What's New in Oracle® Solaris 11.2

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This article summarizes features that are new or have been enhanced in the Oracle Solaris 11.2 release.

Oracle Solaris 11.2 - Engineered for Cloud

Oracle Solaris provides an efficient, secure and compliant, simple, open, and affordable solution for deploying your enterprise-grade clouds. More than just an operating system, Oracle Solaris 11.2 includes features and enhancements that deliver no-compromise virtualization, application-driven software-defined networking, and a complete OpenStack distribution for creating and managing an enterprise cloud, enabling you to meet IT demands and redefine your business.

Key Features in Oracle Solaris 11.2

This section provides introductory descriptions for key features in this release.

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Centralized Cloud Management With OpenStack

Oracle Solaris 11.2 provides a complete OpenStack distribution. OpenStack, the open-source cloud-computing software, provides comprehensive self-service environments for sharing and managing compute, network, and storage resources in the data center through a centralized web-based portal. As OpenStack is integrated into all Oracle Solaris 11.2 core technologies, you can use OpenStack to set up an enterprise-ready private cloud Infrastructure-as-a-Service (IaaS) environment in minutes.

FIGURE 1 OpenStack Horizon Dashboard
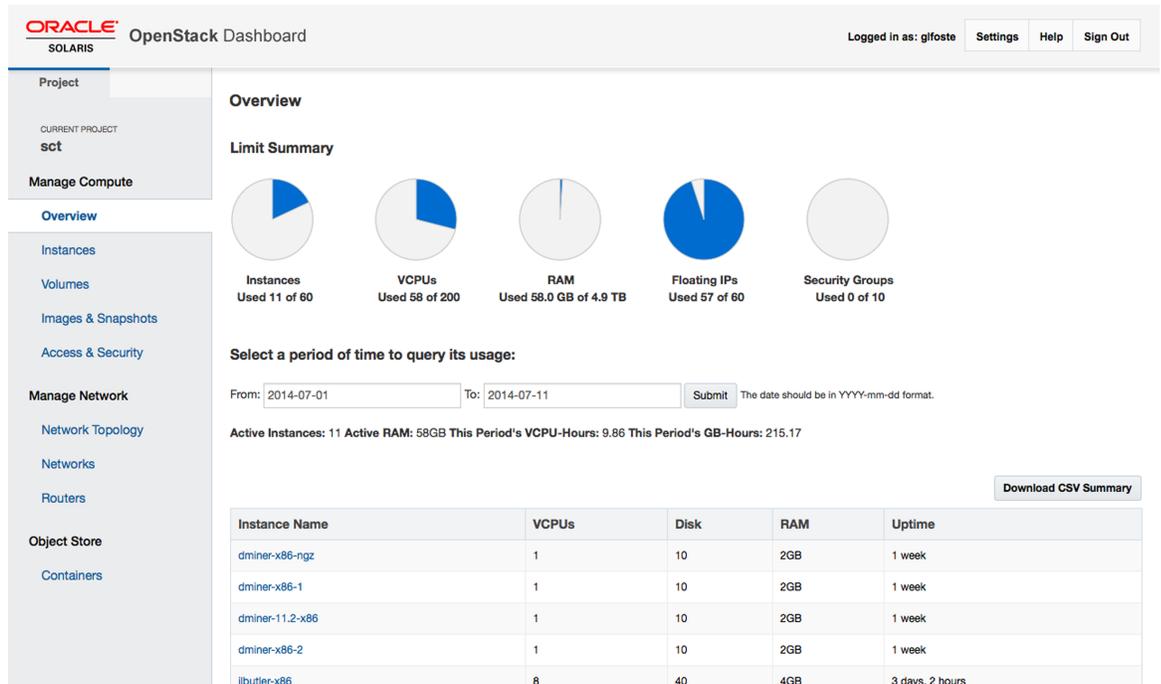
See the OpenStack for Oracle Solaris 11 technology page (http://www.oracle.com/technetwork/ server-storage/solaris11/technologies/openstack-2135773.html) for more information on how to get started with OpenStack distribution.

Note - A new OpenStack-based Unified Archive is also available for download (http://www.oracle.com/ technetwork/server-storage/solaris11/downloads/beta-unified-archives-2190886.html). You can use this archive to easily install a single-node Oracle Solaris OpenStack configuration. Use it for evaluation purposes, proof of concept, or a base for a more complex configuration across multiple nodes.

Independent and Isolated Environments With Kernel Zones

Oracle Solaris Zones includes support for fully independent and isolated environments called Oracle Solaris Kernel Zones, which provide a full kernel and user environment within a zone. Kernel zones increase operational flexibility and are ideal for multitenant environments where maintenance windows are significantly harder to schedule. Kernel zones can run at a different kernel version from the global zone and can be updated separately without requiring a reboot of the global zone. You can also use kernel zones in combination with Oracle VM for SPARC for greater virtualization flexibility.

You configure, install, and boot kernel zones with the existing zonecfg(1M) and zoneadm(1M) commands.

For example, to create and install a kernel zone:

```
# zonecfg -z newzone create -t SYSsolaris-kz

# zoneadm -z newzone install
```

See "Creating and Using Oracle Solaris Kernel Zones " and the `solaris-kz(5)` man page for more information.

Application Provisioning With Unified Archives

This release introduces Unified Archives, a new type of archive format that enables creating a single archive for redeployment either as clones within a cloud environment or for system backup and disaster recovery purposes. You can quickly capture a complete bare-metal system, virtual environments, or a combination of both.

For example, to create a clone archive of a system:

```
# archiveadm create ./newclone.uar
```

To create a full system recovery archive:

```
# archiveadm create --recovery ./newrecovery.uar
```

Unified Archives are portable with a great deal of flexibility for deployment, enabling a variety of physical-to-virtual and virtual-to-physical transformations including use with Oracle Solaris Zones, Oracle VM for SPARC, and Oracle VM for x86.

See "Using Unified Archives for System Recovery and Cloning in Oracle Solaris 11.2 " for more information.

Software-Defined Networking - Elastic Virtual Switch

The Elastic Virtual Switch (EVS) feature enables you to manage multiple virtual switches that are spread across several physical machines, typically in a cloud environment. Building on the network virtualization and software-defined networking (SDN) capabilities included in the Oracle Solaris 11 11/11 release, EVS helps simplify administration by managing these virtual switches as a single virtual switch and including the management of network traffic between virtual machines, MAC and IP addresses, and VLANs and VXLANs. EVS also enforces service level agreements across the network through resource control management.

You can configure an elastic virtual switch by using the `evsadm` command-line utility. To obtain statistics, use the `evsstat` command.

For more information, see Chapter 5, "About Elastic Virtual Switches," in "Managing Network Virtualization and Network Resources in Oracle Solaris 11.2 ". Also, see the `evsadm(1M)` and `evsstat(1M)` man pages.

Software-Defined Networking - Application-Driven Flows

A new socket-level flow API enables an application to directly prioritize its own traffic through a series of network flows, leading to optimized application performance and reducing any adverse impact of resource contention. This application-driven software-defined networking, along with administrative-driven flows, helps to ensure that service-level agreements are maintained within a data center or cloud environment.

You can view these service-socket SLAs by using the `nc(1)` utility.

The API is documented in the `setsockopt(3SOCKET)` man page and the command-line options are discussed in the `flowadm(1M)` man page.

For more information, see "Managing Network Resources by Using Flows" in "Managing Network Virtualization and Network Resources in Oracle Solaris 11.2 ".

Comprehensive Compliance Checking and Reporting

You can meet your compliance requirements by using a new `compliance`(1M) tool that manages a variety of compliance benchmarks and assessments. This tool builds on the existing compliance framework introduced in Oracle Solaris 11 based on the Security Content Automation Protocol (SCAP), a line of standards managed by the National Institute of Standards and Technology (NIST). It provides a standardized approach in maintaining the security of enterprise systems, such as:

- Automatically verifying the presence of critical updates
- Checking system security configuration settings
- Examining systems for signs of compromise

Also included in Oracle Solaris 11.2 is a new Oracle Solaris Security Policy benchmark with support for two new profiles, Baseline and Recommended, and an Oracle Solaris Payment Card Industry PCI-DSS benchmark.

For example, to run a PCI-DSS compliance assessment and report the results:

```
# compliance assess -b pci-dss

# compliance report
```

See "Oracle Solaris 11.2 Security Compliance Guide " for more information.

Immutable Global Zones

Immutable global zones support has been added to extend the immutable zone capability to the global zone. If a system is configured to have an immutable global zone, files in the root file system are read-only. A Trusted Path login allows access to perform maintenance tasks, such as system updates.

For example, to enable immutable global zones:

```
# zonecfg -z global set file-mac-profile=fixed-configuration
```

For more information, see Chapter 12, "Configuring and Administering Immutable Zones," in "Creating and Using Oracle Solaris Zones ".

IT Automation With Puppet

The popular IT automation software, Puppet, is included in Oracle Solaris 11.2. Puppet helps you manage IT infrastructure by automating repetitive tasks, deploying critical applications rapidly, and proactively managing changes required in a system. Puppet automates tasks such as provisioning, configuration, compliance, and software management. Puppet can scale from simple deployments to complex infrastructure, from on-premise to cloud deployments. With enhanced support for Oracle Solaris technologies, administrators can host their Puppet masters on a mission-critical environment and extend their automation to managing a completely heterogeneous data center environment.

For more information, see `Getting Started with Puppet on Oracle Solaris 11 (http://www.oracle.com/technetwork/articles/servers-storage-admin/howto-automate-config-datacenter-2212734.html)`.

Installation and Software Management Features

This section describes installation and software management features in this release.

Firmware Updates With IPS

Oracle Solaris 11.2 adds support for firmware version checking with Oracle Solaris Image Packaging System (IPS). IPS can check installed firmware versions to ensure that they are compatible with driver updates that may occur during a system update. If an incompatibility occurs, IPS prevents the system from being updated and flags that the firmware must be manually updated by the administrator first. For certain hardware drivers, firmware is automatically updated on driver attach to maintain compatibility.

For more information, see "Device Driver with Manually Maintained Firmware" in "Packaging and Delivering Software With the Image Packaging System in Oracle Solaris 11.2 ".

Secure End-to-End Provisioning

This release supports secure end-to-end provisioning using the Automated Installer (AI), from system boot using SPARC WAN boot through to secure installation from IPS package repositories. By protecting the communication and configuration between the installation server and client systems, administrators can ensure complete security across their provisioning/updating environment.

For more information, see "Increasing Security for Automated Installations" in "Installing Oracle Solaris 11.2 Systems ".

Interactive Automated Installer Manifest Creation and Management

A new interactive browser interface enables you to easily create AI manifests that can be used on an AI server. By stepping through a series of screens, you can quickly create a new manifest that describes the disk layout, ZFS datasets, IPS repository, and software packages and zones to be installed. The manifest is saved to the AI server and can later be associated with a client using the `installadm`(1M) command.

FIGURE 2   Automated Installer Manifest Wizard
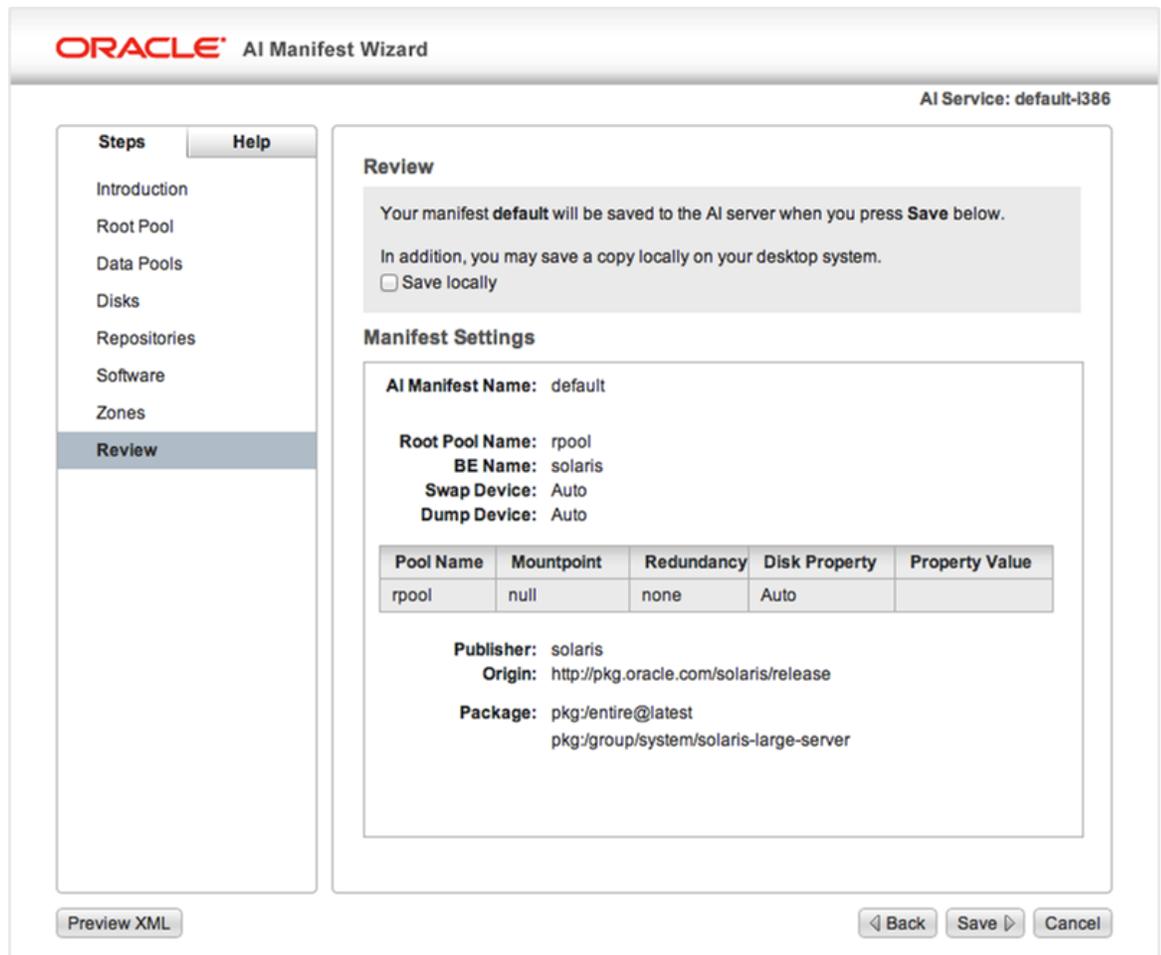
Minimal Server Package Group

A new group package, `solaris-minimal-server`, installs the smallest possible set of Oracle Solaris packages. Fewer packages reduce potential system vulnerabilities, provide faster system updates, faster system cloning, and faster backup in the cloud. See the `Oracle Solaris 11.2 system requirements` `(http://www.oracle.com/technetwork/server-storage/solaris11/documentation/solaris11-2-sys-` `reqs-2191085.pdf)` for an estimate of the amount of disk space needed for an image installed with this new group package.

For more information about `solaris-minimal-server` and packages available in this group package, see "Oracle Solaris 11.2 Package Group Lists ".

Oracle Database Prerequisites Package

The new group package `group/prerequisite/oracle/oracle-rdbms-server-12-1-preinstall` ensures that all the necessary packages required for a graphical and command-line installation of Oracle Database

12c are present on the system, irrespective of the server package group (`solaris-minimal-server`, `solaris-small-server`, `solaris-large-server`, `solaris-desktop`) used to install Oracle Solaris.

Repository Mirroring

Among many new enhancements for managing IPS package repositories is the ability to automatically mirror remote repositories locally using an SMF service, `svc:/application/pkg/mirror`. This service helps you create local IPS package repositories and keep them in sync with Oracle hosted public IPS package repositories.

Additionally, you can use a new `pkgrecv --clone` option to exactly clone a package repository while preserving timestamps.

See "Copying a Repository From the Internet" in "Copying and Creating Package Repositories in Oracle Solaris 11.2 " for more information.

Recursive Package Operations in Oracle Solaris Zones

Oracle Solaris 11.2 provides the ability to run package operations recursively across multiple non-global zones from the global zone in addition to a typical system-wide update. For example, you can easily install a software package into all non-global zones.

For more information, see "Options That Operate on Non-Global Zones" in "Adding and Updating Software in Oracle Solaris 11.2 ".

Baseline Installations With IPS

A new `pkg`(1) subcommand, `exact-install`, enables administrators to easily revert to a baseline installation. This capability is useful when you need to put a system into a baseline state without having to manually uninstall a large number of packages. The result of the `pkg exact-install` command is an image with only the specified packages and their dependencies installed. Any currently installed packages that are not specified on the `pkg exact-install` command line, and are not a dependency of the specified packages are removed.

For more information, see "Reinstalling an Image" in "Adding and Updating Software in Oracle Solaris 11.2 ".

Additional Automated Installer Enhancements for Advanced Configuration

Oracle Solaris 11.2 includes support for the configuration of multiple network interfaces using the Automated Installer. You can use a system configuration profile to configure multiple NICs on a client system that will be installed. You can use this facility in conjunction with zone creation to create a zone with multiple network interfaces.

For more information, see "Configuring Multiple IPv4 Interfaces" in "Installing Oracle Solaris 11.2 Systems ".

Another enhancement for Automated Installer allows passing pre-generated SSH public keys through an SMF profile using the `user_account/ssh_public_keys` group/property for population within the admin user's `$HOME/.ssh/authorized_keys`.

For more information, see "Configuring SSH Keys" in "Installing Oracle Solaris 11.2 Systems ".

Support for provisioning Kerberos clients using the Automated Installer is available in Oracle Solaris 11.2. Kerberos enables strong network authentication, integrity, and privacy protection. You can create and assign Kerberos configuration profiles to AI clients, which enables an AI client installation with a fully provisioned Kerberos configuration capable of hosting secure services.

For more information, see "How to Configure Kerberos Clients Using AI" in "Installing Oracle Solaris 11.2 Systems ".

Bootable USB Media for SPARC

Bootable USB media is supported for SPARC in addition to x86 systems. You can use bootable media for stand-alone system installations that do not use an automated network installation. You can create USB media for SPARC using the Oracle Solaris Distribution Constructor. Additionally, installation images can be copied to USB media by using the dd(1M) command (or its equivalent command on other platforms) in addition to the usbcopy(1M) command.

See the Oracle Solaris 11.2 FAQ (http://www.oracle.com/technetwork/server-storage/solaris11/documentation/solaris-11-2-faqs-2191871.pdf) for more information on using usbcopy or dd.

Data Management Features

This section describes data management features in this release.

Progress Reporting With ZFS Send Streams

You can include a progress report and estimated size of your ZFS send stream during the transfer process.

To estimate the ZFS send stream size:

```
# zfs send -rnv pool/opt@snap1
    sending from @ to pool/opt@snap1
    sending from @ to pool/opt/vol1@snap1
    estimated stream size: 10.1G
```

To monitor the stream size during transfer process:

```
# zfs send pool/opt@snap1 | pv | zfs recv tank/opt
    8.58GB 0:02:37 [95.7MB/s]
```

This enhancement provides visibility into your ZFS send stream transfers so that you can improve planning and scheduling of replication operations.

ZFS Performance Enhancements

Pool resilvering is faster in Oracle Solaris 11.2, with up to 40% improvement on mirrored pools and 4x improvement on RAIDZ pools. Synchronous write transactions are committed in parallel to further optimize SSD log performance.

Virtualization Features

This section describes virtualization features in this release.

Live Zone Reconfiguration

You can dynamically reconfigure Oracle Solaris Zones without requiring a reboot, helping to eliminate system downtime. The following configuration changes can be made to Oracle Solaris Zones without a reboot:

- Changes to resource controls and pools
- Changes to network configuration
- Adding or removing file systems
- Adding or removing virtual and physical devices

For more information, see Chapter 6, "Live Zone Reconfiguration," in "Creating and Using Oracle Solaris Zones ".

Zone Template Properties

Oracle Solaris Zones can also take advantage of zone template properties that enable simplified zone configuration. Default configuration values are populated when zones are created, cloned, and migrated.

For more information, see "zonecfg template Property" in "Introduction to Oracle Solaris Zones ".

Automated Zone Renaming

A new `zoneadm`(1M) subcommand, `rename`, enables easier zone renaming for zones in a configured and installed state.

CMT-Aware Oracle Solaris Zones and Resource Pool Configuration

Enhancements made to Oracle Solaris Zones and resource pools support SPARC chip multithreading (CMT) systems and enable administrators to allocate CMT-based resources (CPUs, cores, and sockets) using the `zonecfg`(1M) and `poolcfg`(1M) commands. Administrators have greater flexibility and control for managing licensing boundaries or dedicating hardware resources solely to a zone.

Multiple Boot Environments for Oracle Solaris 10 Zones

Oracle Solaris 10 Zones support multiple boot environments. Administrators have a greater degree of flexibility and safety when performing patching operations within an Oracle Solaris 10 environment running on an Oracle Solaris 11 system. This feature was introduced in Oracle Solaris 11.1 Support Repository Update (SRU) Version 6.

For more information, see the `zones`(5) and `solaris10`(5) man pages.

Networking Features

This section describes networking features in this release.

Virtual Extensible Local Area Network

Oracle Solaris 11.2 supports virtual extensible local area networks (VXLANs), providing increased flexibility and isolation in cloud environments where virtualization causes an increased stress on physical network infrastructure. VXLANs decouple virtual networks from the underlying L2 layer, reducing the need for specific physical switching capabilities. While traditional network isolation methods such as virtual local area network (VLAN) can have a maximum of 4000 isolated networks, VXLAN provides a significantly higher number of isolated networks by using a 24-bit VXLAN identifier, thereby providing an option to support 16 million isolated networks.

For more information, see Chapter 3, "Configuring Virtual Networks by Using Virtual Extensible Local Area Networks," in "Managing Network Virtualization and Network Resources in Oracle Solaris 11.2 ".

Layer 3 Virtual Router Redundancy Protocol Extension

A new extension to the Virtual Router Redundancy Protocol (VRRP) has been added to implement an L3-based router, providing better support for VRRP over IPMP, InfiniBand, and Oracle Solaris Zones. Instead of using a unique virtual MAC address among VRRP routers in the same virtual router, the Layer 3 VRRP (L3 VRRP) implementation uses the Address Resolution Protocol (ARP) messages and Neighbor Discovery Protocol (NDP) messages to refresh the mapping between the virtual IP addresses and the MAC address of the current master VRRP router.

For more information, see Chapter 3, "Using Virtual Router Redundancy Protocol," in "Configuring an Oracle Solaris 11.2 System as a Router or a Load Balancer " and the `vrrpadm`(1M) man page.

Precision Time Protocol

Precision Time Protocol (PTP) enables synchronizing system time on multiple systems in a LAN to a common master clock in the LAN. This capability is important for benchmarking applications in latency-sensitive environments. PTP in Oracle Solaris implements the standard IEEE 1588 2008 (Version 2). PTP greatly enhances the accuracy of time synchronization. It can also take advantage of the PTP hardware assistance provided by some NICs.

For more information, see "Managing the Precision Time Protocol" in "Introduction to Oracle Solaris 11.2 Network Services " and the `ptpd`(1m) man page.

Probe-Based Failure Detection in Datalink Multipathing

A new probe-based failure detection mode for Datalink Multipathing (DLMP) helps to identify failures between the host and any configured targets. This detection mode is in addition to the existing link-based detection that assists in detecting failures caused by the loss of direct connection between the datalink and the first-hop switch.

For more information, see "Failure Detection in DLMP Aggregation" in "Managing Network Datalinks in Oracle Solaris 11.2 ".

Network Traffic Monitoring Utilities

Two new commands enable you to monitor IP, TCP, and UDP network traffic between remote hosts in an aggregated fashion. `ipstat`(1M) reports IP traffic statistics and `tcpstat`(1M) gathers and reports

TCP and UDP traffic statistics. These commands are in addition to `dlstat`(1M) and other network traffic monitoring utilities already included in Oracle Solaris 11.

For more information, see "Observing Network Traffic With the ipstat and tcpstat Commands" in "Administering TCP/IP Networks, IPMP, and IP Tunnels in Oracle Solaris 11.2 ".

Reflective Relay

With the introduction of network virtualization, inter-VM traffic is sent through an internal software switch without being sent through the physical network infrastructure. This process aids organizations that have networking policies that require all network traffic to be routed through an external network so that access control lists (ACL), packet monitoring, and the like can be configured on the external switch. In this release, you can enable reflective relay to ensure that this inter-VM traffic is also subjected to these same policies.

For more information, see "Reflective Relay" in "Managing Network Virtualization and Network Resources in Oracle Solaris 11.2 ".

InfiniBand Enhancements

InfiniBand (IB) Automatic Path Migration supports two new communication Management Datagram protocols, Suggest Alternate Path (SAP) and Suggest Path Response (SPR). These protocols enable the passive side of an IB (reliable) connection to suggest alternate port information to the active side for consideration in maintaining an up-to-date alternate path information.

EoIB Administration With the `dladm` Command

Ethernet over InfiniBand (EoIB) can be managed directly through the `dladm`(1M) command by using a new `eoib` datalink object. Oracle Solaris InfiniBand users can create, delete, and view EoIB datalinks information using the subcommands `create-eoib`, `delete-eoib`, and `show-eoib`. The `show-ib` subcommand has also been enhanced to display all discovered EoIB gateways information in addition to the IB information it already displayed.

InfiniBand Observability

A new framework enables better observability for InfiniBand, including all upper-layer protocols (ULPs), creating a centralized set of `kstats` in the InfiniBand Transport Framework (IBTF). This capability ensures a better understanding of the activity within an InfiniBand environment and also allows for better security hardening of open ports across all clients.

User and Process Information in the `netstat` Command

Enhancements made to the `netstat`(1M) command enable you to easily trace user and process information to discover who created and controls network endpoints. You can use the `netstat` command with the -u option to display the user and process ID, and the program that created the network endpoint or currently controls the network endpoint.

```
# netstat -u
```

For more information, see "Displaying User and Process Information" in "Administering TCP/IP Networks, IPMP, and IP Tunnels in Oracle Solaris 11.2 ".

System Management Features

This section describes system management features in this release.

Remote Administration Daemon

The Remote Administration Daemon (RAD) supports autogenerated client-side bindings for Python, C, and Java. RAD is a key foundation of the system management architecture, enabling developers to write RAD modules that interface with different sub-subsystems within the Oracle Solaris operating system. Administrators can use RAD to locally and remotely interact with systems. This release extends RAD module support for zones, services, users, kernel statistics, datalinks, and elastic virtual switches.

See the "Remote Administration Daemon Developer Guide " for more information about how to develop RAD modules.

SMF Configuration Stencils, Log Viewing, and Synchronous Operations

The Service Management Facility (SMF) includes SMF Stencils, which enable developers and administrators to easily map configuration properties stored in the SMF repository to an application-specific configuration file (stored in `/etc`, for example). A new command, `svcio`(1), takes a stencil file as input and uses that file and the service properties to create the application configuration file. From there, SMF takes control and regenerates configuration for all stencil-aware services before running the start or refresh SMF methods. For more information, see "Using a Stencil to Create a Configuration File" in "Managing System Services in Oracle Solaris 11.2 ".

Administrators can easily view SMF logs directly by using the `svcs`(1) command. Use the `-L` option to display the name of the log file, the `-xL` option to view the last several lines of the log file, and the `-Lv` option to view the complete log file. See "Viewing Service Log Files" in "Managing System Services in Oracle Solaris 11.2 ".

SMF supports synchronous operations by providing a common and simple interface to improve waiting for the necessary service state transitions to complete. This interface avoids the necessity for service developers and administrators to manually poll when a service has come online.

Security Features

This section describes security features in this release.

Verified Boot

Oracle Solaris Verified Boot is an anti-malware and integrity feature that reduces the risk of introducing malicious or accidentally modified critical boot and kernel components. This feature checks the cryptographic signatures of the firmware, boot system, and kernel and kernel modules. The three policy options are `ignore`, `warn and continue`, and `refuse to load the component`.

This first release of verified boot applies to the SPARC T5, M5, and M6 platforms. For more information, see "Using Verified Boot" in "Securing Systems and Attached Devices in Oracle Solaris 11.2 ".

Verified Boot is one of a series of projects that enhance Oracle Solaris security. The blog post `Solaris Verified Boot (https://blogs.oracle.com/DanX/entry/verified_boot)`, describes details about Verified Boot as well as how the feature fits into an overall Oracle Solaris security architecture.

IKEv2 Support for Oracle Solaris 11

Oracle Solaris 11.2 introduces Internet Key Exchange (IKE) version 2 support. IKEv2 is the latest version of the preferred key management protocol for IPsec. IKEv2 provides automatic Security Association (SA) and key management between peer systems. The key exchanges are protected by a secure channel negotiated between the two peers. The peer's identity is established using either a pre-shared secret or public key certificates.

RBAC Time-Based and Location-Based Access

You can qualify user attributes by location. A new qualifier option for the `usermod`(1M) and `rolemod`(1M) commands can indicate the host or netgroup where user attributes apply. By default, a local entry matching the named user or role has the highest precedence. If no local entry exists, an LDAP query is initiated which returns the entry whose hostname matches the current host, or the first entry matching one of the user's net groups. Otherwise, the unqualified user attributes are used.

A new time-based policy for access to PAM services can be specified by using the new `access_times` keyword of the `useradd`(1M) command. You can use this keyword to specify the days and times when each user can authenticate to specific PAM services. For example, use of SSH can be restricted to weekday mornings.

Auditing of User and Rights Management

The User Management and RBAC profile configuration commands generate audit records.

Kerberos for Long-Running Processes

Kerberos has been enhanced to provide support for long-running processes and cron jobs, where administrators make use of delayed execution and require valid credentials for longer than the usual defaults.

For more information, see "Configuring Delayed Execution for Access to Kerberos Services" in "Managing Kerberos and Other Authentication Services in Oracle Solaris 11.2 ".

Platform Enhancements

This section describes platform enhancements in this release.

Multi-CPU Binding System Call

A new system call, `processor_affinity`(2), can bind a process or thread to multiple CPUs. This new call addresses performance issues in handling threads and interrupts in larger hardware configurations and

also achieves better load balancing for critical applications and services by providing multiple binding targets. It also enhances resource provisioning and management by enabling process or thread binding with greater scalability.

FMA Network Diagnostics

The Fault Management Architecture (FMA) includes a network diagnostic agent that can monitor network resources and report conditions that might lead to degraded network functionality. The agent is able to detect maximum transmission unit (MTU) and VLAN ID configuration issues.

For more information, see Chapter 4, "Performing Network Diagnostics With the network-monitor Transport Module Utility," in "Troubleshooting Network Administration Issues in Oracle Solaris 11.2 ".

Faster Upload Times for Kernel Crash Dumps

The kernel crash dump files have been restructured to allow faster upload times to Oracle Support for dumps from large systems. This feature greatly reduces the time for initial analysis and problem resolution reporting back to the customer. Kernel crash dumps are divided into multiple files based on their contents and better administrative granularity is provided when using the `dumpadm`(1M) and `savecore`(1M) commands.

Memory Access Locality Characterization and Analysis With the `numatop` Command

Most modern systems use Non-Uniform Memory Access (NUMA) design for multiprocessing. In NUMA systems, memory and processors are organized in such a way that for a given processor, some parts of memory are closer to it (that is, connected by a more direct path) while other parts are farther from it. A processor can access memory that is closer to it much faster than the memory that is farther from it. The latency between the processors and different portions of the memory in a NUMA machine might be significantly different.

The new `numatop`(1M) command is an observability tool for runtime memory locality characterization and analysis of processes and threads running on a NUMA system. This tool helps to characterize the NUMA behavior of processes and threads and to identify where the NUMA-related performance bottlenecks reside.

Oracle Hardware Management Pack

The Oracle Hardware Management Pack is integrated into Oracle Solaris. This set of tools enables you to better manage and configure Oracle server hardware and enable automation through scripting. This set comprises command-line interfaces for the following activities:

- Configuring the Oracle Integrated Lights Out Manager (ILOM) service processor
- Configuring hardware RAID volumes used for server data
- Updating server firmware
- Displaying hardware configuration information

A hardware plug-in for the Oracle Solaris SNMP Agent enables monitoring of hardware configuration and status by your existing data center management tools, including notification of hardware faults through SNMP Traps.

You can install the Oracle Hardware Management Pack with the `system/management/hwmgmtd` and `system/management/hwmgmtcli` packages.

For more information, see the Oracle Hardware Management Pack technology page (http://www.oracle.com/technetwork/server-storage/servermgmt/tech/hardware-management-pack/index.html).

Oracle VTS 7.0 Patch Set 18.1

The Oracle Validation Test Suite (Oracle VTS) is a comprehensive hardware diagnostic tool that tests and validates the connectivity and functionality of most controllers and devices on Oracle platforms. Oracle VTS tests are targeted for each hardware component or function in a system. Oracle VTS 7.0 Patch Set 18.1 has significant enhancements to processor, power, power management, memory, and input and output diagnostics. The modified VTS kernel logs the system information of the test server and provides periodic test status summary reports for every test execution.

For the list of enhancements in Oracle VTS 7.0 Patch Set 18.1, see Oracle VTS 7.0 Patch Set 18 Software Release Notes (http://docs.oracle.com/cd/E19719-01/E54322/index.html) and Oracle VTS 7.0 Software User's Guide (http://docs.oracle.com/cd/E19719-01/E21664/index.html).

Next-Generation Hardware Drivers

Oracle Solaris 11.2 continues to provide driver support for the latest-generation hardware components from third parties including Intel CPUs and Ethernet Controllers, Mellanox Ethernet and InfiniBand HBAs, and LSI HBAs.

Developer Tools Enhancements

This section describes the features and enhancements in developer tools.

DTrace `llquantize` Aggregating Action

Oracle Solaris 11.2 includes a new DTrace *linear-log quantize* aggregating action, `llquantize`. This aggregating action enables you to collect data in linear-step buckets, similar to the existing `lquantize` action, across multiple magnitudes simultaneously.

For more information, see "Aggregations" in "Oracle Solaris 11.2 Dynamic Tracing Guide ".

DTrace Scalability Enhancements

A number of enhancements to DTrace improve the performance and scalability of data collection on large processor systems. In particular, the `libdtrace`(3LIB) command now uses multithreading for aggregation function processing.

Oracle Solaris Preflight Applications Checker

The Oracle Solaris Preflight Applications Checker version 11.2 bundles the following three tools:

1. **Application Readiness Checker Tool** – Enables you to determine the readiness of an Oracle Solaris 11 application by analyzing a working application on Oracle Solaris 10. A successful check with this tool is a strong indicator that an application will run on Oracle Solaris 11 without modifications.

2. **Kernel Compliance Checker Tool** – Checks for the compliance of kernel modules or device drivers in Oracle Solaris 11.2. This tool analyzes source code or binaries of the device driver and reports any potential compliance issues.

3. **Application Analyzer Tool** – Checks the application for suboptimal coding, implementation practices, and usage of specific Oracle Solaris features. It also recommends a better way of implementing the same code in Oracle Solaris. This tool analyzes application processes and source code, and generates a recommendation report.

For more information, see the Oracle Solaris Preflight Application Checker (http:// www.oracle.com/technetwork/server-storage/solaris11/downloads/preflight-checker- tool-524493.html) web site.

Oracle Solaris Studio

Oracle Solaris Studio delivers the latest analysis tools, compiler optimization, and multithread performance for better application performance and reliability on Oracle Solaris.

For more information, see the Oracle Solaris Studio page (http://www.oracle.com/technetwork/ server-storage/solarisstudio/overview/index.html).

Software Features

This section describes freeware enhancements and new packages in this release.

Java 8

Java 8, the latest Java release, includes a significant upgrade to the Java programming model and a coordinated evolution of the JVM, Java language, and libraries. Java 8 includes features for productivity, ease of use, improved polyglot programming, security, and improved performance.

You can have multiple versions of Java installed within Oracle Solaris 11.2. Only Java 7 is installed by default. To install Java 8, use the following command:

```
# pkg install jre-8
```

By running this command, Java 8 is set as the default Java environment. If you want to have Java 8 installed and set Java 7 as the default runtime Java version, run the following command:

```
# pkg set-mediator -V 1.7 java
```

For more information, see the Java 8 technology page (http://www.oracle.com/technetwork/java/ javase/overview/java8-2100321.html).

Mozilla Collaboration Suite (Firefox, Thunderbird and Lightning)

Oracle Solaris 11.2 includes the latest versions of the popular collaboration suite from the Mozilla community: the Firefox 17 web browser, Thunderbird 17 email client, and Lightning 1.9 calendar client.

National Language Support Administration

The nlsadm(1M) utility provides a way to get and set information on specific national language properties such as default system locale, console-keymap, or timezone.

Third Party Licenses

Oracle Solaris contains many third-party components. See "Third-Party Licenses and Notices for Oracle Solaris 11.2 "for more information.

New IPS Packages

The following table lists the new IPS packages in Oracle Solaris 11.2. It also includes packages that have previously been delivered in Oracle Solaris 11 but are now provided in a new package.

TABLE 1   New IPS Packages in Oracle Solaris 11.2

Package Name	Package Summary
cloud/openstack	OpenStack Group Package
cloud/openstack/cinder	OpenStack Block Storage Service
cloud/openstack/glance	OpenStack Image Service
cloud/openstack/horizon	OpenStack Dashboard
cloud/openstack/keystone	OpenStack Identity Service
cloud/openstack/neutron	OpenStack Networking Service
cloud/openstack/nova	OpenStack Compute Service
cloud/openstack/swift	OpenStack Object Storage Service
compress/pbzip2	Parallel implementation of bzip2
compress/pixz	Parallel indexing version of XZ
database/mysql-55	MySQL 5.5 Database Management System
database/mysql-55/client	MySQL 5.5 client executables
database/mysql-55/library	MySQL 5.5 client libraries and plugins
database/mysql-55/tests	MySQL 5.5 test suite
developer/build/pkg-config	A tool to query library build-time information
developer/gcc	GCC
developer/gcc/gcc-c	GCC - C Compiler
developer/gcc/gcc-c++	GNU Compiler Collection
developer/gcc/gcc-gfortran	GCC - GNU Fortran Compiler
developer/gcc/gcc-gobjc	GCC - Objective-C Compiler
developer/gcc-4/gcc-c++-47	GNU Compiler Collection
developer/gcc-4/gcc-c++-48	GNU Compiler Collection

Package Name	Package Summary
`developer/gcc-4/gcc-c-47`	GCC C Compiler - 4.7
`developer/gcc-4/gcc-c-48`	GCC C Compiler - 4.8 (Default)
`developer/gcc-4/gcc-common-47`	GCC Common Development Files - 4.7
`developer/gcc-4/gcc-common-48`	GCC Common Development Files - 4.8 (Default)
`developer/gcc-4/gcc-gfortran-47`	GCC Fortran Compiler - 4.7
`developer/gcc-4/gcc-gfortran-48`	GCC Fortran Compiler - 4.8 (Default)
`developer/gcc-4/gcc-gobjc-47`	GCC Objective-C Compiler - 4.7
`developer/gcc-4/gcc-gobjc-48`	GCC Objective-C Compiler - 4.8 (Default)
`developer/gcc-47`	GCC 4.7
`developer/gcc-48`	GCC 4.8 (Default)
`developer/gnu-indent`	GNU indent changes the appearance of a C program by inserting or deleting whitespace
`developer/java/jdk-8`	Java Platform Standard Edition Development Kit (1.8.0_05-b13)
`developer/javascript/jsl`	jsl - JavaScript code linter
`diagnostic/numatop`	NumaTOP NUMA performance observation tool
`driver/storage/lmrc`	LSI MegaRAID SAS 3.0 3108 HBA driver
`driver/storage/nvme`	NVMExpress 1.0e driver
`file/mlocate`	Merging fast file location utility
`group/prerequisite/oracle/oracle-rdbms-server-12-1-preinstall`	Prerequisite package for Oracle Database 12c
`group/system/management/rad/rad-client-interfaces`	RAD client bindings group package
`group/system/management/rad/rad-server-interfaces`	RAD server modules group package
`group/system/solaris-core-platform`	Oracle Solaris Core Platform
`group/system/solaris-minimal-server`	Oracle Solaris Minimal Server
`install/archive`	Solaris System Archive Library and Utilities
`library/java/java-demo-8`	Java Sample and Demonstration Applications (1.8.0_05-b13)
`library/libarchive`	Multiformat archive and compression library
`library/perl-5/authen-pam-512`	Authen::PAM - PAM Perl Module
`library/perl-5/authen-pam-584`	Authen::PAM - PAM Perl Module
`library/perl-5/authen-pam-threaded-512`	Authen::PAM - PAM Perl Module
`library/perl5/perl-tk`	CPAN Perl Tk module
`library/perl5/perl-tk-512`	CPAN Perl Tk module
`library/perl-5/perl-x11-protocol`	CPAN X11::Protocol module
`library/perl-5/perl-x11-protocol-512`	CPAN X11::Protocol module
`library/perl-5/xml-libxml`	Perl interface to `libxml2`

Package Name	Package Summary
`library/perl-5/xml-libxml-512`	Perl interface to `libxml2`
`library/perl-5/xml-libxml-threaded-512`	Perl interface to `libxml2`
`library/perl-5/xml-namespacesupport`	Perl module to process namespaced XML names
`library/perl-5/xml-namespacesupport-512`	Perl module to process namespaced XML names
`library/perl-5/xml-namespacesupport-threaded-512`	Perl module to process namespaced XML names
`library/perl-5/xml-parser-threaded-512`	XML::Parser Perl module
`library/perl-5/xml-sax`	Perl simple API for XML Parsing
`library/perl-5/xml-sax-512`	Perl simple API for XML Parsing
`library/perl-5/xml-sax-base`	Perl base class for SAX
`library/perl-5/xml-sax-base-512`	Perl base class for SAX
`library/perl-5/xml-sax-base-threaded-512`	Perl base class for SAX
`library/perl-5/xml-sax-threaded-512`	Perl simple API for XML Parsing
`library/perl-5/xml-simple-threaded-512`	Perl simple API for XML Parsing
`library/python/ceilometerclient`	Python and command-line clients for the OpenStack Ceilometer API
`library/python/ceilometerclient-26`	Python and command-line clients for the OpenStack Ceilometer API
`library/python/ceilometerclient-27`	Python and command-line clients for the OpenStack Ceilometer API
`library/python/cffi`	Foreign function interface for Python calling C code
`library/python/cffi-26`	Foreign function interface for Python calling C code
`library/python/cffi-27`	Foreign function interface for Python calling C code
`library/python/cinderclient`	Python and command-line clients for the OpenStack Cinder API
`library/python/cinderclient-26`	Python and command-line clients for the OpenStack Cinder API
`library/python/cinderclient-27`	Python and command-line clients for the OpenStack Cinder API
`library/python/django`	Django Python web framework
`library/python/django-26`	Django Python web framework
`library/python/django-27`	Django Python web framework
`library/python/dnspython`	DNS toolkit for Python
`library/python/dnspython-26`	DNS toolkit for Python
`library/python/dnspython-27`	DNS toolkit for Python
`library/python/dogpile.cache`	dogpile lock-based caching API
`library/python/dogpile.cache-26`	dogpile lock-based caching API
`library/python/dogpile.cache-27`	dogpile lock-based caching API
`library/python/dogpile.core`	dogpile lock-based caching API

Package Name	Package Summary
`library/python/dogpile.core-26`	dogpile lock-based caching API
`library/python/dogpile.core-27`	dogpile lock-based caching API
`library/python/glanceclient`	Python and command-line clients for the OpenStack Glance API
`library/python/glanceclient-26`	Python and command-line clients for the OpenStack Glance API
`library/python/glanceclient-27`	Python and command-line clients for the OpenStack Glance API
`library/python/heatclient`	Python and command-line clients for the OpenStack Heat API
`library/python/heatclient-26`	Python and command-line clients for the OpenStack Heat API
`library/python/heatclient-27`	Python and command-line clients for the OpenStack Heat API
`library/python/iso8601`	Simple Python module to parse ISO 8601 dates
`library/python/iso8601-26`	Simple Python module to parse ISO 8601 dates
`library/python/iso8601-27`	Simple Python module to parse ISO 8601 dates
`library/python/jinja2`	Full-featured template engine for Python
`library/python/jinja2-26`	Full-featured template engine for Python
`library/python/jinja2-27`	Full-featured template engine for Python
`library/python/keystoneclient`	Python and command-line clients for the OpenStack Keystone API
`library/python/keystoneclient-26`	Python and command-line clients for the OpenStack Keystone API
`library/python/keystoneclient-27`	Python and command-line clients for the OpenStack Keystone API
`library/python/neutronclient`	Python and command-line clients for the OpenStack Neutron API
`library/python/neutronclient-26`	Python and command-line clients for the OpenStack Neutron API
`library/python/neutronclient-27`	Python and command-line clients for the OpenStack Neutron API
`library/python/novaclient`	Python and command-line clients for the OpenStack Nova API
`library/python/novaclient-26`	Python and command-line clients for the OpenStack Nova API
`library/python/novaclient-27`	Python and command-line clients for the OpenStack Nova API
`library/python/oslo.config`	Oslo Configuration Library
`library/python/oslo.config-26`	Oslo Configuration Library
`library/python/oslo.config-27`	Oslo Configuration Library
`library/python/pbr`	Python Build Reasonableness
`library/python/pbr-26`	Python Build Reasonableness

Package Name	Package Summary
`library/python/pbr-27`	Python Build Reasonableness
`library/python/pycparser`	Complete C99 parser in pure Python
`library/python/pycparser-26`	Complete C99 parser in pure Python
`library/python/pycparser-27`	Complete C99 parser in pure Python
`library/python/python-memcached`	Python memcached client library
`library/python/python-memcached-26`	Python memcached client library
`library/python/python-memcached-27`	Python memcached client library
`library/python/quantumclient`	Python and command-line clients for the OpenStack Quantum API
`library/python/quantumclient-26`	Python and command-line clients for the OpenStack Quantum API
`library/python/quantumclient-27`	Python and command-line clients for the OpenStack Quantum API
`library/python/six`	Python 2 and 3 compatibility utilities
`library/python/six-26`	Python 2 and 3 compatibility utilities
`library/python/six-27`	Python 2 and 3 compatibility utilities
`library/python/swiftclient`	Python and command-line clients for the OpenStack Swift API
`library/python/swiftclient-26`	Python and command-line clients for the OpenStack Swift API
`library/python/swiftclient-27`	Python and command-line clients for the OpenStack Swift API
`library/python/troveclient`	Python and command-line clients for the OpenStack Trove API
`library/python/troveclient-26`	Python and command-line clients for the OpenStack Trove API
`library/python/troveclient-27`	Python and command-line clients for the OpenStack Trove API
`library/python/websockify`	WebSocket to TCP proxy/bridge
`library/python/websockify-26`	WebSocket to TCP proxy/bridge
`library/python/websockify-27`	WebSocket to TCP proxy/bridge
`library/python/xattr`	Python wrapper for extended file system attributes
`library/python/xattr-26`	Python wrapper for extended file system attributes
`library/python/xattr-27`	Python wrapper for extended file system attributes
`library/python-2/alembic`	Database migration tool for SQLAlchemy
`library/python-2/alembic-26`	Database migration tool for SQLAlchemy
`library/python-2/alembic-27`	Database migration tool for SQLAlchemy
`library/python-2/amqp`	AMQP client library for Python
`library/python-2/amqp-26`	AMQP client library for Python
`library/python-2/amqp-27`	AMQP client library for Python

Package Name	Package Summary
library/python-2/anyjson	Python module wrapping the best available JSON implementation with a common interface
library/python-2/anyjson-26	Python module wrapping the best available JSON implementation with a common interface
library/python-2/anyjson-27	Python module wrapping the best available JSON implementation with a common interface
library/python-2/argparse	Python argparse command-line parsing library
library/python-2/argparse-26	Python argparse command-line parsing library
library/python-2/babel	Internationalization utilities for Python
library/python-2/babel-26	Internationalization utilities for Python
library/python-2/babel-27	Internationalization utilities for Python
library/python-2/beautifulsoup4	Screen-scraping library
library/python-2/beautifulsoup4-26	Screen-scraping library
library/python-2/beautifulsoup4-27	Screen-scraping library
library/python-2/boto	Amazon Web Services library for Python
library/python-2/boto-26	Amazon Web Services library for Python
library/python-2/boto-27	Amazon Web Services library for Python
library/python-2/cheetah	Template engine and code generation tool
library/python-2/cheetah-26	Template engine and code generation tool
library/python-2/cheetah-27	Template engine and code generation tool
library/python-2/cliff	Command-line Interface Formulation Framework
library/python-2/cliff-26	Command-line Interface Formulation Framework
library/python-2/cliff-27	Command-line Interface Formulation Framework
library/python-2/cmd2	Extra features for Python cmd module
library/python-2/cmd2-26	Extra features for Python cmd module
library/python-2/cmd2-27	Extra features for Python cmd module
library/python-2/cov-core	Plugin core for use by pytest-cov, nose-cov, and nose2-cov
library/python-2/cov-core-26	Plugin core for use by pytest-cov, nose-cov, and nose2-cov
library/python-2/cov-core-27	Plugin core for use by pytest-cov, nose-cov, and nose2-cov
library/python-2/cssutils	Python package to parse and build CSS Cascading Style Sheets
library/python-2/cssutils-27	Python package to parse and build CSS Cascading Style Sheets
library/python-2/d2to1	Allow distutils2-like setup.cfg files with Python 2
library/python-2/d2to1-26	Allow distutils2-like setup.cfg files with Python 2
library/python-2/d2to1-27	Allow distutils2-like setup.cfg files with Python 2

Package Name	Package Summary
library/python-2/decorator	Python decorator helper module
library/python-2/decorator-26	Python decorator helper module
library/python-2/decorator-27	Python decorator helper module
library/python-2/django_compressor	JavaScript/CSS compressor
library/python-2/django_compressor-26	JavaScript/CSS compressor
library/python-2/django_compressor-27	JavaScript/CSS compressor
library/python-2/django_openstack_auth	Django authentication backend for use with OpenStack Identity
library/python-2/django_openstack_auth-26	Django authentication backend for use with OpenStack Identity
library/python-2/django_openstack_auth-27	Django authentication backend for use with OpenStack Identity
library/python-2/django-appconf	Django app helper class
library/python-2/django-appconf-26	Django app helper class
library/python-2/django-appconf-27	Django app helper class
library/python-2/eventlet	Highly concurrent networking library for Python
library/python-2/eventlet-26	Highly concurrent networking library for Python
library/python-2/eventlet-27	Highly concurrent networking library for Python
library/python-2/filechunkio	filechunkio represents a chunk of an OS-level file
library/python-2/filechunkio-26	filechunkio represents a chunk of an OS-level file
library/python-2/filechunkio-27	filechunkio represents a chunk of an OS-level file
library/python-2/formencode	HTML form validation, generation, and conversion package
library/python-2/formencode-26	HTML form validation, generation, and conversion package
library/python-2/formencode-27	HTML form validation, generation, and conversion package
library/python-2/greenlet	Co-routine module for Python
library/python-2/greenlet-26	Co-routine module for Python
library/python-2/greenlet-27	Co-routine module for Python
library/python-2/httplib2	Comprehensive HTTP client library for Python
library/python-2/httplib2-26	Comprehensive HTTP client library for Python
library/python-2/httplib2-27	Comprehensive HTTP client library for Python
library/python-2/importlib	Python importlib module
library/python-2/importlib-26	Python importlib module
library/python-2/ipython	Enhanced interactive Python shell
library/python-2/ipython-27	Enhanced interactive Python shell
library/python-2/jsonpatch	Python module for creating and applying JSON patches

Package Name	Package Summary
library/python-2/jsonpatch-26	Python module for creating and applying JSON patches
library/python-2/jsonpatch-27	Python module for creating and applying JSON patches
library/python-2/jsonpointer	Python module for resolving JSON pointers
library/python-2/jsonpointer-26	Python module for resolving JSON pointers
library/python-2/jsonpointer-27	Python module for resolving JSON pointers
library/python-2/jsonschema	An implementation of JSON-Schema validation for Python
library/python-2/jsonschema-26	An implementation of JSON-Schema validation for Python
library/python-2/jsonschema-27	An implementation of JSON-Schema validation for Python
library/python-2/kombu	Messaging framework for Python
library/python-2/kombu-26	Messaging framework for Python
library/python-2/kombu-27	Messaging framework for Python
library/python-2/lesscpy	Python LESS compiler
library/python-2/lesscpy-26	Python LESS compiler
library/python-2/lesscpy-27	Python LESS compiler
library/python-2/librabbitmq	Python bindings for AMQP Client
library/python-2/librabbitmq-26	Python bindings for AMQP Client
library/python-2/librabbitmq-27	Python bindings for AMQP Client
library/python-2/lockfile	File-locking module for Python
library/python-2/lockfile-26	File-locking module for Python
library/python-2/lockfile-27	File-locking module for Python
library/python-2/markdown	Python implementation of John Gruber's Markdown
library/python-2/markdown-26	Python implementation of John Gruber's Markdown
library/python-2/markdown-27	Python implementation of John Gruber's Markdown
library/python-2/markupsafe	Python HTML string module
library/python-2/markupsafe-26	Python HTML string module
library/python-2/markupsafe-27	Python HTML string module
library/python-2/mock	unittest library for creating mock objects
library/python-2/mock-26	unittest library for creating mock objects
library/python-2/mock-27	unittest library for creating mock objects
library/python-2/netaddr	Python network address manipulation
library/python-2/netaddr-26	Python network address manipulation
library/python-2/netaddr-27	Python network address manipulation
library/python-2/netifaces	Portable access to network interfaces from Python
library/python-2/netifaces-26	Portable access to network interfaces from Python
library/python-2/netifaces-27	Portable access to network interfaces from Python

Package Name	Package Summary
`library/python-2/nose-cover3`	Coverage support for Nose
`library/python-2/nose-cover3-26`	Coverage support for Nose
`library/python-2/nose-cover3-27`	Coverage support for Nose
`library/python-2/ordereddict`	Python ordereddict library
`library/python-2/ordereddict-26`	Python ordereddict library
`library/python-2/passlib`	Comprehensive password hashing framework for Python
`library/python-2/passlib-26`	Comprehensive password hashing framework for Python
`library/python-2/passlib-27`	Comprehensive password hashing framework for Python
`library/python-2/paste`	Tools for using a Web Server Gateway Interface stack
`library/python-2/paste.deploy`	Load, configure, and compose WSGI applications and servers
`library/python-2/paste.deploy-26`	Load, configure, and compose WSGI applications and servers
`library/python-2/paste.deploy-27`	Load, configure, and compose WSGI applications and servers
`library/python-2/paste-26`	Tools for using a Web Server Gateway Interface stack
`library/python-2/paste-27`	Tools for using a Web Server Gateway Interface stack
`library/python-2/pep8`	pep8 - Python style guide checker
`library/python-2/pep8-26`	pep8 - Python style guide checker
`library/python-2/pep8-27`	pep8 - Python style guide checker
`library/python-2/pip`	Tool for installing and managing Python packages
`library/python-2/pip-26`	Tool for installing and managing Python packages
`library/python-2/pip-27`	Tool for installing and managing Python packages
`library/python-2/prettytable`	Simple Python library for displaying data in an ASCII table
`library/python-2/prettytable-26`	Simple Python library for displaying data in an ASCII table
`library/python-2/prettytable-27`	Simple Python library for displaying data in an ASCII table
`library/python-2/py`	Library with cross-Python path, ini-parsing, IO, code, log facilities
`library/python-2/py-26`	Library with cross-Python path, ini-parsing, IO, code, log facilities
`library/python-2/py-27`	Library with cross-Python path, ini-parsing, IO, code, log facilities
`library/python-2/pyasn1`	Python ASN.1 implementation
`library/python-2/pyasn1-26`	Python ASN.1 implementation
`library/python-2/pyasn1-27`	Python ASN.1 implementation
`library/python-2/pyasn1-modules`	Collection of ASN.1-based protocols modules
`library/python-2/pyasn1-modules-26`	Collection of ASN.1-based protocols modules
`library/python-2/pyasn1-modules-27`	Collection of ASN.1-based protocols modules

Package Name	Package Summary
`library/python-2/pycountry`	ISO country, subdivision, language, currency, and script definitions
`library/python-2/pycountry-26`	ISO country, subdivision, language, currency, and script definitions
`library/python-2/pycountry-27`	ISO country, subdivision, language, currency, and script definitions
`library/python-2/pydns`	Python DNS library
`library/python-2/pydns-26`	Python DNS library
`library/python-2/pydns-27`	Python DNS library
`library/python-2/pyflakes`	Passive checker of Python programs
`library/python-2/pyflakes-26`	Passive checker of Python programs
`library/python-2/pyflakes-27`	Passive checker of Python programs
`library/python-2/pygments`	Syntax highlighting package written in Python
`library/python-2/pygments-26`	Syntax highlighting package written in Python
`library/python-2/pygments-27`	Syntax highlighting package written in Python
`library/python-2/pyparsing`	Python parsing module
`library/python-2/pyparsing-26`	Python parsing module
`library/python-2/pyparsing-27`	Python parsing module
`library/python-2/pyrabbit`	Pythonic interface to the RabbitMQ Management HTTP API
`library/python-2/pyrabbit-26`	Pythonic interface to the RabbitMQ Management HTTP API
`library/python-2/pyrabbit-27`	Pythonic interface to the RabbitMQ Management HTTP API
`library/python-2/pytest`	Python testing tool
`library/python-2/pytest-26`	Python testing tool
`library/python-2/pytest-27`	Python testing tool
`library/python-2/pytest-capturelog`	pytest plugin to capture log messages
`library/python-2/pytest-capturelog-26`	pytest plugin to capture log messages
`library/python-2/pytest-capturelog-27`	pytest plugin to capture log messages
`library/python-2/pytest-codecheckers`	pytest plugin to add source code sanity checks (pep8 and friends)
`library/python-2/pytest-codecheckers-26`	pytest plugin to add source code sanity checks (pep8 and friends)
`library/python-2/pytest-codecheckers-27`	pytest plugin to add source code sanity checks (pep8 and friends)
`library/python-2/pytest-cov`	pytest plugin for coverage reporting
`library/python-2/pytest-cov-26`	pytest plugin for coverage reporting
`library/python-2/pytest-cov-27`	pytest plugin for coverage reporting

Package Name	Package Summary
`library/python-2/python-imaging`	Python's own image processing library
`library/python-2/python-imaging-27`	Python's own image processing library
`library/python-2/python-ldap`	LDAP client library for Python
`library/python-2/python-ldap-26`	LDAP client library for Python
`library/python-2/python-ldap-27`	LDAP client library for Python
`library/python-2/python-mysql`	MySQL database adapter for the Python programming language
`library/python-2/python-mysql-27`	MySQL database adapter for the Python programming language
`library/python-2/python-twisted`	Event-based framework for Internet applications
`library/python-2/python-twisted-27`	Event-based framework for Internet applications
`library/python-2/python-twisted-web2`	HTTP/1.1 Server Framework
`library/python-2/python-twisted-web2-27`	HTTP/1.1 Server Framework
`library/python-2/python-zope-interface`	Zope interfaces package for Python
`library/python-2/python-zope-interface-27`	Zope interfaces package for Python
`library/python-2/pytz`	Python time zone library
`library/python-2/pytz-26`	Python time zone library
`library/python-2/pytz-27`	Python time zone library
`library/python-2/repoze.lru`	Tiny LRU cache implementation and decorator for Python
`library/python-2/repoze.lru-26`	Tiny LRU cache implementation and decorator for Python
`library/python-2/repoze.lru-27`	Tiny LRU cache implementation and decorator for Python
`library/python-2/requests`	Python HTTP for Humans
`library/python-2/requests-26`	Python HTTP for Humans
`library/python-2/requests-27`	Python HTTP for Humans
`library/python-2/routes`	Routing package for Python that matches URLs to dicts and vice versa
`library/python-2/routes-26`	Routing package for Python that matches URLs to dicts and vice versa
`library/python-2/routes-27`	Routing package for Python that matches URLs to dicts and vice versa
`library/python-2/setuptools-git`	setuptools revision control system plugin for Git
`library/python-2/setuptools-git-26`	setuptools revision control system plugin for Git
`library/python-2/setuptools-git-27`	setuptools revision control system plugin for Git
`library/python-2/simplejson`	JSON (Java Script Object Notation) encoder/decoder for Python
`library/python-2/simplejson-27`	JSON (Java Script Object Notation) encoder/decoder for Python
`library/python-2/sqlalchemy`	Python SQL toolkit and Object Relational Mapper

Package Name	Package Summary
`library/python-2/sqlalchemy-26`	Python SQL toolkit and Object Relational Mapper
`library/python-2/sqlalchemy-27`	Python SQL toolkit and Object Relational Mapper
`library/python-2/sqlalchemy-migrate`	Database schema migration for SQLAlchemy
`library/python-2/sqlalchemy-migrate-26`	Database schema migration for SQLAlchemy
`library/python-2/sqlalchemy-migrate-27`	Database schema migration for SQLAlchemy
`library/python-2/stevedore`	Manage dynamic plugins for Python applications
`library/python-2/stevedore-26`	Manage dynamic plugins for Python applications
`library/python-2/stevedore-27`	Manage dynamic plugins for Python applications
`library/python-2/suds`	Lightweight SOAP client
`library/python-2/suds-26`	Lightweight SOAP client
`library/python-2/suds-27`	Lightweight SOAP client
`library/python-2/tempita`	Very small text templating language
`library/python-2/tempita-26`	Very small text templating language
`library/python-2/tempita-27`	Very small text templating language
`library/python-2/tox`	virtualenv-based automation of test activities
`library/python-2/tox-27`	virtualenv-based automation of test activities
`library/python-2/tox-27`	virtualenv-based automation of test activities
`library/python-2/unittest2`	Python unit testing framework
`library/python-2/unittest2-26`	Python unit testing framework
`library/python-2/virtualenv`	Virtual Python Environment builder
`library/python-2/virtualenv-26`	Virtual Python Environment builder
`library/python-2/virtualenv-27`	Virtual Python Environment builder
`library/python-2/waitress`	Waitress WSGI server
`library/python-2/waitress-26`	Waitress WSGI server
`library/python-2/waitress-27`	Waitress WSGI server
`library/python-2/warlock`	Python object model built on JSON Schema and JSON Patch
`library/python-2/warlock-26`	Python object model built on JSON Schema and JSON Patch
`library/python-2/warlock-27`	Python object model built on JSON Schema and JSON Patch
`library/python-2/webob`	WSGI request and response objects
`library/python-2/webob-26`	WSGI request and response objects
`library/python-2/webob-27`	WSGI request and response objects
`library/python-2/webtest`	Helper to test WSGI applications
`library/python-2/webtest-26`	Helper to test WSGI applications

Package Name	Package Summary
library/python-2/webtest-27	Helper to test WSGI applications
network/amqp/rabbitmq	Message broker implementing AMQP
package/pkg/depot	IPS Depot
runtime/java/jre-8	Java Platform Standard Edition Runtime Environment 1.8.0_05-b13
runtime/perl-threaded-512	Perl 5.12
runtime/ruby-19	Ruby, RubyGems, and Rake (Default)
runtime/ruby-19/ruby-tk	Ruby Tk libraries
security/compliance	Compliance Command and Framework
security/compliance/benchmark/pci-dss	PCI-DSS Security Policy Compliance for Oracle Solaris
security/compliance/benchmark/solaris-policy	Oracle Solaris Security Policy Compliance
security/compliance/policy-tests	Oracle Solaris Security Policy Compliance
service/network/dnsmasq	DNS forwarder for NAT firewalls
service/network/evs	Elastic Virtual Switch client commands
service/network/ptp	Precision Time Protocol (PTP) IEEE 1588-2008 (Version 2)
shell/gnu-getopt	Parse command-line arguments from shell scripts
shell/parallel	GNU parallel shell tool for executing jobs in parallel using one or more computers
system/file-system/uafs	Unified Archive File System (UAFS)
system/kernel/ttrace	HV trap trace on sun4v platform
system/ldoms/mib	Oracle VM Server for SPARC MIB
system/library/gcc/gcc-c++-runtime	GNU Compiler Collection
system/library/gcc/gcc-c++-runtime-47	GNU Compiler Collection
system/library/gcc/gcc-c++-runtime-48	GNU Compiler Collection
system/library/gcc/gcc-c-runtime	GCC - C Runtime
system/library/gcc/gcc-c-runtime-47	GCC 4.7 - C Runtime
system/library/gcc/gcc-c-runtime-48	GCC 4.8 - C Runtime (Default)
system/library/gcc/gcc-gfortran-runtime	GCC - Fortran Runtime
system/library/gcc/gcc-gfortran-runtime-47	GCC 4.7 - Fortran Runtime
system/library/gcc/gcc-gfortran-runtime-48	GCC 4.8 - Fortran Runtime (Default)
system/library/gcc/gcc-gobjc-runtime	GCC - Objective-C Runtime
system/library/gcc/gcc-gobjc-runtime-47	GCC 4.7 - Objective-C Runtime
system/library/gcc/gcc-gobjc-runtime-48	GCC 4.8 - Objective-C Runtime (Default)
system/library/gcc/gcc-runtime	GCC - GCC Runtime
system/library/gcc/gcc-runtime-47	GCC 4.7 - GCC Runtime

Package Name	Package Summary
`system/library/gcc/gcc-runtime-48`	GCC 4.8 - GCC Runtime (Default)
`system/library/libv12n`	`libv12n` and `virtinfo` provide a way to determine what virtual environments can be hosted as well as the type of virtual environment currently running and the type of the virtual environment of the parent
`system/library/mmheap`	`mmap`- based heap memory allocator
`system/locale/nls-administration`	National Language Support Administration
`system/locale/setterm`	`setterm` - Build a Stream on a `tty` line
`system/management/biosconfig`	Oracle Hardware Management Pack - `biosconfig`
`system/management/facter`	`facter` - collect and display facts about the system
`system/management/fwupdate`	Oracle Hardware Management Pack - `fwupdate`
`system/management/fwupdate/emulex`	Emulex OneCommand Manager: CLI and library plugin for `fwupdate`
`system/management/fwupdate/qlogic`	QLogic CLI and library plugin for `fwupdate`
`system/management/hwmgmtd`	Oracle Hardware Management Pack - Hardware Agent
`system/management/ipmitool`	`ipmitool` - utility for controlling IPMI-enabled devices
`system/library/hmp-libs`	Oracle Hardware Management Pack shared libraries
`system/management/hmp-snmp`	Oracle Hardware Management Pack - SNMP plugins
`system/management/raidconfig`	Oracle Hardware Management Pack - `raidconfig`
`system/management/ilomconfig`	ILOM Configuration Utility
`system/management/hwmgmtcli`	Oracle Hardware Management Pack - `hwmgmtcli`
`system/management/ubiosconfig`	Oracle Hardware Management Pack - `ubiosconfig`
`system/management/hmp-snmp`	Oracle Hardware Management Pack - SNMP plugins
`system/management/ovm-guest-additions`	Oracle VM Guest Additions
`system/management/puppet`	Puppet - Configuration management toolkit
`system/management/rad/client/rad-c`	RAD C client modules
`system/management/rad/module/rad-dlmgr`	RAD Datalink Manager module
`system/management/rad/module/rad-evs-controller`	Elastic Virtual Switch controller RAD module
`system/management/rad/module/rad-files`	RAD files module for Visual Panels
`system/management/rad/module/rad-network`	RAD network module for Visual Panels
`system/management/rad/module/rad-panels`	RAD panels module for Visual Panels
`system/management/rad/module/rad-time`	RAD time module for Visual Panels
`system/management/rad/radadrgen`	Remote Administration Daemon (RAD) ADR processing utility
`system/management/ubiosconfig`	Oracle Hardware Management Pack - `ubiosconfig`
`system/network/ike`	Internet Key Exchange (IKE) services
`system/security/armor`	ARMOR

Package Name	Package Summary
`system/storage/nvme-utilities`	NVMExpress(`nvme`) utility
`system/zones/brand/brand-solaris-kz`	Solaris Kernel Zones (`solaris-kz` branded zones)
`terminal/cssh`	Cluster `ssh` utility to administer cluster of servers
`terminal/cssh-512`	Cluster `ssh` utility to administer cluster of servers
`terminal/tmux`	`tmux` - Terminal multiplexer
`web/php-53/extension/php-zendopcache`	ZendOpcache extension module for PHP
`x11/diagnostic/intel-gpu-tools`	Intel graphics driver debug tools

Key Resources

- Oracle Solaris 11 How To Guides (http://www.oracle.com/technetwork/server-storage/solaris11/documentation/how-to-517481.html)
- Oracle Solaris 11 Technologies (http://www.oracle.com/technetwork/server-storage/solaris11/technologies/index.html)
- Oracle Solaris 11 Training (http://www.oracle.com/technetwork/server-storage/solaris11/training/index.html)
- Oracle Solaris 11.2 Information Library (http://www.oracle.com/pls/topic/lookup?ctx=E36784)

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