G3-2	G0-4	3 meters
U26	G5-0	G2-6	3 meters
U25	G3-0	G0-6	3 meters
U24	G3-1	G0-5	3 meters
U23	G3-5	G0-1	3 meters
U22	G1-6	G4-0	3 meters
U21	G2-6	G5-0	3 meters
U20	G1-5	G4-1	3 meters
U19	G1-1	G4-5	3 meters
U18	G1-4	G4-2	3 meters
U17	G2-1	G5-5	3 meters
U16	G1-3	G4-3	3 meters
U14	G0-5	G3-1	3 meters
U12	G2-5	G5-1	3 meters
U10	G0-3	G3-3	3 meters
U08	G2-3	G5-3	3 meters
U06	G2-4	G5-2	3 meters
U04	G0-6	G3-0	3 meters
U02	G0-0	G3-6	3 meters
U01	G1-0	G4-6	3 meters

24.6 RDMA Network Fabric Cabling

Use the following RDMA Network Fabric cabling information for Oracle Exadata Storage Expansion Rack X9M-2.

> **Note**
>
> On Exadata X9M-2 High Capacity (HC) and Extreme Flash (EF) storage servers, the RDMA Network Fabric ports are located at PCIe slot 3. On Extreme (XT) storage servers, the RDMA Network Fabric ports are located at PCIe slot 10.

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Table 24-5 RDMA Network Fabric Cabling for Oracle Exadata Storage Expansion Rack X9M-2 Full Rack

From Rack Unit	Port	To RDMA Network Fabric Switch Rack Unit	Port	Description
U41	PCIe QSFP28 Port 2	U22	15	3 meters
U41	PCIe QSFP28 Port 1	U20	15	3 meters
U39	PCIe QSFP28 Port 2	U22	08	3 meters
U39	PCIe QSFP28 Port 1	U20	08	3 meters
U37	PCIe QSFP28 Port 2	U22	09	3 meters
U37	PCIe QSFP28 Port 1	U20	09	3 meters
U35	PCIe QSFP28 Port 2	U22	10	3 meters
U35	PCIe QSFP28 Port 1	U20	10	3 meters
U33	PCIe QSFP28 Port 2	U22	11	3 meters
U33	PCIe QSFP28 Port 1	U20	11	3 meters
U31	PCIe QSFP28 Port 2	U22	12	3 meters
U31	PCIe QSFP28 Port 1	U20	12	3 meters
U29	PCIe QSFP28 Port 2	U22	13	3 meters
U29	PCIe QSFP28 Port 1	U20	13	3 meters
U27	PCIe QSFP28 Port 2	U22	14	3 meters
U27	PCIe QSFP28 Port 1	U20	14	3 meters
U25	PCIe QSFP28 Port 2	U22	16	3 meters
U25	PCIe QSFP28 Port 1	U20	16	3 meters
U23	PCIe QSFP28 Port 2	U22	18	3 meters
U23	PCIe QSFP28 Port 1	U20	18	3 meters
U18	PCIe QSFP28 Port 2	U22	20	3 meters

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Table 24-5 (Cont.) RDMA Network Fabric Cabling for Oracle Exadata Storage Expansion Rack X9M-2 Full Rack

From Rack Unit	Port	To RDMA Network Fabric Switch Rack Unit	Port	Description
U18	PCIe QSFP28 Port 1	U20	20	3 meters
U14	PCIe QSFP28 Port 2	U22	23	3 meters
U14	PCIe QSFP28 Port 1	U20	23	3 meters
U12	PCIe QSFP28 Port 2	U22	24	3 meters
U12	PCIe QSFP28 Port 1	U20	24	3 meters
U10	PCIe QSFP28 Port 2	U22	25	3 meters
U10	PCIe QSFP28 Port 1	U20	25	3 meters
U08	PCIe QSFP28 Port 2	U22	26	3 meters
U08	PCIe QSFP28 Port 1	U20	26	3 meters
U06	PCIe QSFP28 Port 2	U22	27	3 meters
U06	PCIe QSFP28 Port 1	U20	27	3 meters
U04	PCIe QSFP28 Port 2	U22	28	3 meters
U04	PCIe QSFP28 Port 1	U20	28	3 meters
U02	PCIe QSFP28 Port 2	U22	29	3 meters
U02	PCIe QSFP28 Port 1	U20	29	3 meters

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Cabling Tables for Oracle Exadata Storage Expansion Rack X8M and Earlier

> **Note**
>
> For ease of reading, the name "Oracle Exadata Rack" is used when information refers to both Oracle Exadata Database Machine and Oracle Exadata Storage Expansion Rack.

- Storage Expansion Rack Layout Diagrams
  These tables show the component placement within Oracle Exadata Storage Expansion Rack.
- Integrated Lights Out Manager (ILOM) Cabling Tables
  These tables show the ILOM network cabling for the Oracle Exadata Storage Expansion Racks.
- Administrative Network Cabling Tables
  These tables show the Administrative network cabling for the Oracle Exadata Storage Expansion Racks.
- Single Phase Power Distribution Unit Cabling Tables
  These tables show the cabling routes from each single-phase power distribution unit (PDU) to the power supplies configured in each Oracle Exadata Storage Expansion Rack.
- Three Phase Power Distribution Unit Cabling Tables
  These tables show the cabling routes from each three-phase power distribution unit (PDU) to the power supplies configured in each Oracle Exadata Storage Expansion Rack.
- RDMA Network Fabric Network Cabling Tables
  These tables show the RDMA Network Fabric network cabling connections for the Oracle Exadata Storage Expansion Rack.

25.1 Storage Expansion Rack Layout Diagrams

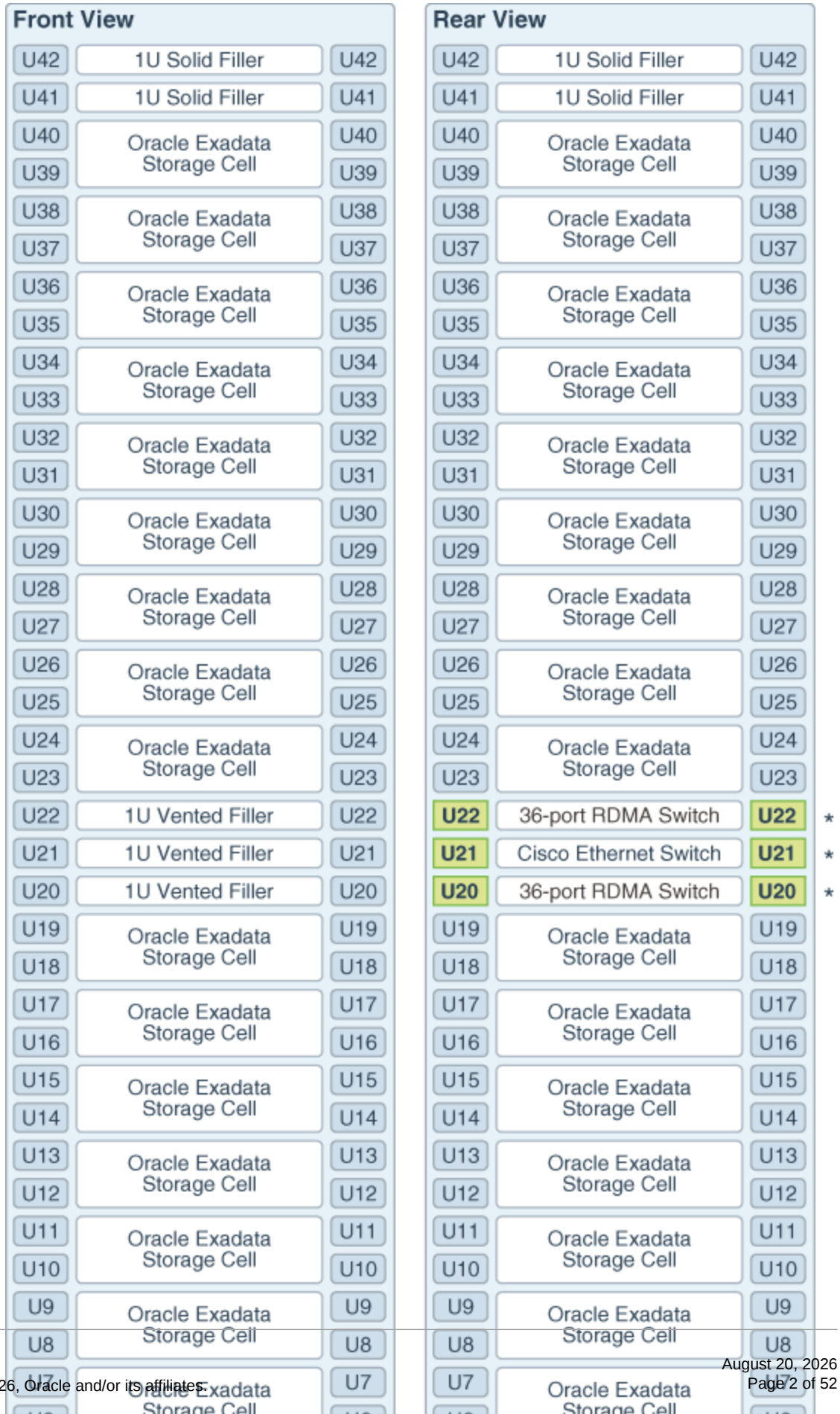
These tables show the component placement within Oracle Exadata Storage Expansion Rack.

Oracle Exadata Storage Expansion Rack X5 to X8M

The following image shows the front and rear of Oracle Exadata Storage Expansion Full Rack for X5 to X8M. The front is shown on the left, and the rear is shown on the right.

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Figure 25-1 Rack Layout of Oracle Exadata Storage Expansion Full Rack X5 to X8M

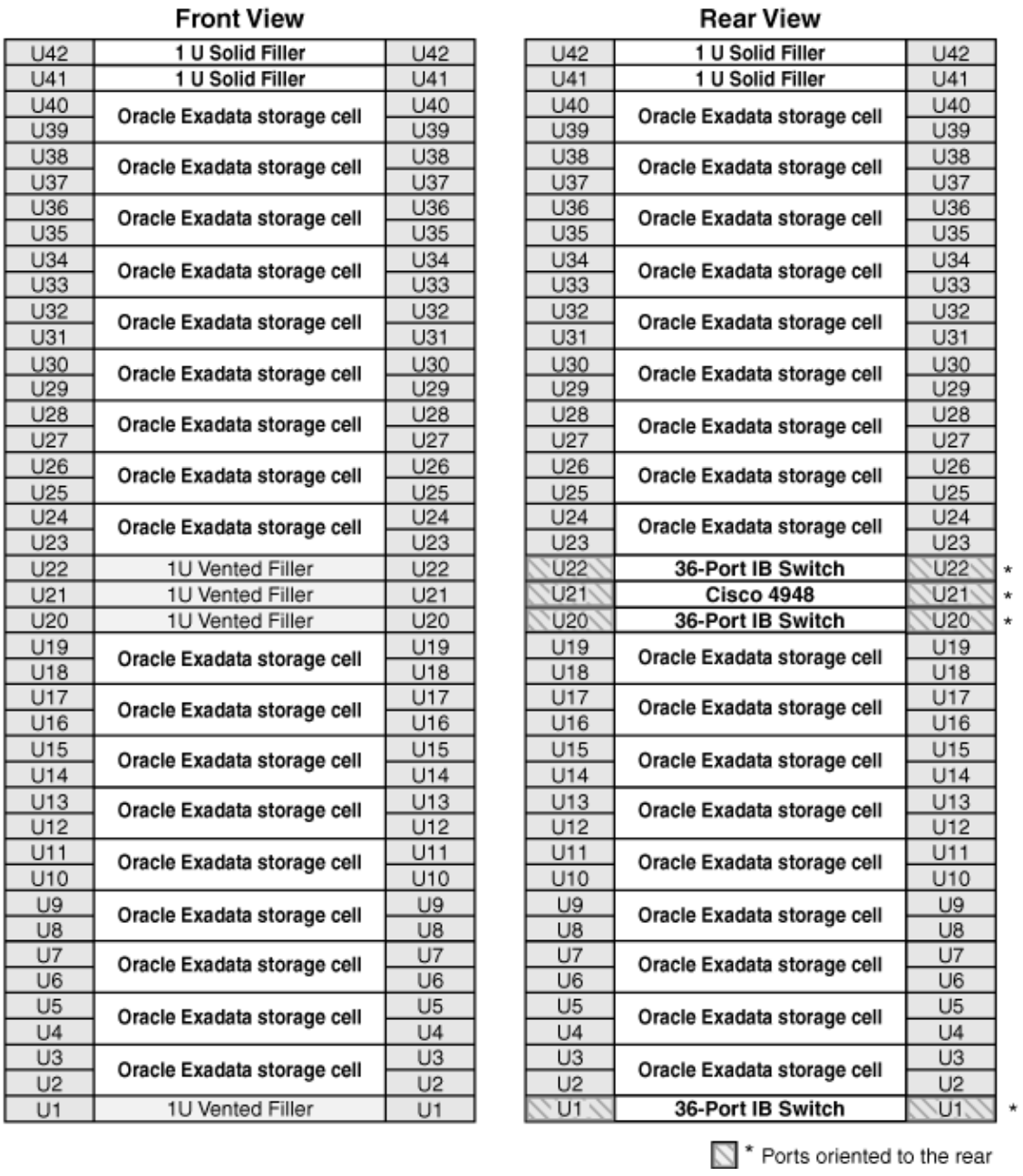


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Oracle Exadata Storage Expansion Rack X3-2 and X4-2

The following image shows the front and rear of Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack. The front is shown on the left, and the rear is shown on the right.

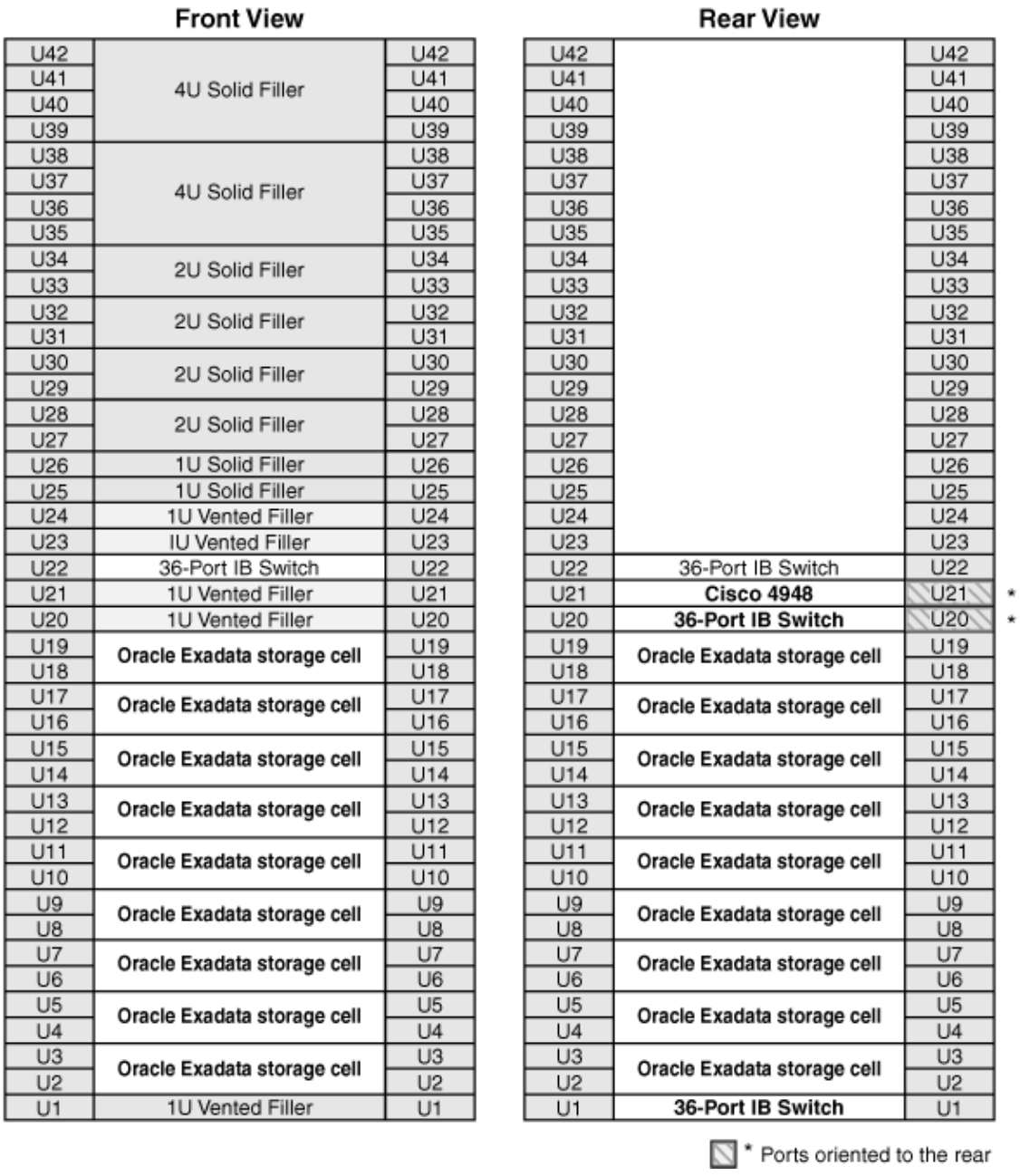
Figure 25-2 Rack Layout of Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack



The following image shows the front and rear of Oracle Exadata Storage Expansion X4-2 Half Rack, and Oracle Exadata Storage Expansion X3-2 Half Rack. The front is shown on the left, and the rear is shown on the right.

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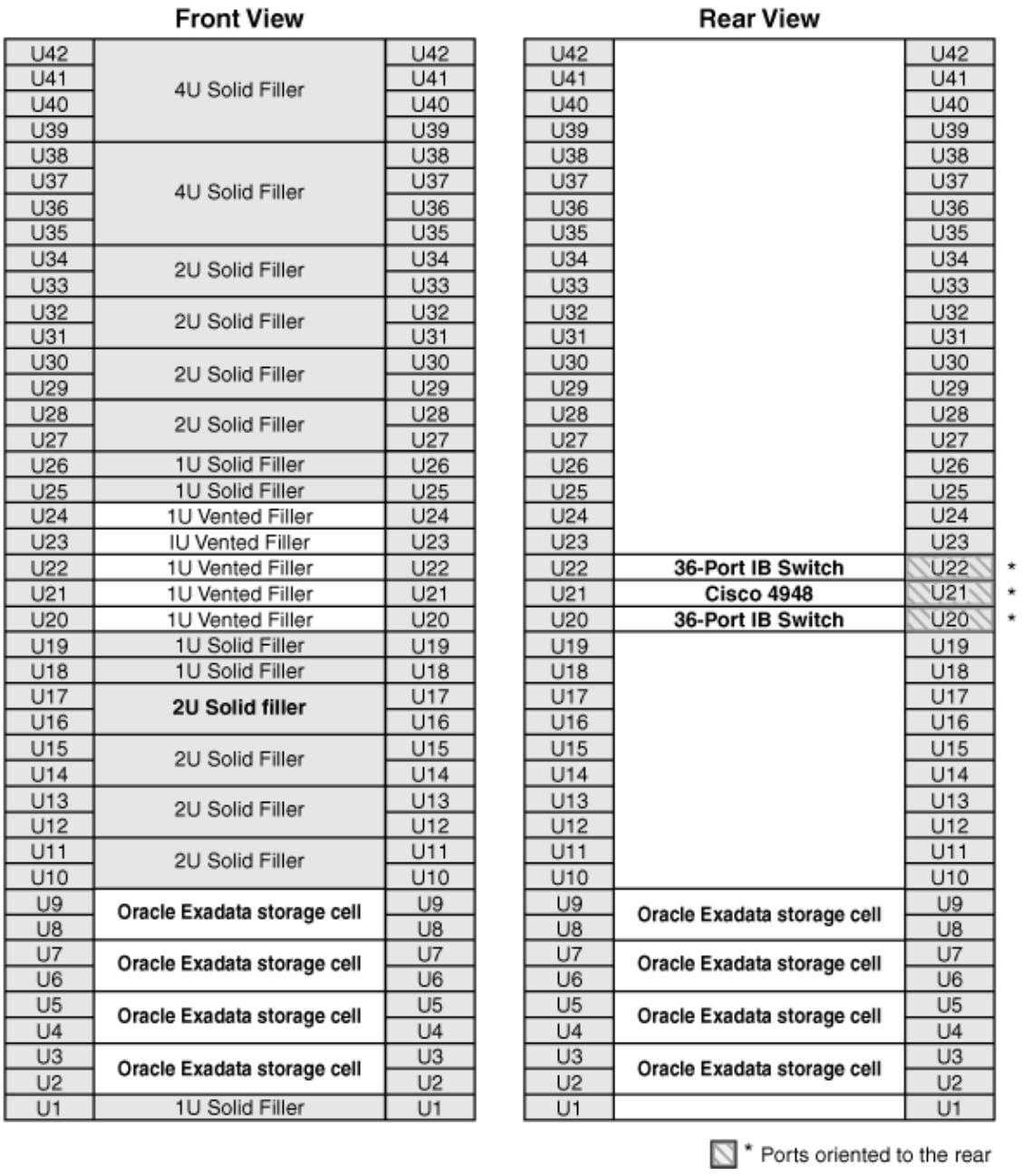
Figure 25-3 Rack Layout of Oracle Exadata Storage Expansion X4-2 Half Rack, and Oracle Exadata Storage Expansion X3-2 Half Rack



The following image shows the front and rear of Oracle Exadata Storage Expansion X4-2 Quarter Rack, and Oracle Exadata Storage Expansion X3-2 Quarter Rack. The front is shown on the left, and the rear is shown on the right.

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Figure 25-4 Rack Layout of Oracle Exadata Storage Expansion X4-2 Quarter Rack, and Oracle Exadata Storage Expansion X3-2 Quarter Rack

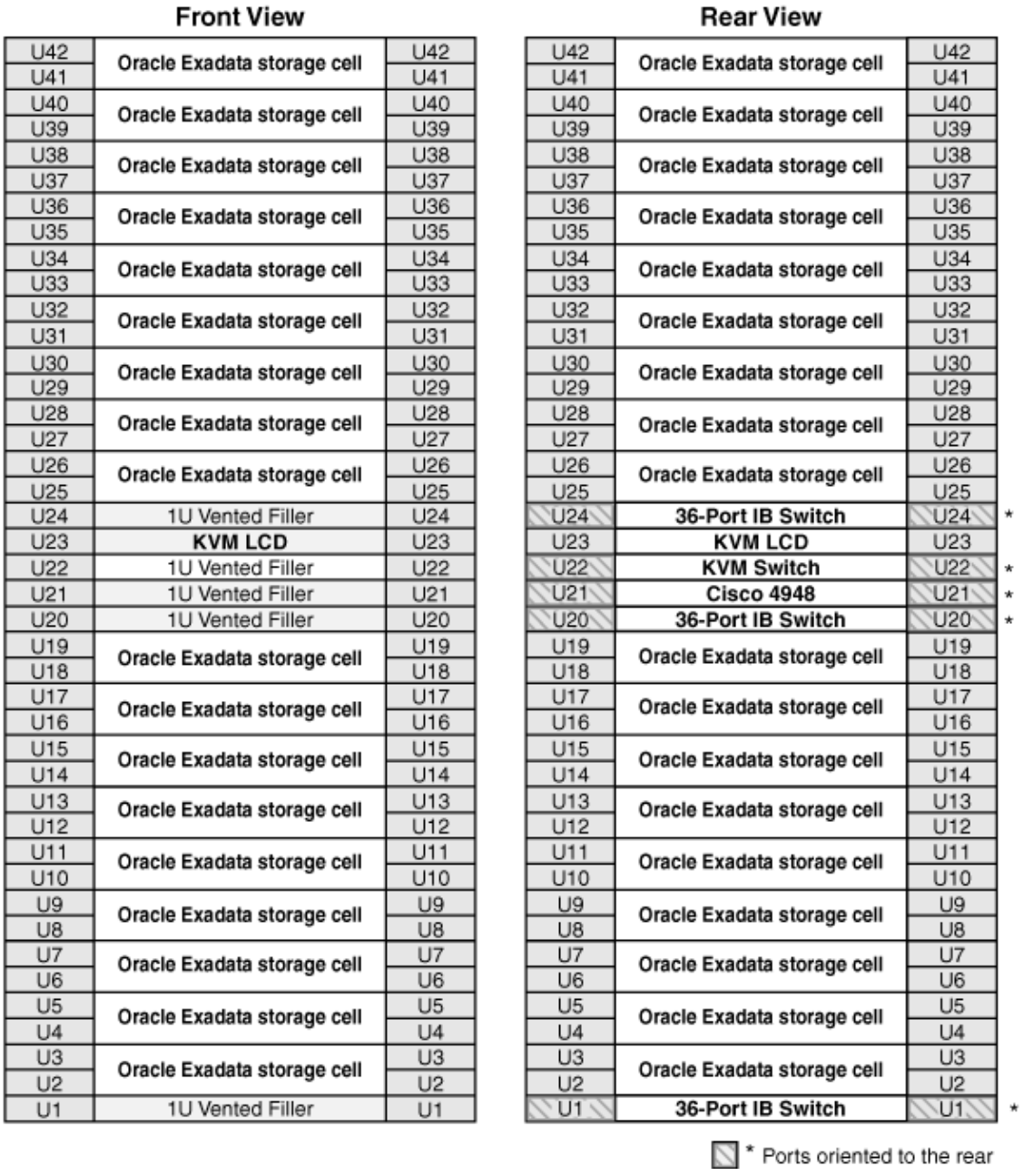


Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

The following image shows the front and rear views of Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers. The front is shown on the left, and the rear is shown on the right.

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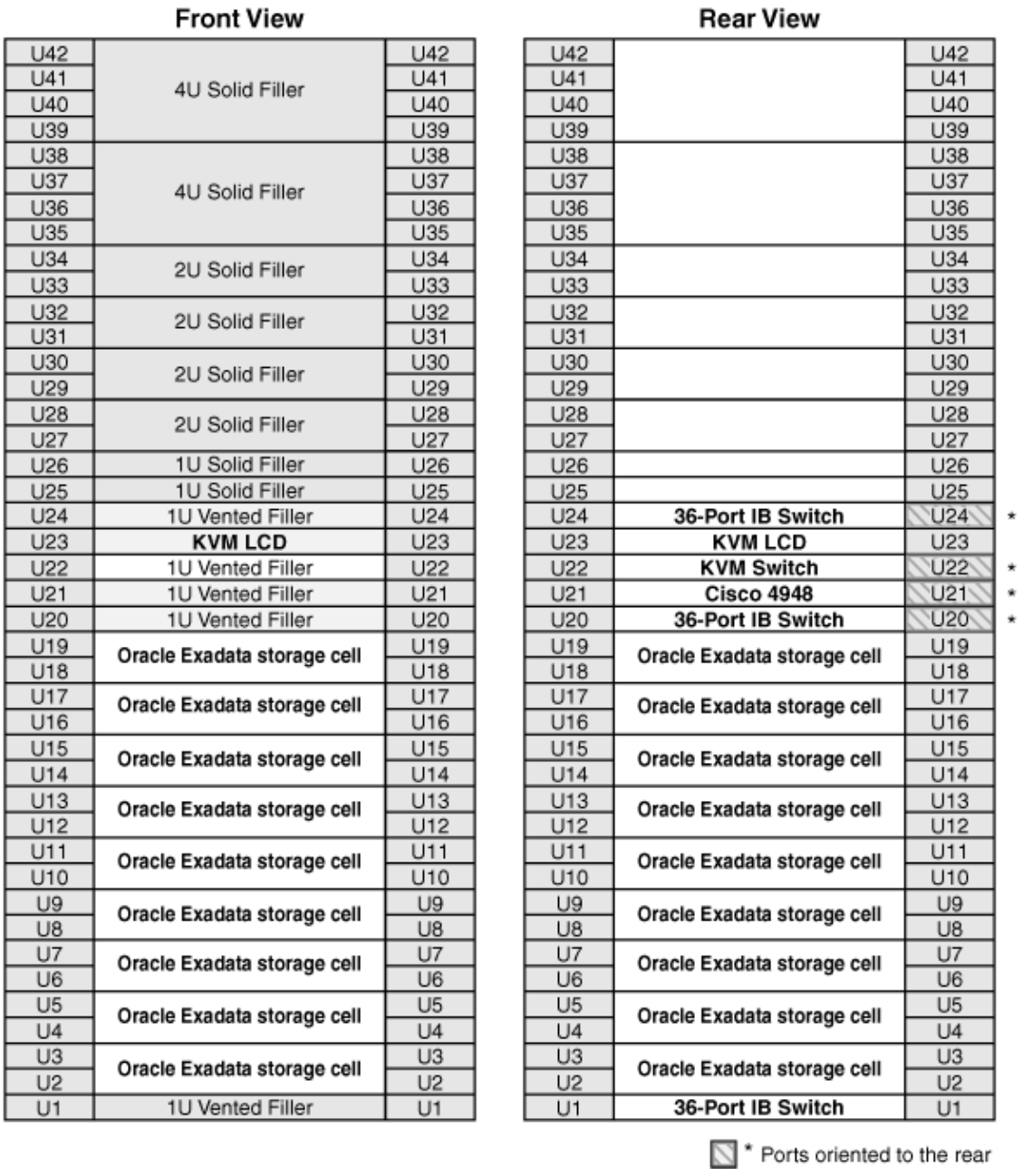
Figure 25-5 Rack Layout of Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers



The following image shows the front and rear views of Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers. The front is shown on the left, and the rear is shown on the right.

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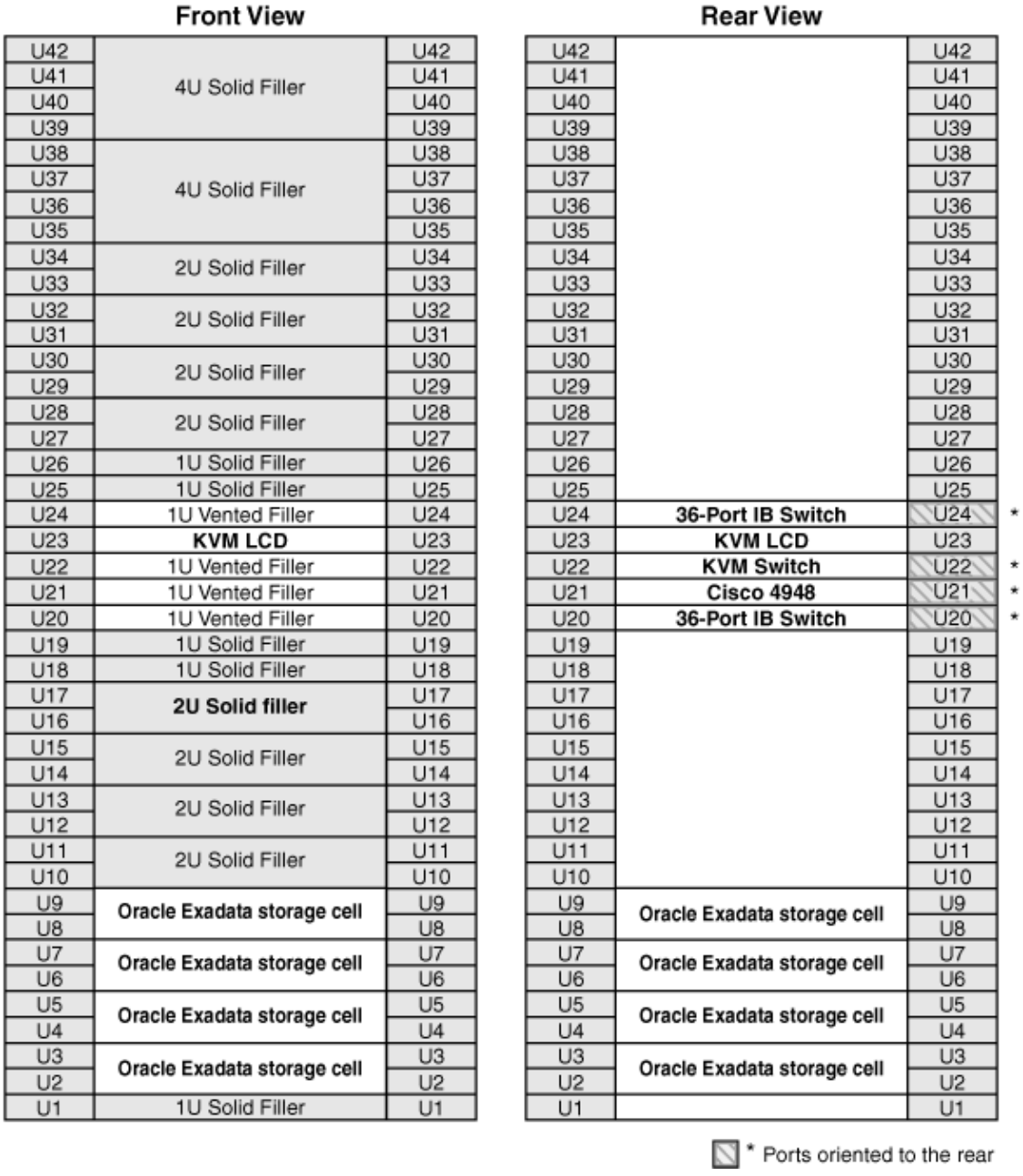
Figure 25-6 Rack Layout of Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers



The following image shows the front and rear views of Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers. The front is shown on the left, and the rear is shown on the right.

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Figure 25-7 Rack Layout of Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers



25.2 Integrated Lights Out Manager (ILOM) Cabling Tables

These tables show the ILOM network cabling for the Oracle Exadata Storage Expansion Racks.

The ILOM port on the servers is labeled NET MGT, and connects to the Management Network Switch located in rack unit 21 on Oracle Exadata Storage Expansion Racks.

- Table 25-1 ILOM Cabling for Oracle Exadata Storage Expansion Rack X6-2, X7-2, X8-2, and X8M-2

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- Table 25-2 ILOM Cabling for Oracle Exadata Storage Expansion Rack X5-2
- Table 25-3 ILOM Cabling for Oracle Exadata Storage Expansion Rack X4-2 Full Rack, and Oracle Exadata Storage Expansion Rack X3-2 Full Rack
- Table 25-4 ILOM Cabling for Oracle Exadata Storage Expansion Rack X4-2 Half Rack, and Oracle Exadata Storage Expansion Rack X3-2 Half Rack
- Table 25-5 ILOM Cabling for Oracle Exadata Storage Expansion Rack X4-2 Quarter Rack, and Oracle Exadata Storage Expansion Rack X3-2 Quarter Rack
- Table 25-6 ILOM Cabling for Oracle Exadata Storage Expansion Rack Full Rack with Storage Server with Sun Fire X4270 M2 Servers
- Table 25-7 ILOM Cabling for Oracle Exadata Storage Expansion Rack Half Rack with Storage Server with Sun Fire X4270 M2 Servers
- Table 25-8 ILOM Cabling for Oracle Exadata Storage Expansion Rack Quarter Rack with Storage Server with Sun Fire X4270 M2 Servers

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion Rack X6-2 and X7-2:

Table 25-1 ILOM Cabling for Oracle Exadata Storage Expansion Rack X6-2, X7-2, X8-2, and X8M-2

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Storage Server	16
U39	Storage Server	2
U37	Storage Server	4
U35	Storage Server	6
U33	Storage Server	8
U31	Storage Server	10
U29	Storage Server	12
U27	Storage Server	14
U25	Storage Server	18
U23	Storage Server	22
U18	Storage Server	26
U16	Storage Server	30
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44
PDU-A	PDU	19
PDU-B	PDU	20

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion Rack X5-2:

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Table 25-2 ILOM Cabling for Oracle Exadata Storage Expansion Rack X5-2

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Storage Server	16
U39	Storage Server	2
U37	Storage Server	4
U35	Storage Server	6
U33	Storage Server	8
U31	Storage Server	10
U29	Storage Server	12
U27	Storage Server	14
U25	Storage Server	18
U23	Storage Server	22
U18	Storage Server	26
U16	Storage Server	30
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack:

Table 25-3 ILOM Cabling for Oracle Exadata Storage Expansion Rack X4-2 Full Rack, and Oracle Exadata Storage Expansion Rack X3-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U39	Storage Server	2
U37	Storage Server	4
U35	Storage Server	6
U33	Storage Server	8
U31	Storage Server	10
U29	Storage Server	12
U27	Storage Server	14
U25	Storage Server	18
U23	Storage Server	22
U18	Storage Server	26
U16	Storage Server	30

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Table 25-3 (Cont.) ILOM Cabling for Oracle Exadata Storage Expansion Rack X4-2 Full Rack, and Oracle Exadata Storage Expansion Rack X3-2 Full Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion Rack X4-2 Half Rack, and Oracle Exadata Storage Expansion Rack X3-2 Half Rack:

Table 25-4 ILOM Cabling for Oracle Exadata Storage Expansion Rack X4-2 Half Rack, and Oracle Exadata Storage Expansion Rack X3-2 Half Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U18	Storage Server	26
U16	Storage Server	30
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion Rack X4-2 Quarter Rack, and Oracle Exadata Storage Expansion Rack X3-2 Quarter Rack:

Table 25-5 ILOM Cabling for Oracle Exadata Storage Expansion Rack X4-2 Quarter Rack, and Oracle Exadata Storage Expansion Rack X3-2 Quarter Rack

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion Rack Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers:

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Table 25-6 ILOM Cabling for Oracle Exadata Storage Expansion Rack Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U41	Storage Server	2
U39	Storage Server	4
U37	Storage Server	6
U35	Storage Server	8
U33	Storage Server	10
U31	Storage Server	12
U29	Storage Server	14
U27	Storage Server	18
U25	Storage Server	22
U18	Storage Server	26
U16	Storage Server	30
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion Rack Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers:

Table 25-7 ILOM Cabling for Oracle Exadata Storage Expansion Rack Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U18	Storage Server	26
U16	Storage Server	30
U14	Storage Server	32
U12	Storage Server	34
U10	Storage Server	36
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44

The following table shows the cable connections from the servers to the ILOM switch in Oracle Exadata Storage Expansion Rack Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers:

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Table 25-8 ILOM Cabling for Oracle Exadata Storage Expansion Rack Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

From Rack Unit	Type of Equipment	Gigabit Ethernet Port
U8	Storage Server	38
U6	Storage Server	40
U4	Storage Server	42
U2	Storage Server	44

25.3 Administrative Network Cabling Tables

These tables show the Administrative network cabling for the Oracle Exadata Storage Expansion Racks.

The port on the storage servers is labeled NET0, and connects to the Management Network Switch located in rack unit 21 on Oracle Exadata Storage Expansion Racks.

- Table 25-9 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X6-2, X7-2, X8-2, and X8M-2
- Table 25-10 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X5-2
- Table 25-11 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 Full Rack, and Oracle Exadata Storage Expansion Rack X3-2 Full Rack
- Table 25-12 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 Half Rack, and Oracle Exadata Storage Expansion Rack X3-2 Half Rack
- Table 25-13 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 Quarter Rack, and Oracle Exadata Storage Expansion Rack X3-2 Quarter Rack
- Table 25-14 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers
- Table 25-15 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers
- Table 25-16 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Rack X6-2, X7-2, X8-2, and X8M-2

Table 25-9 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X6-2, X7-2, X8-2, and X8M-2

From Rack Unit	Type of Equipment	Management Network Switch Port
U41	Storage Server	15
U39	Storage Server	1
U37	Storage Server	3
U35	Storage Server	5

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Table 25-9 (Cont.) Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X6-2, X7-2, X8-2, and X8M-2

From Rack Unit	Type of Equipment	Management Network Switch Port
U33	Storage Server	7
U31	Storage Server	9
U29	Storage Server	11
U27	Storage Server	13
U25	Storage Server	17
U23	Storage Server	21
U22	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46
U18	Storage Server	25
U16	Storage Server	29
U14	Storage Server	31
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
U1	RDMA Network Fabric spine switch	47

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Rack X5-2

Table 25-10 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X5-2

From Rack Unit	Type of Equipment	Management Network Switch Port
U41	Storage Server	15
U39	Storage Server	1
U37	Storage Server	3
U35	Storage Server	5
U33	Storage Server	7
U31	Storage Server	9
U29	Storage Server	11
U27	Storage Server	13
U25	Storage Server	17
U23	Storage Server	21

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Table 25-10 (Cont.) Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X5-2

From Rack Unit	Type of Equipment	Management Network Switch Port
U22	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46
U18	Storage Server	25
U16	Storage Server	29
U14	Storage Server	31
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
U1	RDMA Network Fabric spine switch	47
PDU-A	PDU	19
PDU-B	PDU	20

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Rack X4-2 Full Rack, and Oracle Exadata Storage Expansion Rack X3-2 Full Rack:

Table 25-11 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 Full Rack, and Oracle Exadata Storage Expansion Rack X3-2 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U39	Storage Server	1
U37	Storage Server	3
U35	Storage Server	5
U33	Storage Server	7
U31	Storage Server	9
U29	Storage Server	11
U27	Storage Server	13
U25	Storage Server	17
U23	Storage Server	21
U24	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46
U18	Storage Server	25
U16	Storage Server	29
U14	Storage Server	31

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Table 25-11 (Cont.) Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 Full Rack, and Oracle Exadata Storage Expansion Rack X3-2 Full Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
U1	RDMA Network Fabric spine switch	47
PDU-A	PDU	16
PDU-B	PDU	20

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Rack X4-2 Half Rack, and Oracle Exadata Storage Expansion Rack X3-2 Half Rack:

Table 25-12 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 Half Rack, and Oracle Exadata Storage Expansion Rack X3-2 Half Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U22	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46
U18	Storage Server	25
U16	Storage Server	29
U14	Storage Server	31
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
U1	RDMA Network Fabric spine switch	47
PDU-A	PDU	16
PDU-B	PDU	20

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Rack X4-2 Quarter Rack, and Oracle Exadata Storage Expansion Rack X3-2 Quarter Rack:

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Table 25-13 Administrative Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 Quarter Rack, and Oracle Exadata Storage Expansion Rack X3-2 Quarter Rack

From Rack Unit	Type of Equipment	Management Network Switch Port
U22	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Exadata Storage Server	43
PDU-A	PDU	16
PDU-B	PDU	20

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers:

Table 25-14 Administrative Network Cabling for Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

From Rack Unit	Type of Equipment	Management Network Switch Port
U41	Storage Server	1
U39	Storage Server	3
U37	Storage Server	5
U35	Storage Server	7
U33	Storage Server	9
U31	Storage Server	11
U29	Storage Server	13
U27	Storage Server	17
U25	Storage Server	21
U24	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46
U18	Storage Server	25
U16	Storage Server	29
U14	Storage Server	31
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43

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Table 25-14 (Cont.) Administrative Network Cabling for Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

From Rack Unit	Type of Equipment	Management Network Switch Port
U1	RDMA Network Fabric spine switch	47
PDU-A	PDU	16
PDU-B	PDU	20

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers:

Table 25-15 Administrative Network Cabling for Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

From Rack Unit	Type of Equipment	Management Network Switch Port
U24	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46
U18	Storage Server	25
U16	Storage Server	29
U14	Storage Server	31
U12	Storage Server	33
U10	Storage Server	35
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
U1	RDMA Network Fabric spine switch	47
PDU-A	PDU	16
PDU-B	PDU	20

The following table shows the cable connections from the rack components to the Management Network Switch in Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers:

Table 25-16 Administrative Network Cabling for Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

From Rack Unit	Type of Equipment	Management Network Switch Port
U24	RDMA Network Fabric leaf switch	45
U20	RDMA Network Fabric leaf switch	46

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Table 25-16 (Cont.) Administrative Network Cabling for Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

From Rack Unit	Type of Equipment	Management Network Switch Port
U8	Storage Server	37
U6	Storage Server	39
U4	Storage Server	41
U2	Storage Server	43
PDU-A	PDU	16
PDU-B	PDU	20

25.4 Single Phase Power Distribution Unit Cabling Tables

These tables show the cabling routes from each single-phase power distribution unit (PDU) to the power supplies configured in each Oracle Exadata Storage Expansion Rack.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

- Table 25-17 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8M-2
- Table 25-18 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8-2
- Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X7-2 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X7-2
- Table 25-20 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X6-2
- Table 25-21 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X5-2
- Table 25-22 Single Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack
- Table 25-23 Single Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Half Rack, and Oracle Exadata Storage Expansion X3-2 Half Rack
- Table 25-24 Single Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Quarter Rack, and Oracle Exadata Storage Expansion X3-2 Quarter Rack
- Table 25-25 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers
- Table 25-26 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers
- Table 25-27 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X8M-2.

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Table 25-17 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8M-2

Rack Unit	PS	PDU-A	PDU-B/PS1	Cable Length
U42	PS0	G5-3	G0-3	2 meters
U41	PS0	G5-5	G0-1	2 meters
U40	PS0	G5-6	G0-0	2 meters
U39	PS0	G3-6	G2-0	2 meters
U37	PS0	G3-0	G2-6	2 meters
U35	PS0	G5-4	G0-2	2 meters
U33	PS0	G4-1	G1-5	2 meters
U31	PS0	G5-2	G0-4	2 meters
U29	PS0	G5-1	G0-5	2 meters
U27	PS0	G4-3	G1-3	2 meters
U26	PS0	G4-6	G1-0	2 meters
U25	PS0	G4-5	G1-1	2 meters
U24	PS0	G4-2	G1-4	2 meters
U23	PS0	G4-0	G1-6	2 meters
U22	PS2	G1-6	G4-0	2 meters
U21	PS2	G1-5	G4-1	2 meters
U20	PS2	G1-2	G4-4	2 meters
U19	PS0	G3-2	G2-4	2 meters
U18	PS0	G2-6	G3-0	2 meters
U17	PS0	G0-6	G5-0	2 meters
U16	PS0	G0-3	G5-3	2 meters
U14	PS0	G2-3	G3-3	2 meters
U12	PS0	G2-4	G3-2	2 meters
U10	PS0	G2-0	G3-6	2 meters
U8	PS0	G2-5	G3-1	2 meters
U6	PS0	G0-0	G5-6	2 meters
U4	PS0	G0-1	G5-5	2 meters
U2	PS0	G1-0	G4-6	2 meters
U1	PS2	G3-5	G2-1	3 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X8-2.

Table 25-18 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G3-5	G2-1	2 meters

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Table 25-18 (Cont.) Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U41	G5-5	G0-1	2 meters
U40	G3-3	G2-3	2 meters
U39	G5-4	G0-2	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-2	G0-4	2 meters
U33	G4-4	G1-2	2 meters
U31	G4-3	G1-3	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-0	G2-6	2 meters
U26	G5-1	G0-5	2 meters
U25	G5-0	G0-6	2 meters
U24	G4-1	G1-5	2 meters
U23	G3-6	G2-0	2 meters
U22	G1-2	G4-4	2 meters
U21	G0-5	G5-1	2 meters
U20	G0-4	G5-2	2 meters
U19	G2-4	G3-2	2 meters
U18	G1-1	G4-5	2 meters
U17	G0-3	G5-3	2 meters
U16	G0-2	G5-4	2 meters
U14	G2-3	G3-3	2 meters
U12	G2-2	G3-4	2 meters
U10	G2-1	G3-5	2 meters
U8	G2-0	G3-6	2 meters
U6	G1-0	G4-6	2 meters
U4	G0-1	G5-5	2 meters
U2	G0-0	G5-6	2 meters
U1	G4-0	G1-6	3 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X7-2.

Table 25-19 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X7-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G5-5	G0-1	2 meters
U41	G3-6	G2-0	2 meters

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Table 25-19 (Cont.) Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X7-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U40	G5-2	G0-4	2 meters
U39	G5-6	G0-0	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-1	G0-5	2 meters
U33	G5-0	G0-6	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-3	G1-3	2 meters
U27	G3-5	G2-1	2 meters
U26	G4-5	G1-1	2 meters
U25	G4-2	G1-4	2 meters
U24	G4-1	G1-5	2 meters
U23	G2-5	G3-1	2 meters
U22	G1-4	G4-2	2 meters
U21	G1-3	G4-3	2 meters
U20	G1-5	G4-1	2 meters
U19	G2-3	G3-3	2 meters
U18	G2-2	G3-4	2 meters
U17	G1-6	G4-0	2 meters
U16	G1-2	G4-4	2 meters
U14	G2-4	G3-2	2 meters
U12	G2-1	G3-5	2 meters
U10	G2-0	G3-6	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G4-0	G1-6	3 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X6-2.

Table 25-20 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X6-2

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U42	G3-6	G2-0	2 meters
U41	G4-5	G1-1	2 meters
U40	G5-4	G0-2	2 meters

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Table 25-20 (Cont.) Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X6-2

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U39	G5-6	G0-0	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-6	G2-0	2 meters
U25	G3-5	G2-1	2 meters
U23	G3-3	G2-3	2 meters
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U18	G2-2	G3-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X5-2.

Table 25-21 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X5-2

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G4-5	G1-1	2 meters
U39	G5-6	G0-0	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-6	G2-0	2 meters

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Table 25-21 (Cont.) Single Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X5-2

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U25	G3-5	G2-1	2 meters
U23	G3-3	G2-3	2 meters
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U18	G2-2	G3-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack.

Table 25-22 Single Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U39	G5-6	G0-0	2 meters
U37	G5-3	G0-3	2 meters
U35	G5-0	G0-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-6	G2-0	2 meters
U25	G3-5	G2-1	2 meters
U23	G3-3	G2-3	2 meters
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U18	G2-2	G3-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters

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Table 25-22 (Cont.) Single Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion X4-2 Half Rack, and Oracle Exadata Storage Expansion X3-2 Half Rack.

Table 25-23 Single Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Half Rack, and Oracle Exadata Storage Expansion X3-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U18	G2-2	G3-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion X4-2 Quarter Rack, and Oracle Exadata Storage Expansion X3-2 Quarter Rack.

Table 25-24 Single Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Quarter Rack, and Oracle Exadata Storage Expansion X3-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters

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Table 25-24 (Cont.) Single Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Quarter Rack, and Oracle Exadata Storage Expansion X3-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U20	G2-4	G3-2	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 25-25 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-6	G0-0	2 meters
U39	G5-3	G0-3	2 meters
U37	G5-0	G0-6	2 meters
U35	G4-6	G1-0	2 meters
U33	G4-4	G1-2	2 meters
U31	G4-2	G1-4	2 meters
U29	G3-6	G2-0	2 meters
U27	G3-5	G2-1	2 meters
U25	G3-3	G2-3	2 meters
U24	G3-1	G2-5	2 meters
U23	N/A	G3-0	included
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U18	G2-2	G3-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters
U1	G0-0	G5-6	2 meters

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The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 25-26 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U18	G2-2	G3-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G3-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 25-27 Single Phase PDU Cabling for Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G2-5	2 meters
U21	G3-0	G2-6	2 meters
U20	G2-4	G3-2	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G5-0	2 meters
U4	G0-4	G5-2	2 meters
U2	G0-2	G5-4	2 meters

25.5 Three Phase Power Distribution Unit Cabling Tables

These tables show the cabling routes from each three-phase power distribution unit (PDU) to the power supplies configured in each Oracle Exadata Storage Expansion Rack.

The cables are terminated to PDU-A on the left (when looking at the rear of the rack), and routed to the right to enter the cable management arm (CMA). The cables are bundled in groups of four. The PDU connections list the group and outlet on the PDU. So, for example, G5-5 refers to group 5 outlet 5.

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The following tables are in this section:

- Table 25-28 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8M-2
- Table 25-29 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8-2
- Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X7-2 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X7-2
- Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X6-2 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X6-2
- Table 25-32 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X5-2
- Table 25-33 Three Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack
- Table 25-34 Three Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Half Rack, and Oracle Exadata Storage Expansion X3-2 Half Rack
- Table 25-35 Three Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Quarter Rack, and Oracle Exadata Storage Expansion X3-2 Quarter Rack
- Table 25-36 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers
- Table 25-37 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers
- Table 25-38 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X8M-2.

Table 25-28 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8M-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G5-4	G2-2	2 meters
U41	G5-2	G2-4	2 meters
U40	G5-1	G2-5	2 meters
U39	G5-6	G2-0	2 meters
U37	G3-5	G0-1	2 meters
U35	G3-0	G0-6	2 meters
U33	G5-5	G2-1	2 meters
U31	G5-3	G2-3	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-2	G0-4	2 meters
U26	G5-0	G2-6	2 meters
U25	G4-5	G1-1	2 meters
U24	G3-1	G0-5	2 meters
U23	G4-1	G1-5	2 meters
U22	G1-6	G4-0	2 meters

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Table 25-28 (Cont.) Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8M-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U21	G2-6	G5-0	2 meters
U20	G1-5	G4-1	2 meters
U19	G1-1	G4-5	2 meters
U18	G1-4	G4-2	2 meters
U17	G2-1	G5-5	2 meters
U16	G2-3	G5-3	2 meters
U14	G0-5	G3-1	2 meters
U12	G2-5	G5-1	2 meters
U10	G0-3	G3-3	2 meters
U8	G1-3	G4-3	2 meters
U6	G2-4	G5-2	2 meters
U4	G0-6	G3-0	2 meters
U2	G0-0	G3-6	2 meters
U1	G1-0	G4-6	3 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X8-2.

Table 25-29 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G5-6	G2-0	2 meters
U41	G5-3	G2-3	2 meters
U40	G3-5	G0-1	2 meters
U39	G4-3	G1-3	2 meters
U37	G5-2	G2-4	2 meters
U35	G3-2	G0-4	2 meters
U33	G4-2	G1-4	2 meters
U31	G5-1	G2-5	2 meters
U29	G3-6	G0-0	2 meters
U27	G4-1	G1-5	2 meters
U26	G3-1	G0-5	2 meters
U25	G4-0	G1-6	2 meters
U24	G3-0	G0-6	2 meters
U23	G2-6	G5-0	2 meters
U22	G1-5	G4-1	2 meters
U21	G2-4	G5-2	2 meters

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Table 25-29 (Cont.) Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X8-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U20	G1-4	G4-2	2 meters
U19	G0-6	G3-0	2 meters
U18	G2-3	G5-3	2 meters
U17	G0-2	G3-4	2 meters
U16	G0-1	G3-5	2 meters
U14	G1-3	G4-3	2 meters
U12	G1-2	G4-4	2 meters
U10	G1-1	G4-5	2 meters
U8	G2-2	G5-4	2 meters
U6	G0-0	G3-6	2 meters
U4	G2-1	G5-5	2 meters
U2	G2-0	G5-6	2 meters
U1	G1-0	G4-6	3 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X7-2.

Table 25-30 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X7-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G5-4	G2-2	2 meters
U41	G5-6	G2-0	2 meters
U40	G4-6	G1-0	2 meters
U39	G4-5	G1-1	2 meters
U37	G3-5	G0-1	2 meters
U35	G5-5	G2-1	2 meters
U33	G4-3	G1-3	2 meters
U31	G3-1	G0-5	2 meters
U29	G4-0	G1-6	2 meters
U27	G5-3	G2-3	2 meters
U26	G5-1	G2-5	2 meters
U25	G3-3	G0-3	2 meters
U24	G4-4	G1-2	2 meters
U23	G3-2	G0-4	2 meters
U22	G2-6	G5-0	2 meters
U21	G1-0	G4-6	2 meters
U20	G0-0	G3-6	2 meters

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Table 25-30 (Cont.) Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X7-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U19	G2-5	G5-1	2 meters
U18	G0-6	G3-0	2 meters
U17	G1-6	G4-0	2 meters
U16	G2-1	G5-5	2 meters
U14	G1-4	G4-2	2 meters
U12	G2-3	G5-3	2 meters
U10	G2-0	G5-6	2 meters
U8	G1-2	G4-4	2 meters
U6	G1-1	G4-5	2 meters
U4	G0-2	G3-4	2 meters
U2	G0-1	G3-5	2 meters
U1	G2-2	G5-4	3 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X6-2.

Table 25-31 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X6-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U42	G5-4	G2-2	2 meters
U41	G5-5	G2-1	2 meters
U40	G3-6	G0-0	2 meters
U39	G5-6	G2-0	2 meters
U37	G5-3	G2-3	2 meters
U35	G5-0	G2-6	2 meters
U33	G5-2	G2-4	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G4-1	G1-5	2 meters
U26	G5-1	G2-5	2 meters
U25	G3-5	G0-1	2 meters
U24	G3-4	G0-2	2 meters
U23	G3-3	G0-3	2 meters
U22	G3-2	G0-4	2 meters
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U19	G2-3	G5-3	2 meters

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Table 25-31 (Cont.) Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X6-2

Rack Unit	PDU-A/PSU 0	PDU-B/PSU 1	Cable Length
U18	G2-2	G5-4	2 meters
U17	G2-1	G5-5	2 meters
U16	G1-6	G4-0	2 meters
U14	G1-5	G4-1	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	3 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Rack X5-2.

Table 25-32 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X5-2

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G4-5	G1-1	2 meters
U39	G5-6	G2-0	2 meters
U37	G5-3	G2-3	2 meters
U35	G5-0	G2-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-6	G0-0	2 meters
U25	G3-5	G0-1	2 meters
U23	G3-3	G0-3	2 meters
U22	G2-5	G5-1	1 meter
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U18	G2-2	G5-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters

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Table 25-32 (Cont.) Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack X5-2

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack.

Table 25-33 Three Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Full Rack, and Oracle Exadata Storage Expansion X3-2 Full Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U39	G5-6	G2-0	2 meters
U37	G5-3	G2-3	2 meters
U35	G5-0	G2-6	2 meters
U33	G4-6	G1-0	2 meters
U31	G4-4	G1-2	2 meters
U29	G4-2	G1-4	2 meters
U27	G3-6	G0-0	2 meters
U25	G3-5	G0-1	2 meters
U23	G3-3	G0-3	2 meters
U22	G2-5	G5-1	1 meter
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U18	G2-2	G5-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion X4-2 Half Rack, and Oracle Exadata Storage Expansion X3-2 Half Rack.

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Table 25-34 Three Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Half Rack, and Oracle Exadata Storage Expansion X3-2 Half Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G0-5	1 meter
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U18	G2-2	G5-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion X4-2 Quarter Rack, and Oracle Exadata Storage Expansion X3-2 Quarter Rack.

Table 25-35 Three Phase PDU Cabling for Oracle Exadata Storage Expansion X4-2 Quarter Rack, and Oracle Exadata Storage Expansion X3-2 Quarter Rack

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U22	G3-1	G0-5	1 meter
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 25-36 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U41	G5-6	G2-0	2 meters

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Table 25-36 (Cont.) Three Phase PDU Cabling for Oracle Exadata Storage Expansion Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U39	G5-3	G2-3	2 meters
U37	G5-0	G2-6	2 meters
U35	G4-6	G1-0	2 meters
U33	G4-4	G1-2	2 meters
U31	G4-2	G1-4	2 meters
U29	G3-6	G0-0	2 meters
U27	G3-5	G0-1	2 meters
U25	G3-3	G0-3	2 meters
U24	G3-1	G0-5	2 meters
U23	N/A	G5-0	included
U22	G2-5	G5-1	1 meter
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U18	G2-2	G5-4	2 meters
U16	G1-6	G4-0	2 meters
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 25-37 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U24	G3-1	G0-5	2 meters
U23	N/A	G5-0	included
U22	G2-5	G5-1	1 meter
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U18	G2-2	G5-4	2 meters
U16	G1-6	G4-0	2 meters

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Table 25-37 (Cont.) Three Phase PDU Cabling for Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U14	G2-0	G5-6	2 meters
U12	G1-4	G4-2	2 meters
U10	G1-2	G4-4	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters
U1	G0-0	G3-6	2 meters

The following table shows the cable connections from the PDUs to the rack units in Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 25-38 Three Phase PDU Cabling for Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers

Rack Unit	PDU-A/PS-00	PDU-B/PS-01	Cable Length
U24	G3-1	G0-5	2 meters
U23	N/A	G5-0	included
U22	G2-5	G5-1	1 meter
U21	G3-0	G0-6	2 meters
U20	G2-4	G5-2	2 meters
U8	G1-0	G4-6	2 meters
U6	G0-6	G3-0	2 meters
U4	G0-4	G3-2	2 meters
U2	G0-2	G3-4	2 meters

25.6 RDMA Network Fabric Network Cabling Tables

These tables show the RDMA Network Fabric network cabling connections for the Oracle Exadata Storage Expansion Rack.

- RDMA Network Fabric Cabling for Oracle Exadata Storage Expansion Rack X8M-2
  Use the following RDMA Network Fabric cabling information for the Oracle Exadata Storage Expansion Rack X8M-2
- InfiniBand Network Cabling for Oracle Exadata Storage Expansion X7-2, X6-2 and X5-2
  Use the following InfiniBand cabling information for the Exadata Storage Expansion X7-2, X6-2 and X5-2 systems.
- InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2
  Use the following InfiniBand cabling information for the Oracle Exadata Storage Expansion Rack X4-2 and X3-2.

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- InfiniBand Network Cabling for Oracle Exadata Storage Expansion with Sun Fire X4270 M2 Servers
  Use the following InfiniBand cabling information for the Oracle Exadata Storage Expansion Server with Sun Fire X4270 M2 servers.

25.6.1 RDMA Network Fabric Cabling for Oracle Exadata Storage Expansion Rack X8M-2

Use the following RDMA Network Fabric cabling information for the Oracle Exadata Storage Expansion Rack X8M-2

Table 25-39 RDMA Network Fabric Cabling for Oracle Exadata Storage Expansion Rack X8M-2 Full Rack

From Rack Unit	Port	To RDMA Network Fabric Switch Rack Unit	Port	Description
U41	PCIe 1, P2	U22	15	3 meters
U41	PCIe 1, P1	U20	15	3 meters
U39	PCIe 1, P2	U22	08	3 meters
U39	PCIe 1, P1	U20	08	3 meters
U37	PCIe 1, P2	U22	09	3 meters
U37	PCIe 1, P1	U20	09	3 meters
U35	PCIe 1, P2	U22	10	3 meters
U35	PCIe 1, P1	U20	10	3 meters
U33	PCIe 1, P2	U22	11	3 meters
U33	PCIe 1, P1	U20	11	3 meters
U31	PCIe 1, P2	U22	12	3 meters
U31	PCIe 1, P1	U20	12	3 meters
U29	PCIe 1, P2	U22	13	3 meters
U29	PCIe 1, P1	U20	13	3 meters
U27	PCIe 1, P2	U22	14	3 meters
U27	PCIe 1, P1	U20	14	3 meters
U25	PCIe 1, P2	U22	16	3 meters
U25	PCIe 1, P1	U20	16	3 meters
U23	PCIe 1, P2	U22	18	3 meters
U23	PCIe 1, P1	U20	18	3 meters
U18	PCIe 1, P2	U22	20	3 meters
U18	PCIe 1, P1	U20	20	3 meters
U14	PCIe 1, P2	U22	23	3 meters
U14	PCIe 1, P1	U20	23	3 meters
U12	PCIe 1, P2	U22	24	3 meters
U12	PCIe 1, P1	U20	24	3 meters
U10	PCIe 1, P2	U22	25	3 meters

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Table 25-39 (Cont.) RDMA Network Fabric Cabling for Oracle Exadata Storage Expansion Rack X8M-2 Full Rack

From Rack Unit	Port	To RDMA Network Fabric Switch Rack Unit	Port	Description
U10	PCIe 1, P1	U20	25	3 meters
U08	PCIe 1, P2	U22	26	3 meters
U08	PCIe 1, P1	U20	26	3 meters
U06	PCIe 1, P2	U22	27	3 meters
U06	PCIe 1, P1	U20	27	3 meters
U04	PCIe 1, P2	U22	28	3 meters
U04	PCIe 1, P1	U20	28	3 meters
U02	PCIe 1, P2	U22	29	3 meters
U02	PCIe 1, P1	U20	29	3 meters
U1	PCIe 1, P2	U22		3 meters
U1	PCIe 1, P1	U20		3 meters

25.6.2 InfiniBand Network Cabling for Oracle Exadata Storage Expansion X7-2, X6-2 and X5-2

Use the following InfiniBand cabling information for the Exadata Storage Expansion X7-2, X6-2 and X5-2 systems.

Table 25-40 InfiniBand Network Cabling for Oracle Exadata Storage Expansion X7-2, X6-2 and X5-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Port
U22	6B	U41	PCIe 3, P1
U22	0A	U39	PCIe 3, P1
U22	0B	U37	PCIe 3, P1
U22	1A	U35	PCIe 3, P1
U22	1B	U33	PCIe 3, P1
U22	2A	U31	PCIe 3, P1
U22	2B	U29	PCIe 3, P1
U22	3B	U27	PCIe 2, P1
U22	4A	U25	PCIe 2, P1
U22	5A	U23	PCIe 2, P1
U20	13A	U18	PCIe 2, P1
U20	14B	U16	PCIe 3, P1
U20	14A	U14	PCIe 3, P1
U20	15A	U12	PCIe 3, P1

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Table 25-40 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion X7-2, X6-2 and X5-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Port
U20	15B	U10	PCIe 3, P1
U20	16A	U08	PCIe 3, P1
U20	16B	U06	PCIe 3, P1
U20	17A	U04	PCIe 3, P1
U20	17B	U02	PCIe 3, P1
U20	6B	U41	PCIe 3, P2
U20	0A	U39	PCIe 3, P2
U20	0B	U37	PCIe 3, P2
U20	1A	U35	PCIe 3, P2
U20	1B	U33	PCIe 3, P2
U20	2A	U31	PCIe 3, P2
U20	2B	U29	PCIe 3, P2
U20	3B	U27	PCIe 2, P2
U20	4A	U25	PCIe 2, P2
U20	5A	U23	PCIe 2, P2
U22	13A	U18	PCIe 2, P2
U22	14B	U16	PCIe 3, P2
U22	14A	U14	PCIe 3, P2
U22	15A	U12	PCIe 3, P2
U22	15B	U10	PCIe 3, P2
U22	16A	U08	PCIe 3, P2
U22	16B	U06	PCIe 3, P2
U22	17A	U04	PCIe 3, P2
U22	17B	U02	PCIe 3, P2
U1	1B	U20	8B
U1	0B	U22	8B

25.6.3 InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2

Use the following InfiniBand cabling information for the Oracle Exadata Storage Expansion Rack X4-2 and X3-2.

- Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Full Rack InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Full Rack
- Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Half Rack InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Half Rack

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- Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Quarter Rack InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Quarter Rack

Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Full Rack

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Storage Expansion Rack X4-2 Full Rack, and Oracle Exadata Storage Expansion Rack X3-2 Full Rack.

Table 25-41 InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	0A	U39	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	0B	U37	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	1A	U35	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	1B	U33	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	2A	U31	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	2B	U29	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	3A	U27	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U22	4A	U25	Oracle Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U22	5A	U23	Oracle Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U22	13A	U18	Oracle Exadata Storage Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U22	14A	U16	Oracle Exadata Storage Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U22	14B	U14	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15A	U12	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15B	U10	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16A	U8	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 25-41 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	17B	U2	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0A	U39	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0B	U37	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1A	U35	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1B	U33	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2A	U31	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2B	U29	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3A	U27	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	4A	U25	Oracle Exadata Storage Server	PCIe 2, P2	3 meter QDR InfiniBand cable
U20	5A	U23	Oracle Exadata Storage Server	PCIe 2, P2	3 meter QDR InfiniBand cable
U20	13A	U18	Oracle Exadata Storage Server	PCIe 2, P1	3 meter QDR InfiniBand cable
U20	14A	U16	Oracle Exadata Storage Server	PCIe 2, P1	3 meter QDR InfiniBand cable
U20	14B	U14	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15A	U12	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	2 meter QDR InfiniBand cable

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Table 25-41 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Full Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	2 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	2 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	2 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	2 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	2 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	2 meter QDR InfiniBand cable
U1	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Half Rack

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Storage Expansion Rack X4-2 Half Rack, and Oracle Exadata Storage Expansion Rack X3-2 Half Rack.

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Table 25-42 InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	13A	U18	Oracle Exadata Storage Server	PCIe 2, P2	3 meter QDR InfiniBand cable
U22	14A	U16	Oracle Exadata Storage Server	PCIe 2, P2	3 meter QDR InfiniBand cable
U22	14B	U14	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15A	U12	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	15B	U10	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16A	U8	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	13A	U18	Oracle Exadata Storage Server	PCIe 2, P1	3 meter QDR InfiniBand cable
U20	14A	U16	Oracle Exadata Storage Server	PCIe 2, P1	3 meter QDR InfiniBand cable
U20	14B	U14	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15A	U12	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	2 meter QDR InfiniBand cable

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Table 25-42 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Half Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	2 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	2 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	2 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	2 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	2 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	2 meter QDR InfiniBand cable
U1	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Quarter Rack

The following table lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Storage Expansion Rack X4-2 Quarter Rack, and Oracle Exadata Storage Expansion Rack X3-2 Quarter Rack.

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Table 25-43 InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Quarter Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U22	16A	U8	Oracle Exadata Storage Server	PCIe 2, P2	3 meter QDR InfiniBand cable
U22	16B	U6	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17A	U4	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U22	17B	U2	Oracle Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	16A	U8	Oracle Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	16B	U6	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Oracle Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U22	Sun Datacenter InfiniBand Switch 36 switch	9A	2 meter QDR InfiniBand cable
U20	10B	U22	Sun Datacenter InfiniBand Switch 36 switch	10A	2 meter QDR InfiniBand cable
U20	11B	U22	Sun Datacenter InfiniBand Switch 36 switch	11A	2 meter QDR InfiniBand cable
U20	8A	U22	Sun Datacenter InfiniBand Switch 36 switch	8A	2 meter QDR InfiniBand cable
U20	9A	U22	Sun Datacenter InfiniBand Switch 36 switch	9B	2 meter QDR InfiniBand cable
U20	10A	U22	Sun Datacenter InfiniBand Switch 36 switch	10B	2 meter QDR InfiniBand cable
U20	11A	U22	Sun Datacenter InfiniBand Switch 36 switch	11B	2 meter QDR InfiniBand cable

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Table 25-43 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Rack X4-2 and X3-2 Quarter Rack

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U1	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U22	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

25.6.4 InfiniBand Network Cabling for Oracle Exadata Storage Expansion with Sun Fire X4270 M2 Servers

Use the following InfiniBand cabling information for the Oracle Exadata Storage Expansion Server with Sun Fire X4270 M2 servers.

- Exadata Storage Expansion Full Rack with Sun Fire X4270 M2 Servers
- Exadata Storage Expansion Half Rack with Sun Fire X4270 M2 Servers
- Exadata Storage Expansion Quarter Rack with Sun Fire X4270 M2 Servers

Exadata Storage Expansion Full Rack with Sun Fire X4270 M2 Servers

Table 25-44 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Storage Expansion Full Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 25-44 InfiniBand Network Cabling for Oracle Exadata Storage Expansion Full Rack with Sun Fire X4270 M2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U24	0A	U41	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	0B	U39	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	1A	U37	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	1B	U35	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	2A	U33	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	2B	U31	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable

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Table 25-44 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Full Rack with Sun Fire X4270 M2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U24	3A	U29	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U24	4A	U27	Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U24	5A	U25	Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U24	13A	U18	Exadata Storage Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	14A	U16	Exadata Storage Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	14B	U14	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	15A	U12	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	15B	U10	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	16A	U8	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0A	U41	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	0B	U39	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1A	U37	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	1B	U35	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2A	U33	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	2B	U31	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	3A	U29	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	4A	U27	Exadata Storage Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U20	5A	U25	Exadata Storage Server	PCIe 2, P2	2 meter QDR InfiniBand cable

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Table 25-44 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Full Rack with Sun Fire X4270 M2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	13A	U18	Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14A	U16	Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14B	U14	Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U24	Sun Datacenter InfiniBand Switch 36 switch	9A	2 meter QDR InfiniBand cable
U20	10B	U24	Sun Datacenter InfiniBand Switch 36 switch	10A	2 meter QDR InfiniBand cable
U20	11B	U24	Sun Datacenter InfiniBand Switch 36 switch	11A	2 meter QDR InfiniBand cable
U20	8A	U24	Sun Datacenter InfiniBand Switch 36 switch	8A	2 meter QDR InfiniBand cable
U20	9A	U24	Sun Datacenter InfiniBand Switch 36 switch	9B	2 meter QDR InfiniBand cable
U20	10A	U24	Sun Datacenter InfiniBand Switch 36 switch	10B	2 meter QDR InfiniBand cable

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Table 25-44 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Full Rack with Sun Fire X4270 M2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	11A	U24	Sun Datacenter InfiniBand Switch 36 switch	11B	2 meter QDR InfiniBand cable
U1	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U24	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

Exadata Storage Expansion Half Rack with Sun Fire X4270 M2 Servers

Table 25-45 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Storage Expansion Half Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 25-45 InfiniBand Network Cabling for Oracle Exadata Storage Expansion Half Rack with Sun Fire X4270 M2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U24	13A	U18	Exadata Storage Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	14A	U16	Exadata Storage Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	14B	U14	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	15A	U12	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	15B	U10	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	16A	U8	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable

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Table 25-45 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Half Rack with Sun Fire X4270 M2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	13A	U18	Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14A	U16	Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	14B	U14	Exadata Storage Server	PCIe 3, P1	2 meter QDR InfiniBand cable
U20	15A	U12	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	15B	U10	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16A	U8	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	9B	U24	Sun Datacenter InfiniBand Switch 36 switch	9A	2 meter QDR InfiniBand cable
U20	10B	U24	Sun Datacenter InfiniBand Switch 36 switch	10A	2 meter QDR InfiniBand cable
U20	11B	U24	Sun Datacenter InfiniBand Switch 36 switch	11A	2 meter QDR InfiniBand cable
U20	8A	U24	Sun Datacenter InfiniBand Switch 36 switch	8A	2 meter QDR InfiniBand cable
U20	9A	U24	Sun Datacenter InfiniBand Switch 36 switch	9B	2 meter QDR InfiniBand cable
U20	10A	U24	Sun Datacenter InfiniBand Switch 36 switch	10B	2 meter QDR InfiniBand cable

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Table 25-45 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Half Rack with Sun Fire X4270 M2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	11A	U24	Sun Datacenter InfiniBand Switch 36 switch	11B	2 meter QDR InfiniBand cable
U1	1B	U20	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable
U1	0B	U24	Sun Datacenter InfiniBand Switch 36 switch	8B	3 meter QDR InfiniBand cable

Exadata Storage Expansion Quarter Rack with Sun Fire X4270 M2 Servers

Table 25-46 lists the location, ports and cables for the InfiniBand connections for Oracle Exadata Storage Expansion Quarter Rack with Exadata Storage Server with Sun Fire X4270 M2 Servers.

Table 25-46 InfiniBand Network Cabling for Oracle Exadata Storage Expansion Quarter Rack with Sun Fire X4270 M2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U24	16A	U8	Exadata Storage Server	PCIe 2, P2	2 meter QDR InfiniBand cable
U24	16B	U6	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17A	U4	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U24	17B	U2	Exadata Storage Server	PCIe 3, P2	3 meter QDR InfiniBand cable
U20	16A	U8	Exadata Storage Server	PCIe 2, P1	2 meter QDR InfiniBand cable
U20	16B	U6	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17A	U4	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable
U20	17B	U2	Exadata Storage Server	PCIe 3, P1	3 meter QDR InfiniBand cable

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Table 25-46 (Cont.) InfiniBand Network Cabling for Oracle Exadata Storage Expansion Quarter Rack with Sun Fire X4270 M2 Servers

From InfiniBand Switch Rack Unit	Port	To Rack Unit	Type of Equipment	Port	Cable Description
U20	9B	U24	Sun Datacenter InfiniBand Switch 36 switch	9A	2 meter QDR InfiniBand cable
U20	10B	U24	Sun Datacenter InfiniBand Switch 36 switch	10A	2 meter QDR InfiniBand cable
U20	11B	U24	Sun Datacenter InfiniBand Switch 36 switch	11A	2 meter QDR InfiniBand cable
U20	8A	U24	Sun Datacenter InfiniBand Switch 36 switch	8A	2 meter QDR InfiniBand cable
U20	9A	U24	Sun Datacenter InfiniBand Switch 36 switch	9B	2 meter QDR InfiniBand cable
U20	10A	U24	Sun Datacenter InfiniBand Switch 36 switch	10B	2 meter QDR InfiniBand cable
U20	11A	U24	Sun Datacenter InfiniBand Switch 36 switch	11B	2 meter QDR InfiniBand cable

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