Oracle® Communications

Cloud Native Core, Service Communication Proxy Benchmarking Guide

Release 24.1.0
F96266-01
April 2024

Oracle Communications Cloud Native Core, Service Communication Proxy Benchmarking Guide, Release 24.1.0

F96266-01

Contents

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Acronyms

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

Table 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
MPS	Messages Per Second
NF	Network Function
NRF	Oracle Communications Cloud Native Core, Network Repository Function
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

What's New in This Guide

This section introduces the documentation updates for release 24.1.x.

Release 24.1.x - F96266-01, April 2024

- Updated node type in Table 2-5.
- Added the Model C - Testcase Scenario 1 section to describe the performance and capacity of SCP with Model C based on the Message Feed feature with two trigger points, 110K MPS at SCP, and 110K MPS towards OCNADD.
- Added the Model C - Testcase Scenario 3 section to describe the performance and capacity of SCP with Model C based on the network latency of 150 milliseconds at the rate of 640K MPS with rate limit applied and no ASM.
- Removed the following testcase scenarios from the Benchmarking SCP Model C section:
  - The Model C test is based on the network latency of 150 milliseconds at the rate of 460K MPS with no rate limit applied.
  - The Model C test is based on the network latency of 150 milliseconds at the rate of 460K MPS with rate limit applied.
  - The Model C test with message feed enabled with 2 trigger points, 100K MPS at SCP (100K 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, Service Communication Proxy Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, Service Communication Proxy User Guide*
- *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*

2
Deployment Environment

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

2.1 Deployed Components

Deployment Platform

Oracle Communications Cloud Native Core, Cloud Native Environment (CNE) 23.1.0 and CNE on Bare Metal 23.1.0 can be used for performing benchmark tests.

Observability Services

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

Table 2-1 Observability Services

Service Name	Version
Oracle OpenSearch	2.3.0
Oracle OpenSearch Dashboard	2.3.0
Fluentd	1.16.2
Kibana	7.9.3
Prometheus	2.36.1
Grafana	7.5.11
Jaeger	1.28.0

Cloud Native Orchestrator

Kubernetes 1.20.x is used to manage application pods across the cluster.

cnDBTier

cnDBTier 23.4.0 and 24.1.0 are used to perform benchmark tests.

For more information about above mentioned software, see *Oracle Communications Cloud Native Core, Service Communication Proxy 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

The following table provides information about the types of servers and the number of servers used in the test environment:

Table 2-2 Test Bed 1 - CNE on Bare Metal

Nodes	Type	Count
Master Nodes	HP Gen10 RMS	3
Worker Nodes	HP Gen10 Blades	29
	HP Gen8 Blades	7
Top of Rack Switch	Cisco Nexus9000 93180YC-EX	2
Enclosure Switch	HP 6120	2

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

Table 2-3 CNE Common Services Observability Resources

Service Name	Number of Pods	RAM Request/Limit	vCPU Request/Limit	PVC Size Recommendation
Prometheus Server	2	50Gi/50Gi	12/12	150GB to 200GB
Prometheus-pushgateway	1	32Mi/32Mi	10m/10m	NA
Alert Manager	2	164Mi/164Mi	40m/40m	NA
Fluentd	1 per Worker Node	200Mi/500Mi	100m/100m	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	3/3	32Gi/32Gi (JVM 16)	2/2	300GB
OpenSearch Master	3/3	16Gi/16Gi(JVM 8)	1/1	300GB
ISM Policy	3/3	128Mi/128Mi	100m/100m	NA
OpenSearch Client	1	128Mi/128Mi	100m/100m	NA
Grafana	1	500Mi/500Mi	500m/500m	NA
Kibana	1	500Mi/1Gi	100m/1	NA
kube-state-metrics	1	200Mi/200Mi	50m/50m	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
rook-ceph-osd	1 for each raw disk available to OS on all Worker Node	1Gi/8Gi	500m/1	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

Table 2-4 Test Bed 2 - VMware Tanzu

Nodes	Type	Count
Master Nodes	VM (8 CPU and 64 GB Memory)	3
Worker Nodes	VM(32 CPU and 128 GB Memory)	51
Underlying Hardware	Cisco Nexus9000 93180YC-EX	19

Table 2-5 Test Bed 3 - CNE on Bare Metal

Nodes	Type	Count
Master Nodes	X9 Server and NVME	3
Worker Nodes	X9 Server and NVME	19

Table 2-6 Test Bed 4 - CNE on Bare Metal

Nodes	Type	Count
Master Nodes	ORACLE SERVER X8-2	3
Worker Nodes	ORACLE SERVER X8-2	45
Top of Rack Switch	Cisco 93108tc-ex	2

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

Table 2-7 CNE Common Services Observability Resources

Service Name	Number of Pods	RAM Request/Limit	vCPU Request/Limit	PVC Size Recommendation
Prometheus Server	2	50Gi/50Gi	16/16	150GB to 800GB
Prometheus-pushgateway	1	2Gi/3Gi	2/4	NA
Alert Manager	2	164Mi/164Mi	40m/40m	NA
Fluentd	1 per Worker Node	200Mi/500Mi	100m/100m	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	3/3	164Gi/100Mi	1/8	300GB
OpenSearch Master	3/3	16Gi/16Gi(JVM 8)	1/1	300GB
ISM Policy	3/3	128Mi/128Mi	100m/100m	NA
OpenSearch Client	1	128Mi/128Mi	100m/100m	NA
Grafana	1	500Mi/500Mi	500m/500m	NA
Kibana	1	500Mi/1Gi	100m/1	NA
kube-state-metrics	1	200Mi/200Mi	50m/50m	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
rook-ceph-osd	1 for each raw disk available to OS on all Worker Node	1Gi/8Gi	500m/1	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 describes resources required by cnDBTier 22.3.0 pods to perform SCP benchmark tests.

Table 2-8 Test Bed 1 - cnDBTier Resources

cnDBTier Pods	Replica	vCPU		RAM (GB)		ASM Sidecar		cnDBTier Sidecar		Storage		Ephemeral Storage	
		Request	Limit	Request	Limit	vCPU	RAM (GB)	RAM (GB)	RAM(GB)	PVC(GB)	Count	Req(M)	Limit(G)
SQL - Replication (ndbmysqld) StatefulSet	2	2	3	2	4	1	1	1	1	30	1	90	1
MGMT (ndbmgmd) StatefulSet	3	2	3	2	4	1	1	NA	NA	30	1	90	1
DB (ndbmtd) StatefulSet	4	3	4	4	4	1	1	1	1	30	2	90	1
db-backup-manager-svc	1	1	1	1	1	1	1	NA	NA	NA	NA	90	1
db-replication-svc	1	1	2	1	2	1	1	NA	NA	NA	NA	90	1
db-monitor-svc	1	1	2	1	2	1	1	NA	NA	NA	NA	90	1
db-connitivity-service	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA
SQL - Access (ndbappmysqld) StatefulSet	2	3	4	4	4	1	1	NA	NA	20	2	90	1

Table 2-9 Test Bed 2 - cnDBTier Resources

cnDBTier Pods	Replica	vCPU		RAM (GB)	
		Request	Limit	Request	Limit
SQL - Replication(ndbmysqld)	2	4	4	10	10
MGMT (ndbmgmd) StatefulSet	2	2	2	4	5
DB (ndbmtd) StatefulSet	4	3	3	7	7
SQL - Access (ndbappmysqld)	2	4	4	8	8

Table 2-9 (Cont.) Test Bed 2 - cnDBTier Resources

cnDBTier Pods	Replica	vCPU		RAM (GB)	
		Request	Limit	Request	Limit
db-backup-manager-svc	1	0.1	0.1	0.128	0.128
db-monitor-svc	1	0.2	0.2	0.5	0.5

2.2.3 SCP Resources

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

Table 2-10 SCP Resources

Microservice Name	SCP Service Pods			
	vCPU/Pod		Memory/Pod (in Gi)	
	Min	Max	Min	Max
Helm test	3	3	3	3
Helm Hook	3	3	3	3
scpc-subscription	1	1	1	1
scpc-notification	4	4	4	4
scpc-audit	3	3	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	16	16
scp-mediation	8	8	8	8
scp-nrfproxy-oauth	8	8	8	8
scpc-alternate-resolution	2	2	2	2

3
Benchmarking SCP Model C

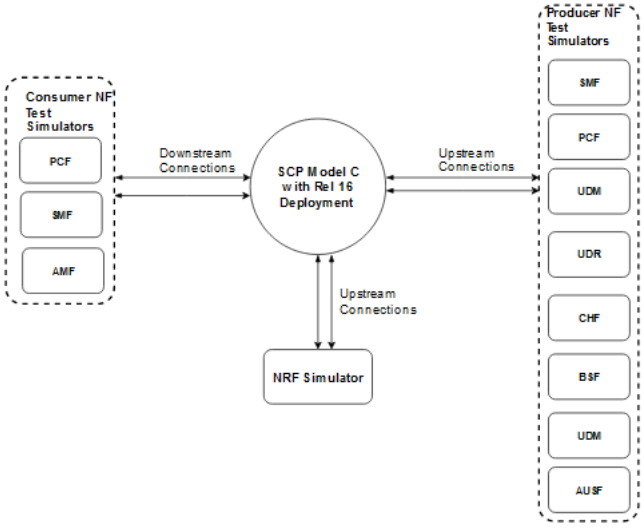
This section describes Model C test topologies and test scenarios for benchmarking SCP.

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

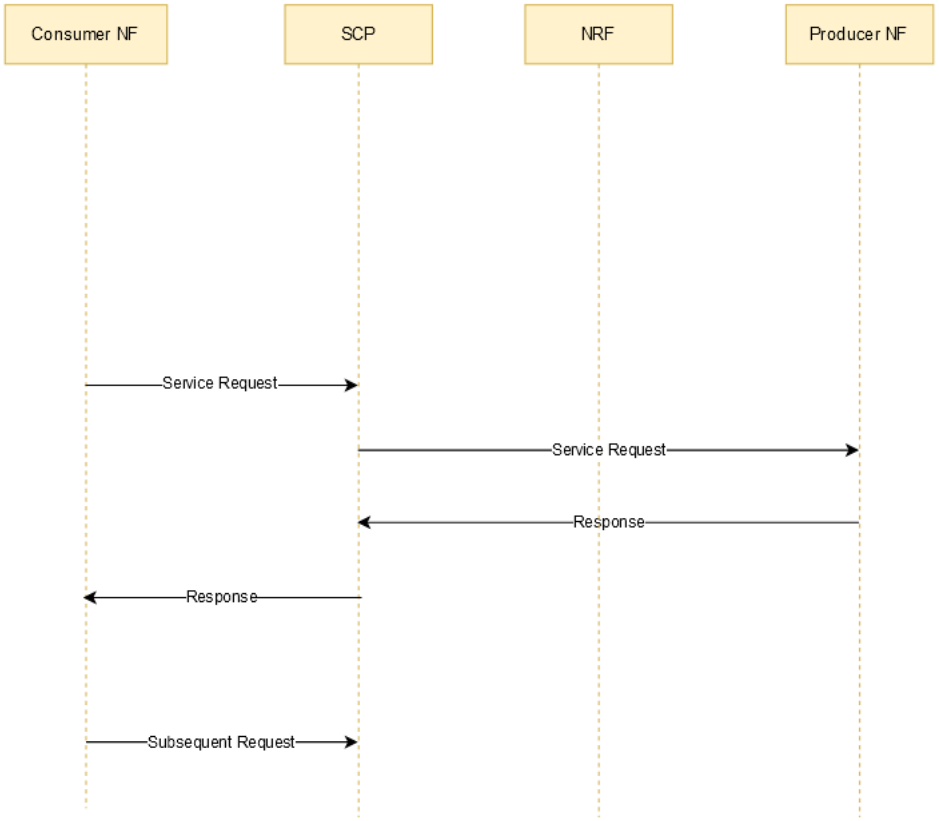
Then, SCP selects an NF service instance and routes the service requests to the selected producer NF. In case of failure, if reselection is required, SCP selects the producer NF instance based on the NF Set.

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



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	NF Service	Percentage (%) of Messages
AMF	SMF	N11	nsmf-pdusession	50.00%

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

NF-C	NF-P	Interface Reference	NF Service	Percentage (%) of Messages
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%
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 3-2 Routing Configuration

NF	Service	Initial Message		Subsequent Message		reverseProxySupport	Deployment	Response Timeout
		routePolicy	reroutePolicy	routePolicy	reroutePolicy			
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 3-3 NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call Flows
AMF	SMF	N11	• nsmf-pdusession • nsmf-event-exposure	nsmf-pdusession	80	SMF1 to SMF80	• Create PDU session • Modify PDU session • Release PDU session
AMF	PCF	N15	• npcf-am-policy-control • npcf-smpolicy control • npcf-policyauthorization • npcf-bdtpolicy control • 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

Table 3-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call Flows
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
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

Table 3-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call Flows
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
PCF	UDR	N36	• nudr-dr • nudr-group-id-map	nudr-dr	10	UDR1 to UDR10	• Create Policy Data Subscription • Delete Policy Data Subscription
PCF	CHF	N28	• nchf-spendinglimitcontrol • nchf-convergedcharging	nchf-spendinglimitcontrol	10	CHF1 to CHF10	• Subscribe to notification • Cancel an existing subscription
AMF	AUSF	N12	• nausf-auth • nausf-sorprotection • nausf-upuprotection	nausf-auth	10	AUSF1 to AUSF10	Authenticate UE

Table 3-3 (Cont.) NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call Flows
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

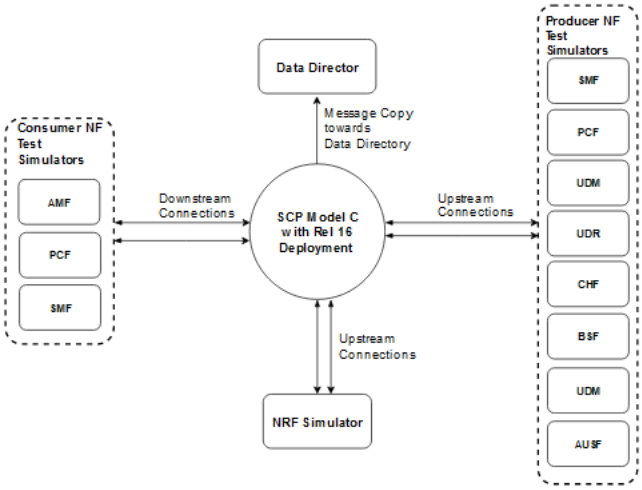
3.2 Test Topology 2 for SCP Model C Benchmarking with SBI Message Feed

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

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

- NRF simulator
- Oracle Communications Network Analytics Data Director (OCNADD)

Figure 3-3 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
- Creates multiple network interfaces for different subnet IPs
- Service requests from consumer NF are copied to OCNADD and then forwarded to the third-party

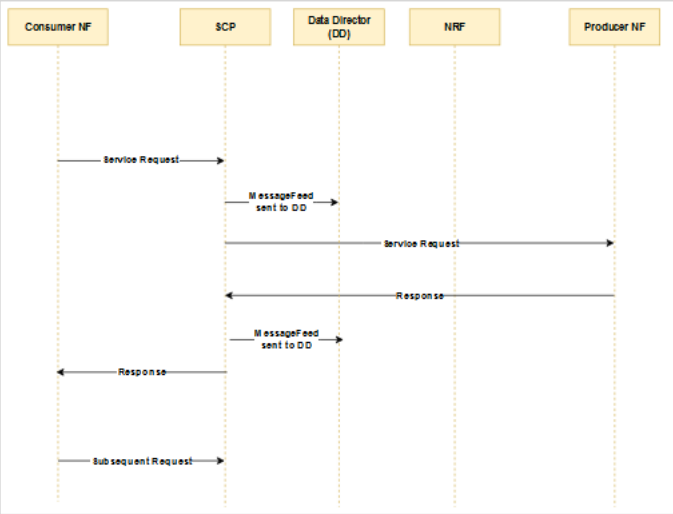
Then, SCP selects an NF service instance and routes the service requests to the selected producer NF. In case of failure, if reselection is required, SCP selects the producer NF instance based on the NF Set.

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.
5. SCP copies the requests and responses to DD.

Figure 3-4 Topology 2 Call Flow



3.2.2 Topology 2 Traffic Distribution

The following table describes the percentage of messages processed by SCP:

Table 3-4 Topology 2 Traffic Distribution

NF-C	NF-P	Interface Reference	NF Service	Percentage (%) of Messages
SMF	PCF	N7	npcf-smpolicycontrol	79.55%
SMF	UDM	N10	• nudm-sdm • nudm-uecm	7.58%
PCF	UDR	N36	nudr-dr	0.76%
PCF	CHF	N28	nchf-spendinglimitcontrol	0.76%
SMF	CHF	N40	nchf-convergedcharging	11.36%

Topology 2 Routing Configuration

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

Table 3-5 Routing Configuration

NF	Service	Initial Message		Subsequent Message		reverseProxySupport	Deployment	Response Timeout
		routePolicy	reroutePolicy	routePolicy	reroutePolicy			
PCF	npcf-smpolicycontrol	Load_Balance	RerouteDisabled	Load_Balance	RerouteDisabled	False	SITE_WIDE	3s
UDM	nudm-sdm	Load_Balance	RerouteDisabled	Load_Balance	RerouteDisabled	False	SITE_WIDE	3s
UDM	nudm-uecm	Load_Balance	RerouteDisabled	Load_Balance	RerouteDisabled	False	SITE_WIDE	3s

Table 3-5 (Cont.) Routing Configuration

NF	Service	Initial Message		Subsequent Message		reverseProxySupport	Deployment	Response Timeout
UDR	nudr-dr	Load_Balance	RerouteDisabled	Load_Balance	RerouteDisabled	False	SITE_WIDE	3s
PCF	nchf-spendinglimitcontrol	Load_Balance	RerouteDisabled	Load_Balance	RerouteDisabled	False	SITE_WIDE	3s
CHF	nchf-convergedcharging	Forward_Route	RerouteWithinSite	Forward_Route	RerouteWithinSite	True	SITE_WIDE	1s

Topology 2 NF Profiles

The following table describes NF profile configuration, traffic, and message call flows for 15 NF profiles registered on SCP:

Table 3-6 NF Profiles

NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows
SMF	PCF	N7	• npcf-bdtpolicycontrol • npcf-policyauthorization • npcf-ue-policy-contro • npcf-am-policy-control • npcf-smpolicycontrol	npcf-smpolicycontrol	8	PCF1-PCF5	• Initial Requests • Subsequent Update • Subsequent Terminate • Notifications Only
SMF	UDM	N10	• nudm-ueau • nudm-uecm • nudm-ee • nudm-pp • nudm-sdm	• nudm-sdm • nudm-uecm	2	UDM1 to UDM2	• UECM Registration • SDM GET • SDM Subscription
PCF	UDR	N36	• nudr-group-id-map • nudr-dr	• nudr-dr	1	UDM1	• Initial Requests (UDR GET) • Subscription (POST) • Unsubscription (POST) • Notifications (POST)

Table 3-6 (Cont.) NF Profiles

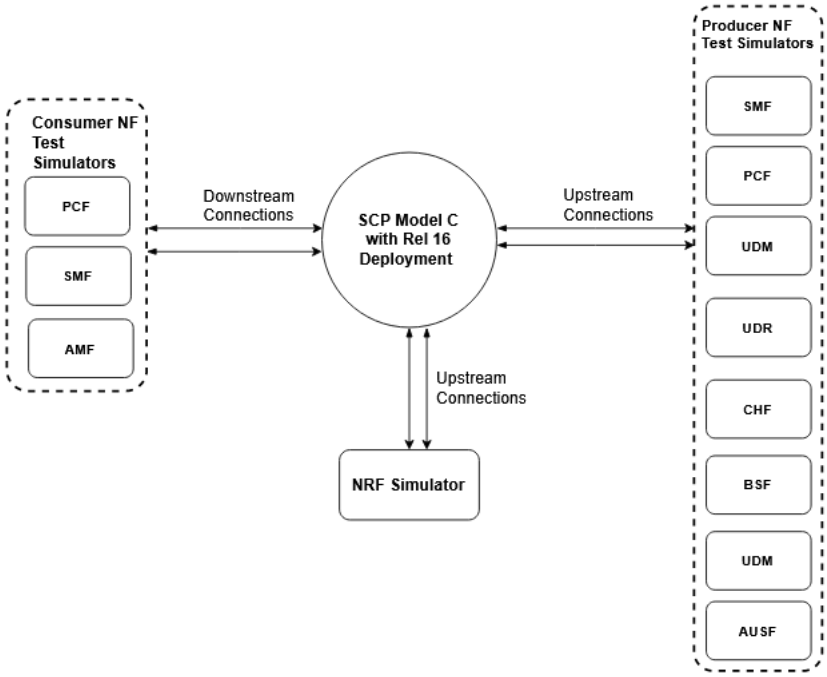
NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows
PCF	CHF	N28	• nchf-spendinglimitcontro • nchf-convergedcharging	nchf-spendinglimitcontrol	2	CHF1-CHF2	• Subscription (CHF POST) • Unsubscription (CHF POST) • Notifications (POST)
SMF	CHF	N40	• nchf-spendinglimitcontrol • nchf-convergedcharging	nchf-convergedcharging	2	CHF1-CHF2	• Charging Data • Update • Release

3.3 Test Topology 3 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 3-5 SCP Model C Topology 3



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

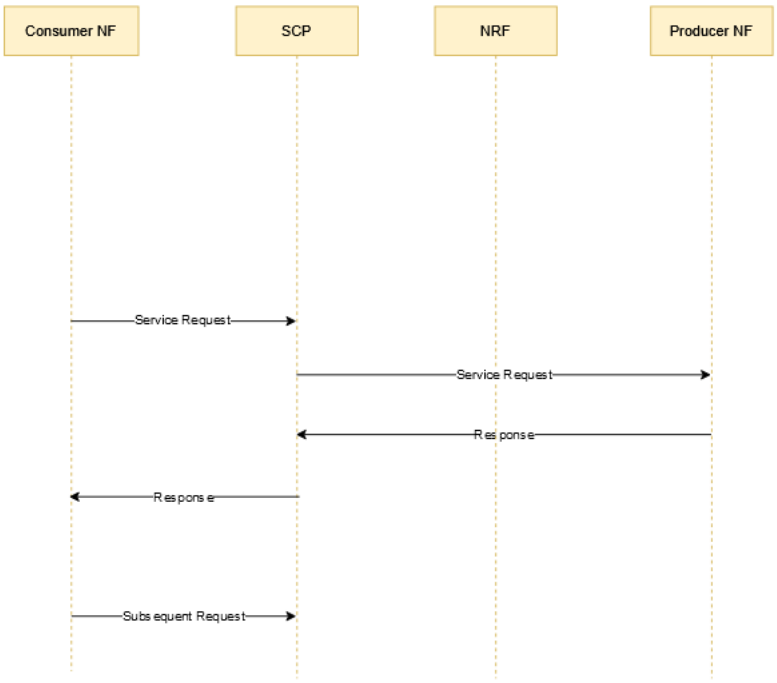
Then, SCP selects an NF service instance and routes the service requests to the selected producer NF. In case of failure, if reselection is required, SCP selects the producer NF instance based on the NF Set.

3.3.1 Topology 3 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 3-6 Topology 3 Call Flow



3.3.2 Topology 3 Traffic Distribution

The following table describes the percentage of messages processed by SCP using N8, N11, N7, N10, N36, N28, and other interfaces.

Table 3-7 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
NRF	SCP	Notifications	10 notifications every 15 minutes

> **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 3 Routing Configuration

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

Table 3-8 Routing Configuration

NF	Service	Initial Message		Subsequent Message		Deployment	ResponseTimeout
		routePolicy	reroutePolicy	routePolicy	reroutePolicy		
PCF	Npcf_SMPolicyControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	3s
UDR	Nudr_dm	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	REGIONAL	3s
CHF	Nchf_SpendingLimitControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	3s
UDM	Nudm_sdm	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	3s
UDM	Nudm_uecm	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	3s
PCF	Npcf_AMPolicyControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	3s
PCF	Npcf_UEPolicyControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	3s
AUSF	Nausf_UEAuthentication	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	3s

Table 3-8 (Cont.) Routing Configuration

NF	Service	Initial Message		Subsequent Message		Deployment	ResponseTimeout
BSF	Nbsf_management	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	1s
UDR	Nudr_udrService	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	3s

Topology 3 NF Profiles

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

Table 3-9 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	30	PCF1 to PCF30	**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 3-9 (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	30	PCF1 to PCF30	• 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	3	UDM1 to UDM3	**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	6	UDM6 to UDM12	**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	24	UDR1 to UDR24	• Create Policy Data Subscription • Delete Policy Data Subscription

Table 3-9 (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	6	CHF1 to CHF6	• Subscribe to notification • Cancel an existing subscription
SMF	CHF	N40	• nchf-spendinglimitcontrol • nchf-convergedcharging	nchf-convergedcharging	6	CHF1 to CHF6	• Subscribe to notification • Cancel an existing subscription
AMF	AUSF	N12	• nausf-auth • nausf-sorprotection • nausf-upuprotection	nausf-auth	6	AUSF1 to AUSF6	Authenticate UE
PCF	BSF	Nbsf	nbsf-management	nbsf-management	6	BSF1 to BSF6	• 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	6	SLF1 to SLF6	SLF Look up

3.4 Model C Testcases

This section provides information about SCP Model C testcases.

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

3.4.1 Model C Testcase Summary

The following table provides a summary of the benchmark tests.

Table 3-10 Benchmark Testcase Summary

Benchmark Testcase Number	Description
Model C - Testcase Scenario 1	The Model C test with message feed enabled with 2 trigger points, 110K MPS at SCP and 110K MPS towards OCNADD.
Model C - Testcase Scenario 2	The Model C test is based on the network latency of 150 milliseconds at the rate of 620K MPS with rate limit applied, ASM (Service Mesh) enabled.
Model C - Testcase Scenario 3	The Model C test is based on the network latency of 150 milliseconds at the rate of 640K MPS with rate limit applied and no ASM.

3.4.2 Model C - Testcase Scenario 1

In Model C testcase scenario, the Message Feed feature is enabled with two trigger points, 110K MPS at SCP, and 110K MPS towards Oracle Communications Network Analytics Data Director (OCNADD).

Objective

This testcase scenario describes the performance and capacity of SCP with Model C. It provides benchmarking results with latency in a network, and no rate limit is applied to the ingress and egress traffic.

The following table describes test bed configurations:

Table 3-11 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	24.1.0
Cluster	Test Bed 3 - CNE on Bare Metal. For more information, see Cluster Details.
Topology	Topology 2. For information about topology, see Test Topology 2 for SCP Model C Benchmarking with SBI Message Feed.

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 3-12 Testcase Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	110K MPS for SCP and 110K MPS towards OCNADD.
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model C Benchmarking with SBI Message Feed.
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)	8

Table 3-12 (Cont.) Testcase 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	150 milliseconds
Number of SCP ingress IPs configured	1
How many connections per published IP/FQDN producers can handle?	68
Per Egress connection max traffic in MPS	1000
How many connections consumer can initiate towards per SCP IP?	119
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	NA
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 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

Table 3-12 (Cont.) Testcase 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: 19 – NRF Proxy: 0 – NRF Auth: 0 – Cache: 3 – Mediation: 0
SCP Worker Pod Profile	8 vCPU and 12 Gi Memory
Oracle Communications Network Analytics Data Director Configurations	• Kafka: 6 Kafka-brokers with 400GB PVC • Aggregation: 5 ocnaddscpaggregation pods • Egress Feed with replication enabled towards third- party server
LCI Configurations	NA
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
OAuth Traffic Rate	NA
OCI Configurations	NA

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 3-13 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	110K MPS
Average MPS per scp-worker pod	5.88K MPS
Success rate	~ 99.98 %
Average SCP processing time (Request and Response)	~25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 3-14 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-cache	0.0103	0.0061	0.92	0.92
scp-load-manager	0.0184	0.0112	0.68	0.67

Table 3-14 (Cont.) SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	2.496	2.464	3.68	3.48
scpc-audit	0.0064	0.0047	0.55	0.556
scpc-configuration	0.0147	0.0108	0.59	0.58
scpc-notification	0.0404	0.0370	1.21	1.20
scpc-subscription	0.034	0.0322	0.48	0.47

Observed Values of cnDBTier Services

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

Table 3-15 Observed Values of cnDBTier Services

cnDBTier Services	Value
CPU usage of data nodes	0.385%
Memory usage of data nodes	3.61%
Read operations per second	4.36 seconds
Write operations per second	0.001 seconds
Transaction rates on data nodes	1.112

3.4.3 Model C - Testcase Scenario 2

The Model C test is based on the network latency of 150 milliseconds at the rate of 620K MPS with a rate limit applied and ASM (Service Mesh) enabled.

Objective

This testcase scenario describes the performance and capacity of SCP with Model C. It provides benchmarking results with latency in a network, and no rate limit is applied to the ingress and egress traffic.

The following table describes test bed configurations:

Table 3-16 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	23.3.1
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 C Benchmarking.

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 3-17 Testcase Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	620K MPS
Network deployment diagram	Topology 3. For information about topology, see Test Topology 3 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)	280
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	150 milliseconds
Number of SCP ingress IPs configured	1
How many connections per published IP/FQDN producers can handle?	260
Per Egress connection max traffic in MPS	1000
How many connections consumer can initiate towards per SCP IP?	455
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: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	NA
NF Discovery response size and Info	NA

Table 3-17 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
Egress and Ingress Rate Limit Configurations	• Number of Global Egress Rate limit configuration (number of unique keys): 280 • Number of Local Egress Rate limit configuration (number of unique keys): 280 • Number of Ingress Rate limit configuration (number of unique keys): 280
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: 280 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: 65 – NRF Proxy: 0 – NRF Auth: 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	• Kafka: 3 Kafka-brokers with 400GB PVC • Aggregation: 2 ocnaddscpaggregation pods • Egress Feed with replication enabled towards third- party server
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 sec • Configured minimum peer LCI change:5 • Number of NF/NFService Instances reporting LCI:280
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
OAuth Traffic Rate	NA
OCI Configurations	NA

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 3-18 Result and Observation

Parameter	Values
Test Duration	12 Hours

Table 3-18 (Cont.) Result and Observation

Parameter	Values
MPS Achieved	620K MPS
Average MPS per scp-worker pod	9.5K 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 3-19 SCP Microservices and their Utilization

SCP Microservices	CPU/Pod		Memory/Pod		CPU/Pod Sidecar		Memory/Pod Sidecar	
	Max	Avg	Max	Avg	Max	Avg	Max	Avg
scp-worker	6.75	5.63	5.29 GB	4.70 GB	4.17	3.89	653 MB	573 MB
scp-nrfproxy	NA	NA	NA	NA	NA	NA	NA	NA
scpc-notification	0.999	0.960	2.13 GB	2.13 GB	0.307	0.295	286 MB	273 MB
scpc-audit	0.00982	0.00686	672 MB	672 MB	0.0371	0.0183	261 MB	248 MB
scpc-configuration	0.0678	0.0573	766 MB	764 MB	0.0614	0.0487	281 MB	268 MB
scpc-subscription	0.0391	0.0350	488 MB	487 MB	0.0303	0.0170	248 MB	235 MB
scp-cache	0.965	0.888	1.19 GB	1.19 GB	0.266	0.0197	238 MB	225 MB
scp-load-manager	0.456	0.0702	1.53 GB	1.53 GB	0.845	0.00948	240 MB	228 MB
scpc-alternate-resolution	0.0133	0.0112	1.39 GB	1.39 GB	0.0277	0.0121	238 MB	225 MB

Observed Values of cnDBTier Services

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

Table 3-20 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	0.5%
CPU usage of data nodes	0.7%
Write operations per second	0.9 seconds
Read operations per second	69 seconds
Transaction rates on data nodes	1.6

3.4.4 Model C - Testcase Scenario 3

The Model C test is based on the network latency of 150 milliseconds at the rate of 640K MPS with rate limit applied and no ASM.

Objective

This testcase 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 3-21 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	24.1.0
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 C Benchmarking.

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 3-22 Testcase Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	640K MPS
Network deployment diagram	Topology 3. For information about topology, see Test Topology 3 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)	280
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	150 milliseconds
Number of SCP ingress IPs configured	1

Table 3-22 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
How many connections per published IP/FQDN producers can handle?	260
Per Egress connection max traffic in MPS	1000
How many connections consumer can initiate towards per SCP IP?	190
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: 2 • Number of NRF NFSets: 3
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): 280 • Number of Local Egress Rate limit configuration (number of unique keys): 280 • Number of Ingress Rate limit configuration (number of unique keys): 280
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: 280 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: 40 – NRF Proxy: 0 – NRF Auth: 0 – Cache: 3 – Mediation: 0 – Load-Manager: 3
SCP Worker Pod Profile	12 vCPU and 16 Gi Memory

Table 3-22 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 sec • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 280
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 3-23 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	640K MPS
Average MPS per scp-worker pod	16K 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 3-24 SCP Microservices and their Utilization

SCP Microservices	CPU/Pod		Memory/Pod	
	Max	Avg	Max	Avg
scp-worker	9.36	8.59	9.64 GB	9.44 GB
scp-nrfproxy	NA	NA	NA	NA
scpc-notification	0.752	0.715	1.65 GB	1.65 GB
scpc-audit	0.0178	0.00677	604 MB	604 MB
scpc-configuration	0.0419	0.0344	769 MB	768 MB
scpc-subscription	0.0643	0.0499	821 MB	820 MB
scp-cache	0.775	0.695	921 MB	917 MB
scp-load-manager	0.402	0.0629	1.48 GB	1.48 GB

Table 3-24 (Cont.) SCP Microservices and their Utilization

SCP Microservices	CPU/Pod		Memory/Pod	
	Max	Avg	Max	Avg
scpc-alternate-resolution	0.0175	0.0107	749 MB	746 MB

Observed Values of cnDBTier Services

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

Table 3-25 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	0.6%
CPU usage of data nodes	0.7%
Write operations per second	1 second
Read operations per second	69 seconds
Transaction rates on data nodes	2.8

4
Benchmarking SCP Model D

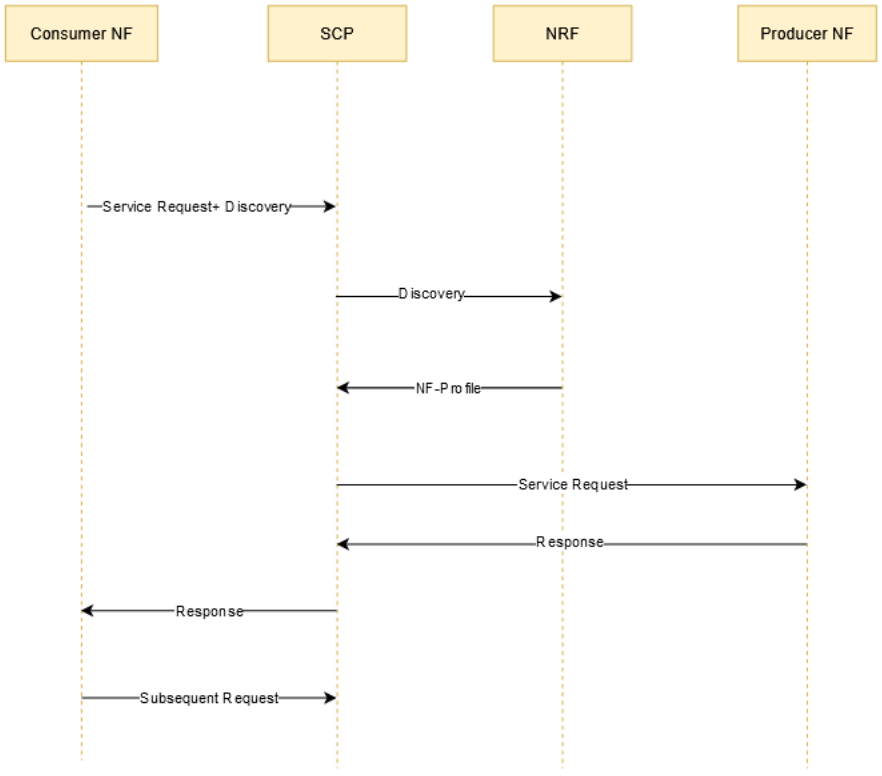
This section describes Model D test topologies and test scenarios for benchmarking SCP.

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



4.1.1 Model D 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 Model D 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
AMF	AUSF	N12	nausf-auth	2.50
AMF	PCF	N15	• npcf-ue-policy-control • npcf-am-policy-control	3.00

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	reroutePolicy			
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

Table 4-2 (Cont.) Routing Configuration

NF	Service	Initial Message		Subsequent Message		reverseProxySupport	Deployment	Response Timeout
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

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	

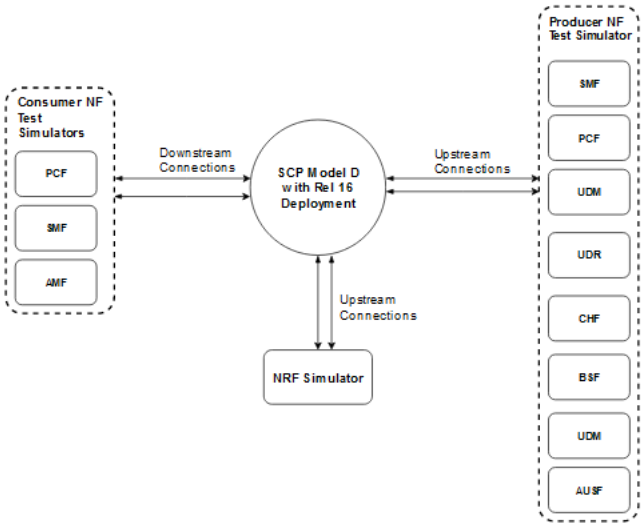
4.2 Test Topology 1 for SCP Model D Benchmarking

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 4-4 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%
AMF	AUSF	N12	nausf-auth	2.50%

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

NF-C	NF-P	Interface Reference	NF Service	Percentage (%) of Messages
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 4-5 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 4-6 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 4-6 (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 4-6 (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 4-6 (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 4-6 (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 4-6 (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 4-6 (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 4-6 (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 4-6 (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 4-7 Data Set

Data Set 1: NFtype level access token	Data Set 1: 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 4-8 OAuth Parameters

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

Table 4-8 (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 has changed
- Load of NF has changed

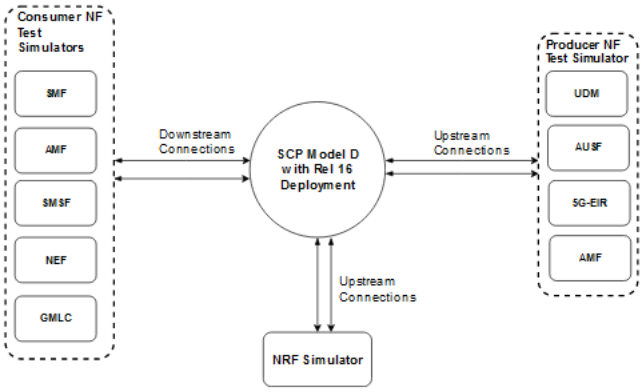
- Addition of SUPI range to NF
- Addition of GPSI range to NF
- Removed service instances from the NF profile
- Added service instances to the NF profile

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:

Table 4-9 Topology 2 Traffic Distribution

NF-C	NF-P	Interface Reference	NF Service	Percentage (%) of Messages
SMF	UDM	N10	nudm-sdm	20%
			nudm-uecm	10%
AMF	UDR	N8	Nudm_sdm	25%
			Nudm_uecm	15%
AMF	AUSF	N12	Nausf-auth	5%
SMSF	UDM	N21	Nudm_sdm	10%
			Nudm_uecm	6%
AMF	5G-EIR	N17	N5g-eir_EquipmentIdentityCheck	5%
NEF	AMF	N51	Namf_Communication	2%
GMLC	AMF	NLg	Namf_Location	2%

Table 4-9 (Cont.) Topology 2 Traffic Distribution

NF-C	NF-P	Interface Reference	NF Service	Percentage (%) of Messages
NRF	SCP	Notifications		10 notifications every 15 minutes

Topology 2 Routing Configuration

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

Table 4-10 Routing Configuration

NF	Service	Initial Message		Subsequent Message		reverseProxySupport	Deployment	Response Timeout
		routePolicy	reroutePolicy	routePolicy	reroutePolicy			
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	Forward_Route	RerouteWithinSite	False	SITE_WIDE	1s
AMF	Namf_Communication	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
AMF	Namf_Location	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s
EIR	N5g-eir_EquipmentIdentityCheck	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	False	SITE_WIDE	1s

Topology 2 NF Profiles

The following table describes NF profile configuration, traffic, and message call flows for 152 NF profiles registered on SCP:

Table 4-11 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-sdm • nudm-uecm	66	UDM 1 to UDM 66	**Nudm_sdm** • Subscribe to Notifications • Modify Subscription • Unsubscribe from Notifications **Nudm_uecm** • Register SMF • Deregister SMF	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type
AMF	UDM	N8	• nudm-ueau • nudm-uecm • nudm-sdm • nudm-ee	• nudm-sdm • nudm-uecm			**Nudm_sdm** • Subscribe to Notifications • Retrieve Subscription Data **Nudm_uecm** • Register AMF • Update Registration	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type
SMSF	UDM	N21	• Nudm_sdm • Nudm_uecm	• Nudm_sdm • Nudm_uecm			• Retrieve SMS Management Subscription Data • Register the serving SMSF • Deregister the serving SMSF	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type

Table 4-11 (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	66	AUSF 1 To AUSF 66	Authenticate UE	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type
AMF	5G-EIR	N17	n5g-eir-eic	n5g-eir-eic	10	5G-EIR 1 to 5G-EIR 10	Retrieve the equipment status	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type
NEF	AMF	N51	namf-comm	namf-comm	10	AMF 1 to AMF 10	• Create UE Context • Release UE Context	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type
GMLC	AMF	NLg	namf-loc	namf-loc			• Provide Positioning Info • Cancel Notification	• 3gpp-sbi-discovery-target-nf-type • 3gpp-sbi-discovery-requester-nf-type

Topology 2 Notification NRF

The following lists the notifications:

- Priority of NF services has changed
- Capacity of NF services has changed
- Priority and Capacity of NF services has changed
- Load of NF has changed
- Addition of SUPI range to NF
- Addition of GPSI range to NF
- Removal of service instances from the NF profile
- Addition of service instances to the NF profile

4.4 Model D Testcases

This section provides information about the SCP Model-D testcases.

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

4.4.1 Model D Testcase Summary

The following table provides a summary of the benchmark tests:

Table 4-12 Benchmark Testcase Summary

Benchmark Testcase Number	Description
Model D - Testcase Scenario 1	The Model D test is based on the network latency of 150 milliseconds at the rate of 120K MPS without rate limit and 20% delegated discovery requests towards NRF.
Model D - Testcase Scenario 2	The Model D test is based on the network latency of 150 milliseconds at the rate of 120K MPS with the rate limit disabled and 20% delegated discovery sent towards NRF. The enforceReqSpecificSvcDiscovery parameter is enabled, and the delegated discovery response is received from NRF with 66 NF profiles and with a validity timer of 600 seconds and 1 second.
Model D - Testcase Scenario 3	The Model D test is based on the network latency of 150 milliseconds at the rate of 120K MPS with the rate limit disabled and 20% delegated discovery sent towards NRF. The enforceReqSpecificSvcDiscovery parameter is disabled, and the delegated discovery response is received from NRF with 66 NF profiles and with a validity timer of 600 seconds and 1 second.
Model D - Testcase Scenario 4	The Model D test is based on the network latency of 150 milliseconds at the rate of 120K MPS with the rate limit disabled and 20% delegated discovery sent towards NRF. The enforceReqSpecificSvcDiscovery parameter is disabled, and the delegated discovery response is received from NRF with 66 NF profiles and with a validity timer of 1800 seconds and 1 second.
Model D - Testcase Scenario 5	The Model D test is based on a network latency of 150 milliseconds at a rate of 186K MPS and 20% delegated discovery sent towards NRF. The enforceReqSpecificSvcDiscovery parameter is enabled, and the delegated discovery response is received from NRF with 66 NF profiles and a validity timer of 1 second.
Model D - Testcase Scenario 6	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 - Testcase Scenario 7	The Model D test is based on a network latency of 150 milliseconds at a rate of 186K MPS with Oauth2.0 enabled and cache disabled.

4.4.2 Model D - Testcase Scenario 1

This is a Model D test based on the network latency of 150 milliseconds without rate limit.
Objective

This testcase scenario describes the performance and capacity of SCP with Model D. It provides the benchmarking results with latency in a network, and no rate limit is applied to the ingress and egress traffic.

The following table describes test bed configurations:

Table 4-13 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	72 Hours
SCP Version Tag	22.3.0
Cluster	Test Bed 1 - CNE on Bare Metal. For more information, see Cluster Details
Topology	Topology 1. For information about topology, see Test Topology 1 for SCP Model D Benchmarking

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 4-14 Testcase Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	120K 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
Number of NFs deployed in the network which 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 single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.

Table 4-14 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
NF Status Information	• Add or Modify or Delete 10 notification every 15 min • 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. – 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 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?	96
Per Egress connection max traffic in MPS	400
How many connections consumer can initiate towards per SCP IP?	384
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: 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: 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): NA
NF Discovery response size and Info	• Largest number of NF profiles returned in discovery response: 6 • Largest number of NF services in each NF profile in discovery response: 5
Egress and Ingress Configurations	NA
Mediation Configurations	NA
Mediation Trigger point configuration	NA

Table 4-14 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
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 – Alternate Resolution:1 • Data plane pods: – Worker: 24 – NRF Proxy: 8 – NRF Auth : 0 – Cache:3 – Mediation:0
SCP Worker Pod Profile	8 vCPU & 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
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 benchmark testing to increase the traffic rate:

Table 4-15 Result and Observation

Parameter	Values
Test Duration	4 Hours
MPS Achieved	120K MPS
Average per scp-worker pod MPS	~4.8 K MPS
Average per scp-nrf pod MPS	~2.4 MPS
Success rate	~99%
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 4-16 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	5.14	4.28	7.42 Gi	6.94 Gi
scp-nrfproxy	7.59	2.63	5.64 Gi	4.71 Gi
scpc-notification	0.114	0.0655	1.31 Gi	1.13 Gi
scpc-audit	0.0218	0.00331	567 MB	488 MB
scpc-configuration	0.0399	0.00242	699 MB	521 MB
scpc-subscription	0.113	0.0713	634 MB	506 MB
scp-cache	0.0172	0.00839	766 MB	731 MB

Observed Values of cnDBTier Services

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

Table 4-17 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	0.7%
CPU usage of data nodes	0.17%
Write operations per second	-
Read operations per second	30.6 seconds
Transaction rates on data nodes	4.24

4.4.3 Model D - Testcase Scenario 2

The Model D test is based on the network latency of 150 milliseconds with 20% delegated and non-delegated discovery requests towards NRF.

Objective

This testcase scenario describes the performance and capacity of SCP with Model D. It provides the benchmarking results with latency in a network, and no rate limit is applied to the ingress and egress traffic.

The following table describes test bed configurations:

Table 4-18 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	22.4.0
Cluster	Test Bed 1 - 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

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 4-19 Testcase Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	120K 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 instances**: 152 profiles as described in Table 3-3. • **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 two instances. 1 UDM profile as 8 service instances. – AUSF profile has 1 services type (nausf-auth), and each service type has two instances. 1 AUSF profile has 2 service instances. – 5G-EIR profile has 1 services type (n5g-eir-eic), each service type has two instances. 1 5G-EIR profile has 2 service instances. – AMF profile has 2 services types (namf-comm, namf-loc), each service type has two instances. 1 AMF profile has 4 service instances. • **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 or Modify or Delete 10 notification every 15 min • 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. – 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 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	8
How many connections per published IP/FQDN producers can handle?	96
Per Egress connection max traffic in MPS	450
How many connections consumer can initiate towards per SCP IP?	480
Per Ingress connection max traffic in MPS	1000

Table 4-19 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
Average Request and Response message size	• Average HTTP Request Packet Size: 1500 Bytes • Average HTTP Response Packet Size: 1500 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: 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: Enabled • 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): – 600 seconds (10% of Delegated Discovery traffic) – 1 second (10% of Delegated Discovery traffic)
NF Discovery response size and Info	• Largest number of NF profiles returned in discovery response: 66 • 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	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 – Alternate Resolution:1 • Data plane pods: – Worker: 24 – NRF Proxy: 8 – NRF Auth : 0 – Cache:3 – Mediation:0
SCP Worker Pod Profile	12 vCPU & 16 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	NA
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
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 benchmark testing to increase the traffic rate:

Table 4-20 Result and Observation

Parameter	Values
MPS Achieved	120K MPS
Average per scp-worker pod MPS	5.2K MPS
Success rate	~99.8%
Number of Discovery requests sent to NRF by SCP	4.8K MPS
Total Number of delegated discovery requests processed by Model D Cache	8.1K MPS
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 4-21 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	7.55	4.1	5.3 GB	5.2 GB
scp-nrfproxy	5.93	3.8	4.3 GB	3.7 GB
scpc-notification	0.278	0.194	1.67 GB	1.63 GB
scpc-audit	0.00826	0.00356	726 MB	724 MB
scpc-configuration	0.0302	0.0263	753 MB	731 MB
scpc-subscription	0.0338	0.0202	555 MB	528 MB
scp-cache	0.0124	0.00956	782 MB	775 MB

Observed Values of cnDBTier Services

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

Table 4-22 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	9.51%
CPU usage of data nodes	0.229%
Write operations per second	10.3 seconds
Read operations per second	146 seconds
Transaction rates on data nodes	12.3

For example, a customer network can achieve the following capabilities:

- The percentage (%) of Delegated Discovery traffic to Network Repository Function (NRF) is 20% of the total traffic per site.

- Redundancy model of maximum 2 SCP sites in a region being offline.
- Mediation: 5% traffic and 4 trigger points per site.
- 2.8M Messages Per Second (MPS) network wide SCP traffic with currently deployed features on 15 HP 28 core servers per site. For example, 210 additional worker nodes. The network supports 24 out of 30 active SCP instances, each SCP instance with 120K MPS.

4.4.4 Model D - Testcase Scenario 3

The Model D test is based on the network latency of 150 milliseconds with 20% delegated and non-delegated discovery requests towards NRF.

Objective

This testcase scenario describes the performance and capacity of SCP with Model D. It provides the benchmarking results with latency in a network, and no rate limit is applied on the Ingress and Egress traffic.

The following table describes test bed configurations:

Table 4-23 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	8 Hours
SCP Version Tag	22.4.0
Cluster	Test Bed 1 - 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

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 4-24 Testcase Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	120K 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 4-24 (Cont.) Testcase 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 instances**: 152 profiles as described in Table 3-3. • **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 two instances. 1 UDM profile as 8 service instances. – AUSF profile has 1 services type (nausf-auth), each service type has two instances. 1 AUSF profile has 2 service instances. – 5G-EIR profile has 1 services type (n5g-eir-eic), each service type has two instances. 1 5G-EIR profile has 2 service instances. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has two instances. 1 AMF profile has 4 service instances. • **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 or Modify or Delete 10 notification every 15 min • 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. – 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 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?	96
Per Egress connection max traffic in MPS	450
How many connections consumer can initiate towards per SCP IP?	456
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 1500 Bytes • Average HTTP Response Packet Size: 1500 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: 2 • Number of NRF NFSets: 3

Table 4-24 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
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): – 600 seconds (10% of Delegated Discovery traffic) – 1 second (10% of Delegated Discovery traffic)
NF Discovery response size and Info	• Largest number of NF profiles returned in discovery response: 66 • 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	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 – Alternate Resolution:1 • Data plane pods: – Worker: 24 – NRF Proxy: 8 – NRF Auth : 0 – Cache:3 – Mediation:0
SCP Worker Pod Profile	12 vCPU & 16 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	NA
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
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 benchmark testing to increase the traffic rate:

Table 4-25 Result and Observation

Parameter	Values
MPS Achieved	120K MPS
Average per scp-worker pod MPS	~5.8 K MPS
Success rate	~99.1%
Number of Discovery requests sent to NRF by SCP	3.7K MPS
Total Number of delegated discovery requests processed by Model D Cache	8.3K MPS
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 4-26 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	7.54	4.1	9.8 GB	9.6 GB
scp-nrfproxy	6.2	4.8	4.8 GB	3.5 GB
scpc-notification	0.260	0.234	1.50 GB	1.49 GB
scpc-audit	0.00762	0.00173	597 MB	594 MB
scpc-configuration	0.00602	0.00161	539 MB	538 MB
scpc-subscription	0.0554	0.0456	518 MB	512 MB
scp-cache	0.0131	0.00914	825 MB	824 MB
scp-load-manager	0.0346	0.0268	718 MB	715 MB

Observed Values of cnDBTier Services

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

Table 4-27 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	9.62%
CPU usage of data nodes	0.4%
Write operations per second	10.2 seconds
Read operations per second	145 seconds
Transaction rates on data nodes	17.1

4.4.5 Model D - Testcase Scenario 4

The Model D test is based on the network latency of 150 milliseconds with 20% delegated and non-delegated discovery requests towards NRF.

Objective

This testcase scenario describes the performance and capacity of SCP with Model D. It provides the benchmarking results with latency in a network, and no rate limit is applied on the ingress and egress traffic.

The following table describes test bed configurations:

Table 4-28 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	22.4.0
Cluster	Test Bed 1 - 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

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 4-29 Testcase Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	120K 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 instances**: 152 profiles as described in Table 3-3. • **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 two instances. 1 UDM profile as 8 service instances. – AUSF profile has 1 services type (nausf-auth), each service type has two instances. 1 AUSF profile has 2 service instances. – 5G-EIR profile has 1 services type (n5g-eir-eic), each service type has two instances. 1 5G-EIR profile has 2 service instances. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has two instances. 1 AMF profile has 4 service instances. • **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 or Modify or Delete 10 notification every 15 min • 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. – Service instances are removed from profiles.

Table 4-29 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
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	8
How many connections per published IP/FQDN producers can handle?	96
Per Egress connection max traffic in MPS	400
How many connections consumer can initiate towards per SCP IP?	432
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 1500 Bytes • Average HTTP Response Packet Size: 1500 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: 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): – 600 seconds (10% of Delegated Discovery traffic) – 1 second (10% of Delegated Discovery traffic)
NF Discovery response size and Info	• Largest number of NF profiles returned in discovery response: 66 • 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	NA
Secured HTTPs connection - % of message on HTTPs?	NA
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-29 (Cont.) Testcase 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: 24 – NRF Proxy: 8 – NRF Auth : 0 – Cache: 3 – Mediation: 0
SCP Worker Pod Profile	12 vCPU & 16 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	NA
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
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 benchmark testing to increase the traffic rate:

Table 4-30 Result and Observation

Parameter	Values
MPS Achieved	120K MPS
Average per scp-worker pod MPS	~5.2 K MPS
Success rate	~99.5%
Number of Discovery requests sent to NRF by SCP	2.5K MPS
Total Number of delegated discovery requests processed by Model D Cache	9.5K MPS
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 4-31 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	6.56	3.5	9.8 GB	9.6 GB

Table 4-31 (Cont.) SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-nrfproxy	4.9	3.5	4.8 GB	3.6
scpc-notification	0.267	0.222	1.44 GB	1.43 GB
scpc-audit	0.0152	0.00185	583 MB	581 MB
scpc-configuration	0.0138	0.00130	632 MB	630 MB
scpc-subscription	0.0572	0.0375	467 MB	456 MB
scp-cache	0.0146	0.00822	841 MB	840 MB
scp-load-manager	0.0374	0.0263	758 MB	747 MB

Observed Values of cnDBTier Services

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

Table 4-32 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	7.38%
CPU usage of data nodes	0.357%
Write operations per second	11.1 seconds
Read operations per second	124 seconds
Transaction rates on data nodes	15.2

4.4.6 Model D - Testcase Scenario 5

The Model D test is based on a network latency of 150 milliseconds with 20% delegated and non-delegated discovery requests toward NRF.

Objective

This testcase scenario describes the performance and capacity of SCP on Model D. It provides results with latency in a network, and no rate limit is applied to the ingress and egress traffic.

The following table describes test bed configurations:

Table 4-33 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	22.4.1
Cluster	Test Bed 1 - CNE on Bare Metal. For more information, see Cluster Details
Topology	Topology 1. For information about topology, see Test Topology 1 for SCP Model D Benchmarking

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 4-34 Testcase 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 D
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	• **Number of NF instances**: 152 profiles as described in Table 3-3. • **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 two instances. 1 UDM profile as 8 service instances. – AUSF profile has 1 services type (nausf-auth), each service type has two instances. 1 AUSF profile has 2 service instances. – 5G-EIR profile has 1 services type (n5g-eir-eic), each service type has two instances. 1 5G-EIR profile has 2 service instances. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has two instances. 1 AMF profile has 4 service instances. • **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 or Modify or Delete 10 notification every 15 min • 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. – 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 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	8
How many connections per published IP/FQDN producers can handle?	148
Per Egress connection max traffic in MPS	500
How many consumers can initiate towards per SCP IP?	740
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 1500 Bytes • Average HTTP Response Packet Size: 1500 Bytes

Table 4-34 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
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: Enabled • enforceReqSpecificSvcDiscovery: Enabled • 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): – 600 seconds (10% of Delegated Discovery traffic) – 1 second (10% of Delegated Discovery traffic)
NF Discovery response size and Info	• Largest number of NF profiles returned in discovery response: 66 • 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	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 – Alternate Resolution:1 • Data plane pods: – Worker: 37 – NRF Proxy: 16 – NRF Auth : 0 – Cache: 3 – Mediation: 0
SCP Worker Pod Profile	12 vCPU & 16 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	NA
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
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 4-35 Result and Observation

Parameter	Values
MPS Achieved	186K MPS
Average per scp-worker pod MPS	5K MPS
Success rate	~100%
Number of Discovery requests sent to NRF by SCP	5.5K
Total Number of delegated discovery requests processed by Model D Cache	14 K
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 4-36 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	8.9	4.0	5.32 GB	5.22 GB
scp-nrfproxy	4.0	2.3	4.88 GB	4.76 GB
scpc-notification	0.41	0.39	2.02 GB	2.02 GB
scpc-audit	0.0056	0.0042	543 MB	543 MB
scpc-configuration	0.0395	0.0271	879 MB	877 MB
scpc-subscription	0.0309	0.0250	615 MB	610 MB
scp-cache	0.0117	0.00968	937 MB	936 MB

Observed Values of cnDBTier Services

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

Table 4-37 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	15.1%
CPU usage of data nodes	0.4%
Write operations per second	11.5 seconds
Read operations per second	144 seconds
Transaction rates on data nodes	16.5

4.4.7 Model D - Testcase Scenario 6

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

Objective

This testcase 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 4-38 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	23.4.0
Cluster	Test Bed 4 - CNE on Bare Metal. For more information, see Cluster Details
Topology	Topology 1. For information about topology, see Test Topology 1 for SCP Model D Benchmarking

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 4-39 Testcase 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%)

Table 4-39 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
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
Per Egress connection max traffic in MPS	400
How many connections consumer can initiate towards per SCP IP?	800
Per Ingress connection, max traffic in MPS	1000

Table 4-39 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
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 – Alternate Resolution:1 • Data plane pods: – Worker: 50 – NRF Proxy: 21 – NRF Auth : 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
OAuth Traffic Rate	40K MPS
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 4-40 Result and Observation

Parameter	Values
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 4-41 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 4-42 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	0.58%
CPU usage of data nodes	0.87%
Write operations per second	2K
Read operations per second	100 seconds
Transaction rates on data nodes	2.50

4.4.8 Model D - Testcase Scenario 7

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

Objective

This testcase 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 disabled
- Model D Cache disabled
- enforceReqSpecificSvcDiscovery parameter enabled

The following table describes test bed configurations:

Table 4-43 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	23.4.0
Cluster	Test Bed 4 - CNE on Bare Metal. For more information, see Cluster Details
Topology	Topology 1. For information about topology, see Test Topology 1 for SCP Model D Benchmarking

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 4-44 Testcase 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%)

Table 4-44 (Cont.) Testcase 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 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 millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	150 milliseconds
Number of SCP ingress IPs configured	1
How many connections per published IP/FQDN producers can handle?	200
Per Egress connection max traffic in MPS	400
How many connections consumer can initiate towards per SCP IP?	800
Per Ingress connection max traffic in MPS	1000

Table 4-44 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
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 the 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 Rate Limit 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 – Alternate Resolution:1 • Data plane pods: – Worker: 50 – NRF Proxy: 21 – NRF Auth : 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
OAuth Traffic Rate	40K MPS
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 4-45 Result and Observation

Parameter	Values
MPS Achieved	186K MPS
Average per scp-worker pod MPS	3790 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 4-46 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	5.38	4.85	4.02 GB	3.50 GB
scp-nrfproxy	2.06	1.81	2.56 GB	2.43 GB
scpc-notification	0.589	0.560	1.82 GB	1.74 GB
scpc-audit	0.0133	0.00536	580 MB	576 MB
scpc-configuration	0.0562	0.0429	763 MB	758 MB
scpc-subscription	0.0355	0.0256	468 MB	462 MB
scp-cache	0.0199	0.0144	1.03 GB	1.02 GB
scp-nrfproxyoauth	4.81	4.41	2.84 GB	2.25 GB
scp-mediation	0.00101	0.000585	374 MB	374 MB
scp-loadmanager	0.0408	0.0298	831 MB	825 MB

Observed Values of cnDBTier Services

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

Table 4-47 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	0.58%
CPU usage of data nodes	0.92%
Write operations per second	2K
Read operations per second	100 seconds
Transaction rates on data nodes	2.50