Oracle® Communications

Cloud Native Core, Unified Data Repository Benchmarking Guide

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Oracle Communications Cloud Native Core, Unified Data Repository Benchmarking Guide, Release 24.2.4

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Contents

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Acronyms

The following table provides information about the acronyms and the terminology used in the document.

Table Acronyms and Terminologies

Acronym	Description
AMF	Access and Mobility Management Function
AUSF	Authentication Server Function
CNE	Oracle Communications Cloud Native Core, Cloud Native Environment
CPU	Central Processing Unit
EIC	Equipment Identity Check
EIR	Equipment Identity Repository
GPSI	Generic Public Subscription Identifier
HTTP	Hypertext Transfer Protocol
MPS	Messages Per Second
NF	Network Function
NRF	Oracle Communications Cloud Native Core, Network Repository Function
PVC	Persistent Volume Claim
RAM	Random Access Memory
SLF	Subscriber Location Function
SOAP	Simple Object Access Protocol
SUPI	Subscription Permanent Identifier
TPS	Transactions Per Second
UDM	Unified Data Management
UDR	Oracle Communications Cloud Native Core, Unified Data Repository
vCNE	Virtual Cloud Native Environment

What's New in This Guide

This section introduces the documentation updates for Release 24.2.x.

Release 24.2.4 - G11189-02, April 2025

- Updated the values in SLF Call Model: 24.2K TPS for Performance-Medium Resource Profile for SLF Lookup section.

Release 24.2.0 - G11189-01, July 2024

- Added Policy Data: 17.2K N36, 300 TPS Notifications and 500 TPS Provisioning section.
- Updated the values in SLF Call Model: 24.2K TPS for Performance-Medium Resource Profile for SLF Lookup section.
- Deleted the following redundant sections from the document:
  - 36K TPS for Performance-Medium Resource Profile for SLF Lookup
  - Policy Data: 10K TPS Signaling Traffic
  - Policy Data Large Profile 10K Mix Traffic with 3K Notifications

1

Introduction

Oracle Communications Cloud Native Core Unified Data Repository (UDR) is a key component of the 5G Service Based Architecture. It is implemented as a cloud native function and offers a unified database for storing application, subscription, authentication, service authorization, policy data, session binding, and application state information. For more information about UDR architecture, see *Oracle Communications Cloud Native Core, Unified Data Repository User Guide*.

1.1 Purpose and Scope

This document is designed to measure the performance and capacity of UDR, UDR microservices, SLF, EIR, and deployment environment setup software such as Cloud Native Environment (CNE) and cnDBTier.

It is recommended that UDR is run through a benchmark on the target cloud native infrastructure to determine the capacity and performance in the target infrastructure. This information can be used to adjust the initial deployment resources and to predict resource requirements when UDR is scaled up.

1.2 References

- *Oracle Communications Cloud Native Core, Unified Data Repository Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, Unified Data Repository User Guide*
- *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*

2
Deployment Environment

This section provides information about the cloud native infrastructure used for UDR, SLF, and EIR benchmarking.

2.1 Deployed Components

Deployment Platform

Oracle Communications Cloud Native Environment (OCCNE) and BareMetal is used for performing benchmark tests.

Observability Services

The following table lists services that are used for UDR benchmark tests. These services fetch UDR metrics, alerts, logs, and traces. For more information about mentioned software, see *Oracle Communications Cloud Native Core, Unified Data Repository Installation, Upgrade, and Fault Recovery Guide*

Table 2-1 Observability Services

Service
Opensearch
Fluentd
Kibana
Prometheus
Grafana
Jaeger

Cloud Native Orchestrator

Kubernetes is used for managing application pods across the cluster.

cnDBTier

cnDBTier is used for performing benchmark tests.

For more information about above mentioned components, see *Oracle Communications Cloud Native Core, Unified Data Repository Installation, Upgrade, and Fault Recovery Guide*.

2.2 Deployment Resources

The performance and capacity of UDR can vary based on the chosen environment and how UDR is deployed. This section provides information about CNE resources used to perform benchmark tests.

2.2.1 Resource Requirements for CNE Observability Services

The following table provides information about number of pods required by each CNE service.

Table 2-2 Resource Requirements for CNE Observability Services

Service Name	Number of Pods
Prometheus Server	1
Prometheus-pushgateway	1
Alert Manager	2
Fluentd	1 per Worker node
Prom-node-exporter	1 per Worker node
MetalLB speaker	1 per Worker node
Opensearch Data/Master	3/3
Opensearch Client	1
Grafana	1
Kibana	1
kube-state-metrics	1
jaeger-agent	1 per Worker node
jaeger-collector	1
jaeger-query	1
rook-ceph-osd	1 for each raw disk available to OS on all Worker nodes
rook-ceph-mgr	1
rook-ceph-mon	3
rook-ceph-osd	1

3
UDR Benchmark Testing

This chapter describes UDR, SLF, and EIR test scenarios.

3.1 Test Scenario 1: SLF Call Deployment Model

This section provides information about SLF call deployment model test scenarios.

3.1.1 SLF Call Model: 24.2K TPS for Performance-Medium Resource Profile for SLF Lookup

This test scenario describes performance and capacity of SLF functionality offered by UDR and provides the benchmarking results for various deployment sizes.

You can perform benchmark tests on UDR/SLF for compute and storage resources by considering the following conditions:

- Signaling (SLF Look Up): 24.2K TPS
- Provisioning: 1260 TPS
- Total Subscribers: 17M
- Profile Size: 450 bytes

The following table describes the benchmarking parameters and their values:

Table 3-1 Traffic Model Details

Request Type	Details	TPS
Lookup 24.2k	SLF Lookup GET Requests	24.2K
Provisioning (1.26K using Provgw one site)	CREATE	126K
	DELETE	126K
	UPDATE	504K
	GET	504K

> **Note**
>
> - To run this model, one UDR site is brought down and 24.2K look up traffic and 1.26K provisioning traffic are run from one site.
> - The values provided is for single site deployment

The following table describes the testcase parameters and their values:

Table 3-2 Testcase Parameters

Input Parameter Details	Configuration Values
UDR Version Tag	24.2.4
Target TPS	24.2K Lookup + 1.26K Provisioning
Traffic Profile	SLF 24.2K Profile
Notification Rate	OFF
UDR Response Timeout	5s
Client Timeout	30s
Signaling Requests Latency Recorded on Client	10ms
Provisioning Requests Latency Recorded on Client	30ms

The following table describes consolidated resource requirement and their utilization:

Table 3-3 Consolidated Resource Requirement

Resource	CPU	Memory	Ephemeral Storage	PVC
cnDBTier	90	283 GB	16 GB	438
SLF	187	119 GB	32 GB	NA
ProvGw	32	30 GB	10 GB	NA
Buffer	50	50 GB	20 GB	200
Total	359	482 GB	78 GB	638

Note

All values are inclusive of ASM sidecar.

The following table describes cnDBTier1 resources and their utilization:

Note

- The same resources and usage are application for cnDBTier2
- For cnDBTier, you must use ocudr_slf_37msub_dbtier and ocudr_udr_10msub_dbtier custom value files for SLF and UDR respectively. For more information, see *Cloud Native Core, Unified Data Repository Installation, Upgrade, and Fault Recovery Guide*.

Table 3-4 cnDBTier Resources and Usage

Microservice Name	Container Name	Number of Pods	CPU Allocation Per Pod (cnDBtier1)	Memory Allocation Per Pod (cnDBtier1)	Ephemeral Storage Per Pod	PVC Allocation Per Pod	Total Resources (cnDBtier)	CPU Usage (cnDBtier)	Memory Usage	PVC Usage
Management node (ndbmgmd)	mysqlndbcluster	2	2 CPUs	11.25 GB	1 GB	16 GB	6 CPUs 31 GB **Ephemeral Storage:** 2 GB **PVC Allocation:** 32 GB	Minimal resources are used		40 MB/pod
	istio-proxy		1 CPUs	4 GB						
Data node (ndbmtd)	mysqlndbcluster	4	4 CPUs	33 GB	1 GB	25 GB (Backup: 56 GB)	28 CPUs 156 GB **Ephemeral Storage:** 4 GB **PVC Allocation:** 324 GB	3 CPU/pod	20 GB/pod	9 GB/pod (Backup: 103 MB/pod)
	istio-proxy		2 CPUs	4 GB						
	db-backup-executor-svc		100m CPU	256 mi						
APP SQL node (ndbappmysqld)	mysqlndbcluster	5	4 CPUs	4 GB	1 GB	10 GB	35 CPUs 40 GB **Ephemeral Storage:** 5 GB **PVC Allocation:** 50 GB	4 CPU/pod	1 GB/pod	205 MB/pod
	istio-proxy		3 CPUs	4 GB						
SQL node (Used for Replication) (ndbmysqld)	mysqlndbcluster	2	4 CPUs	16 GB	1 GB	16 GB	13 CPUs 41GB **Ephemeral Storage:** 2 GB **PVC Allocation:** 32 GB	Minimal resources are used		2.2 GB/pod
	istio-proxy		2 CPUs	4 GB						
	init-sidecar		100m CPU	256 MB						
DB Monitor Service (db-monitor-svc)	db-monitor-svc	1	4 CPUs	4 GB	1 GB	NA	5 CPUs 5 GB **Ephemeral Storage:** 1 GB	Minimal resources are used		Minimal resources are used
	istio-proxy		1 CPUs	1 GB						

Table 3-4 (Cont.) cnDBTier Resources and Usage

Microservice Name	Container Name	Number of Pods	CPU Allocation Per Pod (cnDBtier1)	Memory Allocation Per Pod (cnDBtier1)	Ephemeral Storage Per Pod	PVC Allocation Per Pod	Total Resources (cnDBtier)	CPU Usage (cnDBtier)	Memory Usage	PVC Usage
DB Backup Manager Service (backup-manager-svc)	backup-manager-svc	1	100m CPU	128 MB	1 GB	NA	2 CPUs 2 GB **Ephemeral Storage:** 1 GB	Minimal resources are used		Minimal resources are used
	istio-proxy		1 CPUs	1 GB						
Replication Service (db-replication-svc)	db-replication-svc	1	2 CPU	12 GB	1 GB	NA	3 CPUs 13 GB **Ephemeral Storage:** 1 GB	Minimal resources are used		Minimal resources are used
	istio-proxy		200m CPU	500MB						

The following table describes SLF resources and their utilization for Site1 (Lookup Latency: 10ms):

Table 3-5 SLF Resources and Usage

Microservice name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage	CPU Utilization hpa
Ingress-gateway-sig	ingressgateway-sig	8	6 CPUs	4 GB	80 CPUs 40 GB Memory **Ephemeral Storage:** 8 GB	3 CPU/pod	2 GB/pod	49%
	istio-proxy		4 CPUs	1 GB		2.1 CPU/pod	350 MB/pod	
Ingress-gateway-prov	ingressgateway-prov	2	4 CPUs	4 GB	12 CPUs 10 GB **Ephemeral Storage:** 2 GB	0.9 CPU/pod	1.4 GB/pod	24%
	istio-proxy		2 CPUs	1 GB		0.65 CPU/pod	300 MB/pod	
Nudr-dr-service	nudr-drservice	6	6 CPUs	4 GB	54 CPUs 30 GB **Ephemeral Storage:** 6 GB	3.1 CPU/pod	1.7 GB/pod	55%
	istio-proxy		3 CPUs	1 GB		2 CPU/pod	325 MB/pod	

Table 3-5 (Cont.) SLF Resources and Usage

Microservice name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage	CPU Utilization hpa
Nudr-dr-provservice	nudr-dr-provservice	2	4 CPUs	4 GB	12 CPUs 10 GB **Ephemeral Storage:** 2 GB	.9 CPU/pod	1.5 GB/pod	22%
	istio-proxy		2 CPUs	1 GB		0.5 CPU/pod	300 MB/pod	
Nudr-nrf-client-nfmanagement	nrf-client-nfmanagement	2	1 CPU	1 GB	4 CPUs 4 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
	istio-proxy		1 CPUs	1 GB				
Nudr-egress-gateway	egressgateway	2	1 CPUs	1 GB	4 CPUs 4 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
	istio-proxy		1 CPUs	1 GB				
Nudr-config	nudr-config	2	2 CPUs	2 GB	6 CPUs 6 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
	istio-proxy		1 CPUs	1 GB				
Nudr-config-server	nudr-config-server	2	2 CPUs	2 GB	6 CPUs 6 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
	istio-proxy		1 CPUs	1 GB				
alternate-route	alternate-route	2	1 CPUs	1 GB	4 CPUs 4 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
	istio-proxy		1 CPUs	1 GB				
app-info	app-info	2	1 CPUs	1 GB	4 CPUs 4 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
	istio-proxy		1 CPUs	1 GB				
perf-info	perf-info	2	1 CPUs	1 GB	4 CPUs 4 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
	istio-proxy		1 CPUs	1 GB				

> **Note**
>
> The same resources and usage are used for Site2.

The following table describes provision gateway resources and their utilization (Provisioning Latency: 30ms):

Table 3-6 Provision Gateway Resources and their utilization

Microservice name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage	CPU Utilization hpa
provgw-ingress-gateway	ingressgateway	2	2 CPUs	2 GB	6 CPUs 6 GB Memory **Ephemeral Storage:** 2 GB	0.7 CPU/pod	1.6 GB/pod	45%
	istio-proxy		1 CPUs	1 GB		0.5 CPU/pod	300 MB/pod	
provgw-egress-gateway	egressgateway	2	3 CPUs	2 GB	6 CPUs 6 GB Memory **Ephemeral Storage:** 2 GB	0.8 CPU/pod	1 GB/pod	51%
	istio-proxy		1 CPUs	1 GB		0.6 CPU/pod	300 MB/pod	
provgw-service	provgw-service	2	3 CPUs	2 GB	8 CPUs 6 GB Memory **Ephemeral Storage:** 2 GB	1 CPU/pod	1.2 GB/pod	40%
	istio-proxy		1 CPUs	1 GB		0.6 CPU/pod	300 MB/pod	
provgw-config	provgw-config	2	2 CPUs	2 GB	6 CPUs 6 GB Memory **Ephemeral Storage:** 2 GB	Minimal resources are used. Utilization data is not captured.		
	istio-proxy		1 CPUs	1 GB				
provgw-config-server	provgw-config-server	2	2 CPUs	2 GB	6 CPUs 6 GB Memory **Ephemeral Storage:** 2 GB	Minimal resources are used. Utilization data is not captured.		
	istio-proxy		1 CPUs	1 GB				

The following table provides observation data for the performance test that can be used for the benchmark testing to scale up SLF performance:

Table 3-7 Result and Observation

Parameter	Values
Test Duration	8hr
TPS Achieved	24.2k SLF Lookup + 1.26k Provisioning
Success Rate	100%
Average UDR processing time (Request and Response)	20ms

3.2 Test Scenario 2: EIR Deployment Model

Performance Requirement - 300K subscriber DB size with 10K EIR lookup TPS

This test scenario describes performance and capacity improvements of EIR functionality offered by UDR and provides the benchmarking results for various deployment sizes.

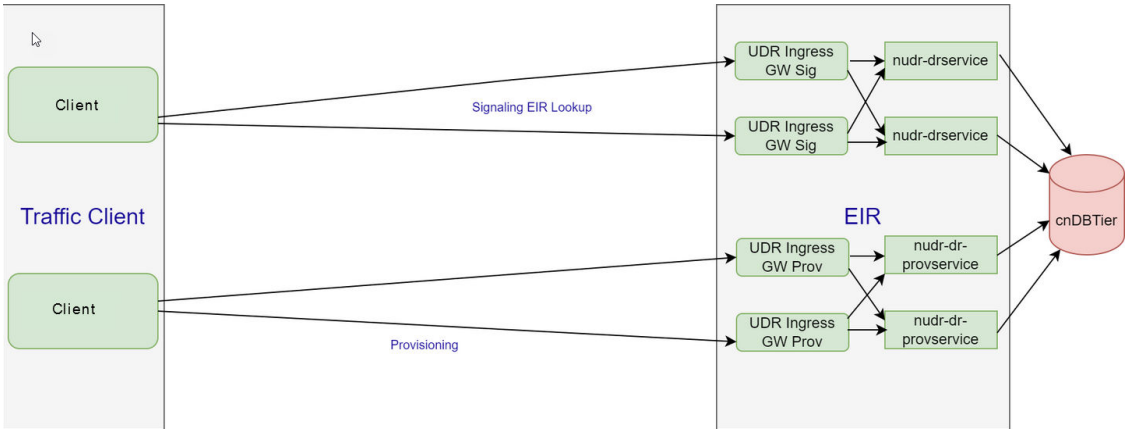
The following features are disabled for this testcase:

- TLS
- OAuth2.0
- Default Response set to EQUIPMENT_UNKNOWN
- Header Validations like XFCC, server header, and user agent header

EIR is benchmarked for compute and storage resources under following conditions:

- Signaling (EIR Look Up): 10K TPS
- Total Subscribers: 300K
- Profile Size: 130 bytes
- Average HTTP Provisioning Request Packet Size: NA
- Average HTTP Provisioning Response Packet Size: NA

Figure 3-1 EIR Deployment Model



The following table describes the benchmarking parameters and their values:

Table 3-8 Traffic Model Details

Request Type	Details	TPS
Lookup 10k	EIR EIC	10k

The following table describes the testcase parameters and their values:

Table 3-9 Testcase Parameters

Input Parameter Details	Configuration Values
UDR Version Tag	22.3.0
Target TPS	10k Lookup
Traffic Profile	10k EIR EIC
Notification Rate	OFF
EIR Response Timeout	5s
Client Timeout	10s
Signaling Requests Latency Recorded on Client	NA
Provisioning Requests Latency Recorded on Client	NA

The following table describes the consolidated resource requirements and their utilization:

Table 3-10 Consolidated Resource Requirement

Resource	CPUs	Memory
EIR	32	30 GB
cnDBTier	177	616 GB
Total	600	903 GB

The following table describes cnDBTier resources and their utilization:

Table 3-11 cnDBTier Resources and their Utilization

Micro service name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage
Management node	mysqlndbcluster	2	4 CPUs	4 GB	4 CPU 8 GB Memory	.013 CPU/pod	.031 GB/pod
Data node	mysqlndbcluster	4	16 CPUs	32 GB	64 CPU 128 GB Memory	1 CPU/pod	15.5 GB/pod
APP SQL node	mysqlndbcluster	3	16 CPUs	32 GB	48 CPU 96 GB Memory	4.1 CPU/pod	.8 GB/pod
SQL node (Used for Replication)	mysqlndbcluster	2	2 CPUs	4 GB	4 CPU 8 GB Memory	.02 CPU/pod	.6 GB/pod

Table 3-11 (Cont.) cnDBTier Resources and their Utilization

Micro service name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage
DB Monitor Service	db-monitor-svc	1	500m CPUs	500 MB	1 CPU 1 GB Memory	Minimal resources are used. Utilization is not captured	
DB Backup Manager Service	replication-svc	1	250m CPUs	320 MB	1 CPU 1 GB Memory	Minimal resources are used. Utilization is not captured	

The following table describes EIR resources and their utilization:

Table 3-12 EIR Resources and their Utilization (Lookup Latency: 16.9ms) without Aspen Service Mesh (ASM) Enabled

Micro service name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage
Ingress-gateway-sig	Ingress-gateway-sig	5	6 CPUs	4 GB	30 CPUs 20 GB Memory	3 CPU/pod	2 GB/pod
Ingress-gateway-prov	Ingress-gateway-prov	2	6 CPUs	4 GB	12 CPUs 8 GB Memory	.07 CPU/pod	.9 GB/pod
Nudr-dr-service	nudr-drservice	6	4 CPUs	4 GB	24 CPUs 24 GB Memory	3 CPU/pod	1.2 GB/pod
Nudr-dr-provservice	nudr-dr-provservice	2	4 CPUs	4 GB	8 CPUs 8 GB Memory	.02 CPU/pod	.5 GB/pod
Nudr-egress-gateway	egressgateway	1	2 CPUs	2 GB	2 CPUs 2 GB Memory	.04 CPU/pod	.4 GB/Pod
Nudr-config	nudr-config	2	2 CPUs	2 GB	4 CPUs 4 GB Memory	Minimal resources are used. Utilization is not captured	
Nudr-config-server	nudr-config-server	2	2 CPUs	2 GB	4 CPU 4 GB Memory	Minimal resources are used. Utilization is not captured	

Note

The following table provides observation data for the performance test that can be used for the benchmark testing to scale up EIR performance:

Table 3-13 Result and Observation

Parameter	Values
Test Duration	8hr
TPS Achieved	10k
Success Rate	100%
Average EIR processing time (Request and Response)	16.9ms

3.3 Test Scenario 3: SOAP and Diameter Deployment Model

2K SOAP provisioning TPS for ProvGw for Medium profile + Diameter 25K with Large profile

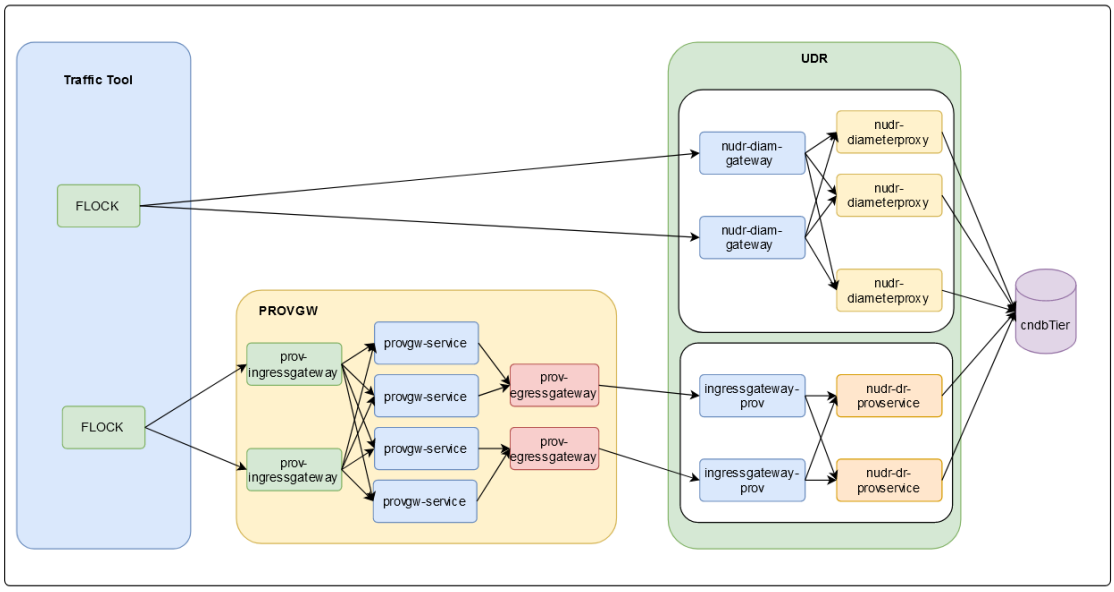
The following features are disabled for this testcase:

- TLS
- OAuth2.0
- Header Validations like XFCC, server header, and user agent header

UDR is benchmarked for compute and storage resources under following conditions:

- Signaling : 10K TPS
- Provisioning: 2K TPS
- Total Subscribers: 1M - 10M range used for Diameter Sh and 1M range used for SOAP/XML
- Profile Size: 2.2KB
- Average HTTP Provisioning Request Packet Size: NA
- Average HTTP Provisioning Response Packet Size: NA

Figure 3-2 SOAP and Diameter Deployment Model



The following table describes the benchmarking parameters and their values:

Table 3-14 Traffic Model Details

Request Type	Details	TPS
Diameter SH Traffic	SH Traffic	25K
Provisioning (2K using Provgw)	SOAP Traffic	2K

Table 3-15 SOAP Traffic Model

Request Type	SOAP Traffic %
GET	33%
DELETE	11%
POST	11%
PUT	45%

Table 3-16 Diameter Traffic Model

Request Type	Diameter Traffic %
SNR	25%
PUR	50%
UDR	25%

The following table describes the benchmarking parameters and their values:

Table 3-17 Testcase Parameters

Input Parameter Details	Configuration Values
UDR Version Tag	22.2.0
Target TPS	25K + 2K
Traffic Profile	25K sh + 2K SOAP
Notification Rate	OFF
UDR Response Timeout	5s
Client timeout	10s
Signaling Requests Latency Recorded on Client	NA
Provisioning Requests Latency Recorded on Client	NA

> **Note**
>
> PNR scenarios are not tested because server stub is not used.

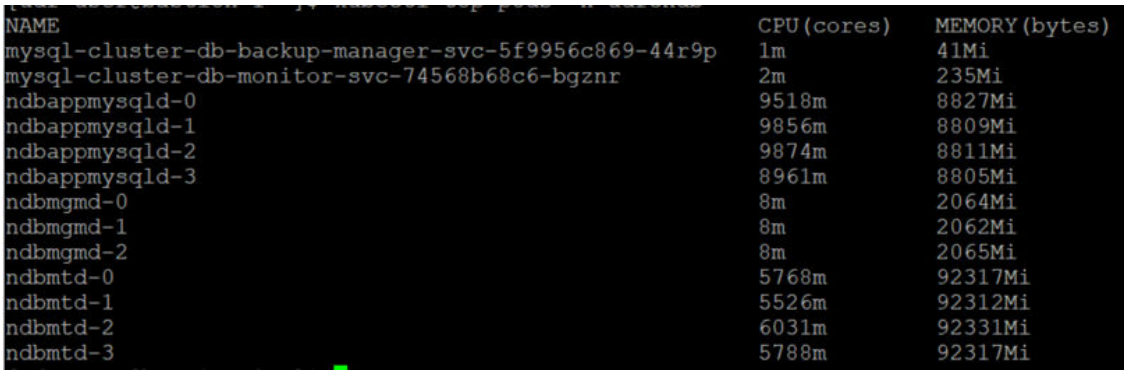
The following table describes cnDBTier resources and their utilization:

Table 3-18 cnDBTier Resources and their Utilization

Micro service name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage
Management node	mysqlndbcluster	3	4 CPUs	10 GB	12 CPUs 30 GB Memory	0.2 CPU/pod	.2 GB/pod
Data node	mysqlndbcluster	4	15 CPUs	98 GB	64 CPU 408 GB Memory	5.8 CPU/pod	92 GB/pod
	db-backup-executor-svc		100m CPU	128 MB		NA	NA
APP SQL node	mysqlndbcluster	4	16 CPUs	16 GB	64 CPUs 64 GB Memory	9.5 CPU/pod	8.8 GB/pod
SQL node (Used for Replication)	mysqlndbcluster	4	8 CPUs	16 GB	49 CPUs 81 GB Memory	Utilization data is not available for this service because of resource constraints, pods are not used.	
DB Monitor Service	db-monitor-svc	1	200m CPUs	500 MB	3 CPUs 2 GB Memory	Minimal resources are used. Utilization is not captured	
DB Backup Manager Service	replication-svc	1	200m CPU	500 MB	3 CPUs 2 GB Memory	Minimal resources are used. Utilization is not captured	

cnDBTier Usage

Results for Kubectl top pods on cndbtier is shown below:



```
NAME                                                CPU(cores)   MEMORY(bytes)
mysql-cluster-db-backup-manager-svc-5f9956c869-44r9p   1m           41Mi
mysql-cluster-db-monitor-svc-74568b68c6-bgznr          2m           235Mi
ndbappmysqld-0                                      9518m        8827Mi
ndbappmysqld-1                                      9856m        8809Mi
ndbappmysqld-2                                      9874m        8811Mi
ndbappmysqld-3                                      8961m        8805Mi
ndbmgmd-0                                           8m           2064Mi
ndbmgmd-1                                           8m           2062Mi
ndbmgmd-2                                           8m           2065Mi
ndbmtd-0                                            5768m        92317Mi
ndbmtd-1                                            5526m        92312Mi
ndbmtd-2                                            6031m        92331Mi
ndbmtd-3                                            5788m        92317Mi
```

Results for Kubectl get hpa on cndbtier is shown below:

```
NAME           REFERENCE                     TARGETS   MINPODS   MAXPODS   REPLICAS   AGE
ndbappmysqld   StatefulSet/ndbappmysqld      59%/80%   4         4         4          10d
ndbmgmd        StatefulSet/ndbmgmd           0%/80%    3         3         3          10d
ndbmtd         StatefulSet/ndbmtd            38%/80%   4         4         4          10d
```

cnDBTier Metrics:

- Data memory usage: 72GB (5.164GB used)
- DB Reads per second: 52k
- DB Writes per second: 24k

The following table describes UDR resources and their utilization:

Table 3-19 UDR Resources and their Utilization (Request Latency: 40ms)

Micro service name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage
nudr-diameterproxy	nudr-diameterproxy	19	2.5 CPUs	4 GB	47.5 CPUs 76 GB Memory	1.75 CPU/pod	1 GB/pod
nudr-diam-gateway	nudr-diam-gateway	3	6 CPUs	4 GB	18 CPUs 12 GB Memory	.2.5 CPU/pod	2 GB/pod
Ingress-gateway-sig	ingressgateway-sig	2	2 CPUs	2 GB	4 CPUs 4 GB Memory	Minimal resources are used. Utilization is not captured	
Ingress-gateway-prov	ingressgateway-prov	2	2 CPUs	2 GB	4 CPUs 4 GB Memory	1 CPU/pod	1 GB/pod
Nudr-dr-service	nudr-drservice	2	2 CPUs	2 GB	4 CPUs 4 GB Memory	Minimal resources are used. Utilization is not captured	
Nudr-dr-provservice	nudr-dr-provservice	2	2 CPUs	2 GB	4 CPUs 4 GB Memory	1.4 CPU/pod	1 GB/pod
Nudr-nrf-client-nfmanagement	nrf-client-nfmanagement	2	1 CPUs	1 GB	2 CPUs 2 GB Memory	Minimal resources are used. Utilization is not captured	
Nudr-egress-gateway	egressgateway	2	2 CPUs	2 GB	4 CPU 4 GB Memory	Minimal resources are used. Usage is not captured	
Nudr-config	nudr-config	2	1 CPUs	1 GB	2 CPU 2 GB Memory	Minimal resources are used. Utilization is not captured	
Nudr-config-server	nudr-config-server	2	1 CPUs	1 GB	2 CPU 2 GB Memory	Minimal resources are used. Utilization is not captured	
alternate-route	alternate-route	2	1 CPUs	1 GB	2 CPU 2 GB Memory	Minimal resources are used. Usage is not captured	
app-info	app-info	2	1 CPUs	1 GB	2 CPU 2 GB Memory	Minimal resources are used. Utilization is not captured	

Table 3-19 (Cont.) UDR Resources and their Utilization (Request Latency: 40ms)

Micro service name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage
perf-info	perf-info	2	1 CPUs	1 GB	2 CPU 2 GB Memory	Minimal resources are used. Usage is not captured	

Resource Utilization

Diameter resource utilization is shown below:

```
ocudr-nudr-diam-gateway-0                   2463m    1958Mi
ocudr-nudr-diam-gateway-1                   2474m    1747Mi
ocudr-nudr-diam-gateway-2                   2453m    1754Mi
ocudr-nudr-diameterproxy-b5c5f55b8-4vglt    1679m    984Mi
ocudr-nudr-diameterproxy-b5c5f55b8-5x94d    1688m    1095Mi
ocudr-nudr-diameterproxy-b5c5f55b8-8f7xg    1818m    1078Mi
ocudr-nudr-diameterproxy-b5c5f55b8-8kbgs    1789m    796Mi
ocudr-nudr-diameterproxy-b5c5f55b8-8wwhv    1845m    781Mi
ocudr-nudr-diameterproxy-b5c5f55b8-bwpzw    1719m    908Mi
ocudr-nudr-diameterproxy-b5c5f55b8-c8nk6    1690m    1054Mi
ocudr-nudr-diameterproxy-b5c5f55b8-cjlvg    1662m    983Mi
ocudr-nudr-diameterproxy-b5c5f55b8-dfkq4    1755m    983Mi
ocudr-nudr-diameterproxy-b5c5f55b8-fqjkw    1761m    979Mi
ocudr-nudr-diameterproxy-b5c5f55b8-gmpfn    1684m    865Mi
ocudr-nudr-diameterproxy-b5c5f55b8-hvmzk    1776m    907Mi
ocudr-nudr-diameterproxy-b5c5f55b8-q5qsp    1763m    863Mi
ocudr-nudr-diameterproxy-b5c5f55b8-qd5w2    1799m    996Mi
ocudr-nudr-diameterproxy-b5c5f55b8-qnkk5    1735m    945Mi
ocudr-nudr-diameterproxy-b5c5f55b8-rlm7k    1789m    811Mi
ocudr-nudr-diameterproxy-b5c5f55b8-tpqhf    1681m    964Mi
ocudr-nudr-diameterproxy-b5c5f55b8-vfq98    1839m    928Mi
ocudr-nudr-diameterproxy-b5c5f55b8-vtvcb    1795m    845Mi
```

UDR HPA resource utilization is shown below:

```
NAME                            REFERENCE                                   TARGETS   MINPODS   MAXPODS   REPLICAS   AGE
ocudr-config-server-hpa         Deployment/ocudr-nudr-config-server         2%/80%    1         2         1          20h
ocudr-egressgateway-v1          Deployment/ocudr-egressgateway              0%/65%    1         4         1          20h
ocudr-ingressgateway-prov-v1    Deployment/ocudr-ingressgateway-prov        43%/65%   2         8         2          20h
ocudr-ingressgateway-sig-v1     Deployment/ocudr-ingressgateway-sig         0%/65%    1         4         1          20h
ocudr-nudr-config               Deployment/ocudr-nudr-config                0%/80%    1         1         1          20h
ocudr-nudr-diameterproxy        Deployment/ocudr-nudr-diameterproxy         70%/80%   19        19        19         20h
ocudr-nudr-dr-provservice       Deployment/ocudr-nudr-dr-provservice        70%/80%   2         2         2          20h
ocudr-nudr-drservice            Deployment/ocudr-nudr-drservice             0%/80%    1         4         1          20h
ocudr-nudr-notify-service       Deployment/ocudr-nudr-notify-service        9%/80%    1         1         1          20h
provgw-config-server-hpa        Deployment/provgw-provgw-config-server      0%/80%    1         2         1          5h24m
provgw-prov-egressgateway-v1    Deployment/provgw-prov-egressgateway        45%/80%   2         4         2          5h24m
provgw-prov-ingressgateway-v1   Deployment/provgw-prov-ingressgateway       64%/80%   2         4         3          5h24m
provgw-provgw-config            Deployment/provgw-provgw-config             0%/80%    1         1         1          5h24m
provgw-provgw-service           Deployment/provgw-provgw-service            72%/80%   4         4         4          5h24m
```

The following table describes provision gateway resources and their utilization:

Table 3-20 Provision Gateway Resources aand their Utilization (Provisioning Request Latency: 40ms)

Micro service name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Total Resources	CPU Usage	Memory Usage
provgw-ingress-gatewa	ingressgateway	3	2 CPUs	2 GB	6 CPUs 6 GB Memory	1.3 CPU/pod	1 GB/pod
provgw-egress-gateway	egressgateway	2	2 CPUs	2 GB	4 CPUs 4 GB Memory	.0.9 CPU/pod	700 Mi/pod
provgw-service	provgw-service	4	2.5 CPUs	3 GB	10 CPUs 12 GB Memory	1.75 CPU/pod	1 GB/pod
provgw-config	provgw-config	2	1 CPUs	1 GB	2 CPUs 2 GB Memory	Minimal resources are used. Utilization is not captured	
provgw-config-server	provgw-config-server	2	1 CPUs	1 GB	2 CPUs 2 GB Memory	Minimal resources are used. Utilization is not captured	

Provisioning Gateway resource utilization is shown below:

```
ocudr-ingressgateway-prov-bc567cb6d-jsr7d     874m         666Mi
ocudr-ingressgateway-prov-bc567cb6d-v8lfp     862m         687Mi
ocudr-nudr-dr-provservice-7c855bb68-4bqns     1445m        815Mi
ocudr-nudr-dr-provservice-7c855bb68-gchlt     1348m        828Mi
provgw-prov-egressgateway-745c9d5d7d-bz7ct    921m         738Mi
provgw-prov-egressgateway-745c9d5d7d-xvj2k    904m         710Mi
provgw-prov-ingressgateway-7bd88db949-8qmps   1850m        1263Mi
provgw-prov-ingressgateway-7bd88db949-g7b25   4m           583Mi
provgw-prov-ingressgateway-7bd88db949-wdg4k   2003m        1281Mi
provgw-provgw-config-6fcc86cd78-jlfqr         4m           536Mi
provgw-provgw-config-server-9dff7cf4f-6qwkb   5m           374Mi
provgw-provgw-service-c54d94bcb-q84gl         159m         582Mi
provgw-provgw-service-c54d94bcb-s8kpz         2501m        742Mi
provgw-provgw-service-c54d94bcb-sqwwr         2427m        1191Mi
provgw-provgw-service-c54d94bcb-zttr9         2103m        1082Mi
```

Resources calculation for UDR, Provisioning Gateway, and cnDbTier are shown below:

Table 3-21 cnUDR and ProvGw Resources Calculation

Resources	cnUDR			ProvGw		
	Core services used for traffic runs (Nudr-diamgw, Nudr-diamproxy, Nudr-ingressgateway-prov and Nudr-dr-prov) at 70% usage	Other Microservices	Total	Core services used for traffic runs (ProvGw-ingressgateway, ProvGw-provgw service and ProvGw-egressgateway) at 70% usage	Other Microservice	Total
CPU	73.5	24	97.5	20	4	24
Memory in GB	96	24	120	22	4	26
Disk Volume (Ephemeral storage) in GB	26	16	42	9	4	13

Table 3-22 cnDbTier Resources Calculation

Resources	cnDbTier					
	SQL nodes (at actual usage)	SQL Nodes (Overhead/ Buffer resources at 20%)	Data nodes (at actual usage)	Data nodes (Overhead/ Buffer resources at 10%)	MGM nodes and other resources (Default resources)	Total
CPU	76	16	23.2	5	18	138.5
Memory in GB	70.4	14	368	36	34	522
Disk Volume (Ephemeral storage) in GB	8	NA	960 (ndbdisksize = 240*4)	NA	20	988

Table 3-23 Total Resources Calculation

Resources	Total
CPU	260
Memory in GB	668 GB
Disk Volume (Ephemeral storage) in GB	104 GB

The following table provides observation data for the performance test that can be used for the benchmark testing to scale up UDR performance:

Table 3-24 Result and Observation

Parameter	Values
Test Duration	18hr

Table 3-24 (Cont.) Result and Observation

Parameter	Values
TPS Achieved	10K
Success Rate	100%
Average UDR processing time (Request and Response)	40ms

3.4 Test Scenario 4: Policy Data Traffic Deployment Model

This section provides information about policy data traffic deployment model test scenarios.

3.4.1 Policy Data: 17.2K N36, 300 TPS Notifications and 500 TPS Provisioning

You can perform benchmark tests on UDR for compute and storage resources by considering the following conditions:

- Signaling : 17.2K
- Provisioning: 500 TPS
- Total Subscribers: 10M

The following table describes the benchmarking parameters and their values:

Table 3-25 Traffic Model Details

Request Type	Details	TPS
N36 traffic (100%) 17.2K TPS for sm-data and subs-to-notify POST/DELETE	subs-to-notify POST	3K (17.45%)
	sm-data GET	4.7K (27.3%)
	subs-to-notify DELETE	3K (17.45%)
	sm-data PATCH	6.5K (37.8%)
500 TPS PROVISIONING Policy Data PUT Operation	UPDATE	300 (60%)
	GET	100 (40%)
	CREATE	50 (10%)
	DELETE	50 (10%)
NOTIFICATIONS (triggered from 300 PUT provisioning traffic)	POST Operation (Egress)	300

The following table describes the test case parameters and their values:

Table 3-26 Testcase Parameters

Input Parameter Details	Configuration Values
UDR Version Tag	24.2.0
Target TPS	17.2K Signaling
Notification Rate	300
UDR Response Timeout	2700ms

Table 3-26 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
Signaling Requests Latency Recorded on Client	19ms
Provisioning Requests Latency Recorded on Client	24ms

Table 3-27 Consolidated Resource Requirement

Resource	CPU	Memory	Ephemeral Storage	PVC
cnDBTier	92 CPUs	485 GB	21 GB	1404 GB
UDR	215 CPUs	156 GB	48 GB	NA
Buffer	50 CPUs	50 GB	20 GB	200 GB
Total	357 CPUs	691 GB	89 GB	1604 GB

The following table describes cnDBTier resources and their utilization:

Table 3-28 cnDBTier Resources and their Utilization

Microservice name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Ephemeral Storage Per Pod	PVC Allocation Per Pod	Total Resources	CPU Usage	Memory Usage	PVC Usage
Management node (ndbmgmd)	mysqlndbcluster	2	2 CPUs	9 GB	1 GB	15 GB	4 CPUs 18 GB **Ephemeral Storage:** 2 GB **PVC Allocation:** 30 GB	Minimal resources are used.		70 MB/pod
Data node (ndbmtd)	mysqlndbcluster	4	4 CPUs	93 GB	1 GB	132 GB Backup: 164 GB	16 CPUs 372 GB **Ephemeral Storage:** 4 GB **PVC Allocation:** 1184 GB	2 CPU/pod	77.5 GB/pod	33 GB/pod

Table 3-28 (Cont.) cnDBTier Resources and their Utilization

Microservice name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Ephemeral Storage Per Pod	PVC Allocation Per Pod	Total Resources	CPU Usage	Memory Usage	PVC Usage
APP SQL node (ndbappmysqld)	mysqlndbcluster	10	6 CPUs	4 GB	1 GB	2 GB	60 CPUs 40 GB **Ephemeral Storage:** 10 GB **PVC Allocation:** 20 GB	4.8 CPU/pod	2 GB/pod	200 MB/pod
SQL node (ndbmysqld,used for replication)	mysqlndbcluster	2	4 CPUs	24 GB	1 GB	13 GB	8 CPUs 48 GB **Ephemeral Storage:** 2 GB **PVC Allocation:** 26 GB	Minimal resources are used.		2 GB/pod
DB Monitor Service	db-monitor-svc	1	4 CPUs	4 GB	1 GB	NA	4 CPU 4 MB **Ephemeral Storage:** 1 GB	Minimal resources are used.		Minimal resources used
DB Backup Manager Service	backup-manager-svc	1	100 millicores CPUs	128 MB	1 GB	NA	1 CPU 128 MB **Ephemeral Storage:** 1 GB	Minimal resources are used.		Minimal resources used
Replication service (Multi site cases)	replication-svc	1	2 CPUs	2 GB	1 GB	143 GB	2 CPUs 2 GB **Ephemeral Storage:** 1 GB **PVC Allocation:** 143 GB	Minimal resources used		NA

The following table describes UDR resources and their utilization:

Table 3-29 UDR Resources and their Utilization (Average Latency: 19ms for N36 and 24ms for Provisioning)

Micro service name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Ephemeral Storage Per Pod	Total Resources	CPU Usage	Memory Usage	CPU Utilization
Ingress-gateway-sig	ingressgateway-sig	9	6 CPUs	4 GB	1 GB	54 CPUs 36 GB **Ephemeral Storage:** 9 GB	2.4 CPU/pod	1.7 GB/pod	39%
Ingress-gateway-prov	ingressgateway-prov	2	4 CPUs	4 GB	1 GB	8 CPUs 8 GB **Ephemeral Storage:** 2 GB	0.5 CPUs/pod	1.1 GB/pod	11%
Nudr-dr-service	nudr-drservice	17	6 CPUs	4 GB	1 GB	102 CPUs 68 GB **Ephemeral Storage:** 17 GB	3 CPUs/pod	2 GB/pod	48%
Nudr-dr-provservice	nudr-dr-provservice	2	4 CPUs	4 GB	1 GB	8 CPUs 8 GB **Ephemeral Storage:** 2 GB	1.4 CPUs/pod	1.9 GB/pod	34%
Nudr-notify-service	nudr-notify-service	3	6 CPUs	5 GB	1 GB	18 CPUs 15 GB **Ephemeral Storage:** 3 GB	4.2 CPUs/pod	2.2 GB/pod	70%
Nudr-egress-gateway	egressgateway	2	6 CPUs	4 GB	1 GB	12 CPUs 8 GB **Ephemeral Storage:** 2 GB	0.75 CPUs/pod	1.2 GB/pod	10%
Nudr-config	nudr-config	2	1 CPU	1 GB	1 GB	2 CPUs 2 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		

Table 3-29 (Cont.) UDR Resources and their Utilization (Average Latency: 19ms for N36 and 24ms for Provisioning)

Micro service name	Container name	Number of Pods	CPU Allocation Per Pod	Memory Allocation Per Pod	Ephemeral Storage Per Pod	Total Resources	CPU Usage	Memory Usage	CPU Utilization
Nudr-config-server	nudr-config-server	2	1 CPU	1 GB	1 GB	2 CPUs 2 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
Alternate-route	alternate-route	2	1 CPU	1 GB	1 GB	2 CPUs 2 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
Nudr-nrf-client-nfmanagement-service	nrf-client-nfmanagement	2	1 CPU	1 GB	1 GB	2 CPUs 2 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
App-info	app-info	2	1 CPU	1 GB	1 GB	2 CPUs 2 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
Perf-info	perf-info	2	1 CPU	1 GB	1 GB	2 CPUs 2 GB **Ephemeral Storage:** 2 GB	Minimal resources are used.		
Nudr-dbcr-auditor-service	nudr-dbcr-auditor-service	1	1 CPU	1 GB	1 GB	1 CPU 1 GB **Ephemeral Storage:** 1 GB	Minimal resources are used.		

The following table provides observation data for the performance test that can be used for the benchmark testing to scale up UDR performance:

Table 3-30 Result and Observation

Parameter	Values
Test Duration	4h30m
TPS Achieved	17.2K Signaling

Table 3-30 (Cont.) Result and Observation

Parameter	Values
Success rate	100%