Oracle® Communications

Cloud Native Core, Converged Policy Benchmarking Guide

Release 25.2.201
G55714-01
April 2026

Oracle Communications Cloud Native Core, Converged Policy Benchmarking Guide, Release 25.2.201

G55714-01

Contents

1 Introduction

1.1 Purpose and Scope 1
1.2 References 1

2 Deployment Environment

2.1 Deployed Components 1

3 Benchmarking Policy Call Models

3.1 CnPCRF Call Models 1
3.1.1 Test Scenario: CnPCRF Data Call Model on Four-Site GeoRedundant setup, with 30K TPS per NFSet (with 7.5K TPS on each instance) 1
3.1.1.1 Test Case and Setup Details 2
3.1.1.2 Results 5
3.1.2 Test Scenario: CnPCRF Voice Call Model on Four-Site Georedundant Setup, with 30K TPS per NFSet (with 7.5K TPS on each instance) 6
3.1.2.1 Test Case and Setup Details 7
3.1.2.2 Results 10
3.1.3 Test Scenario: CnPCRF Data Call Model on Two-Site GeoRedundant setup, with 30K TPS per NFSet (with 15K TPS on each instance) 11
3.1.3.1 Test Case and Setup Details 11
3.1.3.2 Results 16
3.1.4 Test Scenario: CnPCRF Voice Call Model on Two-Site GeoRedundant setup, with 30K TPS per NFSet (with 15K TPS on each instance) 18
3.1.4.1 Test Case and Setup Details 18
3.1.4.2 Results 23
3.1.5 Test Scenario: CnPCRF Data Call Model with 60K TPS per NFSet (with 60K TPS on only one instance) 25
3.1.5.1 Test Case and Setup Details 25
3.1.5.2 Results 29
3.1.6 Test Scenario:CnPCRF Usage Monitoring Data Call Model on Two-Site GeoRedundant Setup, with 28K TPS per NFSet (with 28K TPS on only one instance) 31
3.1.6.1 Test Case and Setup Details 31

3.1.6.2 Results 37
3.1.7 Test Scenario: CnPCRF Voice and Data Call Model with 46.5K TPS per NFSet (with 46.5K TPS on only one instance) 41
3.1.7.1 Test Case and Setup Details 42
3.1.7.2 Results 53
3.2 PCF Call Models 56
3.2.1 Test Scenario: PCF AM/UE Call Model on Two-Site Georedundant Setup, with Single-Site Handling 60K TPS Traffic and ASM Enabled 57
3.2.1.1 Test Case and Setup Details 57
3.2.1.2 Results 60
3.2.2 Test Scenario: PCF AM/UE Call Model on Two-site Georedundant Setup, with 54K TPS per NFSet (with 54K TPS on only one instance) (with ASM) 62
3.2.2.1 Test Case and Setup Details 62
3.2.2.2 Results 68
3.2.3 Test Scenario: PCF SM Call Model on Two-Site GeoRedundant Setup with 55K TPS per NFSet (with 55K TPS on only one instance) (with ASM) 70
3.2.3.1 Test Case and Setup Details 70
3.2.3.2 Results 78

My Oracle Support

My Oracle Support (https://support.oracle.com) is your initial point of contact for all product support and training needs. A representative at Customer Access Support can assist you with My Oracle Support registration.

Call the Customer Access Support main number at 1-800-223-1711 (toll-free in the US), or call the Oracle Support hotline for your local country from the list at http://www.oracle.com/us/support/contact/index.html. When calling, make the selections in the sequence shown in the following list on the Support telephone menu:

- For Technical issues such as creating a new Service Request (SR), select **1**.
- For Non-technical issues such as registration or assistance with My Oracle Support, select **2**.
- For Hardware, Networking and Solaris Operating System Support, select **3**.

You are connected to a live agent who can assist you with My Oracle Support registration and opening a support ticket.

My Oracle Support is available 24 hours a day, 7 days a week, 365 days a year.

Acronyms

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

Table Acronyms and Terminologies

Acronym	Description
ASM	Aspen Service Mesh
AMF	Access and Mobility Management Function
AAR	Authorization Authentication Request
BSF	Oracle Communications Cloud Native Core, Binding Support Function
CPS	Call Per Second
CHF	Charging Function
CNE	Oracle Communications Cloud Native Core, Cloud Native Environment
CnPCRF	Cloud Native Policy and Charging Rules Function
CPU	Central Processing Unit
DNN	Data Network Name
HTTP	Hypertext Transfer Protocol
LDAP	Lightweight Directory Access Protocol
MPS	Messages Per Second
NF	Network Function
NFSet	Network Function Set consisting of multiple NF instances
NRF	Oracle Communications Cloud Native Core, Network Repository Function
OCS	Online Charging System
PER	Policy Event Record
PCF	Oracle Communications Cloud Native Core, Policy Control Function
PCRF	Policy and Charging Rules Function
PV	Persistent Volume
RAM	Random Access Memory
RAR	Re-Authorization Request
SAL	Subscriber Activity Log
SSV	Subscriber State Variable
STR	Session Termination Request
SM	Session Management
Sy	Diameter Sy reference point
TPS	Transactions Per Second
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 25.2.2xx in *Oracle Communications Cloud Native Core, Converged Policy Benchmarking Guide*.

Release 25.2.201 - G55714-01, April 2026

Removed the following old test scenarios:

- Test Scenario: PCRF Data Call Model on Two-Site GeoRedundant setup, with each site handling 11.5K TPS and ASM disabled
- Test Scenario: PCF Call Model on Two-Site GeoRedundant setup, with 15K TPS each for AM/UE and ASM enabled
- Test Scenario: PCF AM/UE Call Model on Two-Site GeoRedundant setup, with each site handling 25K TPS traffic and ASM enabled
- Test Scenario: PCF SM Call Model on Two-Site GeoRedundant setup, with each site handling 43K TPS traffic and ASM Enabled
- Test Scenario: PCF SM Call Model on Two-Site GeoRedundant setup, with each site handling 30K TPS traffic and ASM Enabled
- Test Scenario: PCF AM/UE Call Model on Two-Site Georedundant Setup, with Each Site Handling 30K TPS Traffic and ASM Enabled
- Test Scenario: PCF AM/UE Call Model on Two-Site Georedundant Setup, with Single-Site Handling 60K TPS Traffic and ASM Enabled
- Test Scenario: PCF AM/UE Call Model on Two-Site Georedundant Setup, with Single-Site Handling 75K TPS Traffic and ASM Enabled
- Test Scenario: PCF SM Call Model on Two-Site GeoRedundant setup, with Single-Site Handling 43K TPS traffic and ASM Enabled
- 54K TPS from 1 Site-1 Without Profile
- 41K TPS on Site-1 with NRF Caching and UDR group-id-list Based Discovery Enabled
- Test Scenario: PCF SM Call Model on Two-site Georedundant Setup, with 57K TPS on One Site
- Test Scenario: PCF Call Model on Single-Site Setup, Handling 30K TPS Traffic with Binding Feature Disabled

Updated the following and test scenarios:

- Updated "Test Scenario: 10K TPS Diameter Ingress Gateway and 17K TPS Egress Gateway TPS Traffic with Usage Monitoring Enabled" with Test Scenario:CnPCRF Usage Monitoring Data Call Model on Two-Site GeoRedundant Setup, with 28K TPS per NFSet (with 28K TPS on only one instance)
- Test Scenario: PCF SM Call Model on Two-Site GeoRedundant Setup with 55K TPS per NFSet (with 55K TPS on only one instance) (with ASM)
- **Test Scenario: PCF AM/UE Call Model on Two-site Georedundant Setup, with 54K TPS per NFSet (with 54K TPS on only one instance) (with ASM)**
- Test Scenario: CnPCRF Data Call Model on Two-Site GeoRedundant setup, with 30K TPS per NFSet (with 15K TPS on each instance)

- **Test Scenario: CnPCRF Voice Call Model on Two-Site GeoRedundant setup, with 30K TPS per NFSet (with 15K TPS on each instance)**

1 Introduction

Oracle Communications Cloud Native Core, Converged Policy (Policy) is a key component of the 5G Service Based Architecture (SBA). It is a cloud native solution consisting of both, a 4G Policy and Charging Rules Function (PCRF) and a 5G Policy Control Function (PCF) as a unified framework. It provides a flexible, secure, and scalable policy designing solution.

Policy interacts with other Network Functions (NF) through Network Repository Function (NRF) to provide a unified communication platform for the NFs to interact with each other. It helps operators to design, test, and deploy different network policies supporting 5G deployments. Policy solution supports deployments into cloud native environment, including containers on bare metal managed by Kubernetes or VMs managed by OpenStack.

> **Note**
>
> The performance and capacity of the Policy system may vary based on the Call model, Feature/Interface configurations, underlying CNE and hardware environment, including but not limited to the complexity of deployed policies, policy table size, object expression, and custom json usage in policy design.

For more information about Policy architecture, see *Oracle Communications Cloud Native Core, Converged Policy User Guide*.

1.1 Purpose and Scope

This document is designed to help operators in measuring the performance and capacity of Policy, Policy microservices, and deployment environment setup software such as Cloud Native Environment (CNE) and cnDBTier.

It is recommended that Policy 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 for Policy. These recommendations are just guidelines, since the actual performance of the Policy can vary significantly based on the details of the infrastructure.

1.2 References

- *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, Converged Policy 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 platform infrastructure details for deploying Oracle Communications Cloud Native Core, Converged Policy.

> **Note**
>
> The performance and capacity of the Policy system may vary based on the Call model, Feature/Interface configurations, underlying CNE and hardware environment, including but not limited to the complexity of deployed policies, policy table size, object expression, and custom json usage in policy design.

2.1 Deployed Components

This section provides details about the deployed components.

Deployment Platform

Oracle Communications Cloud Native Core, Cloud Native Environment (CNE) and BareMetal are used for performing benchmark tests.

Policy Infrastructure Details

Infrastructure details specific to each test scenario is documented within the test scenario.

Software Details

The Software details specific to each test scenario is documented within the test scenario.

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

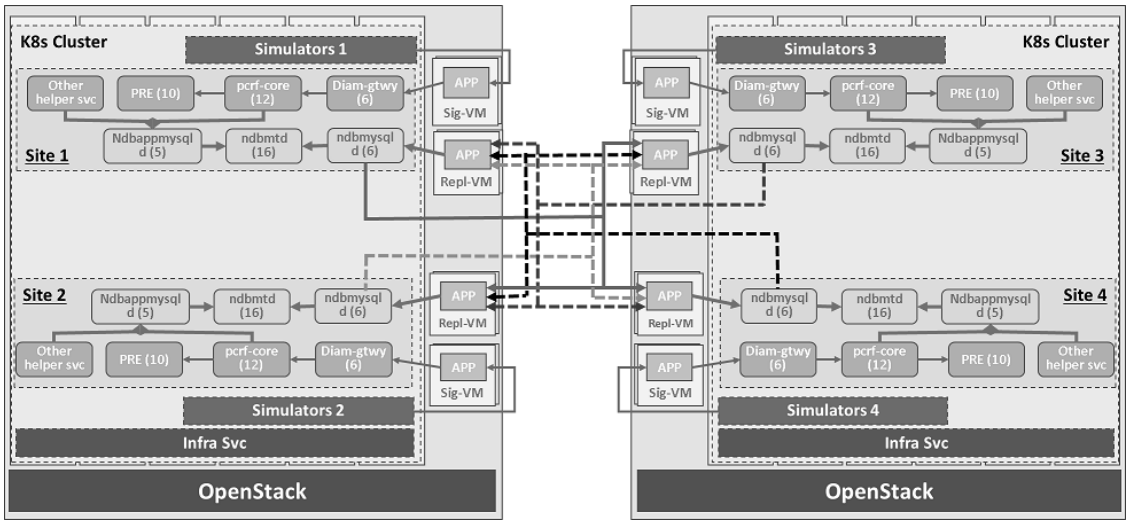
3
Benchmarking Policy Call Models

This section describes different Policy call models and the performance test scenarios which were run using these call model.

3.1 CnPCRF Call Models

The following diagram describes the architecture for a multisite CnPCRF deployment.

Figure 3-1 CnPCRF 4 Site GR Deployment Architecture



To test this CnPCRF call model, the Policy application is deployed in converged mode on a four-site georedundant setup. The cnDBTier database and CnPCRF application are replicated on all the four-site. The database replication is used to perform data synchronization between databases over the replication channels.

> **Note**
>
> This diagram is only for representation purpose.

3.1.1 Test Scenario: CnPCRF Data Call Model on Four-Site GeoRedundant setup, with 30K TPS per NFSet (with 7.5K TPS on each instance)

This test run benchmarks the performance and capacity of CnPCRF data call model that is deployed in converged mode on a four-site georedundant setup. Each site in the setup handles an incoming traffic of 7.5K TPS.

3.1.1.1 Test Case and Setup Details

Test Case Parameters

Table 3-1 Test Case Parameters

Parameters	Values
Call Rate	30K TPS (7.5K TPS on each site)
Execution Time	12 Hours
ASM	Disable

Table 3-2 Call Model Data

Messages	Total CPS Instance-1	sy Traffic	Ldap Traffic	Total TPS
CCR-I	320	320	320	960
CCR-U	320	0	0	320
CCR-T	320	320	0	640
Total Messages	960	640	320	1920

Table 3-3 CnPCRF Configurations

Service Name	Status
Binding Service	Disable
Policy Event Record (PER)	Disable
Subscriber Activity Log (SAL)	Enable
LDAP	Enable
Online Charging System (OCS)	Enable

Table 3-4 PCF Interfaces

Feature Name	Status
N36 UDR query (N7/N15-Nudr)	Disable
N36 UDR subscription (N7/N15-Nudr)	Disable
UDR on-demand nrf discovery	Disable
CHF (SM-Nchf)	Disable
BSF (N7-Nbsf)	Disable
AMF on demand nrf discovery	Disable
LDAP (Gx-LDAP)	Enable
Sy (PCF N7-Sy)	Enable

Table 3-5 PCRF Interfaces

Feature Name	Status
Sy (PCRF Gx-Sy)	Enable
Sd (Gx-Sd)	Disable

Table 3-5 (Cont.) PCRF Interfaces

Feature Name	Status
Gx UDR query (Gx-Nudr)	Disable
Gx UDR subscription (Gx-Nudr	Disable
CHF enabled (AM)	Disable
Usage Monitoring (Gx)	Disable
Subscriber HTTP Notifier (Gx)	Disable

Table 3-6 Configuring cnDBTier Helm Parameters

Helm Parameter	New Value
ndb_batch_size	2G
TimeBetweenEpochs	100
NoOfFragmentLogFiles	50
FragmentLogFileSize	256M
RedoBuffer	1024M
ndbappmysqld Pods Memory	19/20 Gi
ndbmtd pods CPU	8/8
ndb_report_thresh_binlog_epoch_slip	50
ndb_eventbuffer_max_alloc	19G
ndb_log_update_minimal	1
ndbmysqld Pods Memory	25/25 Gi
replicationskiperrors	enable: true
replica_skip_errors	'1007,1008,1050,1051,1022'
numOfEmptyApiSlots	4

Infrastructure Details

Table 3-7 Software Details

Applications	Versions
Policy	24.1.0
cnDBTier	24.1.0
ASM	Disabled
CNE	23.3.3
CNC Console	24.1.0

Table 3-8 Observability Services

Service Names	Versions
OpenSearch	2.3.0
Fluentd	1.16.2
Prometheus	2.51.1
Grafana	9.5.3
Jaeger	1.52.0

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

Table 3-9 Hardware Details

Hardware	Details
Environment	Hypervisor
Server	ORACLE SERVER X8-2
Model	Intel(R) Xeon(R) Platinum 8260 CPU
Clock Speed	2.400 GHz
Total Cores	96
Memory Size	576 GB
Type	DDR4 SDRAM
Installed DIMMs	18
Maximum DIMMs	24
Installed Memory	576 GB

Resource Allocation

The following table describes the resource capacity allocated to the Policy microservices:

Table 3-10 Resource Allocation for Policy Microservices

Service Name	CPU Request Per Pod	CPU Limit Per Pod	Memory Request Per Pod (Gi)	Memory Limit Per Pod (Gi)	Replica Min Replica = Max Replica
ocpcf-appinfo	1	1	0.5	1	1
ocpcf-oc-binding	5	6	1	8	15
ocpcf-oc-diam-connector	3	4	1	2	8
ocpcf-oc-diam-gateway	3	4	1	2	7
ocpcf-occnp-config-server	2	4	0.5	2	1
ocpcf-occnp-egress-gateway	3	4	4	6	2
ocpcf-ocpm-ldap-gateway	3	4	1	2	10
ocpcf-occnp-ingress-gateway	3	4	4	6	2
ocpcf-occnp-nrf-client-nfdiscovery	3	4	0.5	2	2
ocpcf-occnp-nrf-client-nfmanagement	1	1	1	1	2
ocpcf-ocpm-audit-service	1	2	1	1	1
ocpcf-ocpm-cm-service	2	4	0.5	2	1

Table 3-10 (Cont.) Resource Allocation for Policy Microservices

Service Name	CPU Request Per Pod	CPU Limit Per Pod	Memory Request Per Pod (Gi)	Memory Limit Per Pod (Gi)	Replica Min Replica = Max Replica
ocpcf-ocpm-policyds	5	6	1	4	25
ocpcf-ocpm-pre	5	5	0.5	4	25
ocpcf-ocpm-queryservice	1	2	1	1	1
ocpcf-pcf-smservice	7	8	1	4	2
ocpcf-pcrf-core	7	8	8	8	30
ocpcf-performance	1	1	0.5	1	2

Table 3-11 Resource Allocation for cnDBTier Services

Service Name	CPU Request Per Pod	CPU Limit Per Pod	Memory Request Per Pod (Gi)	Memory Limit Per Pod (Gi)	Replica Min Replica = Max Replica
ndbappmysqld	8	8	19	20	5
ndbmgmd	2	2	9	11	2
ndbmtd	8	8	73	83	8
ndbmysqld	4	4	19	20	12

3.1.1.2 Results

CPU and Memory Utilization

This section lists the CPU utilization by Policy and cnDBTier microservices. The CPU utilization is the ratio between the (total CPU utilization against total CPU request (X)) versus (target CPU Utilization (Y) configured for the Pod).

Table 3-12 CPU/Memory Utilization by Policy Microservices

Service	CPU (X/Y) - Site 1	CPU (X/Y)- Site 2	CPU(X/Y) - Site 3	CPU(X/Y) - Site 4
ocpcf-alternate-route	0%/80%	0%/80%	0%/80%	0%/80%
ocpcf-appinfo	1%/80%	2%/80%	2%/80%	3%/80%
ocpcf-occnp-config-server	10%/80%	11%/80%	12%/80%	12%/80%
ocpcf-oc-diam-connector	10%/40%	11%/40%	10%/40%	10%/40%
ocpcf-occnp-egress-gateway	0%/80%	0%/80%	0%/80%	0%/80%
ocpcf-occnp-ingress-gateway	0%/80%	0%/80%	0%/80%	0%/80%
ocpcf-ocpm-ldap-gateway	4%/60%	4%/60%	5%/60%	4%/60%

Table 3-12 (Cont.) CPU/Memory Utilization by Policy Microservices

Service	CPU (X/Y) - Site 1	CPU (X/Y)- Site 2	CPU(X/Y) - Site 3	CPU(X/Y) - Site 4
ocpcf-occnp-nrf-client-nfdiscovery	0%/80%	0%/80%	0%/80%	0%/80%
ocpcf-occnp-nrf-client-nfmanagement	0%/80%	0%/80%	0%/80%	0%/80%
ocpcf-oc-binding	0%/60%	0%/60%	0%/60%	0%/60%
ocpcf-occnp-chf-connector	0%/50%	0%/50%	0%/50%	0%/50%
ocpcf-occnp-udr-connector	0%/50%	0%/50%	0%/50%	0%/50%
ocpcf-ocpm-audit-service	0%/60%	0%/60%	0%/60%	0%/60%
ocpcf-ocpm-policyds	11%/60%	11%/60%	11%/60%	11%/60%
ocpcf-ocpm-soapconnector	0%/60%	0%/60%	0%/60%	0%/60%
ocpcf-ocpm-pre	13%/80%	13%/80%	13%/80%	13%/80%
ocpcf-pcf-smservice	0%/50%	0%/50%	0%/50%	0%/50%
ocpcf-pcrf-core	7%/40%	7%/40%	7%/40%	7%/40%
ocpcf-ocpm-queryservice	0%/80%	0%/80%	0%/80%	0%/80%

Table 3-13 CPU and Memory Utilization by cnDBTier Services

Name	CPU (X/Y) - Site 1	CPU (X/Y) - Site 2	CPU (X/Y) - Site 3	CPU (X/Y) - Site 4
ndbappmysqld	35%/80%	36%/80%	35%/80%	35%/80%
ndbmgmd	1%/80%	1%/80%	0%/80%	0%/80%
ndbmtd	15%/80%	15%/80%	18%/80%	17%/80%
ndbmysqld	5%/80%	5%/80%	5%/80%	5%/80%

Latency

Table 3-14 Average CnPCRF Core JDBC Latency Observations (in ms)

Site 1	Site 2	Site 3	Site 4
2.30 ms	2.20	2.66	2.85

3.1.2 Test Scenario: CnPCRF Voice Call Model on Four-Site Georedundant Setup, with 30K TPS per NFSet (with 7.5K TPS on each instance)

This test run benchmarks the performance and capacity of CnPCRF voice call model that is deployed in converged mode on a four-site georedundant setup. Each of the sites handles a

traffic of 7.5K TPS at Diameter Gateway. For this setup, Policy Event Record (PER) and Binding feature were enabled. This setup has single-channel replication.

3.1.2.1 Test Case and Setup Details

Test Case Parameters

Table 3-15 Test Case Parameters

Parameters	Values
Call Rate (Diameter Gateway)	**30**K TPS (7.5KTPS on four site)
ASM	Disable
Traffic Ratio	CCRI-I, AARI –1, CCRU-2, AARU - 1, RAR-Gx-1, RAR-Rx-1, STR –1, CCRT-1.
Active Subscribers	10000000

Project Details

The Policy Design editor based on the Blockly interface was used to set the Policy project for each of the Policy services. The complexity level of Policy Project configured for this run was **High.**

Complexity Level Definition:

- Low – No usage of loops in Blockly logic, no JSON operations, and no complex Java Script code in object expression/statement expression.
- Medium – Usage of loops in Blockly logic, Policy table wildcard match <= 3 fields, MatchList < 3, and 3 < RegEx match < 6
- High – JSON Operations – Custom, complex Java script code in object Expression/ statement expression, Policy table wildcard match > 3 fields, MatchLists >= 3, and RegEx mat >= 6

CnPCRF Configurations

The following CnPCRF services/features/databases were either enabled or disabled to run this call flow:

Table 3-16 CnPCRF Configurations

Service Name	Status
Binding	Enabled
PRE	Enabled
SAL	Enabled
LDAP	Disabled
OCS	Disabled
Audit	Enabled
Replication	Enabled
Bulwark	Disabled
Alternate routing	Disabled

Table 3-17 Policy Interfaces

Feature Name	Status
AMF on demand nrf discovery	NA
BSF (N7-Nbsf)	NA
CHF (SM-Nchf)	NA
LDAP (Gx-LDAP)	NA
N36 UDR query (N7/N15-Nudr)	NA
N36 UDR subscription (N7/N15-Nudr)	NA
Sy (PCF N7-Sy)	NA
UDR on-demand nrf discovery	NA

Table 3-18 PCRF Interfaces

Feature Name	Status
Sy (PCRF Gx-Sy)	NA
Sd (Gx-Sd)	NA
Gx UDR query (Gx-Nudr)	NA
Gx UDR subscription (Gx-Nudr)	NA
CHF enabled (AM)	NA
Usage Monitoring (Gx)	NA
Subscriber HTTP Notifier (Gx)	NA

Infrastructure Details

Table 3-19 Software Details

Applications	Versions
Policy	24.1.0
cnDBTier	24.1.0
ASM	Disabled
CNE	23.3.3
CNC Console	24.1.0

Table 3-20 Observability Services

Services	Versions
OpenSearch	2.3.0
Fluentd	1.16.2
Prometheus	2.51.1
Grafana	9.5.3
Jaeger	1.52.0

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

Table 3-21 Hardware Details

Hardware	Details
Environment	Hypervisor
Server	ORACLE SERVER X8-2
Model	Intel(R) Xeon(R) Platinum 8260 CPU
Clock Speed	2.400 GHz
Total Cores	96
Memory Size	576 GB
Type	DDR4 SDRAM
Installed DIMMs	18
Maximum DIMMs	24
Installed Memory	576 GB

Resource Allocation

The following table describes the resource capacity allocated to the Policy microservices:

Table 3-22 Resource Allocation for Policy Microservices

Service Name	CPU Request Per Pod	CPU Limit Per Pod	Memory Request Per Pod (Gi)	Memory Limit Per Pod (Gi)	Replicas
Appinfo	1	2	1	2	1
Audit Service	1	2	1	1	1
CM Service	2	4	0.5	2	1
Config Service	2	4	0.5	2	1
Egress Gateway	5	5	6	6	2
Ingress Gateway	3	4	4	6	2
Nrf Client Management	1	1	1	1	2
Diameter Gateway	3	4	1	2	9
Diameter Connector	3	4	1	2	5
Nrf Client Discovery	3	4	0.5	2	2
Query Service	1	2	1	1	1
PCRF Core Service	7	8	8	8	24
Performance	1	1	0.5	1	2
PRE Service	4	4	0.5	4	15
SM Service	7	7	10	10	2
PDS	7	7	8	8	5
Binding Service	5	6	1	8	18

Table 3-23 Resource Allocation for cnDBTier Services

Service Name	CPU Request Per Pod	CPU Limit Per Pod	Memory Request Per Pod (Gi)	Memory Limit Per Pod (Gi)	Replicas Min Replica = Max Replica
ndbappmysqld	8	8	19	20	5
ndbmgmd	2	2	9	11	2
ndbmtd	8	8	73	83	8
ndbmysqld	4	4	25	25	6

3.1.2.2 Results

CPU and Memory Utilization

This section lists the CPU and memory utilization by Policy and cnDBTier microservices. The CPU utilization is the ratio between the (total CPU utilization against total CPU request (X)) versus (target CPU Utilization (Y) configured for the pod).

Table 3-24 CPU/Memory Utilization by Policy Microservices

Service Name	Site 1 CPU (X/Y)	Site 2 CPU (X/Y)	Site 3 CPU (X/Y)	Site 4 CPU (X/Y)
ocpcf-appinfo-hpa-v2	3%/80%	3%/80%	3%/80%	3%/80%
ocpcf-config-server-hpa-v2	8%/80%	9%/80%	7%/80%	7%/80%
ocpcf-diam-connector-hpa	0%/40%	0%/40%	0%/40%	0%/40%
ocpcf-egress-gateway-v2	0%/80%	0%/80%	0%/80%	0%/80%
ocpcf-ingress-gateway-v2	0%/80%	0%/80%	0%/80%	0%/80%
ocpcf-nrf-client-nfdiscovery-v2	0%/80%	0%/80%	0%/80%	0%/80%
ocpcf-nrf-client-nfmanagement-v2	0%/80%	0%/80%	0%/80%	0%/80%
ocpcf-oc-binding-hpa	6%/60%	6%/60%	6%/60%	6%/60%
ocpcf-ocpm-audit-service-hpa-v2	4%/60%	1%/60%	1%/60%	1%/60%
ocpcf-ocpm-policyds-hpa	0%/60%	0%/60%	0%/60%	0%/60%
ocpcf-pcf-pre-hpa	17%/80%	18%/80%	17%/80%	17%/80%
ocpcf-pcrf-core-hpa	12%/40%	12%/40%	12%/40%	12%/40%
ocpcf-query-service-hpa	0%/80%	0%/80%	0%/80%	0%/80%

Table 3-25 CPU and Memory Utilization by CnDBTier Services

Service Name	Site1 - CPU (X/Y)	Site2 - CPU (X/Y)	Site3 - CPU (X/Y)	Site4 - CPU (X/Y)
ndbappmysqld	88%/80%	87%/80%	89%/80%	88%/80%

Table 3-25 (Cont.) CPU and Memory Utilization by CnDBTier Services

Service Name	Site1 - CPU (X/Y)	Site2 - CPU (X/Y)	Site3 - CPU (X/Y)	Site4 - CPU (X/Y)
ndbmgmd	0%/80%	0%/80%	0%/80%	0%/80%
ndbmtd	16%/80%	17%/80%	17%/80%	18%/80%
ndbmysqld	8%/80%	9%/80%	10%/80%	8%/80%

Latency

Table 3-26 Average CnPCRF Core JDBC Latency Observations (in ms)

Site 1	Site 2	Site 3	Site 4
2.19 ms	2.32	2.66	2.56

3.1.3 Test Scenario: CnPCRF Data Call Model on Two-Site GeoRedundant setup, with 30K TPS per NFSet (with 15K TPS on each instance)

This test run benchmarks the performance and capacity of PCRF data call model that is deployed in converged mode on a two-site georedundant setup. Each site in the setup handles an incoming traffic of 15K TPS.

3.1.3.1 Test Case and Setup Details

Test Case Parameters

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

Table 3-27 Test case Parameters

Parameter	Value
Call Rate (Ingress + Egress)	15K TPS on each site
ASM	Disabled
Execution Time	134 hours

Table 3-28 Call Model Data

Messages	Total TPS
CCR-I	3.02K
CCR-U	1.62K
CCR-T	3.02K
SNR	0.60K
RAR	0.60K
Sy	3.24K
LDAP	3.02K
Total TPS	15.12K

Table 3-29 CnPCRF Configurations

Service Name	Status
Overload Control	Enabled (pcrf-core)
Congestion Control	Enabled (diam-gw)
Subscriber Activity Log (SAL)	Disabled
LDAP	Enabled
Online Charging System (OCS)	Enabled
Audit	Enabled
Replication	Enabled
Binding	Enabled
PER	Disabled
PDS Single UEID	Enabled (gpsi)

Table 3-30 CnPCRF Interfaces

Feature Name	Status
UDR on-demand nrf discovery	Disable
Sy (PCF N7-Sy)	Enable
N36 UDR subscription (N7/N15-Nudr)	Disable
N36 UDR query (N7/N15-Nudr)	Disable
LDAP (Gx-LDAP)	Enable
CHF (SM-Nchf)	Disable
BSF (N7-Nbsf)	Disable
AMF on demand nrf discovery	Disable

Infrastructure Details

Table 3-31 Software Details

Applications	Versions
Policy	25.2.201
cnDBTier	25.2.200
ASM	Disabled
OSO	NA
CNE	25.1.100
CNC Console	25.2.200

Table 3-32 Observability Services

Service Names	Versions
OpenSearch	2.11.0
Fluentd	1.17.1
Prometheus	2.52.0
Grafana	9.5.3
Jaeger	1.60.0

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

Table 3-33 Hardware Details

Hardware	Details
Environment	Hypervisor
Server	ORACLE SERVER X8-2
Model	Intel(R) Xeon(R) Platinum 8260 CPU
Clock Speed	2.400 GHz
Total Cores	96
Memory Size	576 GB
Type	DDR4 SDRAM
Installed DIMMs	18
Maximum DIMMs	24
Installed Memory	576 GB

Resource Allocation

The following table describes the resource capacity allocated to the Policy microservices:

Table 3-34 Resource Allocation for Policy Microservices

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replicas
Appinfo	1	1	1Gi	1Gi	1Gi	80Mi	1
Binding Service	6	5	8Gi	1Gi	1Gi	80Mi	15
Diameter Connector	4	3	2Gi	1Gi	1Gi	80Mi	8
Configuration Service	4	2	2Gi	1Gi	1Gi	80Mi	2
Egress Gateway	4	3	6Gi	4Gi	1Gi	80Mi	1
Ingress Gateway	4	3	6Gi	4Gi	1Gi	80Mi	1
NRF Client NF Discovery	4	3	2Gi	0.5Gi	1Gi	80Mi	1
NRF Client NF Management	1	1	1Gi	1Gi	1Gi	80Mi	1
Audit Service	2	1	1Gi	1Gi	1Gi	80Mi	1
CM Service	4	2	2Gi	1Gi	1Gi	80Mi	2
LDAP Gateway	4	3	2Gi	1Gi	1Gi	80Mi	10

Table 3-34 (Cont.) Resource Allocation for Policy Microservices

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replicas
PDS	6	5	4Gi	2Gi	1Gi	80Mi	25
PRE	5	5	4Gi	2Gi	1Gi	80Mi	25
Query Service	2	1	1Gi	1Gi	1Gi	80Mi	1
pcrf-core/ pcrf-core	8	7	8Gi	8Gi	1Gi	80Mi	30
Perfinfo	1	1	1Gi	1Gi	1Gi	80Mi	2
Diameter Gateway	4	3	2Gi	2Gi	1Gi	80Mi	7

Table 3-35 Resource Allocation for cnDBTier Services

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replicas
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	1	1	1Gi	1Gi	1Gi	90Mi	1
mysql-cluster-db-monitor-svc/db-monitor-svc	2	2	2Gi	2Gi	1Gi	90Mi	1
mysql-cluster-one-two-c1-replication-svc/one-two-c1-replication-svc	2	2	12Gi	12Gi	1Gi	90Mi	1
mysql-cluster-two-one-c1-replication-svc/db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	1

Table 3-35 (Cont.) Resource Allocation for cnDBTier Services

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replicas
mysql-cluster-one-two-c2-replication-svc/one-two-c2-replication-svc	1100m	1100m	2Gi	1Gi	1Gi	90Mi	1
ndbappmysqld/ mysqlndbcluster	8	8	20Gi	19Gi	1Gi	90Mi	5
ndbappmysqld/db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	5
ndbappmysqld/init-sidecar	100m	100m	0.25Gi	0.25Gi	1Gi	90Mi	5
ndbmgmd/ mysqlndbcluster	2	2	11.25Gi	9Gi	1Gi	90Mi	2
ndbmgmd/ db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	2
ndbmtd/ mysqlndbcluster	8	8	73Gi	73Gi	1Gi	90Mi	8
ndbmtd/db-backup-executor-svc	2	2	2Gi	2Gi	1Gi	90Mi	8
ndbmtd/db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	8
ndbmysqld/ mysqlndbcluster	4	4	25Gi	25Gi	1Gi	90Mi	4
ndbmysqld/ init-sidecar	100m	100m	0.25Gi	0.25Gi	1Gi	90Mi	4
ndbmysqld/ db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	4

3.1.3.2 Results

CPU and Memory Utilization

This section lists the CPU and memory utilization by Policy and cnDBTier microservices. The CPU utilization is the ratio between the (total CPU utilization against total CPU request (X)) versus (target CPU Utilization (Y) configured for the pod).

Table 3-36 CPU and Memory Utilization by Policy Microservices

Microservices	Site-1 CPU	Site-1 Memory	Site-2 CPU	Site-2 Memory
Appinfo	3.90%	27.54%	4.90%	28.03%
Binding Service	11.29%	20.22%	11.64%	15.41%
Diameter Connector	16.04%	35.03%	15.56%	34.27%
Configuration Service	5.97%	37.52%	5.74%	60.40%
Egress Gateway	0.10%	12.04%	0.10%	12.99%
Ingress Gateway	1.82%	16.99%	1.07%	18.08%
NRF Client NF Discovery	0.12%	27.93%	0.15%	28.52%
NRF Client NF Management	0.40%	42.58%	0.40%	41.80%
Audit Service	4.05%	75.00%	2.25%	69.92%
CM Service	0.27%	54.86%	0.30%	57.37%
LDAP Gateway	7.17%	34.62%	6.97%	34.64%
PDS	16.95%	61.22%	17.82%	59.87%
PRE	18.64%	57.42%	17.95%	57.28%
Query Service	0.10%	19.97%	0.15%	20.46%
ocpcf-pcrf-core/ pcrf-core	15.89%	35.41%	15.52%	37.76%
Perfinfo	30.20%	14.40%	17.45%	14.50%
Diameter Gateway	20.75%	63.37%	19.62%	58.57%

Table 3-37 CPU and Memory Utilization by CnDBTier Services

Microservices	Site-1 CPU	Site-1 Memory	Site-2 CPU	Site-2 Memory
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	0.45%	8.69%	0.09%	8.30%
mysql-cluster-db-monitor-svc/db-monitor-svc	1.00%	33.64%	0.30%	29.05%
mysql-cluster-one-two-c1-replication-svc/one-two-c1-replication-svc	0.60%	2.47%	-	-

Table 3-37 (Cont.) CPU and Memory Utilization by CnDBTier Services

Microservices	Site-1 CPU	Site-1 Memory	Site-2 CPU	Site-2 Memory
mysql-cluster-one-two-c1-replication-svc/db-infra-monitor-svc	0.50%	20.70%	-	-
mysql-cluster-one-two-c2-replication-svc/one-two-c2-replication-svc	0.91%	13.33%	-	-
mysql-cluster-two-one-c1-replication-svc/two-one-c1-replication-svc	-	-	0.55%	2.60%
mysql-cluster-two-one-c1-replication-svc/db-infra-monitor-svc	-	-	1.00%	19.92%
mysql-cluster-two-one-c2-replication-svc/two-one-c2-replication-svc	-	-	1.09%	13.48%
ndbappmysqld/ mysqlndbcluster	70.96%	29.98%	69.34%	29.82%
ndbappmysqld/db-infra-monitor-svc	1.00%	21.72%	1.20%	21.72%
ndbappmysqld/init-sidecar	3.60%	0.39%	3.20%	0.39%
ndbmgmd/ mysqlndbcluster	0.57%	18.06%	0.62%	18.00%
ndbmgmd/db-infra-monitor-svc	1.00%	20.12%	0.75%	20.51%
ndbmtd/ mysqlndbcluster	27.91%	82.66%	22.94%	82.62%
ndbmtd/db-backup-executor-svc	0.05%	2.76%	0.05%	2.75%
ndbmtd/db-infra-monitor-svc	7.25%	20.90%	7.19%	20.90%
ndbmysqld/ mysqlndbcluster	8.12%	21.86%	8.38%	22.13%
ndbmysqld/init-sidecar	3.25%	0.59%	3.00%	0.59%
ndbmysqld/db-infra-monitor-svc	2.00%	24.02%	1.37%	24.61%

Latency

NF Service Latency (in milliseconds) Note: Additional 100ms latency introduced between DIAM-GW and external interfaces	Site1	Site2
PCRF_Policyds	99.873	129.388
PCRF_Binding	38.744	53.576
PCRF_Diam_connector	103.423	106.496
PCRF_Core_JDBC_Latency	9.124	15.534

Table 3-38 Average CnPCRF Core JDBC Latency Observations (in ms)

Methods	50th Percentile (Site1)	99th Percentile (Site1)	50th Percentile (Site2)	99th Percentile (Site2)
DIAM	38.6	100.00	39.7	100.0

3.1.4 Test Scenario: CnPCRF Voice Call Model on Two-Site GeoRedundant setup, with 30K TPS per NFSet (with 15K TPS on each instance)

This test run benchmarks the performance and capacity of CnPCRF voice call model that is deployed in converged mode on two-site georedundant setup. Each site in the setup handles an incoming traffic of 15K TPS.

3.1.4.1 Test Case and Setup Details

Test Case Parameters

The following table describes the testcase parameters and their values:

Table 3-39 Testcase Parameters

Parameter	Value
Call Rate (Ingress + Egress)	(15k TPS each sites) in two-site georedundant setup
ASM	Disabled
Execution Time	72 hours

Table 3-40 Call Model Data

Messages	TPS
CCR-I	630
CCR-U	1260
CCR-T	630
Rx-RAR	1260

Table 3-40 (Cont.) Call Model Data

Messages	TPS
Gx-RAR	1890
AAR-I	630
AAR-U	630
STR	630

The following CnPCRF services/features/databases were either enabled or disabled to run this call flow:

Table 3-41 CnPCRF Configurations

Service Name	Status
Overload Control	Enabled
Congestion Control	Enabled
Subscriber Activity Log (SAL)	Disabled
LDAP	Disabled
Online Charging System (OCS)	Disabled
Audit	Disabled
Replication	Enabled
Binding	Enabled
PER	Enabled
PDS Single UEID	Disabled

Table 3-42 PCF Interfaces

Feature Name	Status
N36 UDR query (N7/N15-Nudr)	Disable
N36 UDR subscription (N7/N15-Nudr)	Disable
UDR on-demand nrf discovery	Disable
CHF (SM-Nchf)	Disable
BSF (N7-Nbsf)	Disable
AMF on demand nrf discovery	Disable
LDAP (Gx-LDAP)	Disable
Sy (PCF N7-Sy)	Disable

Table 3-43 CnPCRF Interfaces

Feature Name	Status
Sy (PCRF Gx-Sy)	Disable
Sd (Gx-Sd)	Disable
Gx UDR query (Gx-Nudr)	Disable
Gx UDR subscription (Gx-Nudr	Disable
CHF enabled (AM)	Disable
Usage Monitoring (Gx)	Disable

Table 3-43 (Cont.) CnPCRF Interfaces

Feature Name	Status
Subscriber HTTP Notifier (Gx)	Disable

Infrastructure Details

Table 3-44 Software Details

Applications	Versions
Policy	25.2.201
cnDBTier	25.2.200
ASM	Disabled
OSO	NA
CNE	25.1.100
CNC Console	25.2.200

Table 3-45 Observability Services

Service Names	Versions
OpenSearch	2.11.0
Fluentd	1.17.1
Prometheus	2.52.0
Grafana	9.5.3
Jaeger	1.60.0

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

Table 3-46 Hardware Details

Hardware	Details
Environment	Hypervisor
Server	ORACLE SERVER X8-2
Model	Intel(R) Xeon(R) Platinum 8260 CPU
Clock Speed	2.400 GHz
Total Cores	96
Memory Size	576 GB
Type	DDR4 SDRAM
Installed DIMMs	18
Maximum DIMMs	24
Installed Memory	576 GB

Resource Allocation

The following table describes the resource capacity allocated to the Policy microservices:

Table 3-47 Resource Allocation for Policy Microservices

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replicas
Appinfo	1	1	1Gi	0.5Gi	1Gi	80Mi	1
Binding Service	6	5	8Gi	1Gi	1Gi	80Mi	18
Diameter Connector	4	3	2Gi	1Gi	1Gi	80Mi	1
Configuration Service	4	2	2Gi	0.5Gi	1Gi	80Mi	2
Egress Gateway	4	3	6Gi	4Gi	1Gi	80Mi	1
Ingress Gateway	4	3	6Gi	4Gi	1Gi	80Mi	1
NRF Client NF Discovery	4	3	2Gi	0.5Gi	1Gi	80Mi	1
NRF Client NF Management	1	1	1Gi	1Gi	1Gi	80Mi	1
Audit Service	2	1	1Gi	1Gi	1Gi	80Mi	1
CM Service	4	2	2Gi	0.5Gi	1Gi	80Mi	2
PDS	6	5	4Gi	1Gi	1Gi	80Mi	5
PRE	8	8	4Gi	4Gi	1Gi	80Mi	24
Query Service	2	1	1Gi	1Gi	1Gi	80Mi	1
pcrf-core/ pcrf-core	8	7	8Gi	8Gi	1Gi	80Mi	24
Perfinfo	1	1	1Gi	0.5Gi	1Gi	80Mi	2
Diameter Gateway	4	3	2Gi	1Gi	1Gi	80Mi	9
Appinfo	1	1	1Gi	0.5Gi	1Gi	80Mi	1
Binding Service	6	5	8Gi	1Gi	1Gi	80Mi	18
Diameter Connector	4	3	2Gi	1Gi	1Gi	80Mi	1
Configuration Service	4	2	2Gi	0.5Gi	1Gi	80Mi	2
Egress Gateway	4	3	6Gi	4Gi	1Gi	80Mi	1
Ingress Gateway	4	3	6Gi	4Gi	1Gi	80Mi	1
NRF Client NF Discovery	4	3	2Gi	0.5Gi	1Gi	80Mi	1

Table 3-47 (Cont.) Resource Allocation for Policy Microservices

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replicas
NRF Client NF Management	1	1	1Gi	1Gi	1Gi	80Mi	1
Audit Service	2	1	1Gi	1Gi	1Gi	80Mi	1
CM Service	4	2	2Gi	0.5Gi	1Gi	80Mi	2

Table 3-48 Resource Allocation for cnDBTier Services

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replicas
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	1100m	1100m	1Gi	1Gi	1Gi	90Mi	1
mysql-cluster-db-monitor-svc/db-monitor-svc	4	4	4Gi	4Gi	1Gi	90Mi	1
mysql-cluster-one-two-replication-svc/one-two-replication-svc	2	2	12Gi	12Gi	1Gi	90Mi	1
mysql-cluster-one-two-replication-svc/db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	1
ndbappmysqld/ mysqlndbcluster	8	8	20Gi	19Gi	1Gi	90Mi	5

Table 3-48 (Cont.) Resource Allocation for cnDBTier Services

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replicas
ndbappmysqld/db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	5
ndbappmysqld/init-sidecar	100m	100m	0.25Gi	0.25Gi	1Gi	90Mi	5
ndbmgmd/mysqlndbcluster	4	4	11.25Gi	9Gi	1Gi	90Mi	2
ndbmgmd/db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	2
ndbmtd/mysqlndbcluster	10	10	83Gi	73Gi	1Gi	90Mi	8
ndbmtd/db-backup-executor-svc	2	2	2Gi	2Gi	1Gi	90Mi	8
ndbmtd/db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	8
ndbmysqld/mysqlndbcluster	10	10	25Gi	25Gi	1Gi	90Mi	2
ndbmysqld/init-sidecar	100m	100m	0.25Gi	0.25Gi	1Gi	90Mi	2
ndbmysqld/db-infra-monitor-svc	200m	200m	0.25Gi	0.25Gi	1Gi	90Mi	2

3.1.4.2 Results

CPU and Memory Utilization

This section lists the CPU and memory utilization by Policy and cnDBTier microservices.

Table 3-49 CPU and Memory Utilization by Policy Microservices

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
Appinfo	3.90%	26.86%	3.30%	26.86%
Binding Service	7.69%	12.43%	7.83%	12.00%
Configuration Service	5.01%	41.19%	3.46%	42.50%
Egress Gateway	0.15%	11.96%	0.12%	15.09%

Table 3-49 (Cont.) CPU and Memory Utilization by Policy Microservices

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
Ingress Gateway	0.57%	15.97%	0.55%	15.85%
NRF Client NF Discovery	0.12%	30.08%	0.18%	29.05%
NRF Client NF Management	0.50%	41.60%	0.40%	41.70%
Audit Service	0.20%	47.66%	0.20%	47.27%
CM Service	0.36%	54.03%	0.34%	55.22%
PRE	11.18%	53.24%	10.32%	56.19%
Query Service	0.10%	34.67%	0.10%	34.67%
ocpcf-pcrf-core/ pcrf-core	28.46%	57.05%	27.83%	54.75%
Perfinfo	5.75%	13.87%	6.80%	13.96%
Diameter Gateway	23.65%	50.15%	20.40%	45.20%

Table 3-50 CPU and Memory Utilization by cnDBTier Services

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	0.10%	8.01%	0.10%	7.71%
mysql-cluster-db-monitor-svc/db-monitor-svc	0.12%	15.65%	1.00%	16.09%
mysql-cluster-two-one-replication-svc/ two-one-replication-svc	-	-	0.45%	2.29%
mysql-cluster-two-one-replication-svc/db-infra-monitor-svc	-	-	1.00%	20.70%
ndbappmysqld/ mysqlndbcluster	45.66%	28.65%	43.67%	28.44%
ndbappmysqld/db-infra-monitor-svc	2.00%	22.34%	2.20%	23.52%
ndbappmysqld/init-sidecar	3.00%	0.39%	3.00%	0.39%
ndbmgmd/ mysqlndbcluster	0.24%	17.99%	0.25%	17.99%
ndbmgmd/db-infra-monitor-svc	2.00%	21.88%	2.00%	21.88%
ndbmtd/ mysqlndbcluster	18.32%	93.10%	19.40%	93.10%
ndbmtd/db-backup-executor-svc	0.10%	2.73%	0.10%	2.73%

Table 3-50 (Cont.) CPU and Memory Utilization by cnDBTier Services

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
mysql-cluster-one-two-replication-svc/one-two-replication-svc	0.40%	2.34%	-	-
ndbmtd/db-infra-monitor-svc	7.87%	22.17%	9.12%	22.36%
ndbmysqld/mysqlndbcluster	4.08%	17.38%	4.33%	17.38%
ndbmysqld/init-sidecar	3.00%	0.39%	3.00%	0.39%
ndbmysqld/db-infra-monitor-svc	2.00%	24.22%	4.00%	23.44%
mysql-cluster-one-two-replication-svc/db-infra-monitor-svc	2.00%	20.70%	-	-

Latency

Table 3-51 Average Latency Observations for CnPCRF In Milliseconds

Services	Site 1	Site 2
PCRF_Binding	14.209	14.008
PCRF_Core_JDBC_Latency	3.607	3.528

Table 3-52 Average Latency Observations for CnPCRF for Percentile in Milliseconds

Methods	50th Percentile (Site1)	99th Percentile (Site1)	50th Percentile (Site2)	99th Percentile (Site2)
DIAM	9.340	45.800	8.270	58.100

3.1.5 Test Scenario: CnPCRF Data Call Model with 60K TPS per NFSet (with 60K TPS on only one instance)

This test run benchmarks the performance and capacity of CnPCRF data call model that is deployed in converged mode on a single site setup. The test was run for 60K TPS on a single site in georedundant setup for 60 hours.

3.1.5.1 Test Case and Setup Details

Test Case Parameters

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

Table 3-53 Testcase Parameters

Parameters	Values
Call Rate (Ingress + Egress)	60K TPS
ASM	Disabled
Traffic Ratio	1.6:4.2:1.6:1 (CCR-I/U/T/RAR)
Active Subscribers	15M

Policy Project Details:

The Policy Design editor based on the Blockly interface was used to set the Policy project for each of the Policy services. The complexity level of Policy Project configured for this run was High.

Complexity Level Definition:

- Low– No Usage of Loops in Blockly logic, No JSON operations, No complex Java Script code in Object Expression /Statement Expression.
- Medium - Usage of Loops in Blockly logic, Policy Table Wildcard match <= 3 fields, MatchList < 3, 3 < RegEx match < 6
- High - JSON Operations – Custom, complex Java Script code in Object Expression / Statement Expression, Policy Table Wildcard match > 3 fields, MatchLists >= 3, RegEx mat >= 6

Call Model Data

Table 3-54 Traffic distribution per call flow

Call Flow	Traffic at Site1
TOTAL-IGW	0
TOTAL-EGW	12168
DIAM-GW-IN-TOTAL	43144
DIAM-GW-OUT-TOTAL	4832
TOTAL-TPS	60144

Following PCF configurations were either enabled or disabled for running this call flow:

Table 3-55 Configurations

Feature	Status
Binding	Disabled
PER	Disabled
SAL	Disabled
LDAP	Disabled
OCS	Disabled
PDS Compression	Disabled
Audit	Enabled
PRIMARYKEY_LOOKUP_ENABLED	Enabled
SINGLE_UE_ID_PREFERENTIAL_SEARCH	Enabled

Table 3-55 (Cont.) Configurations

Feature	Status
Replication	Enabled
USER.allDataTypes.excludeApns	Enabled (ims apn)

Table 3-56 PCF Interfaces

Feature Name	Status
N36 UDR query (N7/N15-Nudr)	Enabled
N36 UDR subscription (N7/N15-Nudr)	Enabled
UDR on-demand nrf discovery	Disabled
CHF (SM-Nchf)	Disabled
BSF (N7-Nbsf)	Disabled
AMF on demand nrf discovery	Disabled
LDAP (Gx-LDAP)	Disabled
Sy (PCF N7-Sy)	Disabled

Table 3-57 CnPCRF Interfaces

Feature Name	Status
Sy (PCRF Gx-Sy)	Disabled
Sd (Gx-Sd)	Disabled
Gx UDR query (Gx-Nudr)	Disabled
Gx UDR subscription (Gx-Nudr	Disabled
CHF enabled (AM)	Disabled
Usage Monitoring (Gx)	Disabled
Subscriber HTTP Notifier (Gx)	Disabled

Infrastructure Details

Table 3-58 Software Details

Aplications	Version
Policy	25.2.100
cnDBTier	25.2.100
UDR	25.2.100
ASM	Disabled
OSO	Disabled
CNE	23.3.5

Table 3-59 Observability Services

Service Names	Versions
OpenSearch	2.3.0
Fluentd	1.16.2

Table 3-59 (Cont.) Observability Services

Service Names	Versions
Prometheus	2.51.1
Grafana	9.5.3
Jaeger	1.52.0

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

Table 3-60 Hardware Details

Hardware	Details
Environment	Hypervisor
Server	ORACLE SERVER X8-2
Model	Intel(R) Xeon(R) Platinum 8260 CPU
Clock Speed	2.400 GHz
Total Cores	96
Memory Size	576 GB
Type	DDR4 SDRAM
Installed DIMMs	18
Maximum DIMMs	24
Installed Memory	576 GB

Resource Allocation

The following table describes the resource capacity allocated to the Policy microservices:

Table 3-61 Resource Allocation for Policy Microservices

Microservices	CPU Request per pod	CPU Limit per pod	Memory Request per pod	Memory Limit per pod	Replicas
Appinfo	2	2	4	4	2
Binding Service	1	1	1	1	0
Diameter Connector	4	4	2	2	1
Diameter Gateway	4	4	2	2	9
Configuration Service	4	4	2	2	2
Egress Gateway	4	4	6	6	10
Ingress Gateway	5	5	6	6	2
Audit Service	2	2	4	4	2
CM Service	2	4	2	2	2
PDS	7	7	8	8	28
PRE	4	4	4	4	28

Table 3-61 (Cont.) Resource Allocation for Policy Microservices

Microservices	CPU Request per pod	CPU Limit per pod	Memory Request per pod	Memory Limit per pod	Replicas
Query Service	2	2	1	1	2
pcrf-core	8	8	8	8	32
Perfinfo	1	1	1	2	2
Alternate Route Service	2	2	4	4	5

Table 3-62 Resource Allocation for cnDBTier Services

Microservices	CPU Request per pod	CPU Limit per pod	Memory Request per pod	Memory Limit per pod	Replicas Min Replica = Max Replica
ndbappmysqld	6	6	13	13	22
ndbmgmd	4	4	8	10	2
ndbmtd	16	16	62	62	14
ndbmysqld	4	4	32	32	4

3.1.5.2 Results

CPU and Memory Utilization

This section lists the CPU and memory utilization by Policy and cnDBTier microservices.

Table 3-63 CPU and Memory Utilization by Policy Microservices

Microservices	CPU utilization	Memory utilization
Appinfo	1.32	6.96
Audit Service	0.687	28.9
CM Service	0.174	45.2
Configuration Service	3.55	48.2
Diameter Connector	0.114	28.3
Diameter Gateway	30.5	42.7
Alternate Route Service	0.0720	16.8
Egress Gateway	22.6	29.5
Ingress Gateway	0.416	25.3
pcrf-core	45.4	55.1
Perfinfo	18.9	7.43
PDS	15.8	25.0
PRE	40.8	56.5
Query Service	0.0389	36.9

Table 3-64 CPU and Memory Utilization by cnDBTier Services

Microservices	CPU Utilization	Memory Utilization
ndbappmysqld	27.9	45.9
ndbmtd	17.8	93.4
ndbmysqld	13.8	42.4
ndbmgmd	0.263	20.9

Latency

Table 3-65 Average Latency Observations (in milliseconds) for the Call Flows:

Service Name	Observed Latency at Site1(ms)
PCF_IGW_Latency	NA
PCF_SM_Svc_Overall	NA
PCF_POLICYPDS_Overall	43.3
PCF_UDRCONNECTOR_Overall	108
PCF_CHFCONNECTOR_Overall	NA
PCF_NRFCLIENT_On_Demand	NA
PCF_UsrSvc_Overall	NA
PCF_EGRESS_Latency	106
PCF_Binding_Svc_Latency	NA
PCRF_Core_JDBC_Latency	0.782
PCF_Diam_Connector_Latency	NA
PCF_Diam_Gw_Latency	NA
PCF_Usage_Mon	NA
Pcrf_Core_Overall	NA

Table 3-66 Latency obervations for cnDBTier services

Site-Slave Node(In Seconds)	cnDBtier Replication Delay
Site-1-ndbmysqld-0	0
Site-1-ndbmysqld-1	0
Site-1-ndbmysqld-2	0
Site-1-ndbmysqld-3	0
Site-2-ndbmysqld-0	0
Site-2-ndbmysqld-1	0
Site-2-ndbmysqld-2	0
Site-2-ndbmysqld-3	0

3.1.6 Test Scenario:CnPCRF Usage Monitoring Data Call Model on Two-Site GeoRedundant Setup, with 28K TPS per NFSet (with 28K TPS on only one instance)

This test was run to benchmark the performance and capacity of CnPCRF call model with 10K TPS Diameter Ingress Gateway and 18K TPS Diameter Egress Gateway TPS Traffic with Usage Monitoring enabled.

3.1.6.1 Test Case and Setup Details

Testcase Parameters

The following table describes the testcase parameters and their values:

Parameters	Values
Call Rate (Ingress + Egress)	28K TPS on a two-site Setup
ASM	Disable
Traffic Ratio	10K Diameter Ingress Gateway TPS and 19K Egress Gateway TPS
Active Subscribers	5M

Project Details

The Policy Design editor based on the Blockly interface was used to set the Policy project for each of the Policy services. The complexity level of Policy Project configured for this run was **High.**

Complexity Level Definition:

- Low – No usage of loops in Blockly logic, no JSON operations, and no complex Java Script code in object expression/statement expression.
- Medium – Usage of loops in Blockly logic, Policy table wildcard match <= 3 fields, MatchList < 3, and 3 < RegEx match < 6
- High – JSON Operations – Custom, complex Java script code in object Expression/ statement expression, Policy table wildcard match > 3 fields, MatchLists >= 3, and RegEx mat >= 6

Configurations

Following configurations were either enabled or disabled for running this call flow:

Table 3-67 Configurations

Name	Status
Binding	Disabled
Subscriber Tracing	Enabled
Overload	Enabled
Bulwark	Enabled

Infrastructure Details

Table 3-68 Software Details

Applications	Versions
Policy	25.1.201
cnDBTier	25.1.201
UDR	25.1.201
ASM	Disabled
OSO	NA
CNE	23.3.5
CNC Console	25.1.201

Table 3-69 Observability Services

Service Names	Versions
OpenSearch	2.3.0
Fluentd	1.16.2
Prometheus	2.51.1
Grafana	9.5.3
Jaeger	1.52.0

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

Table 3-70 Hardware Details

Hardware	Details
Environment	Hypervisor
Server	ORACLE SERVER X8-2
Model	Intel(R) Xeon(R) Platinum 8260 CPU
Clock Speed	2.400 GHz
Total Cores	96
Memory Size	576 GB
Type	DDR4 SDRAM
Installed DIMMs	18
Maximum DIMMs	24
Installed Memory	576 GB

Resource Allocation

The following table describes the resource capacity allocated to the Policy microservices:

Table 3-71 Resource Allocation for Policy Microservices

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
Appinfo	2	1	1	1Gi	1Gi	1Gi	80Mi
Bulwark Service	1	2	2	1Gi	1Gi	1Gi	80Mi
Notifier	1	2	2	1Gi	1Gi	1Gi	80Mi
Binding Service	4	4	4	4Gi	4Gi	1Gi	80Mi
Diameter Connector	1	4	4	2Gi	2Gi	2Gi	80Mi
Configuration Service	2	4	4	2Gi	2Gi	1Gi	80Mi
Egress Gateway	10	4	4	6Gi	6Gi	1Gi	80Mi
Ingress Gateway	2	2	2	2Gi	2Gi	1Gi	80Mi
NRF Client NF Discovery	2	1	1	1Gi	1Gi	1Gi	80Mi
NRF Client NF Management	1	1	1	1Gi	1Gi	1Gi	80Mi
UDR Connector	10	6	6	4Gi	4Gi	1Gi	80Mi
Audit Service	1	2	2	4Gi	4Gi	1Gi	80Mi
CM Service	2	4	4	2Gi	2Gi	2Gi	80Mi
PDS	16	7	7	4Gi	4Gi	4Gi	80Mi
PRE	8	4	4	4Gi	4Gi	1Gi	80Mi
Query Service	1	2	2	1Gi	1Gi	1Gi	80Mi
AM Service	1	1	1	1Gi	1Gi	1Gi	80Mi
SM Service	1	2	2	2Gi	2Gi	1Gi	80Mi
UE Service	1	1	1	1Gi	1Gi	1Gi	80Mi
CnPCRF Core	10	8	8	8Gi	8Gi	8Gi	80Mi
Perfinfo	2	1	1	1Gi	1Gi	1Gi	80Mi
Usage Mon	10	8	8	5Gi	5Gi	4Gi	80Mi
Diameter Gateway	3	4	4	4Gi	4Gi	2Gi	80Mi

Table 3-72 Resource Allocation for UDR

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ocudr-alternate-route/istio-proxy	2	1000m	1000m	1Gi	1Gi	NA	NA
ocudr-alternate-route/ alternate-route	2	2	2	2Gi	2Gi	1Gi	57Mi
ocudr-appinfo/ istio-proxy	2	1000m	1000m	1Gi	1Gi	NA	NA
ocudr-appinfo/ appinfo	2	1	1	1Gi	1Gi	1Gi	57Mi
ocudr-egressgateway/istio-proxy	2	1000m	1000m	1Gi	1Gi	NA	NA
ocudr-egressgateway/ egressgateway	2	6	6	4Gi	4Gi	1Gi	57Mi
ocudr-ingressgateway-prov/ istio-proxy	2	2000m	2000m	1Gi	1Gi	NA	NA
ocudr-ingressgateway-prov/ ingressgateway-prov	2	4	4	4Gi	4Gi	1Gi	57Mi
ocudr-ingressgateway-sig/ istio-proxy	9	4000m	4000m	1Gi	1Gi	NA	NA
ocudr-ingressgateway-sig/ ingressgateway-sig	9	6	6	4Gi	4Gi	1Gi	57Mi
ocudr-nudr-config/istio-proxy	2	1000m	1000m	1Gi	1Gi	NA	NA
ocudr-nudr-config/ nudr-config	2	1	1	1Gi	1Gi	1022Mi	72Mi

Table 3-72 (Cont.) Resource Allocation for UDR

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ocudr-nudr-config-server/istio-proxy	2	1000m	1000m	1Gi	1Gi	NA	NA
ocudr-nudr-config-server/config-server	2	1	1	1Gi	1Gi	1Gi	57Mi
ocudr-nudr-diameterproxy/nudr-diameterproxy	2	6	6	4Gi	4Gi	1022Mi	72Mi
ocudr-nudr-dr-provservice/istio-proxy	2	2000m	2000m	1Gi	1Gi	NA	NA
ocudr-nudr-dr-provservice/nudr-dr-provservice	2	4	4	4Gi	4Gi	1022Mi	72Mi
ocudr-nudr-drservice/istio-proxy	17	3000m	3000m	1Gi	1Gi	NA	NA
ocudr-nudr-drservice/nudr-drservice	17	6	6	4Gi	4Gi	1022Mi	72Mi
ocudr-nudr-notify-service/nudr-notify-service	3	6	6	5Gi	5Gi	1022Mi	72Mi
ocudr-nudr-nrf-client-nfmanagement/istio-proxy	2	1000m	1000m	1Gi	1Gi	NA	NA
ocudr-nudr-nrf-client-nfmanagement/nrf-client-nfmanagement	2	1	1	1Gi	1Gi	1Gi	57Mi

Table 3-72 (Cont.) Resource Allocation for UDR

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ocudr-performance/istio-proxy	2	1000m	1000m	1Gi	1Gi	NA	NA
ocudr-performance/perf-info	2	1	1	1Gi	1Gi	1Gi	57Mi
ocudr-nudr-diam-gateway/ nudr-diam-gateway	2	6	6	5Gi	5Gi	1Gi	72Mi

Table 3-73 Resource Allocation for cnDBTier Services

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	1	1	1	1Gi	1Gi	1Gi	90Mi
mysql-cluster-db-monitor-svc/db-monitor-svc	1	4	4	4Gi	4Gi	1Gi	90Mi
mysql-cluster-one-two-replication-svc/one-two-replication-svc	1	2	2	12Gi	12Gi	1Gi	90Mi
mysql-cluster-one-two-replication-svc/db-infra-monitor-svc	1	100m	100m	256Mi	256Mi	1Gi	90Mi

Table 3-73 (Cont.) Resource Allocation for cnDBTier Services

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ndbappmysqld/ mysqlndbcluster	6	12	12	20Gi	20Gi	1Gi	1Gi
ndbappmysqld/db-infra-monitor-svc	6	100m	100m	256Mi	256Mi	1Gi	90Mi
ndbappmysqld/init-sidecar	6	100m	100m	256Mi	256Mi	1Gi	90Mi
ndbmgmd/ mysqlndbcluster	2	4	4	10Gi	8Gi	1Gi	90Mi
ndbmgmd/ db-infra-monitor-svc	2	100m	100m	256Mi	256Mi	1Gi	90Mi
ndbmtd/ mysqlndbcluster	6	12	12	75Gi	75Gi	1Gi	1Gi
ndbmtd/db-backup-executor-svc	6	1	1	1Gi	1Gi	1Gi	90Mi
ndbmtd/db-infra-monitor-svc	6	100m	100m	256Mi	256Mi	1Gi	90Mi
ndbmysqld/ mysqlndbcluster	2	4	4	16Gi	16Gi	1Gi	1Gi
ndbmysqld/ init-sidecar	2	100m	100m	256Mi	256Mi	1Gi	90Mi
ndbmysqld/ db-infra-monitor-svc	2	100m	100m	256Mi	256Mi	1Gi	90Mi

3.1.6.2 Results

CPU and Memory Utilization

This section lists the CPU and memory utilization by Policy and cnDBTier microservices.

Table 3-74 CPU and Memory Utilization by Policy Microservices

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
Appinfo	3.00%	26.12%	None	None

Table 3-74 (Cont.) CPU and Memory Utilization by Policy Microservices

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
Bulwark Service	36.80%	52.54%	None	None
Notifier	0.05%	27.15%	None	None
Binding Service	22.19%	20.26%	None	None
Diameter Connector	0.12%	22.95%	None	None
Configuration Service	3.35%	41.46%	None	None
Egress Gateway	41.15%	22.13%	None	None
Ingress Gateway	1.95%	50.42%	None	None
NRF Client NF Discovery	0.20%	46.24%	None	None
NRF Client NF Management	0.30%	48.83%	None	None
UDR Connector	33.42%	43.24%	None	None
Audit Service	0.20%	13.31%	None	None
CM Service	0.21%	33.37%	None	None
PDS	45.85%	47.33%	None	None
PRE	39.68%	52.99%	None	None
Query Service	0.05%	30.96%	None	None
AM Service	0.20%	33.11%	None	None
SM Service	0.10%	26.32%	None	None
UE Service	0.30%	37.60%	None	None
CnPCRF core	38.20%	49.64%	None	None
Perfinfo	19.40%	14.79%	None	None
Usage Monitoring	55.45%	73.66%	None	None
Diameter Gateway	25.35%	25.80%	None	None

Table 3-75 CPU and Memory Utilization by UDR

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
ocudr-alternate-route/istio-proxy	0.00%	0.00%	None	None
ocudr-alternate-route/alternate-route	0.10%	26.37%	None	None
ocudr-appinfo/istio-proxy	0.00%	0.00%	None	None
ocudr-appinfo/ appinfo	2.95%	25.34%	None	None
ocudr-egressgateway/ istio-proxy	0.00%	0.00%	None	None
ocudr-egressgateway/ egressgateway	0.07%	19.59%	None	None

Table 3-75 (Cont.) CPU and Memory Utilization by UDR

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
ocudr-ingressgateway-prov/istio-proxy	0.00%	0.00%	None	None
ocudr-ingressgateway-prov/ ingressgateway-prov	0.10%	33.14%	None	None
ocudr-ingressgateway-sig/istio-proxy	0.00%	0.00%	None	None
ocudr-ingressgateway-sig/ ingressgateway-sig	31.78%	47.32%	None	None
ocudr-nudr-config/ istio-proxy	0.00%	0.00%	None	None
ocudr-nudr-config/ nudr-config	0.40%	48.58%	None	None
ocudr-nudr-config-server/istio-proxy	0.00%	0.00%	None	None
ocudr-nudr-config-server/config-server	0.80%	37.65%	None	None
ocudr-nudr-diameterproxy/ nudr-diameterproxy	1.10%	39.76%	None	None
ocudr-nudr-dr-provservice/istio-proxy	0.00%	0.00%	None	None
ocudr-nudr-dr-provservice/nudr-dr-provservice	1.26%	37.23%	None	None
ocudr-nudr-drservice/istio-proxy	0.00%	0.00%	None	None
ocudr-nudr-drservice/nudr-drservice	42.51%	49.26%	None	None
ocudr-nudr-notify-service/nudr-notify-service	81.46%	38.98%	None	None
ocudr-nudr-nrf-client-nfmanagement/ istio-proxy	0.00%	0.00%	None	None
ocudr-nudr-nrf-client-nfmanagement/nrf-client-nfmanagement	0.35%	51.03%	None	None

Table 3-75 (Cont.) CPU and Memory Utilization by UDR

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
ocudr-performance/istio-proxy	0.00%	0.00%	None	None
ocudr-performance/perf-info	3.35%	13.38%	None	None
ocudr-nudr-diam-gateway/nudr-diam-gateway	0.97%	33.75%	None	None

Table 3-76 CPU and Memory Utilization by cnDBTier Services

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	0.10%	8.30%	0.50%	8.59%
mysql-cluster-db-monitor-svc/db-monitor-svc	0.10%	11.52%	0.78%	11.89%
mysql-cluster-two-one-replication-svc/two-one-replication-svc	None	None	0.25%	2.28%
mysql-cluster-two-one-replication-svc/db-infra-monitor-svc	None	None	1.00%	20.31%
mysql-cluster-one-two-replication-svc/one-two-replication-svc	0.25%	2.22%	None	None
mysql-cluster-one-two-replication-svc/db-infra-monitor-svc	1.00%	19.53%	None	None
ndbappmysqld/mysqlndbcluster	45.18%	20.40%	0.12%	18.00%
ndbappmysqld/db-infra-monitor-svc	1.17%	20.83%	1.33%	20.57%
ndbappmysqld/init-sidecar	2.00%	0.39%	2.00%	0.39%
ndbmgmd/mysqlndbcluster	0.12%	20.20%	0.15%	20.20%
ndbmgmd/db-infra-monitor-svc	1.00%	19.53%	1.00%	19.34%
ndbmtd/mysqlndbcluster	29.06%	93.26%	7.27%	93.20%
ndbmtd/db-backup-executor-svc	0.10%	5.45%	0.10%	5.45%

Table 3-76 (Cont.) CPU and Memory Utilization by cnDBTier Services

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
ndbmtd/db-infra-monitor-svc	4.33%	20.25%	3.33%	20.31%
ndbmysqld/ mysqlndbcluster	18.06%	25.26%	9.95%	22.68%
ndbmysqld/init-sidecar	2.00%	0.39%	2.00%	0.39%
ndbmysqld/db-infra-monitor-svc	2.00%	22.66%	2.00%	22.85%

Latency

Table 3-77 Average NF service latency (in milliseconds)

NF Service Latency	Site1	Site2
PCF_IGW_Latency	130.250	NA
PCF_SM_Svc_Overall	0.000	NA
PCF_POLICYPDS_Overall	17.802	NA
PCF_UDRCONNECTOR_Overall	9.095	NA
PCF_CHFCONNECTOR_Overall	0.000	NA
PCF_NRFCLIENT_On_Demand	0.000	NA
PCF_UsrSvc_Overall	0.000	NA
PCF_EGRESS_Latency	7.465	NA
PCF_Binding_Svc_Latency	3.906	NA
PCF_Diam_Connector_Latency	0.000	NA
PCF_Diam_Gw_Latency	2195.993	NA
PCF_Usage_Mon	34719.919	NA
Pcrf_Core_Overall	1000.000	NA

Table 3-78 Average Latency (in milliseconds)

NF Service Latency	Site1	Site2
UDR_DB_Latency	0.030	NA
UDR_Req_Latency	2.470	NA
Diam_Db_Latency	0.000	NA
Diam_Backend_Latency	0.000	NA

3.1.7 Test Scenario: CnPCRF Voice and Data Call Model with 46.5K TPS per NFSet (with 46.5K TPS on only one instance)

This test run benchmarks the performance and capacity of Policy data call model that is deployed in PCF mode. The PCF application's total traffic (Ingress + Egress) of 46.5K TPS on single site PCF Setup with UDR interworking.

3.1.7.1 Test Case and Setup Details

Test Case Parameters

The following table describes the testcase parameters and their values:

Table 3-79 Testcase Parameters

Parameter	Value
Call Rate (Ingress + Egress)	46.5K TPS on a single site with UDR interworking
ASM	Disable
Traffic Ratio	46.5K TPS on a single site
Active User Count	NA

Policy Project Details:

The Policy Design editor based on the Blockly interface was used to set the Policy project for each of the Policy services. The complexity level of Policy Project configured for this run was **High.**

Complexity Level Definition:

- Low– No Usage of Loops in Blockly logic, No JSON operations, No complex Java Script code in Object Expression /Statement Expression.
- Medium - Usage of Loops in Blockly logic, Policy Table Wildcard match <= 3 fields, MatchList < 3, 3 < RegEx match < 6
- High - JSON Operations – Custom, complex Java Script code in Object Expression / Statement Expression, Policy Table Wildcard match > 3 fields, MatchLists >= 3, RegEx mat >= 6

Call Model Data:

Following PCF configurations were either enabled or disabled for running this call flow:

Table 3-80 Policy Configurations

Feature Name	Configuration
SAL	Enabled
Binding Service	Disabled
Congestion and Overload	Disabled
PDS Single UEID	Enabled (GPSI)
PRIMARYKEY_LOOKUP_ENABLED	Enabled (true)
PER	Disabled
OCS	Enabled
Audit	Enabled
PDS Compression scheme	Disabled

Table 3-81 Call Model Data

Service Name	Traffic at Site1	Traffic at Site2
Pcrf-Total-Tps (	46500	-

Infrastructure Details

Infrastructure used for benchmarking Policy performance run is described in this section.

Table 3-82 Hardware Details

Hardware	Details
Environment	BareMetal
Server	ORACLE SERVER X9-2
Model	Intel(R) Xeon(R) Platinum 8358 CPU
Clock Speed	2.600 GHz
Total Cores	128
Memory Size	1024 GB
Type	DDR4 SDRAM
Installed DIMMs	16
Maximum DIMMs	32
Installed Memory	1024 GB

Table 3-83 Software Details

Aplications	Version
Policy	25.1.200
cnDBTier	25.1.200
OSO	NA
CNE	23.3.5

Table 3-84 Observability Services

Service Names	Versions
OpenSearch	2.3.0
Fluentd	1.16.2
Prometheus	2.51.1
Grafana	9.5.3
Jaeger	1.52.0

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

Resource Allocation

Table 3-85 Resource Allocation for CnPCRF

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
NRFsim	2	NA	NA	NA	NA
Appinfo	1	2	1	2Gi	1Gi
Bulwark Service	2	8	8	6Gi	6Gi
Binding Service	1	6	6	8Gi	8Gi
Diameter Connector	4	4	4	2Gi	1Gi
CHF Connector User Service	2	6	6	4Gi	4Gi
Config-server	2	4	4	2Gi	512Mi
Egress Gateway	6	4	4	6Gi	6Gi
Ingress Gateway	2	5	5	6Gi	6Gi
NRF Client NF Discovery	2	4	4	4Gi	4Gi
NRF Client Management	2	1	1	1Gi	1Gi
UDR connector User Service	11	6	6	4Gi	4Gi
Audit Service	2	2	2	4Gi	4Gi
CM service	2	4	2	2Gi	512Mi
PolicyDS	28	7	7	8Gi	8Gi
PRE Service	20	4	4	4Gi	4Gi
Query Service	1	2	1	1Gi	1Gi
AM Service	2	8	8	8Gi	8Gi
SM Service	2	2	2	2Gi	2Gi
UE Policy Service	2	8	8	6Gi	6Gi
PCRF Core	32	8	8	8Gi	8Gi
Perf-info	2	2	1	2Gi	1Gi
UDMsim	2	NA	NA	NA	NA
Diameter Gateway	2	4	4	2Gi	1Gi

Table 3-86 Resource Allocation for UDR

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
UDR-Site1-ocudr-alternate-route/istio-proxy	2	1000m	1000m	1Gi	1Gi

Table 3-86 (Cont.) Resource Allocation for UDR

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
UDR-Site1-ocudr-alternate-route/alternate-route	2	2	2	2Gi	2Gi
UDR-Site1-ocudr-appinfo/istio-proxy	2	1000m	1000m	1Gi	1Gi
UDR-Site1-ocudr-appinfo/appinfo	2	1	1	1Gi	1Gi
UDR-Site1-ocudr-egressgateway/istio-proxy	2	1000m	1000m	1Gi	1Gi
UDR-Site1-ocudr-egressgateway/egressgateway	2	6	6	4Gi	4Gi
UDR-Site1-ocudr-ingressgateway-prov/istio-proxy	2	2000m	2000m	1Gi	1Gi
UDR-Site1-ocudr-ingressgateway-prov/ingressgateway-prov	2	4	4	4Gi	4Gi
UDR-Site1-ocudr-ingressgateway-sig/istio-proxy	9	4000m	4000m	1Gi	1Gi
UDR-Site1-ocudr-ingressgateway-sig/ingressgateway-sig	9	6	6	4Gi	4Gi
UDR-Site1-ocudr-nudr-config/istio-proxy	2	1000m	1000m	1Gi	1Gi
UDR-Site1-ocudr-nudr-config/nudr-config	2	2	2	2Gi	2Gi
UDR-Site1-ocudr-nudr-config-server/istio-proxy	2	1000m	1000m	1Gi	1Gi

Table 3-86 (Cont.) Resource Allocation for UDR

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
UDR-Site1-ocudr-nudr-config-server/config-server	2	2	2	2Gi	512Mi
UDR-Site1-ocudr-nudr-dbcr-auditor-service/istio-proxy	1	1000m	1000m	1Gi	1Gi
UDR-Site1-ocudr-nudr-dbcr-auditor-service/nudr-dbcr-auditor-service	1	2	2	2Gi	2Gi
UDR-Site1-ocudr-nudr-diameterproxy/nudr-diameterproxy	2	6	6	4Gi	4Gi
UDR-Site1-ocudr-nudr-dr-provservice/istio-proxy	2	2000m	2000m	1Gi	1Gi
UDR-Site1-ocudr-nudr-dr-provservice/nudr-dr-provservice	2	4	4	4Gi	4Gi
UDR-Site1-ocudr-nudr-drservice/istio-proxy	12	3000m	3000m	1Gi	1Gi
UDR-Site1-ocudr-nudr-drservice/nudr-drservice	12	6	6	4Gi	4Gi
UDR-Site1-ocudr-nudr-notify-service/nudr-notify-service	3	6	6	5Gi	5Gi
UDR-Site1-ocudr-nudr-nrf-client-nfmanagement/istio-proxy	2	1000m	1000m	1Gi	1Gi

Table 3-86 (Cont.) Resource Allocation for UDR

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
UDR-Site1-ocudr-nudr-nrf-client-nfmanagement/nrf-client-nfmanagement	2	1	1	1Gi	1Gi
UDR-Site1-ocudr-nudr-ondemand-migration/nudr-ondemand-migration	2	2	2	2Gi	2Gi
UDR-Site1-ocudr-performance/istio-proxy	2	1000m	1000m	1Gi	1Gi
UDR-Site1-ocudr-performance/perf-info	2	1	1	1Gi	1Gi
UDR-Site1-ocudr-nudr-diam-gateway/nudr-diam-gateway	2	6	6	5Gi	5Gi

Table 3-87 Resource Allocation for cnDBTier at Site1

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
Site1-mysql-cluster-chio-inde-replication-svc/chio-inde-replication-svc	1	3	2	12Gi	12Gi
Site1-mysql-cluster-chio-inde-replication-svc/db-infra-monitor-svc	1	100m	100m	256Mi	256Mi
Site1-mysql-cluster-chio-inde-replication-svc-2/chio-inde-replication-svc-2	1	2	2	12Gi	12Gi

Table 3-87 (Cont.) Resource Allocation for cnDBTier at Site1

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
Site1-mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	1	100m	100m	128Mi	128Mi
Site1-mysql-cluster-db-monitor-svc/db-monitor-svc	1	5	4	4Gi	4Gi
Site1-ndbappmysqld/mysqlndbcluster	10	9	9	20Gi	20Gi
Site1-ndbappmysqld/db-infra-monitor-svc	10	100m	100m	256Mi	256Mi
Site1-ndbappmysqld/init-sidecar	10	300m	300m	512Mi	512Mi
Site1-ndbmgmd/mysqlndbcluster	2	5	4	10Gi	8Gi
Site1-ndbmgmd/db-infra-monitor-svc	2	100m	100m	256Mi	256Mi
Site1-ndbmtd/mysqlndbcluster	6	12	12	125Gi	125Gi
Site1-ndbmtd/db-backup-executor-svc	6	1200m	1200m	2560Mi	2560Mi
Site1-ndbmtd/db-infra-monitor-svc	6	100m	100m	256Mi	256Mi
Site1-ndbmysqld/mysqlndbcluster	4	5	4	21Gi	21Gi
Site1-ndbmysqld/init-sidecar	4	300m	300m	512Mi	512Mi
Site1-ndbmysqld/db-infra-monitor-svc	4	100m	100m	256Mi	256Mi

Table 3-88 Resource Allocation for cnDBTier at Site2

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
Site2-mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	1	100m	100m	128Mi	128Mi
Site2-mysql-cluster-db-monitor-svc/db-monitor-svc	1	5	4	4Gi	4Gi
Site2-mysql-cluster-inde-chio-replication-svc/inde-chio-replication-svc	1	3	2	12Gi	12Gi
Site2-mysql-cluster-inde-chio-replication-svc/db-infra-monitor-svc	1	100m	100m	256Mi	256Mi
Site2-mysql-cluster-inde-chio-replication-svc-2/inde-chio-replication-svc-2	1	2	2	12Gi	12Gi
Site2-ndbappmysqld/mysqlndbcluster	10	9	9	20Gi	20Gi
Site2-ndbappmysqld/db-infra-monitor-svc	10	100m	100m	256Mi	256Mi
Site2-ndbappmysqld/init-sidecar	10	300m	300m	512Mi	512Mi
Site2-ndbmgmd/mysqlndbcluster	2	5	4	10Gi	8Gi
Site2-ndbmgmd/db-infra-monitor-svc	2	100m	100m	256Mi	256Mi
Site2-ndbmtd/mysqlndbcluster	6	12	12	125Gi	125Gi

Table 3-88 (Cont.) Resource Allocation for cnDBTier at Site2

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
Site2-ndbmtd/db-backup-executor-svc	6	1200m	1200m	2560Mi	2560Mi
Site2-ndbmtd/db-infra-monitor-svc	6	100m	100m	256Mi	256Mi
Site2-ndbmysqld/mysqlndbcluster	4	5	4	21Gi	21Gi
Site2-ndbmysqld/init-sidecar	4	300m	300m	512Mi	512Mi
Site2-ndbmysqld/db-infra-monitor-svc	4	100m	100m	256Mi	256Mi

Table 3-89 cnDBTier (for UDR) Resource Allocation at Site1:

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
Site1-mysql-cluster-chio-inde-replication-svc/chio-inde-replication-svc	1	2	2	12Gi	12Gi
Site1-mysql-cluster-chio-inde-replication-svc/db-infra-monitor-svc	1	100m	100m	256Mi	256Mi
Site1-mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	1	100m	100m	128Mi	128Mi
Site1-mysql-cluster-db-monitor-svc/db-monitor-svc	1	4	4	4Gi	4Gi
Site1-ndbappmysqld/mysqlndbcluster	10	6	6	4Gi	4Gi

Table 3-89 (Cont.) cnDBTier (for UDR) Resource Allocation at Site1:

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
Site1-ndbappmysqld/db-infra-monitor-svc	10	100m	100m	256Mi	256Mi
Site1-ndbappmysqld/init-sidecar	10	100m	100m	256Mi	256Mi
Site1-ndbmgmd/mysqlndbcluster	2	3	3	10Gi	10Gi
Site1-ndbmgmd/db-infra-monitor-svc	2	100m	100m	256Mi	256Mi
Site1-ndbmtd/mysqlndbcluster	4	4	4	120Gi	120Gi
Site1-ndbmtd/db-backup-executor-svc	4	100m	100m	256Mi	256Mi
Site1-ndbmtd/db-infra-monitor-svc	4	100m	100m	256Mi	256Mi
Site1-ndbmysqld/mysqlndbcluster	2	4	4	10Gi	10Gi
Site1-ndbmysqld/init-sidecar	2	100m	100m	256Mi	256Mi
Site1-ndbmysqld/db-infra-monitor-svc	2	100m	100m	256Mi	256Mi

Table 3-90 cnDBTier (for UDR) Resource Allocation at Site2:

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
Site2-mysql-cluster-chio-inde-replication-svc/chio-inde-replication-svc	1	2	2	12Gi	12Gi

Table 3-90 (Cont.) cnDBTier (for UDR) Resource Allocation at Site2:

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
Site2-mysql-cluster-chio-inde-replication-svc/db-infra-monitor-svc	1	100m	100m	256Mi	256Mi
Site2-mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	1	100m	100m	128Mi	128Mi
Site2-mysql-cluster-db-monitor-svc/db-monitor-svc	1	4	4	4Gi	4Gi
Site2-ndbappmysqld/mysqlndbcluster	10	6	6	4Gi	4Gi
Site2-ndbappmysqld/db-infra-monitor-svc	10	100m	100m	256Mi	256Mi
Site2-ndbappmysqld/init-sidecar	10	100m	100m	256Mi	256Mi
Site2-ndbmgmd/mysqlndbcluster	2	3	3	10Gi	10Gi
Site2-ndbmgmd/db-infra-monitor-svc	2	100m	100m	256Mi	256Mi
Site2-ndbmtd/mysqlndbcluster	4	4	4	120Gi	120Gi
Site2-ndbmtd/db-backup-executor-svc	4	100m	100m	256Mi	256Mi
Site2-ndbmtd/db-infra-monitor-svc	4	100m	100m	256Mi	256Mi
Site2-ndbmysqld/mysqlndbcluster	2	4	4	10Gi	10Gi

Table 3-90 (Cont.) cnDBTier (for UDR) Resource Allocation at Site2:

Service Name	Replicas	CPU Limit per Container (#)	CPU Request per Container (#)	Memory Limit per Container	Memory Request per Container
Site2-ndbmysqld/init-sidecar	2	100m	100m	256Mi	256Mi
Site2-ndbmysqld/db-infra-monitor-svc	2	100m	100m	256Mi	256Mi

3.1.7.2 Results

CPU and Memory Utilization

This section lists the CPU and memory utilization by Policy and cnDBTier microservices.

The average CPU utilization is the ratio between the current usage of resource to the requested resources of the pod, that is, total sum of CPU utilized for service pods / total CPU requested for service pods.

Table 3-91 CPU and Memory Utilization by Policy Microservices

Service Name	CPU at Site1	Memory at Site1	CPU at Site2	Memory at Site2
NRFsim	['NA']	['NA']	None	None
Appinfo	2.05%	12.99%	None	None
Bulwark service	0.04%	10.09%	None	None
Binding service	0.03%	7.71%	None	None
Diameter Connector	23.41%	49.26%	None	None
CHF Connector	0.05%	14.72%	None	None
Config Service	5.22%	47.71%	None	None
Egress Gateway	35.83%	34.24%	None	None
Ingress Gateway	0.19%	15.71%	None	None
NRF Client NF Discovery	0.09%	24.73%	None	None
NRF Client NF Management	0.35%	49.02%	None	None
UDR Connector	14.02%	41.10%	None	None
Audit Service	1.12%	29.38%	None	None
CM Service	0.24%	35.28%	None	None
PDS	34.78%	51.91%	None	None
PRE	28.38%	60.54%	None	None
Query Service	0.05%	31.54%	None	None
AM Service	0.04%	8.26%	None	None
SM Service	0.10%	38.28%	None	None
UE Service	0.04%	10.66%	None	None
PCRF Core	34.23%	52.03%	None	None

Table 3-91 (Cont.) CPU and Memory Utilization by Policy Microservices

Service Name	CPU at Site1	Memory at Site1	CPU at Site2	Memory at Site2
PerfInfo	0.10%	6.45%	None	None
UDMsim	['NA']	['NA']	None	None
Diameter Gateway	76.15%	48.80%	None	None

Table 3-92 CPU and Memory Utilization by cnDBTier Microservices

Service Name	CPU at Site1	Memory at Site1	CPU at Site2	Memory at Site2
mysql-cluster-chio-inde-replication-svc/chio-inde-replication-svc	0.20%	2.38%	None	None
mysql-cluster-chio-inde-replication-svc/db-infra-monitor-svc	2.00%	19.92%	None	None
mysql-cluster-chio-inde-replication-svc-2/chio-inde-replication-svc-2	0.30%	2.24%	None	None
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	4.00%	69.53%	None	None
mysql-cluster-db-monitor-svc/db-monitor-svc	0.10%	12.92%	None	None
ndbappmysqld/ mysqlndbcluster	57.55%	28.25%	None	None
ndbappmysqld/db-infra-monitor-svc	1.90%	21.68%	None	None
ndbappmysqld/init-sidecar	0.67%	0.20%	None	None
ndbmgmd/ mysqlndbcluster	0.12%	20.21%	None	None
ndbmgmd/db-infra-monitor-svc	1.00%	20.70%	None	None
ndbmtd/ mysqlndbcluster	37.85%	90.47%	None	None
ndbmtd/db-backup-executor-svc	0.08%	2.17%	None	None
ndbmtd/db-infra-monitor-svc	3.00%	21.22%	None	None
ndbmysqld/ mysqlndbcluster	10.77%	21.37%	None	None
ndbmysqld/init-sidecar	0.67%	0.20%	None	None
ndbmysqld/db-infra-monitor-svc	3.00%	23.05%	None	None

Latency

Table 3-93 Average Latency Observations for CnPCRF In Milliseconds:

Service Name	Latency at Site1	Latency at Site2
PCRF_Policyds	12.7	-
PCRF_Binding	0.00	-
PCRF_Diam_connector	1.17	-
PCRF_Core_JDBC_Latency	1.00	-

Table 3-94 Average Latency Observations for UDR In Milliseconds:

Service Name	Latency at Site1	Latency at Site2
UDR_DB_Latency	0.02	-
UDR_Req_Latency	1.51	-
Diam_Db_Latency	0.00	-
Diam_Backend_Latency	0.00	-

Table 3-95 Average Latency Observations for CnPCRF for current percentile In Milliseconds:

Methods	50th Percentile at Site1	99th Percentile at Site1	50th Percentile at Site2	99th Percentile at Site2
DIAM	0.00	0.02	-	-

Table 3-96 Average Latency Observations for UDR for current percentile In MilliSeconds:

Methods	50th Percentile at Site1	99th Percentile at Site1	50th Percentile at Site2	99th Percentile at Site2
IGW_GET	0.00	0.01	-	-
IGW_DELETE	0.00	0.01	-	-
IGW_PUT	0.00	0.00	-	-
EGW_GET	0.00	0.00	-	-
EGW_DELETE	0.00	0.00	-	-
EGW_PUT	0.00	0.01	-	-

Table 3-97 Additional Latency

Latency	Gx Interface	Rx Interface	Sy Interface
Additional Induced Latency	100ms	100ms	100ms
Additional PER	0.01%	0.01%	0.01%

Table 3-98 Latency obervations for cnDBTier services

Site-Slave Node	cnDBTier Replication Slave Delay (seconds)
Site1-ndbmysqld	0-1
Site2-ndbmysqld	0-1

3.2 PCF Call Models

Following are the cnDBTier Helm Parameters that needs to be configured for all the test scenarios for AM/UE .

Table 3-99 Configuring cnDBTier Helm Parameters

Helm Parameter	Value
db-monitor-svc.restartSQLNodesIfBinlogThreadStalled	true
global.additionalndbconfigurations.mysqld.binlog_cache_size	10485760
global.additionalndbconfigurations.ndb.NoOfFragmentLogFiles	64
global.additionalndbconfigurations.mysqld.ndb_allow_copying_alter_table	1
global.additionalndbconfigurations.ndb.ConnectCheckIntervalDelay	500
global.additionalndbconfigurations.ndb.NoOfFragmentLogParts	6
global.additionalndbconfigurations.ndb.MaxNoOfExecutionThreads	10
global.additionalndbconfigurations.ndb.FragmentLogFileSize	32M
db-monitor-svc.binlogthreadstore.capacity	5
global.additionalndbconfigurations.mysqld.ndb_allow_copying_alter_table	ON
global.additionalndbconfigurations.ndb.MaxNoOfOrderedIndexes	4096
global.additionalndbconfigurations.ndb.binlog_expire_logs_seconds	259200
global.additionalndbconfigurations.ndb.MaxBufferedEpochBytes	536870912
global.additionalndbconfigurations.ndb.MaxBufferedEpochs	1000
global.additionalndbconfigurations.ndb.MaxNoOfUniqueHashIndexes	4096
global.additionalndbconfigurations.ndb.HeartbeatIntervalDbDb	500
global.additionalndbconfigurations.ndb.SchedulerExecutionTimer	100
global.additionalndbconfigurations.ndb.RedoBuffer	32M
global.additionalndbconfigurations.ndb.TotalSendBufferMemory	3072M

3.2.1 Test Scenario: PCF AM/UE Call Model on Two-Site Georedundant Setup, with Single-Site Handling 60K TPS Traffic and ASM Enabled

This test was run to benchmark the performance and capacity of PCF call model with 30K traffic on a single site. Binding feature was enabled.

3.2.1.1 Test Case and Setup Details

Testcase Parameters

The following table describes the testcase parameters and their values:

Parameters	Values
Call Rate (Ingress + Egress)	30K TPS on a single site
ASM	Disable
Traffic Ratio	IGW-11,EGW-26,Diam-in 9,Diam-Out 3IGW-11 ,EGW-26,Diam-in=9,Diam-out - 3

Project Details

The Policy Design editor based on the Blockly interface was used to set the Policy project for each of the Policy services. The complexity level of Policy Project configured for this run was **High.**

Complexity Level Definition:

- Low – No usage of loops in Blockly logic, no JSON operations, and no complex Java Script code in object expression/statement expression.
- Medium – Usage of loops in Blockly logic, Policy table wildcard match <= 3 fields, MatchList < 3, and 3 < RegEx match < 6
- High – JSON Operations – Custom, complex Java script code in object Expression/ statement expression, Policy table wildcard match > 3 fields, MatchLists >= 3, and RegEx mat >= 6

Call Model

Table 3-100 Traffic distribution

Traffic	TPS
Ingress Gateway	6637
Egress Gateway	15988
Diam In	5279
Diam out	1844
Total	29747

Table 3-101 Traffic distribution to Policy databases

Number of Entries	TPS
occnp_pcf_sm.AppSession	132704

Table 3-101 (Cont.) Traffic distribution to Policy databases

Number of Entries	TPS
occnp_pcf_sm.SmPolicyAssociation	434302
occnp_pcf_sm.SmPolicyAssociation$EX	0
occnp_policyds.pdssubscriber	434475
occnp_policyds.pdssubscriber$EX	0
occnp_policyds.pdsprofile	324110
occnp_policyds.pdsprofile$EX	0
occnp_binding.contextbinding	434668
ooccnp_binding.contextbinding$EX	0
occnp_binding.dependentcontextbinding	77294
occnp_binding.dependentcontextbinding$EX	0

Table 3-102 Traffic distribution at Policy services

Policy Service	Avg TPS/MPS
Ingress Gateway(MPS)	13294.09
Egress Gateway(MPS)	30644.41
SM Service(MPS)	46777.97
AM Service(MPS)	0.00
UE Service(MPS)	0.00
PDS(MPS)	13115.32
CHF Connector(MPS)	6452.53
UDR Connector(MPS)	3638.04
Binding(MPS)	0.00

Policy Configurations

Following PCF configurations were either enabled or disabled for running this call flow:

Table 3-103 Policy configurations

Name	Status
Bulwark	Disabled
Binding	Disabled
Subscriber State Variable (SSV)	Enabled
Validate_user	Enabled
Alternate Route	Enabled
Audit	Enabled
Compression (Binding & SM Service)	Disabled
SYSTEM.COLLISION.DETECTION	Disabled

Policy Interfaces

Following Policy interfaces were either enabled or disabled for running this call flow:

Table 3-104 Policy interfaces

Feature Name	Status
Subscriber Tracing[For 100 subscriber]	Enabled
N36 UDR subscription (N7/N15-Nudr)	Enabled
UDR on-demand nrf discovery	NA
CHF (SM-Nchf)	Enabled
BSF (N7-Nbsf)	NA
AMF on demand nrf discovery	NA
LDAP (Gx-LDAP)	NA
Binding Feature	Disabled

Infrastructure Details

Table 3-105 Software Details

Applications	Versions
Policy	24.1.0
cnDBTier	24.1.0
ASM	Disabled
OSO	NA
CNE	23.1.1
CNC Console	24.1.0

Table 3-106 Hardware Details

Hardware	Details
Environment	BareMetal
Server	Oracle Server X8-2
Model	Intel(R) Xeon(R) Platinum 8260
Clock Speed	2.400 GHz
Total Cores	96
Memory Size	576 GB
Type	DDR4 SDRAM
Installed DIMMs	18
Maximum DIMMs	24
Installed Memory	576 GB

Resource Allocation

Table 3-107 Resource Allocation for Policy Microservices

Service Name	Replicas	CPU Request per Pod (#)	CPU Limit per Pod (#)	Memory Request per Pod (Gi)	Memory Limit per Pod (Gi)
Appinfo	2	1	1	0.5	1
Binding Service	2	6	6	8	8

Table 3-107 (Cont.) Resource Allocation for Policy Microservices

Service Name	Replicas	CPU Request per Pod (#)	CPU Limit per Pod (#)	Memory Request per Pod (Gi)	Memory Limit per Pod (Gi)
Diameter Connector	4	4	4	1	2
Diameter Gateway	4	4	4	1	2
Audit Service	1	2	2	4	4
CM Service	1	4	4	0.5	2
Config Service	1	4	4	0.5	2
Egress Gateway	8	4	4	6	6
Ingress Gateway	8	4	4	6	6
NRF Client NF Discovery	1	4	4	0.5	2
NRF Client Management	1	1	1	1	1
Query Service	1	2	2	1	1
PRE	13	4	4	4	4
SM Service	9	8	8	6	6
PDS	8	6	6	6	6
UDR Connector	2	6	6	4	4
CHF Connector/ User Service	2	6	6	4	4

Table 3-108 CnDBTier Resource Allocation

Service Name	Replicas	CPU Request per Pod (#)	CPU Limit per Pod (#)	Memory Request per Pod (Gi)	Memory Limit per Pod (Gi)
ndbappmysqld	4	12	12	28	28
ndbmgmd	2	4	4	9	12
ndbmtd	8	8	8	42	42
db-infra-monitor-svc	1	200	200	500	500
db-backup-manager-svc	1	100	100	128	128

3.2.1.2 Results

CPU and Memory Utilization

The following section describes the CPU and memory utilization for Policy and cnDBTier microservices.

The average CPU utilization is the ratio between the current usage of resource to the requested resources of the pod i.e., total sum of CPU utilized for service pods / total CPU requested for service pods.

Table 3-109 CPU and Memory Utilization by Policy Microservices

App/ Container	CPU	Memory
AppInfo	4.00%	25.40%
Diameter Connector	39.80%	75.70%
CHF Connector	57.30%	58.90%
Config Service	2.78%	3.60%
Egress Gateway	47.50%	26.90%
Ingress Gateway	53.60%	42.42%
NRF Client NF Discovery	0.102%	33.59%
NRF Client NF Management	0.214%	41.6%
UDR Connector	25.50%	71.90%
Audit Service	0.669%	46.3%
CM Service	0.38%	34.16%
PDS	48.67%	64.20%
PRE Service	15.9%	49.6%
Query Service	0.0357%	25.12%
AM Service	0.02%	14.96%
SM Service	64.60%	76.23%
UE Service	0.387%	34.57%

Table 3-110 CPU and Memory Utilization by CnDBTier services

Service	CPU	Memory
ndbappmysqld/mysqlndbcluster	51.50%	44.70%
ndbmgmd/db-infra-monitor-svc	10.30%	16.90%
ndbmtd/mysqlndbcluster	35.1%	72.60%
ndbmtd/db-backup-executor-svc	35.1%	2.32%
ndbmtd/db-infra-monitor-svc	35.1%	13.60%

Latency

Table 3-111 Average latency observations

Scenario	Average Latency (ms)	Peak Latency (ms)
create-dnn_ims	54.142	66.775
N7-dnn_internet_1st	20.316	22.226
N7-dnn_internet_2nd	23.517	26.133
N7-dnn_internet_3rd	20.071	21.323
delete-dnn_ims	29.722	47.689
Overall	29.554	66.775

Table 3-112 Average NF service latency

NF Service Latency (In Seconds)	Avg
PCF_IGW_Latency	17.45
PCF_POLICYPDS_Latency	16.85
PCF_UDRCONNECTOR_Latency	2.19
PCF_NRFCLIENT_Latency	0.00
PCF_EGRESS_Latency	0.51

3.2.2 Test Scenario: PCF AM/UE Call Model on Two-site Georedundant Setup, with 54K TPS per NFSet (with 54K TPS on only one instance) (with ASM)

This test run benchmarks the performance and capacity of Policy AM/UE data call model that is deployed in PCF mode. The PCF application handles a total traffic (Ingress + Egress) of 54K TPS on one site and there is no traffic on the other site. Application compression was enabled. For this setup, Aspen Service Mesh (ASM) was enabled between Policy services. In this test setup, immediate reporting and stale request cleanup for UE is enabled for 72 hrs.

3.2.2.1 Test Case and Setup Details

Test Case Parameters

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

Table 3-113 Testcase Parameters

Parameters	Values
Call Rate (Ingress + Egress)	54k on site-1 and no traffic on site-2
ASM	Enabled
Traffic Ratio	AM- Create-1, AM Delete-1, AM Update- 0.2, UE Create-1, UE Update -0.2, UE Delete-1, N1N2transfer-1, N1subscribe-1, N1Unsubscribe-1
Active Subscribers	8 million subscribers and 16 million sessions
N1N2 Transfer	417
N1N2 Subscribe	417
N1N2 Unsubscribe	417

Policy Project Details:

The Policy Design editor based on the Blockly interface was used to set the Policy project for each of the Policy services. The complexity level of Policy Project configured for this run was High.

Complexity Level Definition:

- Low– No Usage of Loops in Blockly logic, No JSON operations, No complex Java Script code in Object Expression /Statement Expression.

- Medium - Usage of Loops in Blockly logic, Policy Table Wildcard match <= 3 fields, MatchList < 3, 3 < RegEx match < 6
- High - JSON Operations – Custom, complex Java Script code in Object Expression / Statement Expression, Policy Table Wildcard match > 3 fields, MatchLists >= 3, RegEx mat >= 6

Call Model Data

Table 3-114 Traffic distribution per call flow

Call Flow	Traffic at Site1
TOTAL-IGW	22.8K
TOTAL-EGW	32.8K (Including N1 Messages)
DIAM-GW-IN-TOTAL	NA
DIAM-GW-OUT-TOTAL	NA
TOTAL-TPS	54.6K

Following PCF configurations were either enabled or disabled for running this call flow:

Feature Name	Configuration
Binlog	Enabled
Compression	Enabled (AM,UE, PDS)
PRIMARYKEY_LOOKUP_ENABLED	Enabled
Enable Immediate Report on Subscription	Enabled
Congestion Control	Enabled
Overload Control	Enabled
Immediate Reporting	Enabled
POP 25	Enabled
Stale Request Cleanup	Enabled
RAB	Enabled
SAC	Enabled
SINGLE UE ID	Enabled
Location Information Header	Enabled
UE Stale Cleanup	Disabled
Session Limiting	Enabled
Collision Detection set to true in Advanced Settings	
Pending Transaction	Enabled (Bulwark)

Infrastructure Details

Infrastructure used for benchmarking Policy performance run is described in this section.

Table 3-115 Hardware Details

Hardware	Details
Environment	BareMetal
Server	ORACLE SERVER X9-2
Model	Intel(R) Xeon(R) Platinum 8358 CPU
Clock Speed	2.600 GHz

Table 3-115 (Cont.) Hardware Details

Hardware	Details
Total Cores	128
Memory Size	768 GB
Type	DDR4 SDRAM
Installed DIMMs	24
Maximum DIMMs	32
Installed Memory	768 GB

Table 3-116 Software Details

Aplications	Version
Policy	25.2.201
cnDBTier	25.2.200
ASM	1.14.6
OSO	NA
CNE	25.1.200
CNC Console	25.2.200

Table 3-117 Observability Services

Service Names	Versions
OpenSearch	2.15.0
Fluentd	1.17.1
Prometheus	3.2.0
Grafana	9.5.3
Jaeger	1.65.0

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

Resource Allocation

Table 3-118 Resource Allocation for Policy Microservices

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replica
Appinfo	1	1	1Gi	512Mi	1Gi	78Mi	2
Appinfo Istio	2	2	2	2	-	-	2
Bulwark service	8	8	6	6	2Gi	78Mi	13

Table 3-118 (Cont.) Resource Allocation for Policy Microservices

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replica
Bulwark service Istio	2500m	2500m	4	4	-	-	13
Alternate Route Service	2	2	4	2	4Gi	78Mi	12
Alternate Route Service Istio	2	2	2Gi	2Gi	-	-	12
CHF Connector	6	6	4	4	4Gi	78Mi	1
CHF Connector Istio	2	2	2	2	-	-	1
Config Service	4	2	2	512Mi	2Gi	78Mi	2
Config Service Istio	2	2	2	2	-	-	2
Egress Gateway	8	8	6	6	6	78	13
Egress Gateway Istio	4	4	2	2	-	-	13
Ingress Gateway	5	5	6	6	6	78	18
Ingress Gateway Istio	2500m	2500m	2	2	-	-	18
NRF Client NF Management	1	1	1	1	1	78	2
NRF Client NF Management Istio	2	2	2	2	-	-	2
NRF Client NF Discovery	4	4	4	4	1	78	25
NRF Client NF Discovery Istio	2	2	2	2	-	-	25
UDR Connector	6	6	4	4	1	78	22

Table 3-118 (Cont.) Resource Allocation for Policy Microservices

Microservices	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container	Replica
UDR Connector Istio	2	2	2	2	-	-	22
Audit Service	2	2	4	4	1	78	2
Audit Service Istio	2	2	2	2	-	-	2
CM Service	4	4	2	2	2	78	2
CM Service Istio	2	2	2	2	-	-	2
PDS	7	7	8	8	4	78	30
PDS Istio	3	3	4	4	-	-	30
PRE	4	4	4	4	2	78	24
PRE Istio	1500m	1500m	2	2	-	-	24
Query Service	2	1	1	1	1	78	2
Query Service Istio	2	2	2	2	-	-	2
AM Service	8	8	8	8	1	78	28
AM Service Istio	3	3	2	2	-	-	28
UE Policy Service	8	8	6	6	1	78	38
UE Policy Service Istio	2	2	2	2	-	-	38
PerfInfo	1	1	1	512Mi	1	78	2
PerfInfo Istio	1	1	0.5	0.5	-	-	2

Table 3-119 Resource Allocation for cnDBTier Microservices

Microservices	Replica	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
Site1-mysql-cluster-db-backup-manager-svc/istio-proxy	1	1	1	2Gi	2Gi	NA	NA
Site1-mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	1	1	1	1Gi	1Gi	1Gi	90Mi
Site1-mysql-cluster-db-monitor-svc/istio-proxy	1	1	1	2Gi	2Gi	NA	NA
Site1-mysql-cluster-db-monitor-svc/db-monitor-svc	1	4	4	4Gi	4Gi	1Gi	1000Mi
Site1-ndbappmysqld/istio-proxy	16	4	4	2Gi	2Gi	NA	NA
Site1-ndbappmysqld/mysqlndbcluster	16	12	12	20Gi	20Gi	1Gi	1000Mi
Site1-ndbappmysqld/db-infra-monitor-svc	16	100m	100m	256Mi	256Mi	512Mi	512Mi
Site1-ndbappmysqld/init-sidecar	16	300m	300m	512Mi	512Mi	500Mi	200Mi
Site1-ndbmgmd/istio-proxy	2	1	1	2Gi	2Gi	NA	NA

Table 3-119 (Cont.) Resource Allocation for cnDBTier Microservices

Microservices	Replica	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
Site1-ndbmgmd/mysqlndbcluster	2	4	4	10Gi	8Gi	1Gi	1000Mi
Site1-ndbmgmd/db-infra-monitor-svc	2	100m	100m	256Mi	256Mi	1Gi	90Mi
Site1-ndbmtd/istio-proxy	10	5	5	2Gi	2Gi	NA	NA
Site1-ndbmtd/mysqlndbcluster	10	12	12	75Gi	75Gi	2Gi	90Mi
Site1-ndbmtd/db-backup-executor-svc	10	1	1	2Gi	2Gi	512Mi	512Mi
Site1-ndbmtd/db-infra-monitor-svc	10	200m	200m	256Mi	256Mi	512Mi	90Mi
Site1-ndbmysqld/istio-proxy	6	1	1	2Gi	2Gi	NA	NA
Site1-ndbmysqld/mysqlndbcluster	6	4	4	24Gi	24Gi	1Gi	1000Mi
Site1-ndbmysqld/init-sidecar	6	300m	300m	512Mi	512Mi	500Mi	200Mi
Site1-ndbmysqld/db-infra-monitor-svc	6	100m	100m	256Mi	256Mi	512Mi	512Mi

3.2.2.2 Results

CPU and Memory Utilization

The following section describes the CPU and memory utilization by Policy and cnDBTier microservices.

Table 3-120 CPU and Memory Utilization by Policy Microservices

Microservices	CPU utilization	Memory utilization	CPU utilization- ISTIO	Memory utilization- ISTIO
ue-service	15.46%	28.07%	28.70%	8.41%
occnp-ingress-gateway	24.45%	41.09%	27.71%	16.73%
bulwark	19.68%	13.17%	34.89%	3.94%
policyds	32.18%)	27.98%	34.44%	4.54%
udr-connector	32.78%	55.22%	52.31%	8.70%
occnp-egress-gateway	26.30%	31.55%	32.27%	8.67%
am-service	20.23%	39.07%	24.60%	8.54%
perf-info	12.30%	14.99%	-	-
pre-service	9.43%	38.80%	17.44%	8.26%
nrf-client-nfdiscovery	6.81%	36.43%	5.63%	7.64%
config-server	7.85%	37.08%	17.15%	9.67%
appinfo	4.70%	29.10%	0.20%	7.37%
cm-service	0.61%	65.26%	0.90%	6.81%
nrf-client-nfmanagement	0.30%	55.66%	0.12%	10.62%
audit-service	0.12%	22.00%	0.18%	7.03%
queryservice	0.05%	33.79%	0.10%	7.30%
chf-connector	0.10%	29.54%	0.40%	8.11%
occnp-alternate-route	10.73%	20.54%	16.05%	7.39%

Table 3-121 CPU and Memory Utilization by cnDBTier Microservices

Microservices	CPU - Site1	Memory - Site1
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	0.45%	8.69%
mysql-cluster-db-monitor-svc/db-monitor-svc	1.00%	33.64%
mysql-cluster-one-two-c1-replication-svc/one-two-c1-replication-svc	0.60%	2.47%
mysql-cluster-one-two-c1-replication-svc/db-infra-monitor-svc	0.50%	20.70%
mysql-cluster-one-two-c2-replication-svc/one-two-c2-replication-svc	0.91%	13.33%
ndbappmysqld/mysqlndbcluster	70.96%	29.98%
ndbappmysqld/db-infra-monitor-svc	1.00%	21.72%
ndbappmysqld/init-sidecar	3.60%	0.39%
ndbmgmd/mysqlndbcluster	0.57%	18.06%

Table 3-121 (Cont.) CPU and Memory Utilization by cnDBTier Microservices

Microservices	CPU - Site1	Memory - Site1
ndbmgmd/db-infra-monitor-svc	1.00%	20.12%
ndbmtd/mysqlndbcluster	27.91%	82.66%
ndbmtd/db-backup-executor-svc	0.05%	2.76%
ndbmtd/db-infra-monitor-svc	7.25%	20.90%
ndbmysqld/mysqlndbcluster	8.12%	21.86%
ndbmysqld/init-sidecar	3.25%	0.59%
ndbmysqld/db-infra-monitor-svc	2.00%	24.02%

Latency

Table 3-122 Average Latency Observations (in milliseconds) for the call flows:

Microservice	Average Latency
Ingress	22.0
PDS	15.2
UDR	8.24
NrfClient Discovery	0.348
Egress	3.72
AM	18.1
UE	20.7

Table 3-123 Average Current Percentile Latency Observations (in milliseconds)

METHODS	50th Percentile (Site1)	95th Percentile (Site1)
UE CREATE	20.2	44.5
UE POST	29.177	84.797
UE DELETE	4.261	9.461
AM CREATE	28.3	60.2
AM POST	27.561	84.200
AM DELETE	4.260	9.260

3.2.3 Test Scenario: PCF SM Call Model on Two-Site GeoRedundant Setup with 55K TPS per NFSet (with 55K TPS on only one instance) (with ASM)

This test run benchmarks the performance and capacity of Policy data call model that is deployed in PCF mode. The PCF application handles a total (Ingress+Egress) traffic of 55K TPS, for SM call flows. For this setup Aspen Service Mesh (ASM) was enabled.

3.2.3.1 Test Case and Setup Details

Test Case Parameters

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

Table 3-124 Testcase Parameters

Parameters	Values
Call Rate (Ingress + Egress)	55K TPS on one instance in a two site geo-redundant setup
Execution Time	10 hours
ASM	1.14.6
Traffic Ratio	Old Call Model • Internet: SM 1-Create 15-update 1-delete • IMS: SM 1-Create 8-update 1-delete • Application: SM 1-Create 0-update 1-delete • Administrator: SM 1-Create 0-update 1-delete New Call Model • Internet: SM 1-Create 217-update 1-delete • IMS: SM 1-Create 94-update 1-delete • Application: SM 1-Create 0-update 1-delete • Administrator: SM 1-Create 0-update 1-delete
Active Subscribers	15M Subscribers / 30M sessions

Policy Project Details:

The Policy Design editor based on the Blockly interface was used to set the Policy project for each of the Policy services. The complexity level of Policy Project configured for this run was High.

Complexity Level Definition:

- Low– No Usage of Loops in Blockly logic, No JSON operations, No complex Java Script code in Object Expression /Statement Expression.
- Medium - Usage of Loops in Blockly logic, Policy Table Wildcard match <= 3 fields, MatchList < 3, 3 < RegEx match < 6
- High - JSON Operations – Custom, complex Java Script code in Object Expression / Statement Expression, Policy Table Wildcard match > 3 fields, MatchLists >= 3, RegEx mat >= 6

Call Model Data

Table 3-125 Call Model Data

Services	TPS
Total HTTP Ingress	41.9K
Total HTTP Egress	6.86K
Diameter Gateway In	4.33K
Diameter Gateway Out	1.77K

Following PCF configurations were either enabled or disabled for running this call flow:

Table 3-126 PCF Configurations

Local SSV	Enabled
On Demand Discovery UDR (UDR Group ID)	Enabled

Table 3-126 (Cont.) PCF Configurations

Application based Compression (SM & PDS)	Enabled
Overload Control	Enabled
Single_UE_ID_PREFERENTIAL_SEARCH	Enabled
Non-SUPI based On-Demand Discovery Caching	Enabled
Congestion Control	Enabled

Infrastructure Details

Table 3-127 Software Details

Aplications	Version
Policy	25.2.201
cnDBTier	25.2.201
ASM	1.14.6
OSO	25.2.201
CNE	25.1.200
CNC Console	25.2.200

Table 3-128 Observability Services

Service Names	Versions
OpenSearch	2.15.0
Fluentd	1.17.1
Prometheus	3.2.0
Grafana	9.5.3
Jaeger	1.65.0

For more information about Policy Installation, see *Oracle Communications Cloud Native Core, Converged Policy Installation, Upgrade, and Fault Recovery Guide*.

Table 3-129 Hardware Details

Hardware	Details
Environment	BareMetal
Server	Oracle Server X9-2
Model	Intel(R) Xeon(R) Platinum 8358
Clock Speed	2.600 GHz
Total Cores	128
Memory Size	768 GB
Type	DDR4 SDRAM
Installed DIMMs	24
Maximum DIMMs	32
Installed Memory	768 GB

Resource Allocation

Table 3-130 Resource Allocation for Policy Microservices

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ocpcf-appinfo/istio-proxy	2	1.1	1.1	2Gi	2Gi	NA	NA
ocpcf-appinfo/appinfo	2	1100m	1100m	1Gi	1Gi	1Gi	78Mi
ocpcf-bulwark/istio-proxy	22	4	4	2Gi	2Gi	NA	NA
ocpcf-bulwark/bulwark	22	8	8	6Gi	6Gi	2Gi	78Mi
ocpcf-oc-binding/istio-proxy	11	4	4	2Gi	2Gi	NA	NA
ocpcf-oc-binding/binding	11	6	6	8Gi	8Gi	4Gi	78Mi
ocpcf-oc-diam-connector/istio-proxy	5	2	2	2Gi	2Gi	NA	NA
ocpcf-oc-diam-connector/diam-connector	5	4	4	2Gi	2Gi	2Gi	78Mi
ocpcf-occnp-alternate-route/istio-proxy	7	2	2	2Gi	2Gi	NA	NA
ocpcf-occnp-alternate-route/occnp-alternate-route	7	2	2	4Gi	4Gi	1Gi	78Mi
ocpcf-occnp-chf-connector/istio-proxy	3	4	4	2Gi	2Gi	NA	NA

Table 3-130 (Cont.) Resource Allocation for Policy Microservices

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ocpcf-occnp-chf-connector/user-service	3	6	6	6Gi	6Gi	4Gi	78Mi
ocpcf-occnp-config-server/istio-proxy	2	2	2	2Gi	2Gi	NA	NA
ocpcf-occnp-config-server/config-server	2	4	4	2Gi	2Gi	2Gi	78Mi
ocpcf-occnp-egress-gateway/istio-proxy	7	4	4	2Gi	2Gi	NA	NA
ocpcf-occnp-egress-gateway/occnp-egress-gateway	7	8	8	6Gi	6Gi	6Gi	78Mi
ocpcf-occnp-ingress-gateway/istio-proxy	28	4	4	2Gi	2Gi	NA	NA
ocpcf-occnp-ingress-gateway/occnp-ingress-gateway	28	6	6	6Gi	6Gi	6Gi	78Mi
ocpcf-occnp-nrf-client-nfdiscovery/istio-proxy	3	2	2	2Gi	2Gi	NA	NA

Table 3-130 (Cont.) Resource Allocation for Policy Microservices

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ocpcf-occnp-nrf-client-nfdiscovery/nrf-client-nfdiscovery	3	4	4	6Gi	6Gi	1Gi	78Mi
ocpcf-occnp-nrf-client-nfmanagement/istio-proxy	2	2	2	2Gi	2Gi	NA	NA
ocpcf-occnp-nrf-client-nfmanagement/nrf-client-nfmanagement	2	2	2	1Gi	1Gi	1Gi	78Mi
ocpcf-occnp-udr-connector/istio-proxy	3	4	4	2Gi	2Gi	NA	NA
ocpcf-occnp-udr-connector/user-service	3	6	6	4Gi	4Gi	4Gi	78Mi
ocpcf-ocpm-audit-service/istio-proxy	2	2	2	2Gi	2Gi	NA	NA
ocpcf-ocpm-audit-service/audit-service	2	2	2	4Gi	4Gi	1Gi	78Mi
ocpcf-ocpm-cm-service/istio-proxy	2	2	2	2Gi	2Gi	NA	NA
ocpcf-ocpm-cm-service/cm-service	2	4	4	2Gi	2Gi	2Gi	78Mi

Table 3-130 (Cont.) Resource Allocation for Policy Microservices

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ocpcf-ocpm-policyds/istio-proxy	27	4	4	4Gi	4Gi	NA	NA
ocpcf-ocpm-policyds/policyds	27	8	8	8Gi	8Gi	4Gi	78Mi
ocpcf-ocpm-pre/istio-proxy	39	2	2	2Gi	2Gi	NA	NA
ocpcf-ocpm-pre/pre-service	39	4	4	4Gi	4Gi	2Gi	78Mi
ocpcf-ocpm-queryservice/istio-proxy	2	2	2	2Gi	2Gi	NA	NA
ocpcf-ocpm-queryservice/queryservice	2	2	2	1Gi	1Gi	1Gi	78Mi
ocpcf-pcf-smservice/istio-proxy	63	4	4	2Gi	2Gi	NA	NA
ocpcf-pcf-smservice/sm-service	63	8	8	10Gi	10Gi	4Gi	78Mi
ocpcf-performance/istio-proxy	2	2	2	2Gi	2Gi	NA	NA
ocpcf-performance/perf-info	2	2	2	1Gi	1Gi	1Gi	78Mi
ocncc-iam-kc/istio-proxy	1	2	2	2Gi	2Gi	NA	NA
ocncc-iam-kc/healthcheck	1	1100m	1100m	512Mi	290Mi	1102Mi	57Mi
ocncc-iam-kc/iam-kc	1	2	2	2Gi	2Gi	1102Mi	57Mi

Table 3-130 (Cont.) Resource Allocation for Policy Microservices

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ocpcf-oc-diam-gateway/istio-proxy	4	2	2	2Gi	2Gi	NA	NA
ocpcf-oc-diam-gateway/diam-gateway	4	4	4	2Gi	2Gi	2Gi	78Mi

Table 3-131 Resource Allocation for cnDBTier Microservices

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
mysql-cluster-db-backup-manager-svc/istio-proxy	1	1.1	1.1	2Gi	2Gi	NA	NA
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	1	1100m	1100m	1Gi	1Gi	1Gi	200Mi
mysql-cluster-db-monitor-svc/istio-proxy	1	2	2	2Gi	2Gi	NA	NA
mysql-cluster-db-monitor-svc/db-monitor-svc	1	4	4	4Gi	4Gi	1Gi	90Mi
ndbappmysqld/istio-proxy	18	4000m	4000m	2Gi	2Gi	NA	NA
ndbappmysqld/mysqlndbcluster	18	12	12	18Gi	18Gi	1Gi	200Mi

Table 3-131 (Cont.) Resource Allocation for cnDBTier Microservices

Microservices	Replicas	CPU Limit per Container	CPU Request per Container	Memory Limit per Container	Memory Request per Container	Ephemeral Storage Limit per Container	Ephemeral Storage Request per Container
ndbappmysqld/db-infra-monitor-svc	18	200m	200m	256Mi	256Mi	1Gi	200Mi
ndbappmysqld/init-sidecar	18	100m	100m	256Mi	256Mi	500Mi	200Mi
ndbmgmd/istio-proxy	2	1.1	1.1	2Gi	2Gi	NA	NA
ndbmgmd/mysqlndbcluster	2	3100m	3100m	10Gi	10Gi	1Gi	200Mi
ndbmgmd/db-infra-monitor-svc	2	200m	200m	256Mi	256Mi	1Gi	200Mi
ndbmtd/istio-proxy	10	4000m	4000m	2Gi	2Gi	NA	NA
ndbmtd/mysqlndbcluster	10	10	10	116Gi	116Gi	2100Mi	2000Mi
ndbmtd/db-backup-executor-svc	10	2	2	2Gi	2Gi	512Mi	512Mi
ndbmtd/db-infra-monitor-svc	10	200m	200m	256Mi	256Mi	1Gi	200Mi
ndbmysqld/istio-proxy	12	4	4	2Gi	2Gi	NA	NA
ndbmysqld/mysqlndbcluster	12	4	4	24Gi	24Gi	1Gi	200Mi
ndbmysqld/init-sidecar	12	100m	100m	256Mi	256Mi	500Mi	200Mi
ndbmysqld/db-infra-monitor-svc	12	200m	200m	256Mi	256Mi	1Gi	200Mi

3.2.3.2 Results

CPU and Memory Utilization

This section lists the CPU utilization for Policy and cnDBTier microservices. The CPU utilization is the ratio between the total CPU utilization against total CPU request (X) versus target CPU Utilization (Y) configured for the pod.

Table 3-132 CPU and Memory Utilization by Policy Microservices

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
ocpcf-occnp-egress-gateway/ occcnp-egress-gateway	11.92%	43.79%		
ocpcf-occnp-ingress-gateway/ istio-proxy	22.08%	10.48%		
ocpcf-occnp-ingress-gateway/ occnp-ingress-gateway	28.20%	42.19%		
ocpcf-occnp-nrf-client-nfdiscovery/ istio-proxy	1.70%	9.93%		
ocpcf-occnp-nrf-client-nfdiscovery/ nrf-client-nfdiscovery	1.64%	14.62%		
ocpcf-occnp-nrf-client-nfmanagement/ istio-proxy	0.18%	8.30%		
ocpcf-occnp-nrf-client-nfmanagement/nrf-client-nfmanagement	0.18%	44.04%		
ocpcf-occnp-udr-connector/istio-proxy	8.09%	9.16%		
ocpcf-occnp-udr-connector/user-service	8.69%	22.53%		
ocpcf-ocpm-audit-service/istio-proxy	2.17%	9.11%		
ocpcf-ocpm-audit-service/audit-service	1.77%	36.29%		
ocpcf-ocpm-cm-service/istio-proxy	0.97%	8.59%		
ocpcf-ocpm-cm-service/cm-service	0.61%	47.95%		
ocpcf-ocpm-policyds/istio-proxy	19.18%	5.14%		
ocpcf-ocpm-policyds/policyds	19.31%	20.79%		
ocpcf-ocpm-pre/ istio-proxy	15.82%	9.64%		
ocpcf-ocpm-pre/ pre-service	48.32%	59.02%		

Table 3-132 (Cont.) CPU and Memory Utilization by Policy Microservices

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
ocpcf-ocpm-queryservice/istio-proxy	1.52%	8.45%		
ocpcf-ocpm-queryservice/queryservice	3.23%	37.16%		
ocpcf-pcf-smservice/istio-proxy	30.98%	11.29%		
ocpcf-pcf-smservice/sm-service	39.04%	30.88%		
ocpcf-performance/istio-proxy	0.60%	7.84%		
ocpcf-performance/perf-info	8.92%	14.99%		
ocpcf-appinfo/istio-proxy	0.50%	9.25%		
ocpcf-appinfo/appinfo	6.09%	29.44%		
ocpcf-bulwark/istio-proxy	24.54%	9.48%		
ocpcf-bulwark/bulwark	32.42%	14.89%		
ocpcf-oc-binding/istio-proxy	7.81%	10.54%		
ocpcf-oc-binding/binding	7.58%	12.04%		
ocpcf-oc-diam-connector/istio-proxy	22.95%	11.05%		
ocpcf-oc-diam-connector/diam-connector	17.23%	42.48%		
ocpcf-occnp-alternate-route/istio-proxy	3.17%	8.93%		
ocpcf-occnp-alternate-route/occnp-alternate-route	2.29%	18.12%		
ocpcf-occnp-chf-connector/istio-proxy	4.08%	9.00%		
ocpcf-occnp-chf-connector/user-service	3.58%	11.86%		
ocpcf-occnp-config-server/istio-proxy	11.38%	12.01%		

Table 3-132 (Cont.) CPU and Memory Utilization by Policy Microservices

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
ocpcf-occnp-config-server/config-server	8.91%	37.11%		
ocpcf-occnp-egress-gateway/istio-proxy	15.37%	14.54%		

Table 3-133 CPU and Memory Utilization by cnDBTier Microservices

Microservices	CPU Site1	Memory Site1	CPU Site2	Memory Site2
mysql-cluster-db-backup-manager-svc/istio-proxy	0.30%	8.59%		
mysql-cluster-db-backup-manager-svc/db-backup-manager-svc	0.09%	7.32%		
mysql-cluster-db-monitor-svc/istio-proxy	0.20%	7.71%		
mysql-cluster-db-monitor-svc/db-monitor-svc	0.62%	22.90%		
ndbappmysqld/istio-proxy	35.95%	10.53%		
ndbappmysqld/mysqlndbcluster	36.53%	27.78%		
ndbappmysqld/db-infra-monitor-svc	0.97%	21.29%		
ndbappmysqld/init-sidecar	2.00%	0.39%		

Latency

Table 3-134 Average Current Percentile Latency Observations (in milliseconds)

METHODS	50th Percentile (Site1)	99th Percentile (Site1)
SM POST	71.538	215.557
SM DELETE	19.334	63.399