Oracle® Communications

Cloud Native Core, Service Communication Proxy Benchmarking Guide

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Oracle Communications Cloud Native Core, Service Communication Proxy Benchmarking Guide, Release 25.2.201

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The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

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Acronyms

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

Table 1 Acronyms

Acronym	Description
AMF	Access and Mobility Management Function
AUSF	Authentication Server Function
CPU	Central Processing Unit
CNE	Oracle Communications Cloud Native Core, Cloud Native Environment
GPSI	Generic Public Subscription Identifier
HTTP	Hypertext Transfer Protocol
LBVM	Load Balancer Virtual Machine
LCI	Load Control Information
MPS	Messages Per Second
NF	Network Function
NRF	Oracle Communications Cloud Native Core, Network Repository Function
OCI	Oracle Cloud Infrastructure
OCNADD	Oracle Communications Network Analytics Data Director
PVC	Persistent Volume Claim
RAM	Random Access Memory
SCP	Oracle Communications Cloud Native Core, Service Communication Proxy
SMSF	SMS Function
SMF	Session Management Function
SUPI	Subscription Permanent Identifier
UDM	Unified Data Management
vCNE	Virtualized CNE

What's New in This Guide

This section introduces the documentation updates for release 25.2.2xx.

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- Updated cnDBTier release version to 25.2.200 in the Deployed Components section.
- Updated the values of nodes used in each test bed in the Cluster Details section.
- Update the cnDBTier resources in the cnDBTier Resources section.
- Update the SCP resources in the SCP Resources section.
- Added the OSO Resources section with information about OSO resource requirements.
- Updated the Model C - Test Case Scenario 2 section to describe the performance and capacity of SCP with Model C based on the network latency of 200 milliseconds at the rate of 730K MPS with the LCI, OCI, Ingress Rate Limiting, Global Egress Rate Limiting, and ASM enabled.
- Added the Test Topology 3 for SCP Model D Benchmarking section.
- Added the Model D Test Scenario 4 section to describe the performance and capacity of SCP with Model D based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation enabled on vCNE.
- Added the Model D Test Scenario 5 section to describe the performance and capacity of SCP with Model D based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation enabled on BareMetal.
- Added the Model D Test Scenario 6 section to describe the performance and capacity of SCP with Model D based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation on BareMetal with 20% Static Discovery in case the discovery mode is set to "NRF Followed BY SCP".
- Added the Model D Test Scenario 7 section to describe the performance and capacity of SCP with Model D based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation on BareMetal with 20% Static Discovery in case the discovery mode is set to "SCP Followed BY NRF".
- Added the Model D Test Scenario 8 section to describe the performance and capacity of SCP with Model D based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation with 2 ingress Cloud Native Load Balancer (CNLB) and without egress configuration enabled.
- Added the Model D Test Scenario 9 section to describe the performance and capacity of SCP with Model D based on the network latency of 150 milliseconds at the rate of 450K MPS with Cloud Native Load Balancer (CNLB) and egress bypass.
- Added the Model D Test Scenario 10 section to describe the performance and capacity of SCP with Model D and Mediation on BareMetal and OCNADD enabled with four trigger points, 650K MPS towards OCNADD.

1 Introduction

Service Communication Proxy (SCP) is a decentralized solution composed of Service Proxy Controllers and Service Proxy Workers. SCP is deployed alongside 5G network functions and provides routing control, resiliency, and observability to the core network. For more information about SCP architecture, see *Oracle Communications Cloud Native Core, Service Communication Proxy User Guide*.

SCP can optionally leverage the service mesh for internal and external communications. The service mesh integration supports the services by deploying a special sidecar proxy in the environment to intercept network communications between microservices.

This document describes test topologies and corresponding test scenarios for various features of SCP to understand the performance of SCP in a different network environment. The benchmarking tests are performed on a single nonredundant SCP nodal instance.

1.1 Purpose and Scope

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

This document provides SCP performance and capacity data.

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

1.2 References

- *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, Service Communication Proxy User Guide*
- *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, Operations Services Overlay Installation Guide*
- *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, Service Communication Proxy Installation, Upgrade, and Fault Recovery Guide*

2
Deployment Environment

This section provides information about the cloud native platform used for SCP benchmarking.

2.1 Deployed Components

Deployment Platform

To perform benchmark tests, use CNE and Kubernetes as specified for each test bed in the Cluster Details section.

cnDBTier

cnDBTier 25.2.201 is used to perform benchmark tests.

For more information about above mentioned software, see *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*.

2.2 Deployment Resources

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

2.2.1 Cluster Details

This section provides information about different test beds, outlining the types of servers and the number of servers used for various test case scenarios.

Table 2-1 Test Bed 1 - CNE on BareMetal

Nodes	Type	CPU	Memory (GB)	Model Name	Hyperthreading (Enabled/ Disabled)	Count
Master Nodes	ORACLE SERVER X8-2	24	67	Intel Xeon Processor (Cascadelake)	Enabled	3
Worker Nodes	ORACLE SERVER X8-2	96	384	Intel(R) Xeon(R) Platinum 8260 CPU @ 2.40GHz	Enabled	45
Top of Rack Switch	Cisco 93108TC-ex	NA	NA	NA	NA	2

This test bed uses Oracle Communications CNE on BareMetal 24.1.0 for performing benchmark tests.

Cloud Native Orchestrator

Kubernetes 1.28.6 is used to manage application pods across the cluster.

The following table lists services that are part of CNE and used for fetching SCP metrics.

Table 2-2 Observability Services

Service Name	Version
Oracle OpenSearch	2.3.0
Oracle OpenSearch Dashboard	2.3.0
Prometheus	2.51.1
Grafana	9.5.3
Jaeger	1.52.0

Table 2-3 Test Bed 2 - vCNE on OpenStack

Nodes	Type	CPU	Memory (GB)	Model Name	Hyperthreading (Enabled/ Disabled)	Count
Master Nodes	ORACLE SERVER X8-2	16	125Gi	Intel Xeon Processor (Cascadelake)	Enabled	3
Worker Nodes	ORACLE SERVER X8-2	46	270Gi	Intel Xeon Processor (Cascadelake)	Enabled	42
Top of Rack Switch	Cisco 93108TC-ex	NA	NA	NA	NA	2

Table 2-4 LBVM Resources used for vCNE

Resources	Value
Number of LBVM	4 **Note:** There are two pairs of LBVMs in this setup, with 2 LBVMs in each pair. For testing purposes, only one LBVM pair was used, with one LBVM operating in active mode and the other in standby mode.
RAM	16 GB
vCPU	4
Disk Size	40 GB

This test bed uses Oracle Communications CNE on vCNE 24.1.0 for performing benchmark tests.

Cloud Native Orchestrator

Kubernetes 1.28.6 is used to manage application pods across the cluster.

The following table lists services that are part of CNE and used for fetching SCP metrics.

Table 2-5 Observability Services

Service Name	Version
Oracle OpenSearch	2.3.0
Oracle OpenSearch Dashboard	2.3.0
Prometheus	1.7.0
Grafana	1.26.1
Jaeger	1.52.0

Table 2-6 Test Bed 3 - vCNE on Openstack

Nodes	Type	Model Name	Hyperthreading (Enabled/ Disabled)	Count
Hypervisor Nodes	ORACLE SERVER X9-2	Intel Xeon Processor (Icelake)	Enabled	23
Top of Rack Switch	Cisco 93108TC-ex	NA	NA	2

Table 2-7 Node Requirements

Node	CPU Per Node	Memory Per Node	Count
Master Node	16	125 Gi	3
Worker Node	124	471 Gi	22
Medium Worker Node	92	349 Gi	22
CNLB Node	16	64 Gi	12

> **Note**
>
> Airazor has 1:2 CPU distribution.

This test bed uses Oracle Communications CNE on vCNE 25.2.200 for performing benchmark tests.

Cloud Native Orchestrator

Kubernetes 1.34.1 is used to manage application pods across the cluster.

The following table lists services that are part of CNE and used for fetching SCP metrics.

Table 2-8 Observability Services

Service Name	Version
Oracle OpenSearch	2.19.1
Oracle OpenSearch Dashboard	2.19.1
Prometheus	3.6.0
Grafana	7.5.17-1.0.4
Jaeger	1.72.0

Table 2-9 Test Bed 4 -CNE on BareMetaL

Nodes	Type	CPU	Memory (GB)	Model Name	Hyperthreading (Enabled/ Disabled)	Count
Master Nodes	ORACLE SERVER X9-2	24	62 GB	Intel Xeon Processor (Icelake)	Enabled	3

Table 2-9 (Cont.) Test Bed 4 -CNE on BareMetaL

Nodes	Type	CPU	Memory (GB)	Model Name	Hyperthreading (Enabled/ Disabled)	Count
Worker Nodes	ORACLE SERVER X9-2	128	1006 GB	Intel(R) Xeon(R) Platinum 8358 CPU @ 2.60GHz	Enabled	46
Top of Rack Switch	Cisco 93108TC-ex	NA	NA	NA	NA	2

This test bed uses Oracle Communications CNE on BareMetal 25.1.200 for performing benchmark tests.

Cloud Native Orchestrator

Kubernetes 1.32.0 is used to manage application pods across the cluster.

The following table lists services that are part of CNE and used for fetching SCP metrics.

Table 2-10 Observability Services

Service Name	Version
Oracle OpenSearch	2.15.0
Oracle OpenSearch Dashboard	2.15.0
Prometheus	3.2.0
Grafana	9.5.3
Jaeger	1.65.0

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

Table 2-11 CNE Common Services Observability Resources

Service Name	Number of Pods	RAM Request/Limit	vCPU Request/Limit	PVC Size Recommendation
Prometheus Server	2	4Gi/150Gi	2m/20m	800Gi
Alert Manager	2	4Gi/32Gi	2m/6m	NA
Fluentd	1 per Worker Node	2Gi/20Gi	100m/1m	NA
Prom-node-exporter	1 per Worker Node	512Mi/512Mi	800m/800m	NA
MetalLB speaker	1 per Worker Node	100Mi/100Mi	100m/100m	NA
OpenSearch Data	5/5	32Gi/32Gi	2m/2m	400Gi
OpenSearch Master	3/3	16Gi/16Gi	1m/1m	400Gi
ISM Policy	3/3	128Mi/128Mi	100m/100m	NA
OpenSearch Client	3/3	16Gi/16Gi	2m/2m	NA
Grafana	1	500Mi/500Mi	200m/200m	NA
kube-state-metrics	1	32Mi/1Gi	20m/20m	NA
jaeger-agent	1 per Worker Node	128Mi/512Mi	256m/500m	NA
jaeger-collector	1	512Mi/1Gi	500m/1250m	NA
jaeger-query	1	128Mi/512Mi	256m/500m	NA

Table 2-11 (Cont.) CNE Common Services Observability Resources

Service Name	Number of Pods	RAM Request/Limit	vCPU Request/Limit	PVC Size Recommendation
promxy	1	512Mi/2Gi	100m/100m	NA
prom-stack-kube-operator	1	100Mi/200Mi	100m/200m	NA
rook-ceph-osd	1 for each raw disk available to OS on all Worker Node	1Gi/8Gi	500m/1m	NA
rook-ceph-mgr	1	1Gi/1Gi	500m/500m	NA
rook-ceph-mon	3	1Gi/1Gi	500m/500m	NA
rook-ceph-operator	1	2Gi/2Gi	100m/500m	NA

2.2.2 cnDBTier Resources

The following table provides information about cnDBTier resources for both ASM and non-ASM setups required to perform SCP benchmark tests:

Table 2-12 cnDBTier Resource Requirements (Non-ASM)

Service Name	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
postInstallJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
preUpgradeJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
preRollbackJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
postUpgradeJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
postRollbackJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
helm-test	0.1	0.1	256Mi		NA	NA	90Mi	1Gi
MGMT (ndbmgmd)	2	2	4	5	14	NA	90	1000
DB (ndbmtd)	2	2	8	8	14	6	90	1000
SQL - Replication (ndbmysqld)	4	4	10	10	25	NA	90	1000
SQL - Access (ndbappmysqld)	4	4	8	8	20	NA	90	1000
Monitor Service (db-monitor-svc)	4	4	4	4	0	NA	90	1000
db-connectivity-service	0	0	0	0	0	NA	0	0
Replication Service(db-replication-svc)	2	2	12	12	190	NA	90	1000
Replication Service - Other(db-replication-svc)	1.1	1.1	1	2	NA	NA	90	1000

Table 2-12 (Cont.) cnDBTier Resource Requirements (Non-ASM)

Service Name	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
Backup Manager Service (db-backup-manager-svc)	1.1	1.1	1	1	0	NA	90	1000

Table 2-13 cnDBTier Resource Requirements (Non-ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
postInstallJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
postInstallJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postInstallJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
postInstallJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
preUpgradeJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
preUpgradeJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
preUpgradeJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
preUpgradeJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
preRollbackJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
preRollbackJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
preRollbackJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
preRollbackJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postUpgradeJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
postUpgradeJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-13 (Cont.) cnDBTier Resource Requirements (Non-ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
postUpgradeJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
postUpgradeJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postRollbackJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
postRollbackJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postRollbackJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
postRollbackJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
helm-test init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
helm-test db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
helm-test init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
helm-test db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
MGMT (ndbmgmd) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
MGMT (ndbmgmd) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
MGMT (ndbmgmd) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
MGMT (ndbmgmd) db-infra-monitor-svc	0.2	0.2	0.256	0.256	14	NA	90	1000
DB (ndbmtd) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
DB (ndbmtd) db-executor-svc	2	2	2	2	14	6	90	1000

Table 2-13 (Cont.) cnDBTier Resource Requirements (Non-ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
DB (ndbmtd) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
DB (ndbmtd) db-infra-monitor-svc	0.2	0.2	0.256	0.256	14	6	90	1000
SQL - Replication (ndbmysqld) init-sidecar	0.1	0.1	0.256	0.256	25	NA	90	1000
SQL - Replication (ndbmysqld) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
SQL - Replication (ndbmysqld) init-discover-sql-ips	0.2	0.2	0.256	0.256	25	NA	90	1000
SQL - Replication (ndbmysqld) db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
SQL - Access (ndbappmysqld) init-sidecar	0.1	0.1	0.256	0.256	20	NA	90	1000
SQL - Access (ndbappmysqld) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
SQL - Access (ndbappmysqld) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
SQL - Access (ndbappmysqld) db-infra-monitor-svc	0.2	0.2	0.256	0.256	20	NA	90	1000
Monitor Service (db-monitor-svc) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
Monitor Service (db-monitor-svc) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Monitor Service (db-monitor-svc) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
Monitor Service (db-monitor-svc) db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-13 (Cont.) cnDBTier Resource Requirements (Non-ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
db-connectivity-service init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
db-connectivity-service db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
db-connectivity-service init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
db-connectivity-service db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Replication Service(db-replication-svc) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
Replication Service(db-replication-svc) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Replication Service(db-replication-svc) init-discover-sql-ips	0.2	0.2	0.5	0.5	190	NA	90	1000
Replication Service(db-replication-svc) db-infra-monitor-svc	0.2	0.2	0.256	0.256	190	NA	90	1000
Replication Service - Other(db-replication-svc) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
Replication Service - Other(db-replication-svc) db-executor-svc	0.2	0.2	0.5	0.5	NA	NA	90	1000
Replication Service - Other(db-replication-svc) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-13 (Cont.) cnDBTier Resource Requirements (Non-ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
Replication Service - Other(db-replication-svc) db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Backup Manager Service (db-backup-manager-svc) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
Backup Manager Service (db-backup-manager-svc) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Backup Manager Service (db-backup-manager-svc) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
Backup Manager Service (db-backup-manager-svc) db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-14 cnDBTier Resource Requirements (ASM)

Service Name	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
postInstallJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
preUpgradeJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
preRollbackJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
postUpgradeJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
postRollbackJob	0.1	0.1	256Mi	256Mi	NA	NA	90Mi	1Gi
helm-test	0.1	0.1	256Mi		NA	NA	90Mi	1Gi
MGMT (ndbmgmd)	2	2	4	5	14	NA	90	1000
DB (ndbmtd)	2	2	8	8	14	6	90	1000
SQL - Replication (ndbmysqld)	4	4	10	10	25	NA	90	1000
SQL - Access (ndbappmysqld)	4	4	8	8	20	NA	90	1000

Table 2-14 (Cont.) cnDBTier Resource Requirements (ASM)

Service Name	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
Monitor Service (db-monitor-svc)	4	4	4	4	0	NA	90	1000
db-connectivity-service	0	0	0	0	0	NA	0	0
Replication Service(db-replication-svc)	2	2	12	12	190	NA	90	1000
Replication Service - Other(db-replication-svc)	1.1	1.1	1	2	NA	NA	90	1000
Backup Manager Service (db-backup-manager-svc)	1.1	1.1	1	1	0	NA	90	1000

Table 2-15 cnDBTier Resource Requirements (ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
postInstallJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
postInstallJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postInstallJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
postInstallJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postInstallJob sevice mesh sidecar (envoy)	NA	NA	NA	NA	NA	NA	NA	NA
preUpgradeJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
preUpgradeJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
preUpgradeJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
preUpgradeJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
preUpgradeJob sevice mesh sidecar (envoy)	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-15 (Cont.) cnDBTier Resource Requirements (ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
preRollbackJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
preRollbackJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
preRollbackJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
preRollbackJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
preRollbackJob sevice mesh sidecar (envoy)	NA	NA	NA	NA	NA	NA	NA	NA
postUpgradeJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
postUpgradeJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postUpgradeJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
postUpgradeJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postUpgradeJob sevice mesh sidecar (envoy)	NA	NA	NA	NA	NA	NA	NA	NA
postRollbackJob init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
postRollbackJob db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postRollbackJob init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
postRollbackJob db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
postRollbackJob sevice mesh sidecar (envoy)	NA	NA	NA	NA	NA	NA	NA	NA
helm-test init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
helm-test db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
helm-test init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-15 (Cont.) cnDBTier Resource Requirements (ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
helm-test db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
helm-test sevice mesh sidecar (envoy)	NA	NA	NA	NA	NA	NA	NA	NA
MGMT (ndbmgmd) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
MGMT (ndbmgmd) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
MGMT (ndbmgmd) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
MGMT (ndbmgmd) db-infra-monitor-svc	0.2	0.2	0.256	0.256	14	NA	90	1000
MGMT (ndbmgmd) sevice mesh sidecar (envoy)	2	2	1	1	14	NA	90	1000
DB (ndbmtd) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
DB (ndbmtd) db-executor-svc	2	2	2	2	14	6	90	1000
DB (ndbmtd) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
DB (ndbmtd) db-infra-monitor-svc	0.2	0.2	0.256	0.256	14	6	90	1000
DB (ndbmtd) sevice mesh sidecar (envoy)	2	2	1	1	14	6	90	1000
SQL - Replication (ndbmysqld) init-sidecar	0.1	0.1	0.256	0.256	25	NA	90	1000
SQL - Replication (ndbmysqld) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
SQL - Replication (ndbmysqld) init-discover-sql-ips	0.2	0.2	0.256	0.256	25	NA	90	1000

Table 2-15 (Cont.) cnDBTier Resource Requirements (ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
SQL - Replication (ndbmysqld) db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
SQL - Replication (ndbmysqld) sevice mesh sidecar (envoy)	2	2	2	2	25	NA	90	1000
SQL - Access (ndbappmysqld) init-sidecar	0.1	0.1	0.256	0.256	20	NA	90	1000
SQL - Access (ndbappmysqld) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
SQL - Access (ndbappmysqld) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
SQL - Access (ndbappmysqld) db-infra-monitor-svc	0.2	0.2	0.256	0.256	20	NA	90	1000
SQL - Access (ndbappmysqld) sevice mesh sidecar (envoy)	2	2	2	2	20	NA	90	1000
Monitor Service (db-monitor-svc) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
Monitor Service (db-monitor-svc) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Monitor Service (db-monitor-svc) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
Monitor Service (db-monitor-svc) db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Monitor Service (db-monitor-svc) sevice mesh sidecar (envoy)	2	2	1	1	NA	NA	NA	NA
db-connectivity-service init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-15 (Cont.) cnDBTier Resource Requirements (ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
db-connectivity-service db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
db-connectivity-service init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
db-connectivity-service db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
db-connectivity-service sevice mesh sidecar (envoy)	NA	NA	NA	NA	NA	NA	NA	NA
Replication Service(db-replication-svc) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
Replication Service(db-replication-svc) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Replication Service(db-replication-svc) init-discover-sql-ips	0.2	0.2	0.5	0.5	190	NA	90	1000
Replication Service(db-replication-svc) db-infra-monitor-svc	0.2	0.2	0.256	0.256	190	NA	90	1000
Replication Service(db-replication-svc) sevice mesh sidecar (envoy)	2	2	1	1	190	NA	90	1000
Replication Service - Other(db-replication-svc) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
Replication Service - Other(db-replication-svc) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA

Table 2-15 (Cont.) cnDBTier Resource Requirements (ASM with Sidecar)

Service Name with Sidecar	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	PVC1	PVC2	Min (MB)	Max (MB)
Replication Service - Other(db-replication-svc) init-discover-sql-ips	0.2	0.2	0.5	0.5	NA	NA	90	1000
Replication Service - Other(db-replication-svc) db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Replication Service - Other(db-replication-svc) sevice mesh sidecar (envoy)	2	2	1	1	NA	NA	90	1000
Backup Manager Service (db-backup-manager-svc) init-sidecar	NA	NA	NA	NA	NA	NA	NA	NA
Backup Manager Service (db-backup-manager-svc) db-executor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Backup Manager Service (db-backup-manager-svc) init-discover-sql-ips	NA	NA	NA	NA	NA	NA	NA	NA
Backup Manager Service (db-backup-manager-svc) db-infra-monitor-svc	NA	NA	NA	NA	NA	NA	NA	NA
Backup Manager Service (db-backup-manager-svc) sevice mesh sidecar (envoy)	2	2	1	1	NA	NA	90	1000

2.2.3 SCP Resources

The following table provides information about resource requirements to perform SCP benchmark tests:

Table 2-16 SCP Resources

Microservice Name	SCP Service Pods			
	vCPU/Pod		Memory/Pod (in Gi)	
	Min	Max	Min	Max
Helm test	1.1	1.1	1	1
Helm Hook	1.1	1.1	1	1
scpc-subscription	2	2	2	2
scpc-notification	8	8	8	8
scpc-audit	4	4	4	4
scpc-configuration	2	2	2	2
scp-cache	8	8	8	8
scp-loadmanager	8	8	8	8
scp-nrfproxy	8	8	8	8
scp-worker (Profile 1)	4	4	8	8
scp-worker (Profile 2)	8	8	12	12
scp-worker (Profile 3)	12	12	24	24
scp-mediation	8	8	8	8
scp-nrfproxy-oauth	8	8	8	8
scpc-alternate-resolution	2	2	2	2

2.2.4 OSO Resources

The following table provides information about OSO resource requirements to perform benchmark tests:

Table 2-17 OSO Resources

OSO Microservice Name	Replica	OSO Service Pods				Total Resources Per Service
		vCPU/Pod		Memory/Pod (in GB)		
		Min	Max	Min	Max	
prom-Alertmanager	2	0.5	0.5	1	1	CPU: 1 Memory: 2 Disk: 2Gi
prom-server	1	16	16	256	256	CPU: 16 Memory: 256 Disk: 450Gi

3
Benchmarking SCP Model C

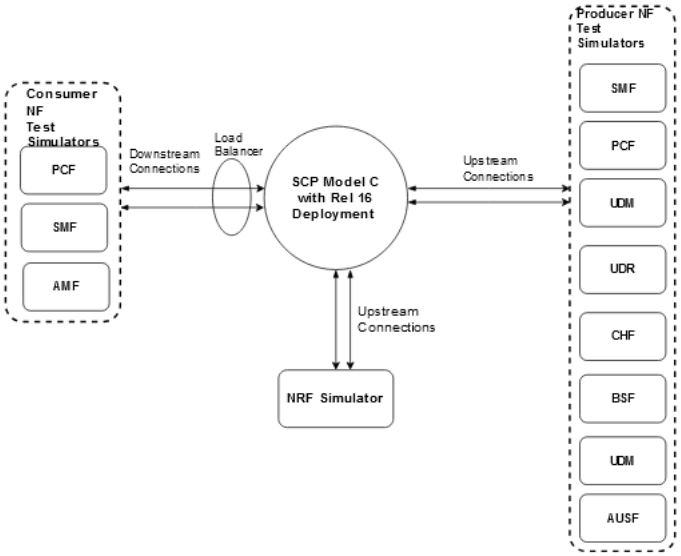
This section describes Model C test topologies and test scenarios for benchmarking SCP.

3.1 Test Topology 1 for SCP Model C Benchmarking

The following image represents the test topology consisting of the following components:

- SCP
- Consumer NF test simulator
- Producer NF test simulator
- NRF simulator

Figure 3-1 SCP Model C Topology 1



The aforementioned image represents the Model C test topology. In Release 16 Model C indirect 5G SBI communication mode, the consumer NF sends NF discovery service requests to NRF. After receiving the discovery response with NF profiles, the consumer NF performs the following tasks:

- Selects an NF Set or a specific NF instance from the NF Set
- Sends a service request to SCP with the address of the selected service producer NF in 3gpp-Sbi-Target-apiRoot header
- Creates multiple network interfaces for different subnet IPs

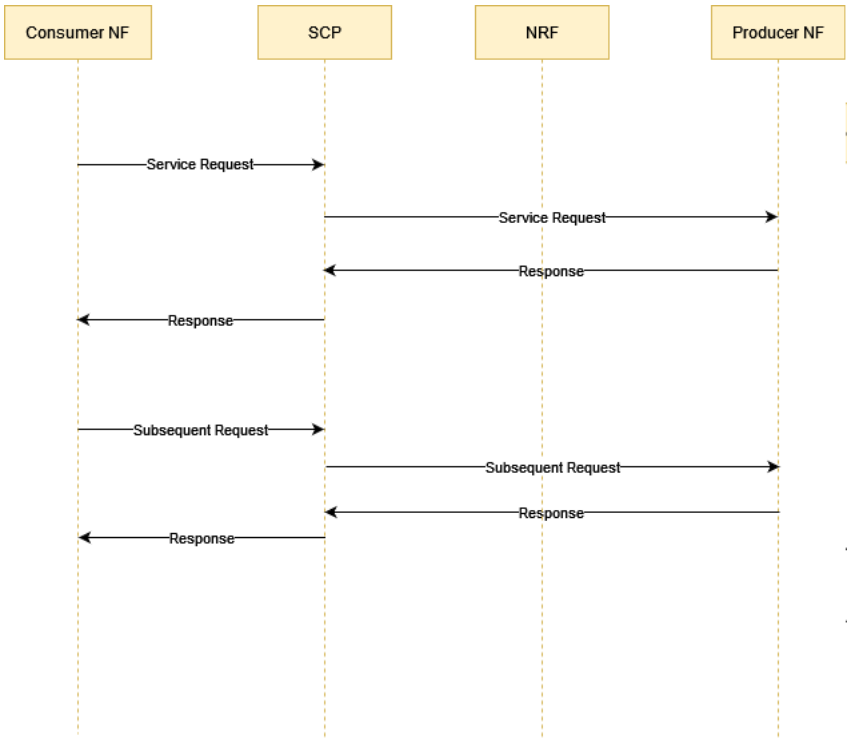
Then, SCP selects an NF service instance and routes the service requests to the selected producer NF. In case of failure, if reselection is required, SCP selects the producer NF instance based on the NF Set.

3.1.1 Topology 1 Call Flow

The following call flow represents how a service request is processed by SCP:

1. Consumer NF sends the service request to SCP.
2. SCP sends the request to the producer NF based on the NF profiles registered through NRF.
3. Producer NF sends the response to SCP for the service request.
4. SCP routes the response received from the producer NF to the consumer NF.

Figure 3-2 Topology 1 Call Flow



Network Topology

The following image represents communication between SCP and NRF to process service requests in different sites:

Figure 3-3 Network Topology

3.1.2 Topology 1 Traffic Distribution

The following table describes the percentage of messages processed by SCP using N11, N7, N10, N36, N28, and other interfaces:

Table 3-1 Topology 1 Traffic Distribution

NF-C	NF-P	Interface Reference	Percentage (%) of Messages
SMF	PCF	N7	60
SMF	UDM	N10	5
PCF	UDR	N36	1

Table 3-1 (Cont.) Topology 1 Traffic Distribution

NF-C	NF-P	Interface Reference	Percentage (%) of Messages
PCF	CHF	N28	1
SMF	CHF	N40	10
NRF	SLF	-	3
PCF	BSF	Nbsf	2
AMF	UDM	N8	7.5
AMF	AUSF	N12	7.5
AMF	PCF	N15	3
NRF	SCP	Notifications	10 notifications every 15 minutes

> **Note**
>
> 40% InterSCP traffic is routed towards twenty two regions.

Topology 1 NF Configuration Across All Regions

The following table describes the NF configurations across multiple regions:

Table 3-2 NF Configuration Across All Regions

Region	Total NFs	SCP	NRF	PCF	CHF	AMF	UDR	UDM	SLF	SMF	AUSF	BSF	Locality
Site1	118	SCP1 to SCP2	NRF1 to NRF2	PCF1 to PCF8 PCF51 to PCF86	CHF1 to CHF2	AMF1 to AMF2 AMF45 to AMF52	UDR1 to UDR2 UDR45 to UDR52	UDM1 to UDM2 UDM45 to UDM52	SLF1 to SLF2 SLF45 to SLF52	SMF1 to SMF2 SMF45 to SMF52	AUSF1 to AUSF2 AUSF45 to SMF52	BSF1 to BSF2 BSF45 to BSF52	USEast
Site2	20	SCP3 to SCP4	NRF3 to NRF4	PCF9 to PCF10	CHF3 to CHF4	AMF3 to AMF4 AMF45 to AMF52	UDR3 to UDR4	UDM3 to UDM4	SLF3 to SLF4	SMF3 to SMF4	AUSF3 to AUSF4	BSF3 to BSF4	Loc1r3
Site3	20	SCP5 to SCP6	NRF5 to NRF6	PCF11 to PCF12	CHF5 to CHF6	AMF5 to AMF6	UDR5 to UDR6	UDM5 to UDM6	SLF5 to SLF6	SMF5 to SMF6	AUSF5 to AUSF6	BSF5 to BSF6	Loc1r5
Site4	18	SCP7 to SCP8	NRF7 to NRF8	PCF13 to PCF14	-	AMF7 to AMF8	UDR7 to UDR8	UDM7 to UDM8	SLF7 to SLF8	SMF7 to SMF8	AUSF7 to AUSF8	BSF7 to BSF8	Loc1r7
Site5	18	SCP9 to SCP10	NRF9 to NRF10	PCF15 to PCF16	-	AMF9 to AMF10	UDR9 to UDR10	UDM9 to UDM10	SLF9 to SLF10	SMF9 to SMF10	AUSF9 to AUSF10	BSF9 to BSF10	Loc1r9

Table 3-2 (Cont.) NF Configuration Across All Regions

Region	Total NFs	SCP	NRF	PCF	CHF	AMF	UDR	UDM	SLF	SMF	AUSF	BSF	Locality
Site6	18	SCP11 to SCP12	NRF11 to NRF12	PCF17 to PCF18	-	AMF11 to AMF12	UDR11 to UDR12	UDM11 to UDM12	SLF11 to SLF12	SMF11 to SMF12	AUSF11 to AUSF12	BSF11 to BSF12	Loc1r11
Site7	18	SCP13 to SCP14	NRF13 to NRF14	PCF19 to PCF20	-	AMF13 to AMF14	UDR13 to UDR14	UDM13 to UDM14	SLF13 to SLF14	SMF13 to SMF14	AUSF13 to AUSF14	BSF13 to BSF14	Loc1r13
Site8	18	SCP15 to SCP16	NRF15 to NRF16	PCF21 to PCF22	-	AMF15 to AMF16	UDR15 to UDR16	UDM15 to UDM16	SLF15 to SLF16	SMF15 to SMF16	AUSF15 to AUSF16	BSF15 to BSF16	Loc1r15
Site9	18	SCP17 to SCP18	NRF17 to NRF18	PCF23 to PCF24	-	AMF17 to AMF18	UDR17 to UDR18	UDM17 to UDM18	SLF17 to SLF18	SMF17 to SMF18	AUSF17 to AUSF18	BSF17 to BSF18	Loc1r17
Site10	18	SCP19 to SCP20	NRF19 to NRF20	PCF25 to PCF26	-	AMF19 to AMF20	UDR19 to UDR20	UDM19 to UDM20	SLF19 to SLF20	SMF19 to SMF20	AUSF19 to AUSF20	BSF19 to BSF20	Loc1r19
Site11	18	SCP21 to SCP22	NRF21 to NRF22	PCF27 to PCF28	-	AMF21 to AMF22	UDR21 to UDR22	UDM21 to UDM22	SLF21 to SLF22	SMF21 to SMF22	AUSF21 to AUSF22	BSF21 to BSF22	Loc1r21
Site12	18	SCP23 to SCP24	NRF23 to NRF24	PCF29 to PCF30	-	AMF23 to AMF24	UDR23 to UDR24	UDM23 to UDM24	SLF23 to SLF24	SMF23 to SMF24	AUSF23 to AUSF24	BSF23 to BSF24	Loc1r23
Site13	18	SCP25 to SCP26	NRF25 to NRF26	PCF31 to PCF32	-	AMF25 to AMF26	UDR25 to UDR26	UDM25 to UDM26	SLF25 to SLF26	SMF25 to SMF26	AUSF25 to AUSF26	BSF25 to BSF26	Loc1r25
Site14	18	SCP27 to SCP28	NRF27 to NRF28	PCF33 to PCF34	-	AMF27 to AMF28	UDR27 to UDR28	UDM27 to UDM28	SLF27 to SLF28	SMF27 to SMF28	AUSF27 to AUSF28	BSF27 to BSF28	Loc1r27
Site15	18	SCP29 to SCP30	NRF29 to NRF30	PCF35 to PCF36	-	AMF29 to AMF30	UDR29 to UDR30	UDM29 to UDM30	SLF29 to SLF30	SMF29 to SMF30	AUSF29 to AUSF30	BSF29 to BSF30	Loc1r29
Site16	18	SCP31 to SCP32	NRF31 to NRF32	PCF37 to PCF38	-	AMF31 to AMF32	UDR31 to UDR32	UDM31 to UDM32	SLF31 to SLF32	SMF31 to SMF32	AUSF31 to AUSF32	BSF31 to BSF32	Loc1r31
Site17	18	SCP33 to SCP34	NRF33 to NRF34	PCF39 to PCF40	-	AMF33 to AMF34	UDR33 to UDR34	UDM33 to UDM34	SLF33 to SLF34	SMF33 to SMF34	AUSF33 to AUSF34	BSF33 to BSF34	Loc1r33
Site18	18	SCP35 to SCP36	NRF35 to NRF36	PCF41 to PCF42	-	AMF35 to AMF36	UDR35 to UDR36	UDM35 to UDM36	SLF35 to SLF36	SMF35 to SMF36	AUSF35 to AUSF36	BSF35 to BSF36	Loc1r35

Table 3-2 (Cont.) NF Configuration Across All Regions

Region	Total NFs	SCP	NRF	PCF	CHF	AMF	UDR	UDM	SLF	SMF	AUSF	BSF	Locality
Site19	18	SCP37 to SCP38	NRF37 to NRF38	PCF43 to PCF44	-	AMF37 to AMF38	UDR37 to UDR38	UDM37 to UDM38	SLF37 to SLF38	SMF37 to SMF38	AUSF37 to AUSF38	BSF37 to BSF38	Loc1r37
Site20	18	SCP39 to SCP40	NRF39 to NRF40	PCF45 to PCF46	-	AMF39 to AMF40	UDR39 to UDR40	UDM39 to UDM40	SLF39 to SLF40	SMF39 to SMF40	AUSF39 to AUSF40	BSF39 to BSF40	Loc1r39
Site21	18	SCP41 to SCP42	NRF41 to NRF42	PCF47 to PCF48	-	AMF41 to AMF42	UDR41 to UDR42	UDM41 to UDM42	SLF41 to SLF42	SMF41 to SMF42	AUSF41 to AUSF42	BSF41 to BSF42	Loc1r41
Site22	18	SCP43 to SCP44	NRF43 to NRF44	PCF49 to PCF50	-	AMF43 to AMF44	UDR43 to UDR44	UDM43 to UDM44	SLF43 to SLF44	SMF43 to SMF44	AUSF43 to AUSF44	BSF43 to BSF44	Loc1r43
Total	500	44	44	86	6	52	52	52	52	52	52	52	-

Topology 1 NF Profiles

The following table describes NF profile configuration, traffic, and message call flows for 280 NF profiles registered on SCP:

Table 3-3 NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related Traffic	NF Range	Profiles Registered	Message Call Flows
AMF	PCF	N15	• npcf-am-policy-control • npcf-smpolicycontrol • npcf-policyauthorization • npcf-bdtpolicycontrol • npcf-ue-policy-control	• npcf-ue-policy-control • npcf-am-policy-control	50	PCF1 to PCF50	**Npcf_AMPolicyControl** • Create AM Policy Association • Retrieve SM Policy • Update Policy • Policy Update Notification **Npcf_UEPolicyControl** • Create Policy Association • Retrieve Policy Association • Update Policy Association • Policy Update Notification

Table 3-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related Traffic	NF Range	Profiles Registered	Message Call Flows
SMF	PCF	N7	• npcf-am-policy-control • npcf-smpolicycontrol • npcf-policyauthorization • npcf-bdtpolicycontrol • npcf-ue-policy-control	npcf-smpolicycontrol	50	PCF1 to PCF50	• Create SM Policy • Update SM Policy • Delete SM Policy
SMF	UDM	N10	• nudm-ueau • nudm-uecm • nudm-sdm • nudm-ee • nudm-pp	• nudm-sdm • nudm-uecm	44	UDM1 to UDM44	**Nudm_sdm** • Subscribe to Notifications • Data Change Notification • Unsubscribe from Notifications **Nudm_uecm** • Register SMF • Deregister SMF
AMF	UDM	N8	• nudm-ueau • nudm-uecm • nudm-sdm • nudm-ee • nudm-pp	• nudm-sdm • nudm-uecm	44	UDM1 to UDM44	**Nudm_sdm** • Subscribe to Notifications • Data Change Notification • Unsubscribe from Notifications **Nudm_uecm** • Register AMF • Deregister AMF
PCF	UDR	N36	• nudr-dr • nudr-group-id-map	nudr-dr	44	UDR1 to UDR44	• Create Policy Data Subscription • Delete Policy Data Subscription

Table 3-3 (Cont.) NF Profiles

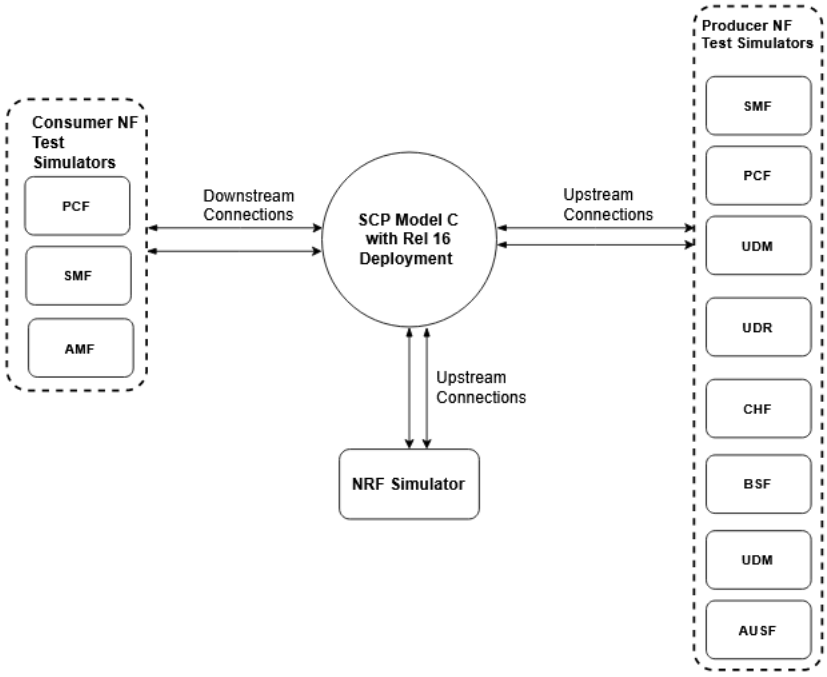
NF-C	NF-P	Interfaces	Supported Services	Service-related Traffic	NF Range	Profiles Registered	Message Call Flows
PCF	CHF	N28	• nchf-spendinglimitcontrol • nchf-convergedcharging	nchf-spendinglimitcontrol	44	CHF1 to CHF44	• Subscribe to notification • Cancel an existing subscription
SMF	CHF	N40	• nchf-spendinglimitcontrol • nchf-convergedcharging	nchf-convergedcharging	44	CHF1 to CHF44	• Subscribe to notification • Cancel an existing subscription
AMF	AUSF	N12	• nausf-auth • nausf-sorprotection • nausf-upuprotection	nausf-auth	44	AUSF1 to AUSF44	Authenticate UE
PCF	BSF	Nbsf	nbsf-management	nbsf-management	44	BSF1 to BSF44	• Register the session binding information • Retrieve the session binding information • Remove an existing session binding
NRF	SLF	-	nudr-group-id-map	nudr-group-id-map	44	SLF1 to SLF44	SLF Look up

3.2 Test Topology 2 for SCP Model C Benchmarking

The following image represents the test topology consisting of the following components:

- SCP
- Consumer NF test simulator
- Producer NF test simulator
- NRF simulator

Figure 3-4 SCP Model C Topology 2



The aforementioned image represents the Model C test topology. In Release 16 Model C indirect 5G SBI communication mode, the consumer NF sends NF discovery service requests to NRF. After receiving the discovery response with NF profiles, the consumer NF performs the following tasks:

- Selects an NF Set or a specific NF instance from the NF Set
- Sends a service request to SCP with the address of the selected service producer NF in 3gpp-Sbi-Target-apiRoot header
- Creates multiple network interfaces for different subnet IPs

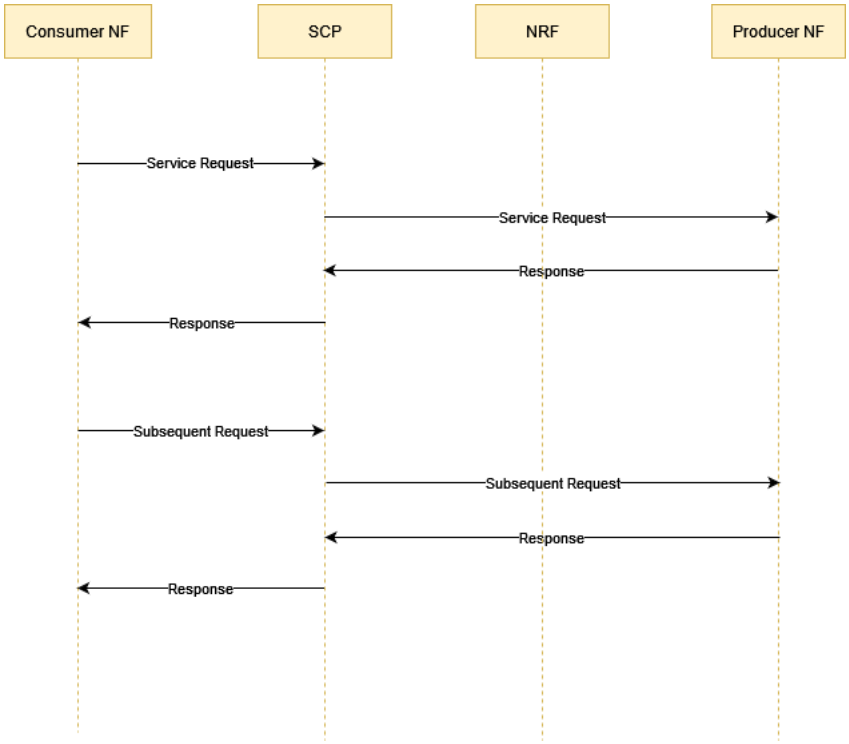
Then, SCP selects an NF service instance and routes the service requests to the selected producer NF. In case of failure, if reselection is required, SCP selects the producer NF instance based on the NF Set.

3.2.1 Topology 2 Call Flow

The following call flow represents how a service request is processed by SCP:

1. Consumer NF sends the service request to SCP.
2. SCP sends the request to the producer NF based on the NF profiles registered through NRF.
3. Producer NF sends the response to SCP for the service request.
4. SCP routes the response received from the producer NF to the consumer NF.

Figure 3-5 Topology 2 Call Flow



3.2.2 Topology 2 Traffic Distribution

The following table describes the percentage of messages processed by SCP using N11, N7, N10, N12, N36, N40, N28, and other interfaces:

Table 3-4 Topology 2 Traffic Distribution

NF-C	NF-P	Interface Reference	Percentage (%) of Messages
SMF	PCF	N7	30
AMF	PCF	N10	7.5
AMF	AUSF	N12	1.5
SMF	UDM	N10	5
SMF	CHF	N40	5
PCF	CHF	N28	5
PCF	BSF	-	2
AMF	UDM	N8	7.5
AMF	SMSF	-	5
PCF	BSF	-	3
PCF	UDR	N36	2.5
PCF	AMF	-	2.5
UDM	UDR	N35	2.5
CHF	PCF		2.5
SMSF	AMF		2.5
AMF	NSSF	N22	2.5

Table 3-4 (Cont.) Topology 2 Traffic Distribution

NF-C	NF-P	Interface Reference	Percentage (%) of Messages
NRF	SLF		2
CBCF	AMF	N50	1.5
SMSF	UDM	-	1.5
GMLC	AMF	-	1.5
GMLC	UDM	-	1.5
LMF	AMF	-	1.5
NEF	UDM	N52	1.5
AMF	NSSAAF	N58	0.5
AUSF	UDM	N13	0.5
UDM	SMF	N10	0.5
CHF	SMF	-	0.5
PCF	SMF	-	0.5
PCF	AMF	-	0.5
AMF	PCF	-	0.5
UDR	PCF	-	0.5
UDM	AMF	-	0.5
NRF	SCP	-	• 30 notifications per second continuously during the test. • A burst of 100 notifications per second, occurring once every hour • A burst of 200 notifications per second, occurring once every two hours.

> **Note**
>
> Only UDM, AUSF, and UDR traffic traverses between regions through inter-SCP and is ~30% of the overall AUSF, UDM, and UDR traffic rates as represented by the rate captured for SCP.

Topology 2 NF Profiles

The following table describes NF profile configuration, traffic, and message call flows for 1200 NF profiles registered on SCP across 4 regions:

Table 3-5 NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
SMF	PCF	N7	Npcf_SMPolicyControl	• Npcf_SMPolicyControl_Create/ Update/ Delete • Npcf_SMPolicyControl_UpdateNotify Update • Npcf_SMPolicyControl_UpdateNotify Terminate	70	PCF30 to PCF64, PCF 94 to PCF 128	**Npcf_SMPolicyControl** • Create SM Policy • Update SM Policy • Delete SM Policy
AMF	PCF		Npcf_AMPolicyControlNpcf-UEPolicyControl	• Npcf_AMPolicyControl_Create/ Update/ Delete • Npcf_UEPolicyControl_Create/ Update/ Delete • Npcf_AMPolicyControl_UpdateNotify Update/ Terminate • Npcf_UEPolicyControl_UpdateNotify Update/ Terminate	58	PCF1 to PCF29, PCF 65 to PCF93	**Npcf_AMPolicyControl** • Create AM Policy Association • Retrieve SM Policy • Update Policy • Policy Update Notification **Npcf_UEPolicyControl** • Create Policy Association • Retrieve Policy Association • Update Policy Association • Policy Update Notification
AMF	AUSF	N12	Nausf_UEAuthentication	Nausf_UEAuthentication_Authenticate	62	AUSF1 to AUSF31, AUSF32 to AUSF62,	Authenticate UE

Table 3-5 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
SMF	UDM	N10	Nudm_uecmNudm_sdm	• Nudm_UEContextManagement - Registration • Nudm_UEContextManagement - Deregistration • Nudm_SubscriberDataManagement - Get • Nudm_SubscriberDataManagement - Subscribe • Nudm_SubscriberDataManagement - Unsubscribe	80	UDM1 to UDM31, UDM32 to UDM62, UDM63 to UDM71, UDM72 to UDM80	**Nudm_sdm** • Subscribe to Notifications • Data Change Notification • Unsubscribe from Notifications **Nudm_uecm** • Register SMF • Deregister SMF
SMF	CHF	N40	Nchf_ConvergedCharging	• Nchf_ConvergedCharging_Create • Nchf_ConvergedCharging_Update • Nchf_ConvergedCharging_Release	6	SMSF1 to SMSF3, SMSF4 to SMSF6	• Subscribe to notification • Cancel an existing subscription
PCF	CHF	N28	Nchf_SpendingLimitControl	Nchf_SpendingLimitControl Subscribe/ Unsubscribe	6	CHF1 to CHF3, CHF4 to CHF6	• Subscribe to notification • Cancel an existing subscription

Table 3-5 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
AMF	UDM	N8	Nudm_sdmNudm_uecm	• Nudm_UEContextManagement - Registration • Nudm_UEContextManagement - Deregistration • Nudm_SubscriberDataManagement - Get • Nudm_SubscriberDataManagement - Subscribe • Nudm_SubscriberDataManagement - Unsubscribe	80	UDM1 to UDM31, UDM32 to UDM62, UDM63 to UDM71, UDM72 to UDM80	**Nudm_sdm** • Subscribe to Notifications • Data Change Notification • Unsubscribe from Notifications **Nudm_uecm** • Register AMF • Deregister AMF
AMF	SMSF		Nsmsf-sms	• Nsmsf_SMService_Activate • Nsmsf_SMService_Deactivate	6	SMSF1 to SMSF3, SMSF4 to SMSF6	• SMSF Activate • SMSF Deactivate
PCF	BSF		Nbsf_Management	• Nbsf_Management_Register • Nbsf_Management_DeRegister	6	BSF1 to BSF3, BSF4 to BSF6	• Register the session binding information • Retrieve the session binding information • Remove an existing session binding
PCF	UDR	N36	Nudr-dr	• Nudr_DataRepository_Get • Nudr_DataRepository_Subscribe	470	UDR1 to UDR201, UDR202 to UDR402, UDR403 to UDR435, UDR436 to UDR470	• Create Policy Data Subscription • Delete Policy Data Subscription

Table 3-5 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
PCF	AMF		Namf_Communication	• Namf_Communication_N1N2MessageSubscribe • Namf_Communication_N1N2MessageUnSubscribe	80	AMF1 to AMF40, AMF41 to AMF80	• Subscribe • Unsubscribe
UDM	UDR	N35	Nudr-dr	Nudr_DataRepository	470	UDR1 to UDR201, UDR202 to UDR402, UDR403 to UDR435, UDR436 to UDR470	• Get UDR sm data
CHF	PCF		SpendingLimitStatus	SpendingLimitStatus	58	PCF1 to PCF29, PCF 65 to PCF93	• Create Policy Data Subscription • Delete Policy Data Subscription
SMSF	AMF		Namf-evts	• Namf_EnableReachability • Namf_Communication_N1N2MessageTransfer • Namf_EventExposure_Subscribe	80	AMF1 to AMF40, AMF41 to AMF80	• Subscribe • N1N2 Message transfer
AMF	NSSF	N22	Nnssf_NSSAIAvailability, Nnssf_NSSelection	• nnssf_nssaiavailability • nnssf_nsselection	6	NSSF1 to NSSF3, NSSF4 to NSSF6	• Get network slice information Selection • nssaiavailability subscription
NRF	SLF		Nudr_GroupIDmap	Nudr GET (SLF group id query)	470	UDR1 to UDR201, UDR202 to UDR402, UDR403 to UDR435, UDR436 to UDR470	• Get Group id

Table 3-5 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
CBCF	AMF	N50	Namf_Communication	• Namf_Communication_NonUeN2InfoSubscribe • Namf_Communication_NonUeN2InfoUnsubscribe • Namf_Communication_NonUeN2MessageTransfer	80	AMF1 to AMF40, AMF41 to AMF80	• Subscribe • Unsubscribe
SMSF	UDM		Nudm_uecm	Nudm_UECM (Registration,Delete)	80	UDM1 to UDM31, UDM32 to UDM62, UDM63 to UDM71, UDM72 to UDM80	• Registration • Delete
GMLC	AMF		Namf_Location	Namf_Location_ProvidePositioningInfo	80	AMF1 to AMF40, AMF41 to AMF80	• Get Location Information
GMLC	UDM		Nudm_uecm	Nudm_UEContextManagement Get Request/ Response	80	UDM1 to UDM31, UDM32 to UDM62, UDM63 to UDM71, UDM72 to UDM80	• Get Ue context management
LMF	AMF		Namf_Communication	Namf_Communication_N1N2MessageTransfer	80	AMF1 to AMF40, AMF41 to AMF80	• Post N1N2 message

Table 3-5 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
NEF	UDM	N52	Nudm_sdmNudm_uecmNudm_EventExposure	• Nudm_Sdm_Get • Nudm_Uecm_Get • Nudm_EventExposure_Subscribe • Nudm_EventExposure_ModifySubscription • Nudm_EventExposure_Unsubscribe	80	UDM1 to UDM31, UDM32 to UDM62, UDM63 to UDM71, UDM72 to UDM80	• Get • Subscribe • Unsubscribe
AMF	NSSAAF	N58	Nnssaaf-nssaa	Nnssaaf_NSSAA_Authenticate Request/ Response	6	NSSAAF1 to NSSAAF3, NSSAAF4 to NSSAAF6	Post Slice authentication
AUSF	UDM	N13	Nudm_UEAuthenticationNudm_sucideconceal	• Nudm_UEAuthentication - Authentication • Information Retrieval - POST • Nudm_UEAuthentication - ResultConfirmation - POST • Nudm_SuciDeconseal - de-concealment - GET	80	UDM1 to UDM31, UDM32 to UDM62, UDM63 to UDM71, UDM72 to UDM80	• Post Authentication • Get

3.3 Model C Test Cases

This section provides information about SCP Model C test cases.

This test scenario describes the performance and capacity of SCP with Model C and provides the benchmarking results with latency in a network.

3.3.1 Model C Test Case Summary

The following table provides a summary of the benchmark tests.

Table 3-6 Benchmark Test Case Summary

Benchmark Test Case Number	Description
Model C - Test Case Scenario 1	The Model C test is based on the network latency of 150 milliseconds at the rate of 150K MPS across 22 regions with rate limit enabled on a non ASM setup.
Model C - Test Case Scenario 2	The Model C test is based on the network latency of 200 milliseconds at the rate of 730K MPS with the LCI, OCI, Ingress Rate Limiting, Global Egress Rate Limiting, and ASM enabled.

3.3.2 Model C - Test Case Scenario 1

The Model C test is based on the network latency of 150 milliseconds at the rate of 150K MPS across 22 regions with rate limit enabled on a non ASM setup.

Objective

This test case scenario describes the performance and capacity of SCP with Model C. It provides benchmarking results with latency in a network, and rate limit is applied to the ingress and egress traffic.

The following table describes test bed configurations:

Table 3-7 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	24.2.0
Cluster	Test Bed 1 - CNE on BareMetal. For more information, see Cluster Details.
Topology	Topology 1. For information about topology, see Test Topology 1 for SCP Model C Benchmarking.

Test Case Parameters

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

Table 3-8 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	150K MPS
Network deployment diagram	Topology 1. For information about topology, see Test Topology 1 for SCP Model C Benchmarking.
Mode of Network deployment (Model-C or Model-D)	Model C
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	500

Table 3-8 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes. • Profile notification updates were run every 15 minutes along with traffic run. • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, and Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	300 milliseconds
Number of SCP ingress IPs configured	1
How many connections per published IP/FQDN producers can handle?	406
Per Egress connection max traffic in MPS	1000
How many connections consumer can initiate toward per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 190 ingress connections towards SCP IP
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4000 Bytes • Average HTTP Response Packet Size: 4500 Bytes
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 3600 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 44 • Number of NRF NFSets: 22
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	NA
NF Discovery response size and Info	NA
Egress and Ingress Rate Limit Configurations	• Number of Global Egress Rate limit configuration (number of unique keys): 0 • Number of Local Egress Rate limit configuration (number of unique keys): 500 • Number of Ingress Rate limit configuration (number of unique keys): 500
Mediation Configurations	NA

Table 3-8 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Mediation Trigger point configuration	NA
Secured HTTPs connection - % of message on HTTPs?	NA
DNS SRV configuration and response time	• Number of DNS SRV configuration: 500 SRV records • DNS query response time: 5ms
Roaming traffic details	NA
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 1 • Data plane pods: – Worker: 13 – NRF Proxy: 0 – NRF OAuth: 0 – Cache: 3 – Mediation: 0 – Load-Manager: 3
SCP Worker Pod Profile	12 vCPU and 16 Gi Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 500
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled. • Frequency of OCI header received with changed values: 15 seconds. • Number of NF/NFService Instances reporting OCI: 70.

Result and Observation

The performance test observation data shown in the following table can be used to conduct benchmark testing to raise the traffic rate:

Table 3-9 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	150K MPS
Average MPS per scp-worker pod	11.5K MPS
Success rate	100 %

Table 3-9 (Cont.) Result and Observation

Parameter	Values
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 3-10 SCP Microservices and their Utilization

SCP Microservices	CPU/Pod		Memory/Pod	
	Max	Avg	Max	Avg
scp-worker	7.85	6.86	5.63 GB	5.52 GB
scp-nrfproxy	NA	NA	NA	NA
scpc-notification	0.255	0.238	1.63 GB	1.63 GB
scpc-audit	0.0141	0.00778	855 MB	853 MB
scpc-configuration	0.0494	0.0117	623 MB	618 MB
scpc-subscription	0.0127	0.00828	909 MB	894 MB
scp-cache	0.257	0.209	1.05 GB	1.05 GB
scp-load-manager	0.0458	0.0363	668 MB	667 MB

Observed Values of cnDBTier Services

The following table provides information about observed values of cnDBTier services:

Table 3-11 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	0.48%
CPU usage of data nodes	0.114%
Write operations per second	0.002
Read operations per second	5.95
Transaction rates on data nodes	2.0

3.3.3 Model C - Test Case Scenario 2

The Model C test is based on the network latency of 200 milliseconds at the rate of 730K MPS with the LCI, OCI, Ingress Rate Limiting, Global Egress Rate Limiting, and ASM enabled.

Objective

This test case scenario describes the performance and capacity of SCP with Model C. It provides benchmarking results with latency in a network, and rate limit is applied to the ingress and egress traffic. In this scenario, ASM is enabled.

The following table describes test bed configurations:

Table 3-12 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	72 Hours
SCP Version Tag	25.2.201
Cluster	Test Bed 1Cluster Details - CNE on BareMetal. For more information, see .
Topology	Topology 2. For information about topology, see Test Topology 2 for SCP Model C Benchmarking.

Test Case Parameters

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

Table 3-13 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	730K MPS
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model C Benchmarking.
Mode of Network deployment (Model-C or Model-D)	Model C
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	1200
NF Status Information	Type of Notifications (Notification call model): • Priority, Capacity: 70% • Suspend: 10% • Deregistration: 5% • API Version changes: 3% • Update of IpEndPoint: 2% • SUPI range updates: 2% • Service Instance changes: 0% • Other types (upto Oracle to consider): 8%
NF Profile - Priority, Capacity, and Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	200 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	300 milliseconds
Number of SCP ingress IPs configured	1
How many connections per published IP/FQDN producers can handle?	360
Per Egress connection max traffic in MPS	1000
How many connections consumer can initiate towards per SCP IP (inclusive of upstream NF's processing latency)?	• Up to 10 connections per SCP IP per consumer • Total 4550 ingress connections towards SCP IP
Per Ingress connection max traffic in MPS	1500

Table 3-13 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Average Request and Response message size	• Average HTTP Request Packet Size: 4000 Bytes • Average HTTP Response Packet Size: 4500 Bytes
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	3%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 3 • Number of NRFs: 2
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	NA
NF Discovery response size and Info	NA
Egress and Ingress Rate Limit Configurations	• Global Egress Rate Limit configuration: – Configured keys: 3018 – Used keys: 1770 • Egress Rate Limit configuration: – Configured keys: 0 – Used keys: 0 • Ingress Rate Limit configuration: – Configured keys: 2874 – Used keys: 1600
Mediation Configurations	NA
Mediation Trigger point configuration	NA
Secured HTTPs connection - % of message on HTTPs?	NA
DNS SRV configuration and response time	• Number of DNS SRV configuration: 1200 SRV records • DNS query response time: 5ms
Roaming traffic details	NA
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 1 • Data plane pods: – Worker: 45 – NRF Proxy: 0 – NRF OAuth: 0 – Cache: 3 – Load-Manager: 3
SCP Worker Pod Profile	12vCPU and 24Gi Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 1200

Table 3-13 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • Frequency of OCI headers received with changed values is set to 15 seconds • Number of NF/NFService instances reporting OCI is 20

Result and Observation

The performance test observation data shown in the following table can be used to conduct benchmark testing to raise the traffic rate:

Table 3-14 Result and Observation

Parameter	Values
Test Duration	72 Hours
MPS Achieved	730K MPS
Average MPS per scp-worker pod	16.2K MPS
Mediation pod average MPS	NA
Success rate	100 %
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 3-15 SCP Microservices and their Utilization

SCP Microservices	CPU/Pod		Memory/Pod		Sidecar CPU		Sidecar Memory	
	Max	Avg	Max	Avg	Max	Avg	Max	Avg
scpc-subscription	0.037	0.028	484 MB	484 MB	0.118	0.027	607 MB	590 MB
scpc-notification	2.454	2.079	3.10 GB	3.09 GB	0.675	0.49	1.02 GB	991 MB
scpc-audit	0.127	0.024	652 MB	648 MB	0.127	0.033	609 MB	591 MB
scpc-configuration	0.021	0.018	678 MB	665 MB	0.154	0.057	630 MB	605 MB
scp-cache	0.624	0.545	1.01 GB	1.01 GB	0.114	0.026	868 MB	826 MB
scp-worker	7.84	7.51	4.05 GB	3.49 GB	6.556	6.421	1.35 GB	1.28 GB
scp-loadmanager	0.199	0.129	754 MB	749 MB	0.112	0.025	616 MB	590 MB
scp-nrfproxy	NA	NA	NA	NA	NA	NA	NA	NA
scp-mediation	NA	NA	NA	NA	NA	NA	NA	NA
scp-alternate-resolution	0.132	0.122	505 MB	503 MB	0.132	0.034	616 MB	598 MB

The following table describes OSO microservices and their utilization for a 72-hour test duration:

Table 3-16 OSO Resources

OSO Miscroservices	PVC	vCPU	Memory	Samples Scraped
prom-server	92.5 Gi	3.7	75 GB	11M
vz-oso-alm-0	24 KiB	0.002	0.0421 GB	
vz-oso-alm-1	24 KiB	0.002	0.0421 GB	

Observed Values of cnDBTier Services

The following table provides information about the observed values of cnDBTier services:

Table 3-17 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	2.99%
CPU usage of data nodes	4.17%
Write operations per second	0.4
Read operations per second	435
Transaction rates on data nodes	7.8

4
Benchmarking SCP Model D

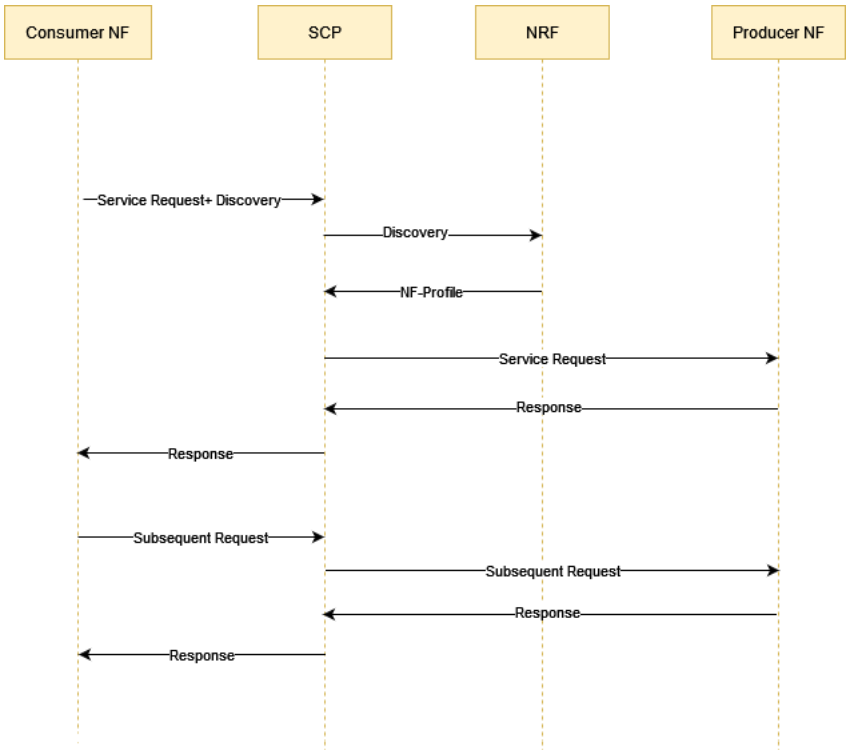
This section describes Model D test topologies and test scenarios for benchmarking SCP.

4.1 Model D Call Flow

The following call flow represents how a service request is processed by SCP.

1. Consumer NF sends the service request to SCP with discovery parameters.
2. SCP sends the discovery request to NRF with the received discovery parameters.
3. NRF responds with the NF profile list that contains information about the preferred producer NFs.
4. SCP sends the request to the producer NF based on the NF profile list received from NRF.
5. Producer NF sends the response to SCP for the service request.
6. SCP routes the response received from the producer NF to the consumer NF.

Figure 4-1 Model D Call Flow

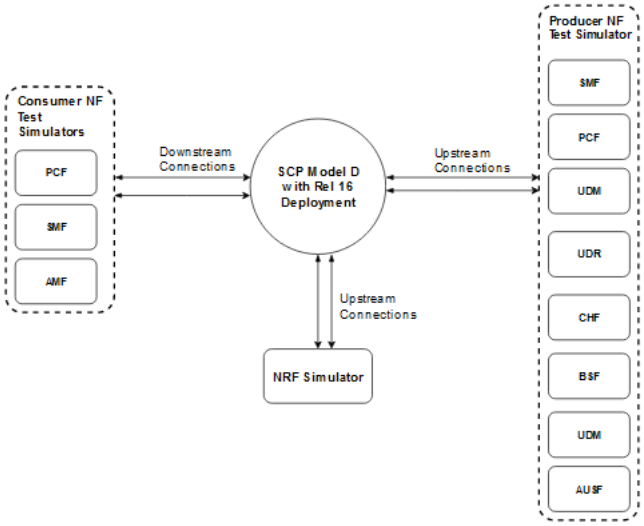


4.2 Test Topology 1 for SCP Model D Benchmarking

The following image represents the test topology consisting of the following components:

- SCP
- Consumer NF test simulator
- Producer NF test simulator
- NRF simulator

Figure 4-2 SCP Model D Topology



The aforementioned image represents the Model D test topology. In Release 16 Model D indirect 5G SBI communication with delegated discovery mode, the consumer NF delegates the producer NF discovery procedure to SCP by adding discovery parameters to the service requests. SCP performs NF discovery with NRF using the received discovery parameters and sends the request to the producer NF based on the NF profile list received from NRF.

4.2.1 Topology 1 Traffic Distribution

The following table describes the percentage of messages processed by SCP using N11, N7, N10, N36, N28, and so on interfaces:

Table 4-1 Topology 1 Traffic Distribution

NF-C	NF-P	Interface Reference	NF Service	Percentage (%) of Messages
AMF	SMF	N11	nsmf-pdusession	50.00
SMF	PCF	N7	npcf-smpolicycontrol	30.00
SMF	UDM	N10	• nudm-sdm • nudm-uecm	10.90
PCF	UDR	N36	nudr-dr	0.40
PCF	CHF	N28	nchf-spendinglimitcontrol	0.40
PCF	BSF	Nbsf	nbsf-management	0.30
AMF	UDM	N8	• nudm-sdm • nudm-uecm	2.50

Table 4-1 (Cont.) Topology 1 Traffic Distribution

NF-C	NF-P	Interface Reference	NF Service	Percentage (%) of Messages
AMF	AUSF	N12	nausf-auth	2.50
AMF	PCF	N15	• npcf-ue-policy-control • npcf-am-policy-control	3.00

Topology 1 Routing Configuration

The following table describes the routing configurations for the NF services:

Table 4-2 Routing Configuration

NF	Service	Initial Message		Subsequent Message		reverseProxySupport	Deployment	Response Timeout
		routePolicy	reroutePolicy	routePolicy	routePolicy			
SMF	Nsmf_PDUSession	Load_Balance	RerouteWithinRegion	Load_Balance	RerouteWithinRegion	False	REGIONAL	1s
PCF	Npcf_SMPolicyControl	Load_Balance	RerouteWithinRegion	Load_Balance	RerouteWithinRegion	False	REGIONAL	1s
UDR	Nudr_dm	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
CHF	Nchf_SpendingLimitControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
UDM	Nudm_sdm	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
UDM	Nudm_uecm	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
PCF	Npcf_AMPolicyControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
PCF	Npcf_UEPolicyControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
AUSF	Nausf_UEAuthentication	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
BSF	Nbsf_management	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
UDR	Nudr_udrService	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s

Topology 1 NF Profiles

The following table describes NF profile configuration, traffic, and message call flows for 176 NF profiles registered on SCP:

Table 4-3 NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows	Discover parameters (Delegated Discovery)
AMF	SMF	N11	• nsmf-pdusession • nsmf-event-exposure	nsmf-pdusession	80	SMF1 to SMF80	• Create PDU session • Modify PDU session • Release PDU session	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type • 3gpp-Sbi-Discovery-Snssais • 3gpp-Sbi-Discovery-dnn • 3gpp-Sbi-Discovery-tai • 3gpp-Sbi-Discovery-service-names

Table 4-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows	Discover parameters (Delegated Discovery)
AMF	PCF	N15	• npcf-am-policy-control • npcf-smpolicycontrol • npcf-policyauthorization • npcf-bdtpolicycontrol • npcf-ue-policy-control	• npcf-ue-policy-control • npcf-am-policy-control	12	PCF1 to PCF12	**Npcf_AMPolicyControl** • Create AM Policy Association • Retrieve SM Policy • Update Policy • Policy Update Notification **Npcf_UEPolicyControl** • Create Policy Association • Retrieve Policy Association • Update Policy Association • Policy Update Notification	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type • 3gpp-Sbi-discovery-snssais • 3gpp-Sbi-discovery-preferred-locality • 3gpp-Sbi-discovery-preferred-api-versions • 3gpp-Sbi-Discovery-service-names

Table 4-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows	Discover parameters (Delegated Discovery)
SMF	PCF	N7	• npcf-am-policy-control • npcf-smpolicycontrol • npcf-policyauthorization • npcf-bdtpolicycontrol • npcf-ue-policy-control	npcf-smpolicycontrol	38	PCF13 to PCF50	• Create SM Policy • Update SM Policy • Delete SM Policy	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type • 3gpp-Sbi-discovery-snssais • 3gpp-Sbi-discovery-dnn • 3gpp-Sbi-discovery-preferred-locality • 3gpp-Sbi-discovery-preferred-api-versions

Table 4-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows	Discover parameters (Delegated Discovery)
SMF	UDM	N10	• nudm-ueau • nudm-uecm • nudm-sdm • nudm-ee • nudm-pp	• nudm-sdm • nudm-uecm	3	UDM1 to UDM3	**Nudm_sdm** • Subscribe to Notifications • Data Change Notification • Unsubscribe from Notifications **Nudm_uecm** • Register SMF • Deregister SMF	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type • 3gpp-Sbi-discovery-preferred-locality • 3gpp-Sbi-discovery-preferred-api-versions • 3gpp-sbi-discovery-supi • 3gpp-sbi-discovery-group-id-list

Table 4-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows	Discover parameters (Delegated Discovery)
AMF	UDM	N8	• nudm-ueau • nudm-uecm • nudm-sdm • nudm-ee • nudm-pp	• nudm-sdm • nudm-uecm	3	UDM4 to UDM6	**Nudm_sdm** • Subscribe to Notifications • Data Change Notification • Unsubscribe from Notifications **Nudm_uecm** • Register AMF • Deregister AMF	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type • 3gpp-Sbi-discovery-preferred-locality • 3gpp-Sbi-discovery-preferred-api-versions • 3gpp-sbi-discovery-supi • 3gpp-sbi-discovery-group-id-list

Table 4-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows	Discover parameters (Delegated Discovery)
PCF	UDR	N36	• nudr-dr • nudr-group-id-map	nudr-dr	10	UDR1 to UDR10	• Create Policy Data Subscription • Delete Policy Data Subscription	• 3gpp-sbi-discovery-requester-nf-type • 3gpp-Sbi-discovery-preferred-locality • 3gpp-Sbi-discovery-preferred-api-versions • 3gpp-sbi-discovery-supi • 3gpp-Sbi-Discovery-data-set

Table 4-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows	Discover parameters (Delegated Discovery)
PCF	CHF	N28	• nchf-spendinglimitcontrol • nchf-convergedcharging	nchf-spendinglimitcontrol	10	CHF1 to CHF10	• Subscribe to notification • Cancel an existing subscription	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type • 3gpp-Sbi-discovery-preferred-locality • 3gpp-Sbi-discovery-preferred-api-versions

Table 4-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows	Discover parameters (Delegated Discovery)
AMF	AUSF	N12	• nausf-auth • nausf-sorprotection • nausf-upuprotection	nausf-auth	10	AUSF1 to AUSF10	Authenticate UE	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type • 3gpp-Sbi-discovery-preferred-locality • 3gpp-Sbi-discovery-preferred-api-versions

Table 4-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows	Discover parameters (Delegated Discovery)
PCF	BSF	Nbsf	nbsf-management	nbsf-management	10	BSF1 to BSF10	• Register the session binding information • Retrieve the session binding information • Remove an existing session binding	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type • 3gpp-Sbi-discovery-preferred-locality • 3gpp-Sbi-discovery-preferred-api-versions

Access Token Request Parameters

The following table lists the data set of NF instance level access token:

Table 4-4 Data Set

Data Set 1: NFtype level access token	Data Set 2: NFtype level access token
nfInstanceId, nfType, targetNfType, scope, requesterSnssaiList, targetSnssaiList	nfInstanceId, scope, requesterSnssaiList, targetSnssaiList, targetNfInstanceId, targetNfServiceSetId

OAuth Parameters

The following table describes the OAuth parameters and their data set:

Table 4-5 OAuth Parameters

Parameter	Data Set 1	Data Set 2	Data Set 3
Average size of access token (in bytes)	500	1000	500

Table 4-5 (Cont.) OAuth Parameters

Parameter	Data Set 1	Data Set 2	Data Set 3
Average size of AccessTokenReq message sent to NRF (in bytes)	500	1000	1500
Average value of Access Token Expiry time (in hr)	1	24	• 50% tokens: 1 hr • 50% tokens: 24 hr
Will the access token expiration time be the same for all access tokens or different? What are the criteria?	All access tokens expire at same time	All access tokens expire at same time	Half of tokens expire at same time
Non-Roaming partners			
Maximum number of consumer NFs using oAuth	200	100	200
Maximum number of producer NFs for which OAuth enabled	200	200	200
Average number of producer NF Types to whom each consumer NFs communicates	5	5	5
Number of NF-Sets per NF Type (Number of NF instances in a GR deployment per NF Type)	• 3 • 9	• 3 • 9	• 3 • 9
Max. number of slices for which token is to be granted	3	3	3
Max. number of PLMNs in local network for which token is to be granted	5	5	10
Access Token Cache Size (# of records) - Derived from (6-11)	45000	22500	99000
Roaming partners			
Max. Number of roaming PLMNs	200	100	500
Call mix			
Access Token Type mix	• 33% NF Type level tokens • 33% NF instance level tokens	• 50% NF Type level tokens • 25% NF instance level tokens	• 50% NF Type level tokens • 25% NF instance level tokens

Topology 1 Notification NRF

The following table describes NF profile configuration, traffic, and message call flows for NF profiles registered on SCP:

- Priority of NF services has changed
- Capacity of NF services has changed
- Priority and Capacity of NF services have changed
- Load of NF has changed

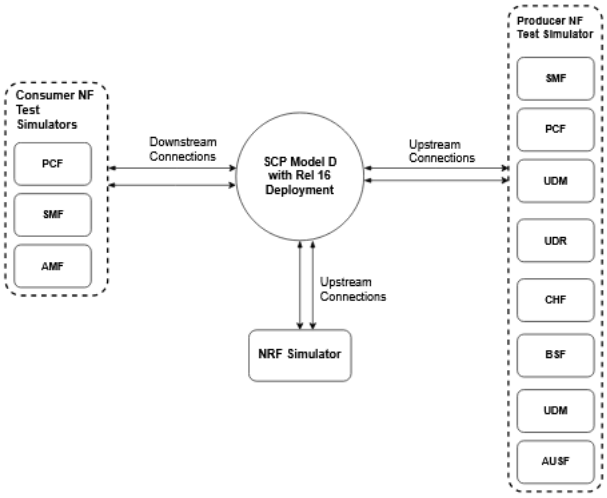
- Addition of SUPI range to NF
- Addition of GPSI range to NF
- Service instances are removed from the NF profile
- Service instances are added from the NF profile

4.3 Test Topology 2 for SCP Model D Benchmarking

The following image represents the test topology consisting of the following components:

- SCP
- Consumer NF test simulator
- Producer NF test simulator
- NRF simulator

Figure 4-3 SCP Model D Topology 2



4.3.1 Topology 2 Traffic Distribution

The following table describes the percentage of messages processed by SCP using N11, N7, N10, N36, N28, and other interfaces:

Table 4-6 Topology 2 Traffic Distribution

NF-C	NF-P	Interface Reference	Percentage (%) of Messages
SMF	PCF	N7	60
SMF	UDM	N10	5
PCF	UDR	N36	1
PCF	CHF	N28	1
SMF	CHF	N40	10
NRF	SLF	-	3
PCF	BSF	Nbsf	2

Table 4-6 (Cont.) Topology 2 Traffic Distribution

NF-C	NF-P	Interface Reference	Percentage (%) of Messages
AMF	UDM	N8	7.5
AMF	AUSF	N12	7.5
AMF	PCF	N15	3
NRF	SCP	Notifications	Type of Notifications (Notification call model): • Priority, Capacity: 70% • Suspend: 10% • Deregistration: 5% • API version changes: 3% • Update of IpEndPoint: 2% • SUPI range updates: 2% • Service Instance changes: 1% • Other types: 8% **Frequency of Notifications:** • Bulk Notifications (where all NF instances update at once): Once a month • NF load update: once every 2 seconds • NF priority, capacity change: once every 10 seconds • NF suspend: once every 15 seconds • NF instance update (IP endpoint, API version, service instance): once every 20 seconds

Table 4-7 Number of NF

NF Name	NF Count
AMF	150
SMF	150
PCF	50
UDM	40
AUSF	40
UDR	10
BSF	10
CHF	20
SLF	10
NRF	3 Stubs
SCP	2 SCP triplets in one region (1 real SCP and rest all Stubs)
Total	480 (excluding NRF and SCP)

Topology 2 Routing Configuration

The following table describes the routing configurations for the NF services:

Table 4-8 Routing Configuration

NF	Service	Deployment	Response Timeout
PCF	Npcf_SMPolicyControl	SITE_WIDE	3s
UDR	Nudr_dm	SITE_WIDE	3s
CHF	Nchf_SpendingLimitControl	SITE_WIDE	3s
UDM	Nudm_sdm	SITE_WIDE	3s
UDM	Nudm_uecm	SITE_WIDE	3s
PCF	Npcf_AMPolicyControl	SITE_WIDE	3s
PCF	Npcf_UEPolicyControl	SITE_WIDE	3s
AUSF	Nausf_UEAuthentication	SITE_WIDE	3s
BSF	Nbsf_management	SITE_WIDE	3s
UDR	Nudr_udrService	SITE_WIDE	3s

Topology 2 NF Profiles

The following table describes NF profile configuration, traffic, and message call flows for 176 NF profiles registered on SCP:

Table 4-9 NF Profiles

NF-C	NF-P	Reference	Producer NF Service	Discovery Parameter
SMF	PCF	N7	Npcf_SMPolicyControl	• 3gpp-Sbi-Discovery-requester-nf-type: SMF • 3gpp-Sbi-Discovery-target-nf-type: PCF • 3gpp-Sbi-Discovery-preferred-snssais: <S-NSSAI> • 3gpp-Sbi-Discovery-dnn=<DNN> • 3gpp-Sbi-Discovery-preferred-locality: <Locality of SMF> • 3gpp-Sbi-Discovery-preferred-api-versions
SMF	UDM	N10	Nudm_sdm, Nudm_uecm	• 3gpp-Sbi-Discovery-requester-nf-type: SMF • 3gpp-Sbi-Discovery-target-nf-type: UDM • 3gpp-Sbi-Discovery-preferred-locality: <Locality of SMF> • 3gpp-Sbi-Discovery-preferred-api-versions • 3gpp-Sbi-Discovery- supi: <SUPI> • [3gpp-Sbi-Discovery-group-id-list =<UDM Group ID>] **Note**: SMF receives UDM Group Id from AMF, SMF will not receive UDM Groupd ID from MME.

Table 4-9 (Cont.) NF Profiles

NF-C	NF-P	Reference	Producer NF Service	Discovery Parameter
PCF	UDR	N36	Nudr_dm	• 3gpp-Sbi-Discovery-requester-nf-type: PCF • 3gpp-Sbi-Discovery-target-nf-type: UDR • 3gpp-Sbi-Discovery-preferred-locality: <Locality of PCF> • 3gpp-Sbi-Discovery-supi:<supi> • 3gpp-Sbi-Discovery-data-set:<data set> • 3gpp-Sbi-Discovery-preferred-api-versions
PCF	CHF	N28	Nchf_SpendingLimitControl	• 3gpp-Sbi-Discovery-requester-nf-type: PCF • 3gpp-Sbi-Discovery-target-nf-type: CHF • 3gpp-Sbi-Discovery-preferred-locality: <Locality of PCF> • 3gpp-Sbi-Discovery-preferred-api-versions
SMF	CHF	N40	--	• 3gpp-Sbi-Discovery-requester-nf-type: SMF • 3gpp-Sbi-Discovery-target-nf-type: CHF • 3gpp-Sbi-Discovery-preferred-locality: <Locality of SMF> • 3gpp-Sbi-Discovery- supi: <SUPI> • 3gpp-Sbi-Discovery-preferred-api-versions **Note**: NRF will perform SLF lookup for SUPI to CHF Group Id translation
PCF	BSF	Nbsf	Nbsf_management	• 3gpp-Sbi-Discovery-requester-nf-type: PCF • 3gpp-Sbi-Discovery-target-nf-type: BSF • 3gpp-Sbi-Discovery-preferred-locality: <Locality of PCF> • 3gpp-Sbi-Discovery- ue-ipv4-address or 3gpp-Sbi-Discovery- ue-ipv6-prefix (only one of these headers is applicable) • 3gpp-Sbi-Discovery-ip-domain (Only applicable for IPv4 address) • 3gpp-Sbi-Discovery-preferred-api-versions • 3gpp-Sbi-Discovery-dnn: <DNN> • 3gpp-Sbi-Discovery-snssais: <S-NSSAI>

Table 4-9 (Cont.) NF Profiles

NF-C	NF-P	Reference	Producer NF Service	Discovery Parameter
AMF	UDM	N8	Nudm_sdm, Nudm_uecm	Common discovery parameters: • 3gpp-Sbi-Discovery-requester-nf-type: AMF • 3gpp-Sbi-Discovery-target-nf-type: UDM • 3gpp-Sbi-Discovery-preferred-locality: <Locality of AMF> • 3gpp-Sbi-Discovery-preferred-api-versions • 3gpp-Sbi-Discovery- supi: <SUPI> • 3gpp-Sbi-Discovery-group-id-list =<UDM Group ID>
AMF	AUSF	N12	Nausf_UEAuthentication	Common discovery parameters: • 3gpp-Sbi-Discovery-requester-nf-type: AMF • 3gpp-Sbi-Discovery-target-nf-type: AUSF • 3gpp-Sbi-Discovery-preferred-locality: <Locality of AMF> • 3gpp-Sbi-Discovery-preferred-api-versions • 3gpp-Sbi-Discovery-routing-indicator: <Routing Indicator> • 3gpp-Sbi-Discovery-supi: <SUPI> • 3gpp-Sbi-Discovery-group-id-list =<AUSF Group ID>

Table 4-9 (Cont.) NF Profiles

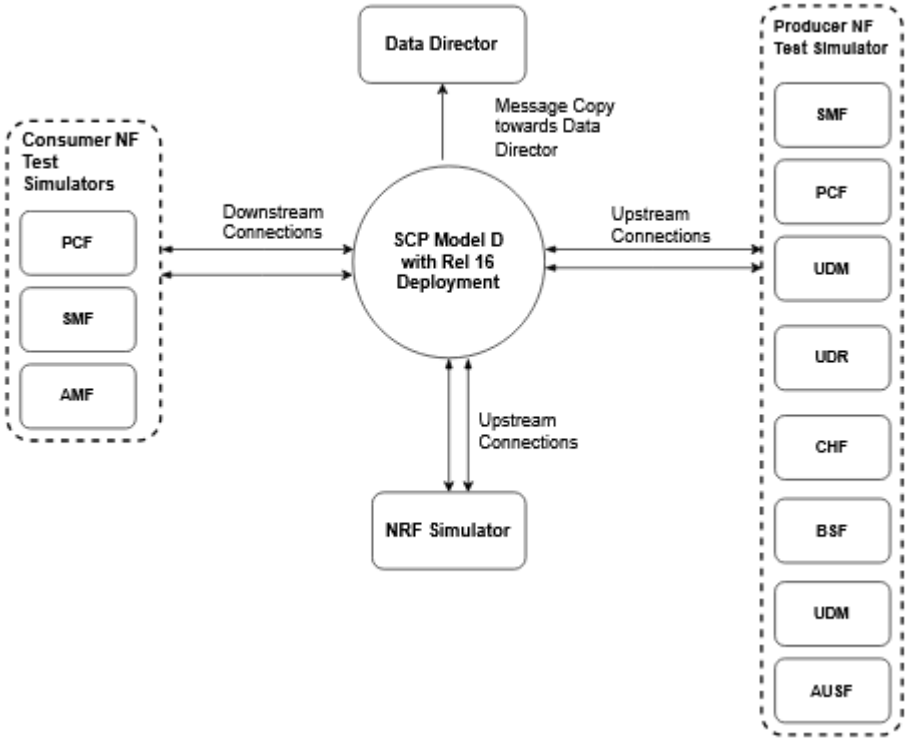
NF-C	NF-P	Reference	Producer NF Service	Discovery Parameter
AMF	PCF	N15	Npcf_AMPolicyControl, Npcf_UEPolicyControl	**Scenario 1** AMF will include the following discovery headers to SCP for PCF discovery at AM Policy Association establishment time: • 3gpp-Sbi-Discovery-requester-nf-type: AMF • 3gpp-Sbi-Discovery-target-nf-type: PCF • 3gpp-Sbi-Discovery-preferred-snssais: <S-NSSAI> • 3gpp-Sbi-Discovery-preferred-locality: <Locality of AMF> • 3gpp-Sbi-Discovery-service-names={npcf-am-policy-control, npcf-ue-policy-control} • 3gpp-Sbi-Discovery-preferred-api-versions **Scenario 2** AMF will include the following discovery headers to SCP for PCF discovery at UE Policy Association establishment time: • 3gpp-Sbi-Discovery-requester-nf-type: AMF • 3gpp-Sbi-Discovery-target-nf-type: PCF • 3gpp-Sbi-Discovery-preferred-target-nf-instance-id: <PCF instance id > • 3gpp-Sbi-Discovery-preferred-api-versions

4.4 Test Topology 3 for SCP Model D Benchmarking

The following image represents the test topology consisting of the following components:

- SCP
- Consumer NF test simulator
- Producer NF test simulator
- NRF simulator
- Data Director

Figure 4-4 SCP Model D Topology 3



The aforementioned image represents the Model D test topology. In Release 16 Model D indirect 5G SBI communication with delegated discovery mode, the consumer NF delegates the producer NF discovery procedure to SCP by adding discovery parameters to the service requests. SCP performs NF discovery with NRF using the received discovery parameters and sends the request to the producer NF based on the NF profile list received from NRF.

4.4.1 Topology 3 Traffic Distribution

The following table describes the percentage of messages processed by SCP using N11, N7, N10, N36, N28, and other interfaces:

Table 4-10 Topology 3 Traffic Distribution

NF-C	NF-P	Interface Reference	Percentage (%) of Messages
SMF	PCF	N7	60
SMF	UDM	N10	5
PCF	UDR	N36	1
PCF	CHF	N28	1
SMF	CHF	N40	10
NRF	SLF	-	3
PCF	BSF	Nbsf	2
AMF	UDM	N8	7.5
AMF	AUSF	N12	7.5
AMF	PCF	N15	3

Table 4-10 (Cont.) Topology 3 Traffic Distribution

NF-C	NF-P	Interface Reference	Percentage (%) of Messages
NRF	SCP	Notifications	Type of Notifications (Notification call model): • Priority, Capacity: 70% • Suspend: 10% • Deregistration: 5% • API version changes: 3% • Update of IpEndPoint: 2% • SUPI range updates: 2% • Service Instance changes: 1% • Other types: 8% **Frequency of Notifications:** • Bulk Notifications (where all NF instances update at once): once a month • NF load update: once every 2 seconds • NF priority, capacity change: once every 10 seconds • NF suspend: once every 15 seconds • NF instance update (IP endpoint, API version, service instance): once every 20 seconds

Table 4-11 Number of NF

NF Name	NF Count
AMF	150
SMF	150
PCF	50
UDM	40
AUSF	40
UDR	10
BSF	10
CHF	20
SLF	10
NRF	3 Stubs
SCP	2 SCP triplets in one region (1 real SCP and rest all Stubs)
Total	480 (excluding NRF and SCP)

Topology 3 Routing Configuration

The following table describes the routing configurations for the NF services:

Table 4-12 Routing Configuration

NF	Service	Deployment	Response Timeout
PCF	Npcf_SMPolicyControl	SITE_WIDE	3s
UDR	Nudr_dm	SITE_WIDE	3s
CHF	Nchf_SpendingLimitControl	SITE_WIDE	3s

Table 4-12 (Cont.) Routing Configuration

NF	Service	Deployment	Response Timeout
UDM	Nudm_sdm	SITE_WIDE	3s
UDM	Nudm_uecm	SITE_WIDE	3s
PCF	Npcf_AMPolicyControl	SITE_WIDE	3s
PCF	Npcf_UEPolicyControl	SITE_WIDE	3s
AUSF	Nausf_UEAuthentication	SITE_WIDE	3s
BSF	Nbsf_management	SITE_WIDE	3s
UDR	Nudr_udrService	SITE_WIDE	3s

Topology 3 NF Profiles

The following table describes NF profile configuration, traffic, and message call flows for 176 NF profiles registered on SCP:

Table 4-13 NF Profiles

NF-C	NF-P	Reference	Producer NF Service	Discovery Parameter
SMF	PCF	N7	Npcf_SMPolicyControl	• 3gpp-Sbi-Discovery-requester-nf-type: SMF • 3gpp-Sbi-Discovery-target-nf-type: PCF • 3gpp-Sbi-Discovery-preferred-snssais: <S-NSSAI> • 3gpp-Sbi-Discovery-dnn=<DNN> • 3gpp-Sbi-Discovery-preferred-locality: <Locality of SMF> • 3gpp-Sbi-Discovery-preferred-api-versions
SMF	UDM	N10	Nudm_sdm, Nudm_uecm	• 3gpp-Sbi-Discovery-requester-nf-type: SMF • 3gpp-Sbi-Discovery-target-nf-type: UDM • 3gpp-Sbi-Discovery-preferred-locality: <Locality of SMF> • 3gpp-Sbi-Discovery-preferred-api-versions • 3gpp-Sbi-Discovery- supi: <SUPI> • [3gpp-Sbi-Discovery-group-id-list =<UDM Group ID>] **Note**: SMF receives UDM Group Id from AMF, SMF will not receive UDM Groupd ID from MME.

Table 4-13 (Cont.) NF Profiles

NF-C	NF-P	Reference	Producer NF Service	Discovery Parameter
PCF	UDR	N36	Nudr_dm	• 3gpp-Sbi-Discovery-requester-nf-type: PCF • 3gpp-Sbi-Discovery-target-nf-type: UDR • 3gpp-Sbi-Discovery-preferred-locality: <Locality of PCF> • 3gpp-Sbi-Discovery-supi:<supi> • 3gpp-Sbi-Discovery-data-set:<data set> • 3gpp-Sbi-Discovery-preferred-api-versions
PCF	CHF	N28	Nchf_SpendingLimitControl	• 3gpp-Sbi-Discovery-requester-nf-type: PCF • 3gpp-Sbi-Discovery-target-nf-type: CHF • 3gpp-Sbi-Discovery-preferred-locality: <Locality of PCF> • 3gpp-Sbi-Discovery-preferred-api-versions
SMF	CHF	N40	--	• 3gpp-Sbi-Discovery-requester-nf-type: SMF • 3gpp-Sbi-Discovery-target-nf-type: CHF • 3gpp-Sbi-Discovery-preferred-locality: <Locality of SMF> • 3gpp-Sbi-Discovery- supi: <SUPI> • 3gpp-Sbi-Discovery-preferred-api-versions **Note**: NRF will perform SLF lookup for SUPI to CHF Group Id translation
PCF	BSF	Nbsf	Nbsf_management	• 3gpp-Sbi-Discovery-requester-nf-type: PCF • 3gpp-Sbi-Discovery-target-nf-type: BSF • 3gpp-Sbi-Discovery-preferred-locality: <Locality of PCF> • 3gpp-Sbi-Discovery- ue-ipv4-address or 3gpp-Sbi-Discovery- ue-ipv6-prefix (only one of these headers is applicable) • 3gpp-Sbi-Discovery-ip-domain (Only applicable for IPv4 address) • 3gpp-Sbi-Discovery-preferred-api-versions • 3gpp-Sbi-Discovery-dnn: <DNN> • 3gpp-Sbi-Discovery-snssais: <S-NSSAI>

Table 4-13 (Cont.) NF Profiles

NF-C	NF-P	Reference	Producer NF Service	Discovery Parameter
AMF	UDM	N8	Nudm_sdm, Nudm_uecm	Common discovery parameters: • 3gpp-Sbi-Discovery-requester-nf-type: AMF • 3gpp-Sbi-Discovery-target-nf-type: UDM • 3gpp-Sbi-Discovery-preferred-locality: <Locality of AMF> • 3gpp-Sbi-Discovery-preferred-api-versions • 3gpp-Sbi-Discovery- supi: <SUPI> • 3gpp-Sbi-Discovery-group-id-list =<UDM Group ID>
AMF	AUSF	N12	Nausf_UEAuthentication	Common discovery parameters: • 3gpp-Sbi-Discovery-requester-nf-type: AMF • 3gpp-Sbi-Discovery-target-nf-type: AUSF • 3gpp-Sbi-Discovery-preferred-locality: <Locality of AMF> • 3gpp-Sbi-Discovery-preferred-api-versions • 3gpp-Sbi-Discovery-routing-indicator: <Routing Indicator> • 3gpp-Sbi-Discovery-supi: <SUPI> • 3gpp-Sbi-Discovery-group-id-list =<AUSF Group ID>

Table 4-13 (Cont.) NF Profiles

NF-C	NF-P	Reference	Producer NF Service	Discovery Parameter
AMF	PCF	N15	Npcf_AMPolicyControl, Npcf_UEPolicyControl	**Scenario 1** AMF will include the following discovery headers to SCP for PCF discovery at AM Policy Association establishment time: • 3gpp-Sbi-Discovery-requester-nf-type: AMF • 3gpp-Sbi-Discovery-target-nf-type: PCF • 3gpp-Sbi-Discovery-preferred-snssais: <S-NSSAI> • 3gpp-Sbi-Discovery-preferred-locality: <Locality of AMF> • 3gpp-Sbi-Discovery-service-names={npcf-am-policy-control, npcf-ue-policy-control} • 3gpp-Sbi-Discovery-preferred-api-versions **Scenario 2** AMF will include the following discovery headers to SCP for PCF discovery at UE Policy Association establishment time: • 3gpp-Sbi-Discovery-requester-nf-type: AMF • 3gpp-Sbi-Discovery-target-nf-type: PCF • 3gpp-Sbi-Discovery-preferred-target-nf-instance-id: <PCF instance id > • 3gpp-Sbi-Discovery-preferred-api-versions

4.5 Model D Test Cases

This section provides information about the SCP Model D test cases.

This test scenario describes the performance and capacity of SCP with Model D and provides the benchmarking results with latency in a network.

4.5.1 Model D Test Case Summary

The following table provides a summary of the benchmark tests:

Table 4-14 Benchmark Test Case Summary

Benchmark Test Case Number	Description
Model D - Test Case Scenario 1	The Model D test is based on a network latency of 150 milliseconds at a rate of 186K MPS with Oauth2.0 and Cache enabled.
Model D - Test Case Scenario 2	The Model D test is based on the network latency of 50 milliseconds at the rate of 400K MPS without features enabled in the TLS enabled BareMetal CNE setup.
Model D - Test Case Scenario 3	The Model D test is based on the network latency of 150 milliseconds at the rate of 400K MPS with the features enabled in the TLS enabled vCNE setup.

Table 4-14 (Cont.) Benchmark Test Case Summary

Benchmark Test Case Number	Description
Model D Test Scenario 4	The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation enabled on vCNE.
Model D Test Scenario 5	The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation enabled on BareMetal.
Model D Test Scenario 6	The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation on BareMetal with 20% Static Discovery in case the discovery mode is set to "NRF Followed BY SCP".
Model D Test Scenario 7	The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation on BareMetal with 20% Static Discovery in case the discovery mode is set to "SCP Followed BY NRF".
Model D Test Scenario 8	The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation with 2 ingress Cloud Native Load Balancer (CNLB) and without egress configuration enabled.
Model D Test Scenario 9	The Model D test is based on the network latency of 150 milliseconds at the rate of 450K MPS with Cloud Native Load Balancer (CNLB) and egress bypass.
Model D Test Scenario 10	The Model D test with Mediation on BareMetal and OCNADD enabled with four trigger points, 650K MPS towards OCNADD.

4.5.2 Model D - Test Case Scenario 1

This is a Model D test based on the network latency of 150 milliseconds with no rate limit applied.

Objective

This test case scenario describes the performance and capacity of SCP with the 186K MPS Model D deployment model and the following configurations:

- OAuth parameters and OAuth2.0 feature enabled
- OAuth Cache enabled
- Model D Cache disabled
- enforceReqSpecificSvcDiscovery parameter enabled

The following table describes test bed configurations:

Table 4-15 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	23.4.0
Cluster	Test Bed 1 - CNE on BareMetal. For more information, see Cluster Details
Topology	Topology 1. For information about topology, see Test Topology 1 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-16 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	186K MPS
Network deployment diagram	Topology 1. For information about topology, see Test Topology 1 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model C (80%) and Model D (20%)
Number of NFs deployed in the network that SCP is supposed to learn (number of NF profiles)	• **Number of NF instances**: 176 profiles as described in Table 3-3. • **NF Services per NF instance**: – SMF profile has two service types, such as nsmf-pdusession and nsmf-event-exposure. Each service type has one instance. – PCF profile has five service types, such as npcf-am-policy-control, npcf-smpolicycontrol, npcf-policyauthorization, npcf-bdtpolicycontrol, npcf-ue-policy-control. Each service type has one instance. – UDM profile has five service types, such as nudm-ueau, nudm-uecm, nudm-sdm, nudm-ee, and nudm-pp. Each service type has one instance. – UDR profile has two service types, such as nudr-dr and nudr-group-id-map. Each service type has one instance. – CHF profile has two service types, such as nchf-spendinglimitcontrol and nchf-convergedcharging. Each service type has one instance. – AUSF profile has three service types, such as nausf-auth, nausf-sorprotection, and nausf-upuprotection. Each service type has one instance. – BSF profile has one service type, such as nbsf-management. Each service type has one instance. • **IP/FQDN per service**: Each service instance has a single unique IP endpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add, modify, or delete 10 notifications every 15 minutes. • Profile notification updates were run every 15 minutes, along with traffic runs. • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles. – Service instances are removed from profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in milliseconds	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in milliseconds	150 milliseconds
Number of SCP ingress IPs configured	1
How many connections per published IP/FQDN producers can handle?	200

Table 4-16 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Per Egress connection max traffic in MPS	400
How many connections consumer can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 800 ingress connections towards SCP IP
Per Ingress connection, max traffic in MPS	1000
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 3600 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Disabled • enforceReqSpecificSvcDiscovery: Enabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide a list of discovery parameters for every 3GPP interface. • ValidityPeriod value in discovery response (cache TTL): NA
NF Discovery response size and Info	• Largest number of NF profiles returned in the discovery response: 6 • Largest number of NF services in each NF profile in the discovery response: 5
Egress and Ingress Configurations	NA
Mediation Configurations	NA
Mediation Trigger point configuration	NA
Secured HTTPs connection - % of message on HTTPs?	NA
DNS SRV configuration and response time	NA
Roaming traffic details	NA
Pods deployed	• Control plane pods: – Notification:1 – Subscription:1 – Audit:1 – Configuration:1 • Data plane pods: – Worker: 50 – NRF Proxy: 21 – NRF OAuth: 4 – Cache: 3 – Mediation: 1
SCP Worker Pod Profile	8 vCPU and 12 Gi Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	NA
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	40K MPS

Table 4-16 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
OCI Configurations	NA

Result and Observation

The following table provides observation data for the performance test that can be used for testing to increase the traffic rate:

Table 4-17 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	186K MPS
Average per scp-worker pod MPS	3730 MPS
Success rate	~100%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-18 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	4.72	4.36	4.69 GB	4.51 GB
scp-nrfproxy	2.01	1.58	2.63 GB	2.61 GB
scpc-notification	0.640	0.621	1.87 GB	1.85 GB
scpc-audit	0.0106	0.00521	586 MB	584 MB
scpc-configuration	0.0632	0.0471	785 MB	778 MB
scpc-subscription	0.0304	0.0254	481 MB	478 MB
scp-cache	0.0199	0.0144	2.98 GB	2.92 GB
scp-nrfproxyoauth	2.26	1.97	3.08 GB	3.06 GB
scp-mediation	0.000644	0.000583	374 MB	374 MB
scp-loadmanager	0.0422	0.0309	844 MB	837 MB

Observed Values of cnDBTier Services

The following table provides information about the observed values of cnDBTier services:

Table 4-19 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	0.58%
CPU usage of data nodes	0.87%

Table 4-19 (Cont.) Observed Values of cnDBTier Services

cnDBTier Services	Value
Write operations per second	2K
Read operations per second	100
Transaction rates on data nodes	2.50

4.5.3 Model D - Test Case Scenario 2

The Model D test is based on the network latency of 50 milliseconds at the rate of 400K MPS without features enabled in the TLS enabled BareMetal CNE setup.

Objective

This test case scenario describes the performance and capacity of SCP with 400K MPS Model D deployment model and the following configurations:

- Mediation Trigger point configuration
- Model D Cache enabled

The following table describes test bed configurations:

Table 4-20 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	72 Hours
SCP Version Tag	25.1.200
Cluster	Test Bed 1 - CNE on BareMetal. For more information, see Cluster Details
Topology	Topology 1. For information about topology, see Test Topology 1 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-21 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	400K MPS
Network deployment diagram	Topology 1. For information about topology, see Test Topology 1 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D

Table 4-21 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	300 milliseconds
Number of SCP ingress IPs configured	2

Table 4-21 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
How many connections per published IP/FQDN producers can handle?	485
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 640 ingress connections towards SCP IP
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): – 4 seconds (10% of Delegated Discovery traffic) – 10 seconds (10% of Delegated Discovery traffic)
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 4
Egress and Ingress Configurations	NA
Mediation Configurations	NA
Mediation Trigger point configuration	Number of Mediation Trigger Points: 367
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA
Pods deployed	• Control plane pods: – Notification:1 – Subscription:1 – Audit:1 – Configuration:1 – Alternate Resolution:1 • Data plane pods: – Worker: 55 – NRF Proxy: 7 – NRF OAuth: 0 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory

Table 4-21 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	NA
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	NA

Result and Observation

The following table provides observation data for the performance test that can be used for testing to increase the traffic rate:

Table 4-22 Result and Observation

Parameter	Values
Test Duration	72 Hours
MPS Achieved	400K MPS
Average per scp-worker pod MPS	7K MPS
Success rate	~100%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-23 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	7.374	7.136	7.23 GB	7.22 GB
scpc-notification	1.187	1.142	1.68 GB	1.68 GB
scpc-audit	0.018	0.012	541 MB	541 MB
scpc-configuration	0.024	0.018	861 MB	857 MB
scpc-subscription	0.008	0.006	515 MB	515 MB
scp-cache	0.01	0.01	552 MB	551 MB
scp-nrfpproxy	3.998	3.911	2.80 GB	2.80 GB
scp-nrfproxyoauth	0.008	0.007	453 MB	452 MB
scp-mediation	0.029	0.031	1.57 GB	1.57 GB
scp-loadmanager	0.023	0.021	969 MB	969 MB

Observed Values of cnDBTier Services

The following table provides information about the observed values of cnDBTier services:

Table 4-24 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	3.9%
CPU usage of data nodes	0.5%
Write operations per second	13.1
Read operations per second	520
Transaction rates on data nodes	30.2

4.5.4 Model D - Test Case Scenario 3

The Model D test is based on the network latency of 150 milliseconds at the rate of 400K MPS with the features enabled in the TLS enabled vCNE setup.

Objective

This test case scenario describes the performance and capacity of SCP with 400K MPS Model D deployment model and the following features enabled:

- LCI
- OCI
- Mediation Trigger Points
- Support for HTTPS
- Outlier Detection
- Circuit Breaking
- Alternate Routing based on NFSets
- Pod Overload Control
- Enhanced 5G SBI Message Failure Handling
- Egress Congestion Control Support at SCP
- Message Priority Assignment and Override
- Enhanced NF Status Processing (Mode 1)

The following table describes test bed configurations:

Table 4-25 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hrs
SCP Version Tag	25.1.200
Cluster	Test Bed 2 - CNE on Bare Metal. For more information, see Cluster Details
Topology	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-26 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	400K MPS
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds

Table 4-26 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	300 milliseconds
Number of SCP ingress IPs configured	1
How many connections per published IP/FQDN producers can handle?	490
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 655 ingress connections towards SCP IP
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): – 4 seconds (10% of Delegated Discovery traffic) – 10 seconds (10% of Delegated Discovery traffic)
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 6
Egress and Ingress Rate Limit Configurations	NA
Mediation Configurations	• Traffic rate at mediation service (% of traffic requiring mediation): 12% • Number of rules configured at mediation: 630 • Number of groups: 50 • Number of rules within a group: 12 • Distribution among message mediation actions in mediation rules configuration – % (number) Header manipulation 70% – % (number) JSON IE manipulation 30%
Mediation Trigger point configuration	Number of Mediation Trigger Points: 367
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-26 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Pods deployed	• Control plane pods: – Notification:1 – Subscription:1 – Audit:1 – Configuration:1 – Alternate Resolution:1 • Data plane pods: – Worker: 55 – NRF Proxy: 15 – NRF OAuth: 0 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • Frequency of OCI header received with changed values: 15 seconds • Number of NF/NFService Instances reporting OCI: 70

Result and Observation

The following table provides observation data for the performance test that can be used for benchmark testing to increase the traffic rate:

Table 4-27 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	400K MPS
Average per scp-worker pod MPS	7K MPS
Success rate	~100%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-28 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	7.801	7.501	7.37 GB	7.31 GB
scpc-notification	0.958	0.939	1.66 GB	1.65 GB
scpc-audit	0.013	0.011	530 MB	530 MB
scpc-configuration	0.024	0.024	743 MB	743 MB
scpc-subscription	0.029	0.027	606 MB	605 MB
scp-cache	0.017	0.016	498 MB	498 MB
scp-nrfpproxy	2.391	2.275	2.25 GB	2.25 GB
scp-mediation	3.624	3.286	1.24 GB	1.24 GB
scp-loadmanager	0.184	0.172	1.33 GB	1.33 GB
scp-alternate-resolution	0.010	0.009	550 MB	460 MB

Observed Values of cnDBTier Services

The following table provides information about observed values of cnDBTier services:

Table 4-29 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	5.2%
CPU usage of data nodes	0.7%
Write operations per second	13.1
Read operations per second	520
Transaction rates on data nodes	35.6

4.5.5 Model D Test Scenario 4

The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation enabled on vCNE.

Objective

This test case scenario describes the performance and capacity of SCP with 650K MPS Model D deployment model and the following features enabled:

- LCI
- OCI
- Mediation Trigger Points
- Support for HTTPS
- Outlier Detection
- Circuit Breaking
- Alternate Routing based on NFSets
- Pod Overload Control
- Enhanced 5G SBI Message Failure Handling

- Egress Congestion Control Support at SCP
- Message Priority Assignment and Override
- Enhanced NF Status Processing (Mode 1)

The following table describes test bed configurations:

Table 4-30 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	48 Hrs
SCP Version Tag	25.2.201
Cluster	Test Bed 3 - vCNE on OpenStack. For more information, see Cluster Details
Topology	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-31 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	650K MPS
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D

Table 4-31 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	NA
Number of SCP ingress IPs configured	1

Table 4-31 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
How many connections per published IP/FQDN producers can handle?	512
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 2023 ingress connections towards SCP IP
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): 30 seconds
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 6
Egress and Ingress Rate Limit Configurations	NA
Mediation Configurations	• Traffic rate at mediation service (% of traffic requiring mediation): 10% • Number of rules configured at mediation: 630 • Distribution among message mediation actions in mediation rules configuration – % (number) Header manipulation 70% – % (number) JSON IE manipulation 30%
Mediation Trigger point configuration	Number of Mediation Trigger Points: 3
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-31 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 0 • Data plane pods: – Worker: 65 – NRF Proxy: 13 – NRF OAuth: 0 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • No traffic is enabled to report OCI

Result and Observation

The following table provides observation data for the performance test that can be used for benchmark testing to increase the traffic rate:

Table 4-32 Result and Observation

Parameter	Values
Test Duration	48 Hours
MPS Achieved	650K MPS
Average per scp-worker pod MPS	10K MPS
Success rate	~ 99.90%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-33 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	8.7	6.0	4.78 GB	4.77 GB
scpc-notification	1.4	1.1	3.05 GB	3.00 GB
scpc-audit	0.01	0.01	494 MB	494 MB
scpc-configuration	0.05	0.02	751 MB	712 MB
scpc-subscription	0.03	0.02	502 MB	484 MB
scp-cache	0.02	0.01	580 MB	577 MB
scp-nrfpproxy	1.6	1.3	832 MB	764 MB
scp-nrfproxy-oauth	0.03	0.02	576 MB	574 MB
scp-mediation	3.1	2.6	688 MB	675 MB
scp-loadmanager	0.4	0.3	911 MB	904 MB
scp-alternate-resolution	NA	NA	NA	NA

Observed Values of cnDBTier Services

The following table provides information about observed values of cnDBTier services:

Table 4-34 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	3.2%
CPU usage of data nodes	0.8%
Write operations per second	17.3
Read operations per second	528
Transaction rates on data nodes	9.3

4.5.6 Model D Test Scenario 5

The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation enabled on BareMetal.

Objective

This test case scenario describes the performance and capacity of SCP with 650K MPS Model D deployment model and the following features enabled:

- LCI
- OCI
- Mediation Trigger Points
- Support for HTTPS
- Outlier Detection
- Circuit Breaking
- Alternate Routing based on NFSets
- Pod Overload Control

- Enhanced 5G SBI Message Failure Handling
- Egress Congestion Control Support at SCP
- Message Priority Assignment and Override
- Enhanced NF Status Processing (Mode 1)

The following table describes test bed configurations:

Table 4-35 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	22 Hrs
SCP Version Tag	25.2.201
Cluster	Test Bed 4 - CNE on BareMetal. For more information, see Cluster Details
Topology	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-36 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	650K MPS
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D

Table 4-36 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	NA
Number of SCP ingress IPs configured	1

Table 4-36 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
How many connections per published IP/FQDN producers can handle?	512
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 2011 ingress connections towards SCP IP
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): 30 seconds
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 6
Egress and Ingress Rate Limit Configurations	NA
Mediation Configurations	• Traffic rate at mediation service (% of traffic requiring mediation): 10% • Number of rules configured at mediation: 630 • Distribution among message mediation actions in mediation rules configuration – % (number) Header manipulation 70% – % (number) JSON IE manipulation 30%
Mediation Trigger point configuration	Number of Mediation Trigger Points: 3
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-36 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 0 • Data plane pods: – Worker: 64 – NRF Proxy: 13 – NRF OAuth: 1 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • No traffic is enabled to report OCI

Result and Observation

The following table provides observation data for the performance test that can be used for benchmark testing to increase the traffic rate:

Table 4-37 Result and Observation

Parameter	Values
Test Duration	22 Hours
MPS Achieved	650K MPS
Average per scp-worker pod MPS	10K MPS
Success rate	~ 100%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-38 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	5.9	5.7	4.54 GB	4.41 GB
scpc-notification	0.98	0.94	2.79 GB	2.78 GB
scpc-audit	0.01	0.009	499 MB	498 MB
scpc-configuration	0.03	0.01	880 MB	838 MB
scpc-subscription	0.02	0.01	492 MB	489 MB
scp-cache	0.02	0.01	611 MB	610 MB
scp-nrfpproxy	2.1	2.1	1.96 GB	1.96 GB
scp-mediation	2.4	2.1	597 MB	553 MB
scp-loadmanager	0.12	0.09	800 MB	796 MB
scp-alternate-resolution	NA	NA	NA	NA

Observed Values of cnDBTier Services

The following table provides information about observed values of cnDBTier services:

Table 4-39 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	4.8%
CPU usage of data nodes	0.9%
Write operations per second	18.5
Read operations per second	765
Transaction rates on data nodes	6.5

4.5.7 Model D Test Scenario 6

The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation on BareMetal with 20% Static Discovery in case the discovery mode is set to "NRF Followed BY SCP".

Objective

This test case scenario describes the performance and capacity of SCP with 650K MPS Model D deployment model and the following features enabled:

- LCI
- OCI
- Mediation Trigger Points
- Support for HTTPS
- Outlier Detection
- Circuit Breaking
- Alternate Routing based on NFSets
- Pod Overload Control

- Enhanced 5G SBI Message Failure Handling
- Egress Congestion Control Support at SCP
- Message Priority Assignment and Override
- Enhanced NF Status Processing (Mode 1)

The following table describes test bed configurations:

Table 4-40 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hrs
SCP Version Tag	25.2.201
Cluster	Test Bed 4 - CNE on BareMetal. For more information, see Cluster Details
Topology	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-41 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	650K MPS
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D

Table 4-41 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	NA
Number of SCP ingress IPs configured	1

Table 4-41 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
How many connections per published IP/FQDN producers can handle?	512
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 2120 ingress connections towards SCP IP
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): 30 seconds
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 6
Egress and Ingress Rate Limit Configurations	NA
Mediation Configurations	• Traffic rate at mediation service (% of traffic requiring mediation): 10% • Number of rules configured at mediation: 630 • Number of groups: 50 • Number of rules within a group: 12 • Distribution among message mediation actions in mediation rules configuration – % (number) Header manipulation 70% – % (number) JSON IE manipulation 30%
Mediation Trigger point configuration	Number of Mediation Trigger Points: 367
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-41 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 1 • Data plane pods: – Worker: 64 – NRF Proxy: 13 – NRF OAuth: 1 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • No traffic is enabled to report OCI

Result and Observation

The following table provides observation data for the performance test that can be used for benchmark testing to increase the traffic rate:

Table 4-42 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	650K MPS
Average per scp-worker pod MPS	10K MPS
Success rate	~ 100%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-43 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scpc-subscription	0.022	0.019	490 MB	489 MB
scpc-notification	1.003	0.961	2.79 GB	2.79 GB
scpc-audit	0.014	0.009	499 MB	498 MB
scpc-configuration	0.025	0.014	836 MB	835 MB
scp-cache	0.01	0.01	611 MB	611 MB
scp-worker	7.445	7.063	5.74 GB	5.72 GB
scp-loadmanager	0.112	0.098	798 MB	796 MB
scp-nrfproxy	2.077	2.017	1.69 GB	1.44 GB
scp-mediation	1.932	1.879	571 MB	570 MB
scp-alternate-resolution	N.A	N.A	N.A	N.A

Observed Values of cnDBTier Services

The following table provides information about observed values of cnDBTier services:

Table 4-44 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	2.1%
CPU usage of data nodes	3.8%
Write operations per second	0.23
Read operations per second	556
Transaction rates on data nodes	6.61

4.5.8 Model D Test Scenario 7

The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation on BareMetal with 20% Static Discovery in case the discovery mode is set to "SCP Followed BY NRF".

Objective

This test case scenario describes the performance and capacity of SCP with 650K MPS Model D deployment model and the following features enabled:

- LCI
- OCI
- Mediation Trigger Points
- Support for HTTPS
- Outlier Detection
- Circuit Breaking
- Alternate Routing based on NFSets
- Pod Overload Control

- Enhanced 5G SBI Message Failure Handling
- Egress Congestion Control Support at SCP
- Message Priority Assignment and Override
- Enhanced NF Status Processing (Mode 1)

The following table describes test bed configurations:

Table 4-45 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hrs
SCP Version Tag	25.2.201
Cluster	Test Bed 4 - CNE on BareMetal. For more information, see Cluster Details
Topology	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-46 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	650K MPS
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D

Table 4-46 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	NA
Number of SCP ingress IPs configured	1

Table 4-46 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
How many connections per published IP/FQDN producers can handle?	512
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 2114 ingress connections towards SCP IP
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): 30 seconds
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 6
Egress and Ingress Rate Limit Configurations	NA
Mediation Configurations	• Traffic rate at mediation service (% of traffic requiring mediation): 10% • Number of rules configured at mediation: 630 • Number of groups: 50 • Number of rules within a group: 12 • Distribution among message mediation actions in mediation rules configuration – % (number) Header manipulation 70% – % (number) JSON IE manipulation 30%
Mediation Trigger point configuration	Number of Mediation Trigger Points: 367
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-46 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 1 • Data plane pods: – Worker: 64 – NRF Proxy: 13 – NRF OAuth: 1 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • No traffic is enabled to report OCI

Result and Observation

The following table provides observation data for the performance test that can be used for benchmark testing to increase the traffic rate:

Table 4-47 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	650K MPS
Average per scp-worker pod MPS	10K MPS
Success rate	~ 100%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-48 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scpc-subscription	0.02	0.019	490 MB	489 MB
scpc-notification	0.953	0.923	2.79 GB	2.79 GB
scpc-audit	0.01	0.01	499 MB	499 MB
scpc-configuration	0.015	0.014	848 MB	847 MB
scp-cache	0.013	0.012	612 MB	612 MB
scp-worker	5.902	5.684	3.55 GB	3.55 GB
scp-loadmanager	0.097	0.093	796 MB	796 MB
scp-nrfproxy	0.016	0.014	1.30 GB	1.30 GB
scp-mediation	2.043	1.968	570 MB	570 MB
scp-alternate-resolution	N.A	N.A	N.A	N.A

Observed Values of cnDBTier Services

The following table provides information about observed values of cnDBTier services:

Table 4-49 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	1.83%
CPU usage of data nodes	3.5%
Write operations per second	0.19
Read operations per second	665
Transaction rates on data nodes	7.61

4.5.9 Model D Test Scenario 8

The Model D test is based on the network latency of 150 milliseconds at the rate of 650K MPS with Mediation with 2 ingress Cloud Native Load Balancer (CNLB) and without egress configuration enabled.

Objective

This test case scenario describes the performance and capacity of SCP with 650K MPS Model D deployment model and the following features enabled:

- LCI
- OCI
- Mediation Trigger Points
- Support for HTTPS
- Outlier Detection
- Circuit Breaking
- Alternate Routing based on NFSets
- Pod Overload Control

- Enhanced 5G SBI Message Failure Handling
- Egress Congestion Control Support at SCP
- Message Priority Assignment and Override
- Enhanced NF Status Processing (Mode 1)

The following table describes test bed configurations:

Table 4-50 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hrs
SCP Version Tag	25.2.201
Cluster	Test Bed 3 - vCNE on OpenStack. For more information, see Cluster Details
Topology	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-51 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	650K MPS
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D

Table 4-51 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	NA
Number of SCP ingress IPs configured	1

Table 4-51 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
How many connections per published IP/FQDN producers can handle?	512
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 2048 ingress connections towards SCP IP
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): 30 seconds
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 6
Egress and Ingress Rate Limit Configurations	NA
Mediation Configurations	• Traffic rate at mediation service (% of traffic requiring mediation): 10% • Number of rules configured at mediation: 630 • Distribution among message mediation actions in mediation rules configuration – % (number) Header manipulation 70% – % (number) JSON IE manipulation 30%
Mediation Trigger point configuration	Number of Mediation Trigger Points: 3
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-51 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 0 • Data plane pods: – Worker: 64 – NRF Proxy: 13 – NRF OAuth: 1 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • No traffic is enabled to report OCI

Result and Observation

The following table provides observation data for the performance test that can be used for benchmark testing to increase the traffic rate:

Table 4-52 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	650K MPS
Average per scp-worker pod MPS	10K MPS
Success rate	~ 99.89%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-53 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	7.9	7.0	4.08 GB	2.53 GB
scpc-notification	2.3	1.3	2.12 GB	1.98 GB
scpc-audit	0.02	0.01	503 MB	498 MB
scpc-configuration	0.05	0.04	712 MB	696 MB
scpc-subscription	0.04	0.03	519 MB	509 MB
scp-cache	0.05	0.02	564 MB	557 MB
scp-nrfpproxy	3.1	2.9	2.64 GB	2.64 GB
scp-mediation	3.5	3.4	745 MB	667 MB
scp-loadmanager	0.4	0.3	635 MB	623 MB
scp-nrfproxy-oauth	0.04	0.03	776 MB	771 MB

Observed Values of cnDBTier Services

The following table provides information about observed values of cnDBTier services:

Table 4-54 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	1.76%
CPU usage of data nodes	3.2%
Write operations per second	0.17
Read operations per second	734
Transaction rates on data nodes	6.52

4.5.10 Model D Test Scenario 9

The Model D test is based on the network latency of 150 milliseconds at the rate of 450K MPS with Cloud Native Load Balancer (CNLB) and egress bypass.

Objective

This test case scenario describes the performance and capacity of SCP with 450K MPS Model D deployment model and the following features enabled:

- LCI
- OCI
- Mediation Trigger Points
- Support for HTTPS
- Outlier Detection
- Circuit Breaking
- Alternate Routing based on NFSets
- Pod Overload Control
- Enhanced 5G SBI Message Failure Handling

- Egress Congestion Control Support at SCP
- Message Priority Assignment and Override
- Enhanced NF Status Processing (Mode 1)

The following table describes test bed configurations:

Table 4-55 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	9 Hrs
SCP Version Tag	25.2.201
Cluster	Test Bed 3 - vCNE on OpenStack. For more information, see Cluster Details
Topology	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-56 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	450K MPS
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D

Table 4-56 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	NA
Number of SCP ingress IPs configured	1

Table 4-56 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
How many connections per published IP/FQDN producers can handle?	512
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 2042 ingress connections towards SCP IP
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): 30 seconds
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 6
Egress and Ingress Rate Limit Configurations	NA
Mediation Configurations	• Traffic rate at mediation service (% of traffic requiring mediation): 10% • Number of rules configured at mediation: 630 • Distribution among message mediation actions in mediation rules configuration – % (number) Header manipulation 70% – % (number) JSON IE manipulation 30%
Mediation Trigger point configuration	Number of Mediation Trigger Points: 3
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-56 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 0 • Data plane pods: – Worker: 65 – NRF Proxy: 13 – NRF OAuth: 0 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • No traffic is enabled to report OCI

Result and Observation

The following table provides observation data for the performance test that can be used for benchmark testing to increase the traffic rate:

Table 4-57 Result and Observation

Parameter	Values
Test Duration	9 Hours
MPS Achieved	450K MPS
Average per scp-worker pod MPS	6.9K MPS
Success rate	~ 99.92%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-58 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	5.7	5.3	7.21 GB	7.21 GB
scpc-notification	1.2	1.1	2.71 GB	2.59 GB
scpc-audit	0.02	0.01	534 MB	514 MB
scpc-configuration	0.05	0.03	689 MB	685 MB
scpc-subscription	0.03	0.02	476 MB	474 MB
scp-cache	0.02	0.01	611 MB	610 MB
scp-nrfpproxy	0.9	0.8	1.45 GB	1.44 GB
scp-mediation	2.0	1.9	553 MB	504 MB
scp-loadmanager	0.06	0.03	751 MB	740 MB
scp-nrfproxy-oauth	0.03	0.02	611 MB	610 MB

Observed Values of cnDBTier Services

The following table provides information about observed values of cnDBTier services:

Table 4-59 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	1.12%
CPU usage of data nodes	2.5%
Write operations per second	0.12
Read operations per second	442
Transaction rates on data nodes	4.26

4.5.11 Model D Test Scenario 10

The Model D test with Mediation on BareMetal and OCNADD enabled with four trigger points, 650K MPS towards OCNADD.

Objective

This test case scenario describes the performance and capacity of SCP with 450K MPS Model D deployment model and the following features enabled:

- LCI
- OCI
- Mediation Trigger Points
- Support for HTTPS
- Outlier Detection
- Circuit Breaking
- Alternate Routing based on NFSets
- Pod Overload Control
- Enhanced 5G SBI Message Failure Handling

- Egress Congestion Control Support at SCP
- Message Priority Assignment and Override
- Enhanced NF Status Processing (Mode 1)

The following table describes test bed configurations:

Table 4-60 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	18 Hrs
SCP Version Tag	25.2.201
Cluster	Test Bed 4 - CNE on Bare Metal. For more information, see Cluster Details
Topology	Topology 3. For information about topology, see Test Topology 3 for SCP Model D Benchmarking

Test Case Parameters

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

Table 4-61 Test Case Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	650K MPS
Network deployment diagram	Topology 3. For information about topology, see Test Topology 3 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D

Table 4-61 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	NA
Number of SCP ingress IPs configured	1

Table 4-61 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
How many connections per published IP/FQDN producers can handle?	512
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	• Up to 10 connections per SCP IP per consumer • Total 2053 ingress connections towards SCP IP
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): 30 seconds
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 6
Egress and Ingress Rate Limit Configurations	NA
Mediation Configurations	• Traffic rate at mediation service (% of traffic requiring mediation): 10% • Number of rules configured at mediation: 630 • Distribution among message mediation actions in mediation rules configuration – % (number) Header manipulation 70% – % (number) JSON IE manipulation 30%
Mediation Trigger point configuration	Number of Mediation Trigger Points: 3
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-61 (Cont.) Test Case Parameters

Input Parameter Details	Configuration Values
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 0 • Data plane pods: – Worker: 64 – NRF Proxy: 13 – NRF OAuth: 0 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	Number of Kafka brokers used for testing is 4. Configurations are as follows: • kafkaPartitionSelectionLogic: RoundRobin • securityProtocol: ssl • acks: 1 • retryCount: 0 • deliveryTimeoutMs: 5000 • retryBackoffMs: 100 • requestTimeoutMs: 1000 • trafficfeedBlockingSendTimeoutMs: 500 • trafficfeedDegradationperiod: 1000 • trafficfeedConsecutiveFailures: 10 • trafficfeedMaxBlockMsConfig: 100 • bufferMemory: 128000000 allowedTrafficPercentage: 100 % The following four trigger points enabled: • TxRequest • RxResponse • RxRequest • TxResponse
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • No traffic is enabled to report OCI

Result and Observation

The following table provides observation data for the performance test that can be used for benchmark testing to increase the traffic rate:

Table 4-62 Result and Observation

Parameter	Values
Test Duration	18 Hrs
MPS Achieved	650K MPS
Traffic towards OCNADD	1.37M MPS
Average per scp-worker pod MPS	10K MPS
Success rate	~ 100%
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-63 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	8.4	7.12	3.49 GB	3.38 GB
scpc-notification	1	0.97	2.79 GB	2.78 GB
scpc-audit	0.01	0.01	499 MB	498 MB
scpc-configuration	0.05	0.01	953 MB	837 MB
scpc-subscription	0.02	0.02	490 MB	489 MB
scp-cache	0.01	0.009	612 MB	611 MB
scp-nrfpproxy	2.2	1.8	1.69 GB	1.69 GB
scp-mediation	2.4	2.4	580 MB	565 MB
scp-loadmanager	0.13	0.10	803 MB	798 MB
scp-nrfproxy-oauth	0.02	0.01	527 MB	526 MB

Observed Values of cnDBTier Services

The following table provides information about observed values of cnDBTier services:

Table 4-64 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	3.66%
CPU usage of data nodes	4.2 %
Write operations per second	0.24
Read operations per second	654
Transaction rates on data nodes	8.3