Oracle® Communications

Cloud Native Core, Service Communication Proxy Benchmarking Guide

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Preface

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The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
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Acronyms

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

Table 1 Acronyms

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

What's New in This Guide

This section introduces the documentation updates for release 25.1.2xx.

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- Added the following acronyms to the Acronyms section:
  - LBVM
  - vCNE
- Added the Table 2-7.
- Added information about cnDBTier resources for both ASM and non-ASM setups in the cnDBTier Resources section.
- 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 200 milliseconds at the rate of 730K MPS with the LCI, OCI, Ingress Rate Limiting, Global Egress Rate Limiting, and ASM enabled.
- Updated the Test Topology 2 for SCP Model D Benchmarking section.
- Added the Model D - Testcase Scenario 2 section to describe the performance and capacity of SCP with Model D based on the network latency of 50 milliseconds at the rate of 400K MPS without the features enabled in the TLS enabled setup.
- Added the Model D - Testcase Scenario 3 section to describe the performance and capacity of SCP with Model D based on the network latency of 50 milliseconds at the rate of 400K MPS with the features enabled in the TLS enabled setup.
- Added the Model D - Testcase Scenario 4 section to describe the performance and capacity of SCP with Model D based on the network latency of 150 milliseconds at the rate of 400K MPS with the features enabled in the TLS enabled vCNE setup.

1 Introduction

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

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

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

1.1 Purpose and Scope

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

This document provides SCP performance and capacity data.

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

1.2 References

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

2
Deployment Environment

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

2.1 Deployed Components

Deployment Platform

Oracle Communications Cloud Native Core, Cloud Native Environment (CNE) 24.2.0 and CNE on BareMetal 24.1.0 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
Fluentd	1.16.2
Grafana	1.26.1
Jaeger	1.52.0
Kibana	7.9.3
Oracle OpenSearch	2.3.0
Oracle OpenSearch Dashboard	2.3.0
Prometheus	1.7.0

Cloud Native Orchestrator

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

cnDBTier

cnDBTier 25.1.200 is used to perform benchmark tests.

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

2.2 Deployment Resources

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

2.2.1 Cluster Details

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 BareMetal

Nodes	Type	Count
Primary 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
Primary 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 BareMetal

Nodes	Type	Count
Primary Nodes	X9 Server and NVME	3
Worker Nodes	X9 Server and NVME	17

Table 2-6 Test Bed 4 - CNE on BareMetal

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

Table 2-7 Test Bed 5 - vCNE on OpenStack

Nodes	Type	Count
Master Nodes	ORACLE SERVER X8-2	3
Worker Nodes	ORACLE SERVER X8-2	42
Top of Rack Switch	Cisco 93108TC-ex	2

Table 2-8 Test Bed 5 - LBVM Resources used for vCNE

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

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

Table 2-9 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
Alert Manager	2	64Mi/64Mi	40m/40m	NA
Fluentd	1 per Worker Node	4Gi/4Gi	400m/500m	NA
Prom-node-exporter	1 per Worker Node	512Mi/512Mi	800m/800m	NA
Grafana	1	2Gi/2Gi	2000m/2000m	NA
jaeger-agent	1 per Worker Node	128Mi/512Mi	256m/500m	NA
jaeger-collector	1	512Mi/1Gi	500m/1250m	NA
jaeger-query	1	128Mi/512Mi	256m/500m	NA

Table 2-9 (Cont.) CNE Common Services Observability Resources

Service Name	Number of Pods	RAM Request/Limit	vCPU Request/Limit	PVC Size Recommendation
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 provides information about cnDBTier resources for both ASM and non-ASM setups required to perform SCP benchmark tests:

Table 2-10 cnDBTier Resources (Non-ASM)

Service Name	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage (MB)		Sidecar CPU/Pod		Sidecar Memory/Pod (in GB)		Sidecar Ephemeral Storage (MB)	
	Min	Max	Min	Max	PVC 1	PVC 2	Min	Max	Min	Max	Min	Max	Min	Max
MGMT (ndbmgmd)	2	2	4	5	14	NA	90	1000	0.2	0.2	0.256	0.256	90	1000
DB(ndbmtd)	2	2	8	8	15	8	90	1000	1.2	1.2	2.256	2.256	180	3000
SQL - Replication(ndbmysqld)	4	4	10	10	25	NA	90	1000	0.3	0.3	0.512	0.512	180	2000
SQL - Access(ndbappmysqld)	4	4	8	8	20	NA	90	1000	0.3	0.3	0.512	0.512	180	2000
Monitor Service(db-monitor-svc)	4	4	4	4	0	NA	90	1000	0	0	0	0	0	0
db-connectivity-service	0	0	0	0	0	NA	0	0	NA	NA	NA	NA	NA	NA
Replication Service - Leader(db-replication-svc)	2	2	12	12	190	NA	90	1000	0.2	0.2	0.5	0.5	90	1000

Table 2-10 (Cont.) cnDBTier Resources (Non-ASM)

Service Name	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage (MB)		Sidecar CPU/Pod		Sidecar Memory/Pod (in GB)		Sidecar Ephemeral Storage (MB)	
	Min	Max	Min	Max	PVC 1	PVC 2	Min	Max	Min	Max	Min	Max	Min	Max
Replication Service - Other(db-replication-svc)	0.6	1	1	2	NA	NA	90	1000	0.2	0.2	0.5	0.5	NA	NA
Backup Manager Service(db-backup-manager-svc)	1	1	1	1	0	NA	90	1000	0	0	0	0	0	0

Table 2-11 cnDBTier Resources (ASM)

Service Name	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage (MB)		Sidecar CPU/Pod		Sidecar Memory/Pod (in GB)		Sidecar Ephemeral Storage (MB)	
	Min	Max	Min	Max	PVC 1	PVC 2	Min	Max	Min	Max	Min	Max	Min	Max
MGMT (ndbmgmd)	2	2	4	5	14		90	1000	1.2	1.2	1.256	1.256	90	1000
DB(ndbmtd)	2	2	8	8	15	8	90	1000	2.2	2.2	3.256	3.256	180	3000
SQL - Replication(ndbmysqld)	4	4	10	10	25	NA	90	1000	2.3	2.3	2.512	2.512	180	2000
SQL - Access(ndbappmysqld)	4	4	8	8	20	NA	90	1000	2.3	2.3	2.512	2.512	180	2000
Monitor Service(db-monitor-svc)	4	4	4	4	0	NA	90	1000	1	1	1	1	0	0
db-connectivity-service	0	0	0	0	0	NA	0	0	NA	NA	NA	NA	NA	NA

Table 2-11 (Cont.) cnDBTier Resources (ASM)

Service Name	CPU/Pod		Memory/Pod (in GB)		PVC Size (in GB)		Ephemeral Storage (MB)		Sidecar CPU/Pod		Sidecar Memory/Pod (in GB)		Sidecar Ephemeral Storage (MB)	
	Min	Max	Min	Max	PVC 1	PVC 2	Min	Max	Min	Max	Min	Max	Min	Max
Replication Service - Leader(db-replication-svc)	2	2	12	12	190	NA	90	1000	1.2	1.2	1.5	1.5	90	1000
Replication Service - Other(db-replication-svc)	0.6	1	1	2	NA	NA	90	1000	1.2	1.2	1.5	1.5	NA	NA
Backup Manager Service(db-backup-manager-svc)	1	1	1	1	0	NA	90	1000	1	1	1	1	0	0

2.2.3 SCP Resources

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

Table 2-12 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

Table 2-12 (Cont.) SCP Resources

Microservice Name	SCP Service Pods			
	vCPU/Pod		Memory/Pod (in Gi)	
	Min	Max	Min	Max
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

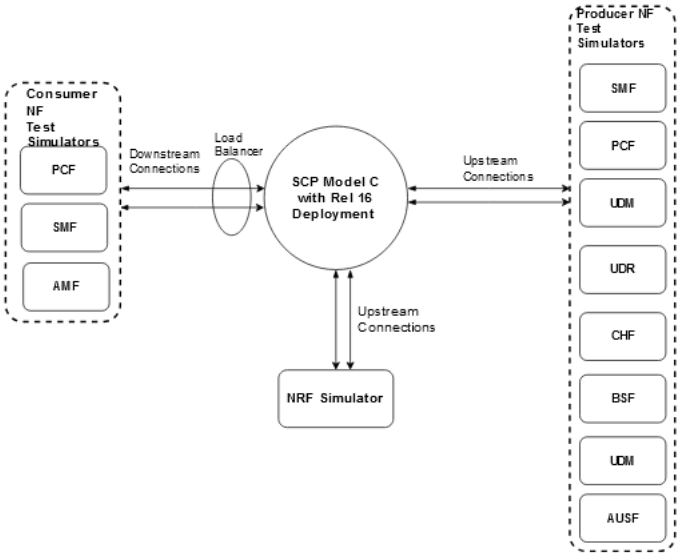
This section describes Model C test topologies and test scenarios for benchmarking SCP.

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

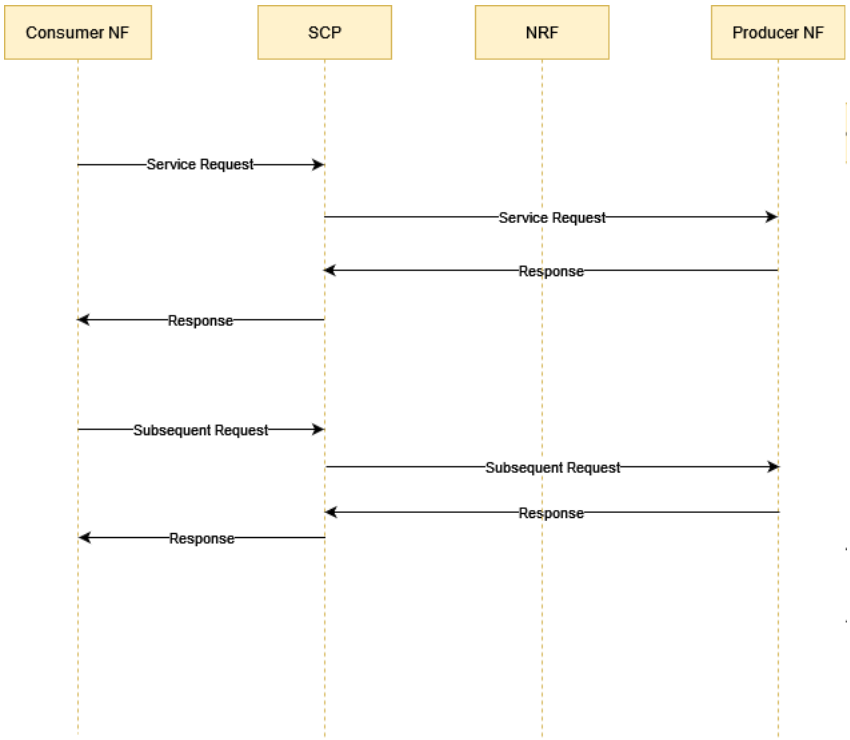
Then, SCP selects an NF service instance and routes the service requests to the selected producer NF. In case of failure, if reselection is required, SCP selects the producer NF instance based on the NF Set.

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



Network Topology

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

Figure 3-3 Network Topology

3.1.2 Topology 1 Traffic Distribution

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

Table 3-1 Topology 1 Traffic Distribution

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

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

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

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

Topology 1 NF Configuration Across All Regions

The following table describes the NF configurations across multiple regions:

Table 3-2 NF Configuration Across All Regions

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

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

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

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

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

Topology 1 NF Profiles

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

Table 3-3 NF Profiles

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

Table 3-3 (Cont.) NF Profiles

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

Table 3-3 (Cont.) NF Profiles

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

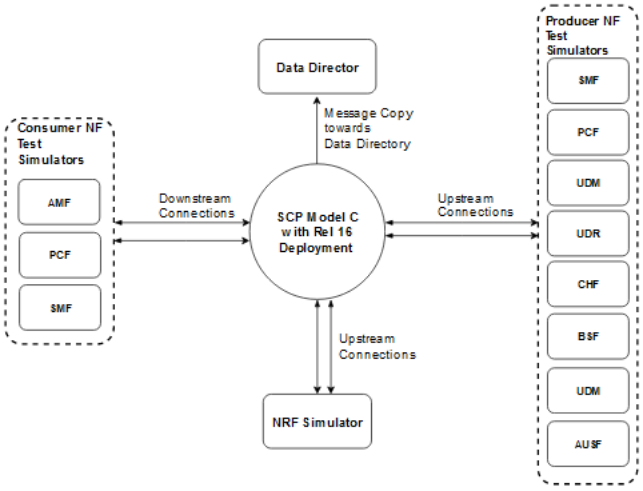
3.2 Test Topology 2 for SCP Model C Benchmarking with SBI Message Feed

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 3-4 SCP Model C Topology 2



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

- Selects an NF Set or a specific NF instance from the NF Set
- Sends a service request to SCP with the address of the selected service producer NF
- Creates multiple network interfaces for different subnet IPs
- Service requests from consumer NF are copied to OCNADD and then forwarded to the third-party

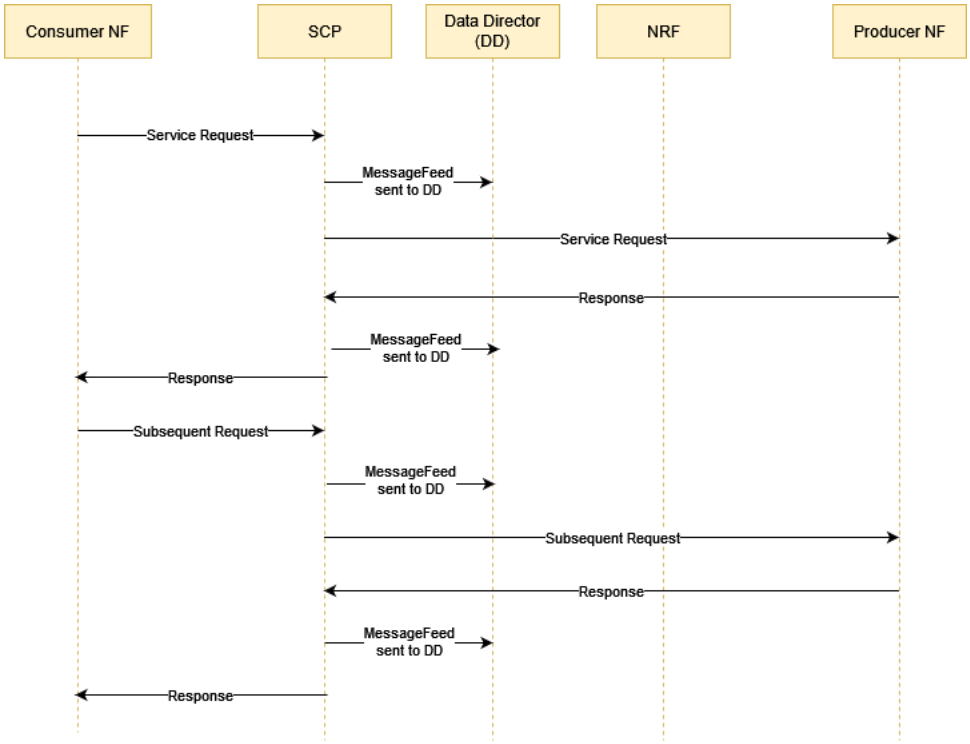
Then, SCP selects an NF service instance and routes the service requests to the selected producer NF. In case of failure, if reselection is required, SCP selects the producer NF instance based on the NF Set.

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 3-5 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			

Table 3-5 (Cont.) Routing Configuration

NF	Service	Initial Message		Subsequent Message		reverseProxySupport	Deployment	Response Timeout
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
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

Table 3-6 (Cont.) NF Profiles

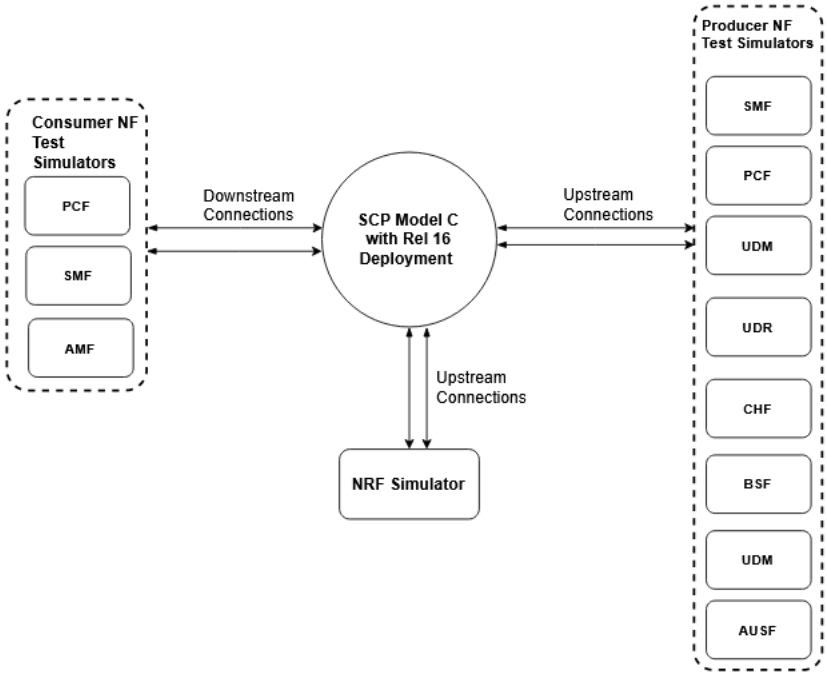
NF-C	NF-P	Interfaces	Supported Services	Service-related traffic	Profiles Registered	NF Range	Message Call flows
PCF	UDR	N36	• nudr-group-id-map • nudr-dr	• nudr-dr	1	UDM1	• Initial Requests (UDR GET) • Subscription (POST) • Unsubscription (POST) • Notifications (POST)
PCF	CHF	N28	• nchf-spendinglimitcontro • nchf-converged charging	nchf-spendinglimitcontrol	2	CHF1-CHF2	• Subscription (CHF POST) • Unsubscription (CHF POST) • Notifications (POST)
SMF	CHF	N40	• nchf-spendinglimitcontrol • nchf-converged charging	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 3-6 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

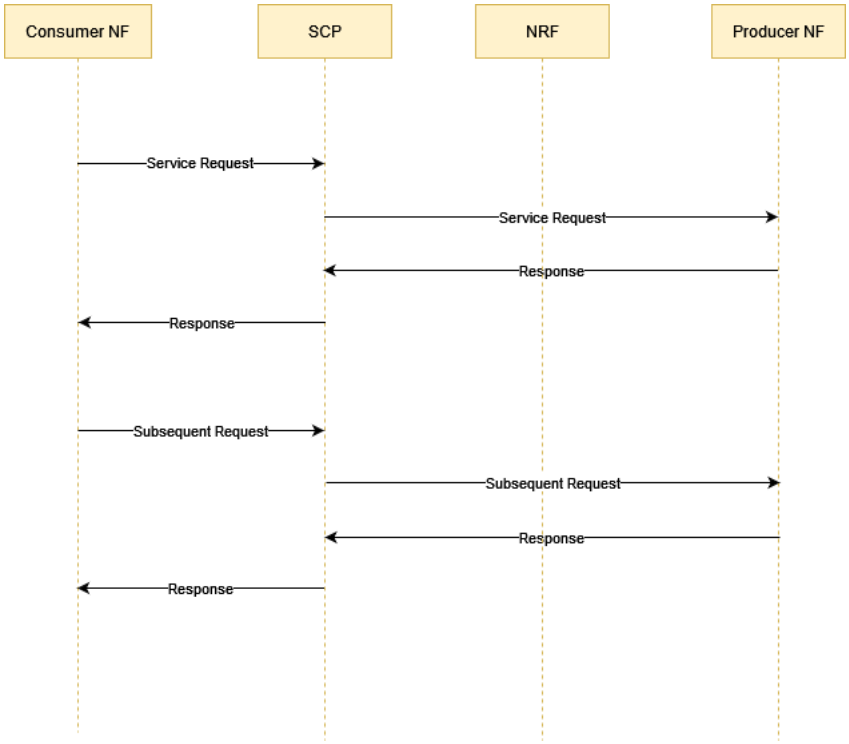
Then, SCP selects an NF service instance and routes the service requests to the selected producer NF. In case of failure, if reselection is required, SCP selects the producer NF instance based on the NF Set.

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 3-7 Topology 3 Call Flow



3.3.2 Topology 3 Traffic Distribution

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

Table 3-7 Topology 3 Traffic Distribution

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

Table 3-7 (Cont.) Topology 3 Traffic Distribution

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

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

Topology 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	2s
PCF	Npcf_AMPolicyControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
PCF	Npcf_UEPolicyControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s

Table 3-8 (Cont.) Routing Configuration

NF	Service	Initial Message		Subsequent Message		Deployment	ResponseTimeout
AUSF	Nausf_UEAuthentication	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
UDM	Nudm_uecm	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
UDM	Nudm_sdm	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
CHF	Nchf_ConvergedCharging	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
CHF	Nchf_SpendingLimitControl	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
BSF	Nbsf_Management	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
UDR	Nudr_dr	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
AMF	Namf_Communication	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
PCF	SpendingLimitStatus	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
AMF	Namf_evts	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
NSSF	Nnssf_NSSAIAvailability	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
NSSF	Nnssf_NSSelection	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
UDR	Nudr_GroupIDmap	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
AMF	Namf_Communication	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
AMF	Namf_Location	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
UDM	Nudm_EventExposure	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
NSSF	Nnssaaf_nssaa	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
UDM	Nudm_UEAuthentication	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
UDM	Nudm_sucideconceal	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
UDM	Nudm_SDM_Notification	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
CHF	Nchf_ConvergedCharging_Notify	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
PCF	Npcf_SMPolicyUpdateNotification	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s

Table 3-8 (Cont.) Routing Configuration

NF	Service	Initial Message		Subsequent Message		Deployment	ResponseTimeout
PCF	Npcf_AMPolicyControl_UpdateNotify	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
PCF	N1MessageNotification	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
PCF	PolicyDataChangeNotification	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
UDM	Nudm_SDM_Notification	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s
SCP	Notifications	Load_Balance	RerouteWithinSite	Load_Balance	RerouteWithinSite	SITE_WIDE	2s

Topology 3 NF Profiles

The following table provides details on the NF profile configuration, traffic, and message call flows for the 700 NF profiles registered on the SCP:

Table 3-9 NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
SMF	PCF	N7	Npcf_SMPolicyControl	• Npcf_SMPolicyControl_Create/Update/Delete • Npcf_SMPolicyControl_UpdateNotify Update • Npcf_SMPolicyControl_UpdateNotify Terminate	30	PCF1 to PCF30, PCF 31 to PCF60	**Npcf_SMPolicyControl** • Create SM Policy • Update SM Policy • Delete SM Policy

Table 3-9 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
AMF	PCF		Npcf_AMPolicyControlNpcf-UEPolicyControl	• Npcf_AMPolicyControl_Create/ Update/ Delete • Npcf_UEPolicyControl_Create/ Update/ Delete • Npcf_AMPolicyControl_UpdateNotify Update/ Terminate • Npcf_UEPolicyControl_UpdateNotify Update/ Terminate	12	PCF61 to PCF79, PCF 80 to PCF 95	**Npcf_AMPolicyControl** • Create AM Policy Association • Retrieve SM Policy • Update Policy • Policy Update Notification **Npcf_UEPolicyControl** • Create Policy Association • Retrieve Policy Association • Update Policy Association • Policy Update Notification
AMF	AUSF	N12	Nausf_UEAuthentication	Nausf_UEAuthentication_Authenticate	24	AUSF1 to AUSF40	Authenticate UE
SMF	UDM	N10	Nudm_uecmNudm_sdm	• Nudm_UEContextManagement - Registration • Nudm_UEContextManagement - Deregistration • Nudm_SubscriberDataManagement - Get • Nudm_SubscriberDataManagement - Subscribe • Nudm_SubscriberDataManagement - Unsubscribe	24	UDM1 to UDM40	**Nudm_sdm** • Subscribe to Notifications • Data Change Notification • Unsubscribe from Notifications **Nudm_uecm** • Register SMF • Deregister SMF

Table 3-9 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
SMF	CHF	N40	Nchf_ConvergedCharging	• Nchf_ConvergedCharging_Create • Nchf_ConvergedCharging_Update • Nchf_ConvergedCharging_Release	6	CHF1 to CHF10	• Subscribe to notification • Cancel an existing subscription
PCF	CHF	N28	Nchf_SpendingLimitControl	Nchf_SpendingLimitControl Subscribe/ Unsubscribe	6	CHF1 to CHF10	• Subscribe to notification • Cancel an existing subscription
AMF	UDM	N8	Nudm_sdmNudm_uecm	• Nudm_UEContextManagement - Registration • Nudm_UEContextManagement - Deregistration • Nudm_SubscriberDataManagement - Get • Nudm_SubscriberDataManagement - Subscribe • Nudm_SubscriberDataManagement - Unsubscribe	24	UDM1 to UDM40	**Nudm_sdm** • Subscribe to Notifications • Data Change Notification • Unsubscribe from Notifications **Nudm_uecm** • Register AMF • Deregister AMF
AMF	SMSF		Nsmsf-sms	• Nsmsf_SMService_Activate • Nsmsf_SMService_Deactivate	6	SMSF1 to SMSF8	• SMSF Activate • SMSF Deactivate
PCF	BSF		Nbsf_Management	• Nbsf_Management_Register • Nbsf_Management_DeRegister	6	BSF1 to BSF10	• Register the session binding information • Retrieve the session binding information • Remove an existing session binding

Table 3-9 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
PCF	UDR	N36	Nudr-dr	• Nudr_DataRepository_Get • Nudr_DataRepository_Subscribe	10	UDR1 to UDR30	• Create Policy Data Subscription • Delete Policy Data Subscription
PCF	AMF		Namf_Communication	• Namf_Communication_N1N2MessageSubscribe • Namf_Communication_N1N2MessageUnSubscribe	102	AMF1 to AMF150	• Subscribe • Unsubscribe
UDM	UDR	N35	Nudr-dr	Nudr_DataRepository	10	UDR1 to UDR30	• Get UDR sm data
CHF	PCF		SpendingLimitStatus	SpendingLimitStatus	42	PCF1 to PCF95	• Create Policy Data Subscription • Delete Policy Data Subscription
SMSF	AMF		Namf-evts	• Namf_EnableReachability • Namf_Communication_N1N2MessageTransfer • Namf_EventExposure_Subscribe	102	AMF1 to AMF150	• Subscribe • N1N2 Message transfer
AMF	NSSF	N22	Nnssf_NSSAIAvailability, Nnssf_NSSelection	• nnssf_nssaiavailability • nnssf_nsselection	6	NSSF1 to NSSF8	• Get network slice information Selection • nssaiavailability subscription
NRF	SLF		Nudr_GroupIDmap	Nudr GET (SLF group id query)	10	UDR1 to UDR30	• Get Group id

Table 3-9 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
CBCF	AMF	N50	Namf_Communication	• Namf_Communication_NonUeN2InfoSubscribe • Namf_Communication_NonUeN2InfoUnsubscribe • Namf_Communication_NonUeN2MessageTransfer	102	AMF1 to AMF150	• Subscribe • Unsubscribe
SMSF	UDM		Nudm_uecm	Nudm_UECM (Registration,Delete)	24	UDM1 to UDM24	• Registration • Delete
GMLC	AMF		Namf_Location	Namf_Location_ProvidePositioningInfo	102	AMF1 to AMF150	• Get Location Information
GMLC	UDM		Nudm_uecm	Nudm_UEContextManagement Get Request/ Response	24	UDM1 to UDM30	• Get Ue context management
LMF	AMF		Namf_Communication	Namf_Communication_N1N2MessageTransfer	102	AMF1 to AMF150	• Post N1N2 message
NEF	UDM	N52	Nudm_sdmNudm_uecmNudm_EventExposure	• Nudm_Sdm_Get • Nudm_Uecm_Get • Nudm_EventExposure_Subscribe • Nudm_EventExposure_ModifySubscription • Nudm_EventExposure_Unsubscribe	24	UDM1 to UDM30	• Get • Subscribe • Unsubscribe
AMF	NSSAAF	N58	Nnssaaf-nssaa	Nnssaaf_NSSAA_Authenticate Request/ Response	6	NSSAAF1 to NSSAAF8	Post Slice authentication

Table 3-9 (Cont.) NF Profiles

NF-C	NF-P	Interface	Supported Services	Service-related traffic	NF Range	Profile Registered	Message Call Flows
AUSF	UDM	N13	Nudm_UEAuthenticationNudm_sucideconceal	• Nudm_UEAuthentication - Authentication • Information Retrieval - POST • Nudm_UEAuthentication - ResultConfirmation - POST • Nudm_SuciDeconseal - de-concealment - GET	24	UDM1 to UDM30	• Post Authentication • Get

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, 270K MPS towards SCP and 270K 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 150K MPS across 22 regions with rate limit enabled on a non ASM setup.
Model C - Testcase Scenario 3	The Model C test is based on the network latency of 200 milliseconds at the rate of 730K MPS with the LCI, OCI, Ingress Rate Limiting, Global Egress Rate Limiting, and ASM enabled.

3.4.2 Model C - Testcase Scenario 1

In Model C testcase scenario, the Message Feed feature is enabled with two trigger points, 270K MPS toward SCP, and 270K MPS toward 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	24.3.0
Cluster	Test Bed 3 - CNE on Bare Metal. For more information, see Table 2-5.
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)	270K MPS for SCP and 270K MPS toward 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
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 3-12 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
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 toward per SCP IP?	119
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 3800 Bytes • Average HTTP Response Packet Size: 3600 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
Pods deployed	• Control plane pods: – Notification: 1 – Subscription: 1 – Audit: 1 – Configuration: 1 – Alternate Resolution: 1 – loadmanager: 2 • Data plane pods: – Worker: 23 – NRF Proxy: 0 – NRF OAuth: 0 – Cache: 3 – Mediation: 0
SCP Worker Pod Profile	8 vCPU and 12 Gi Memory
Oracle Communications Network Analytics Data Director Configurations	• Kafka: 11 Kafka-brokers with 400GB PVC • Aggregation: 11 ocnaddscpaggregation pods • 1 Egress Feed with replication enabled toward 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	270K MPS
Average MPS per scp-worker pod	11.7K MPS
Success rate	~ 99.98 %
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing
Response Time (from producer NF test simulator) including network latency	150ms
Response time (latency) from NRF simulator	300ms

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-worker	5.64	4.87	6.7	6.04
scpc-notification	0.03	0.03	1.25	1.23
scpc-audit	0.02	0.005	0.59	0.58
scpc-subscription	0.04	0.03	0.53	0.5
scpc-configuration	0.02	0.012	0.63	0.62
scp-cache	0.06	0.018	0.51	0.5
scp-load-manager	0.03	0.01	0.68	0.67

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	0.125%
Memory usage of data nodes	4.72%
Read operations per second	4.92
Write operations per second	0.001
Transaction rates on data nodes	1.92

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 150K MPS across 22 regions with rate limit enabled on a non ASM setup.

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 3-16 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hours
SCP Version Tag	24.2.0
Cluster	Test Bed 4 - CNE on BareMetal. For more information, see Table 2-6.
Topology	Topology 1. For information about topology, see Test Topology 1 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)	150K MPS
Network deployment diagram	Topology 1. For information about topology, see Test Topology 1 for SCP Model C Benchmarking.
Mode of Network deployment (Model-C or Model-D)	Model C
Number of NFs deployed in the network which SCP is supposed to learn (number of NF Profiles)	500
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

Table 3-17 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	300 milliseconds
Number of SCP ingress IPs configured	1
How many connections per published IP/FQDN producers can handle?	406
Per Egress connection max traffic in MPS	1000
How many connections consumer can initiate toward per SCP IP?	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: 44 • Number of NRF NFSets: 22
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	NA
NF Discovery response size and Info	NA
Egress and Ingress Rate Limit Configurations	• Number of Global Egress Rate limit configuration (number of unique keys): 0 • Number of Local Egress Rate limit configuration (number of unique keys): 500 • Number of Ingress Rate limit configuration (number of unique keys): 500
Mediation Configurations	NA
Mediation Trigger point configuration	NA
Secured HTTPs connection - % of message on HTTPs?	NA
DNS SRV configuration and response time	• Number of DNS SRV configuration: 500 SRV records • DNS query response time: 5ms
Roaming traffic details	NA

Table 3-17 (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: 13 – NRF Proxy: 0 – NRF OAuth: 0 – Cache: 3 – Mediation: 0 – Load-Manager: 3
SCP Worker Pod Profile	12 vCPU and 16 Gi Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 500
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled. • Frequency of OCI header received with changed values: 15 seconds. • Number of NF/NFService Instances reporting OCI: 70.

Result and Observation

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

Table 3-18 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	150K MPS
Average MPS per scp-worker pod	11.5K MPS
Success rate	100 %
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	
	Max	Avg	Max	Avg
scp-worker	7.85	6.86	5.63 GB	5.52 GB
scp-nrfproxy	NA	NA	NA	NA
scpc-notification	0.255	0.238	1.63 GB	1.63 GB
scpc-audit	0.0141	0.00778	855 MB	853 MB
scpc-configuration	0.0494	0.0117	623 MB	618 MB
scpc-subscription	0.0127	0.00828	909 MB	894 MB
scp-cache	0.257	0.209	1.05 GB	1.05 GB
scp-load-manager	0.0458	0.0363	668 MB	667 MB

Observed Values of cnDBTier Services

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

Table 3-20 Observed Values of cnDBTier Services

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

3.4.4 Model C - Testcase Scenario 3

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

Objective

This 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. In this scenario, ASM is enabled.

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	25.1.200
Cluster	Test Bed 4 - CNE on Bare Metal. For more information, see Table 2-6.
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)	730K 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)	700
NF Status Information	Type of Notifications (Notification call model): • Priority, Capacity: 70% • Suspend: 10% • Deregistration: 5% • API Version changes: 3% • Update of IpEndPoint: 2% • SUPI range updates: 2% • Service Instance changes: 0% • Other types (upto Oracle to consider): 8%
NF Profile - Priority, Capacity, and Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	200 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	300 milliseconds
Number of SCP ingress IPs configured	1
How many connections per published IP/FQDN producers can handle?	1514
Per Egress connection max traffic in MPS	1000
How many connections consumer can initiate toward per SCP IP?	680
Per Ingress connection max traffic in MPS	1500
Average Request and Response message size	• Average HTTP Request Packet Size: 4000 Bytes • Average HTTP Response Packet Size: 4500 Bytes
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	3%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 3 • Number of NRFs: 2
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	NA
NF Discovery response size and Info	NA

Table 3-22 (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): 700 • Number of Local Egress Rate limit configuration (number of unique keys): 0 • Number of Ingress Rate limit configuration (number of unique keys): 700
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: 700 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 OAuth: 0 – Cache: 3 – Load-Manager: 3
SCP Worker Pod Profile	12vCPU and 24Gi Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 700
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • Frequency of OCI headers received with changed values is set to 15 seconds • Number of NF/NFService instances reporting OCI is 20

Result and Observation

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

Table 3-23 Result and Observation

Parameter	Values
Test Duration	12 Hours
MPS Achieved	730K MPS
Average MPS per scp-worker pod	18.2K MPS
Mediation pod average MPS	NA
Success rate	100 %
Average SCP processing time (Request and Response)	Less than 25 milliseconds for both Request and Response processing

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 3-24 SCP Microservices and their Utilization

SCP Microservices	CPU/Pod		Memory/Pod		Sidecar CPU		Sidecar Memory	
	Max	Avg	Max	Avg	Max	Avg	Max	Avg
scpc-subscription	0.04	0.02	665 MB	656 MB	0.04	0.01	525 MB	504 MB
scpc-notification	1.1	0.8	2.78 GB	2.76 GB	0.3	0.2	550 MB	531 MB
scpc-audit	0.1	0.01	642 MB	611 MB	0.04	0.01	516 MB	497 MB
scpc-configuration	0.02	0.01	769 MB	769 MB	0.05	0.03	534 MB	515 MB
scp-cache	0.2	0.2	807 MB	785 MB	0.04	0.01	537 MB	516 MB
scp-worker	7.9	7.3	8.28 GB	6.96 GB	6.9	6.7	628 MB	605 MB
scp-loadmanager	0.08	0.06	4.96 GB	4.55 GB	0.03	0.01	540 MB	519 MB
scp-nrfproxy	NA	NA	NA	NA	NA	NA	NA	NA
scp-mediation	NA	NA	NA	NA	NA	NA	NA	NA
scp-alternate-resolution	0.08	0.07	521 MB	520 MB	0.03	0.01	520 MB	502 MB

Observed Values of cnDBTier Services

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

Table 3-25 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	2.9%
CPU usage of data nodes	0.4%
Write operations per second	12.3
Read operations per second	421
Transaction rates on data nodes	25.3

4
Benchmarking SCP Model D

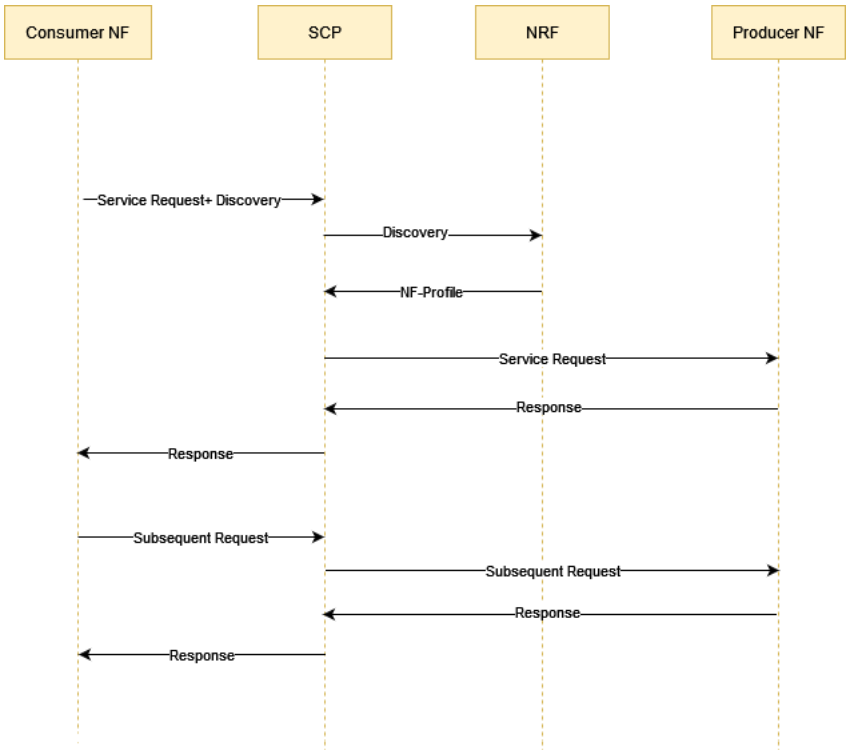
This section describes Model D test topologies and test scenarios for benchmarking SCP.

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	

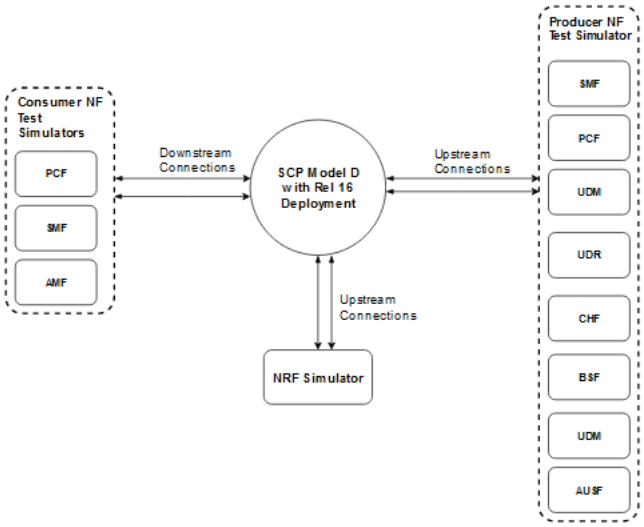
4.2 Test Topology 1 for SCP Model D Benchmarking

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

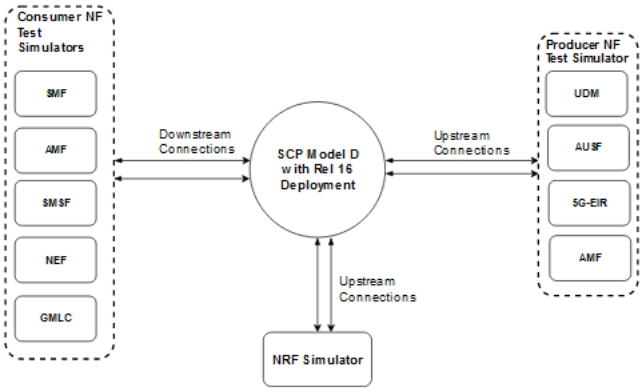
- Addition of SUPI range to NF
- Addition of GPSI range to NF
- Removed service instances from the NF profile
- Added service instances to the NF profile

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 using N11, N7, N10, N36, N28, and other interfaces:

Table 4-9 Topology 2 Traffic Distribution

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

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

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

Table 4-10 Number of NF

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

Topology 2 Routing Configuration

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

Table 4-11 Routing Configuration

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

Table 4-11 (Cont.) Routing Configuration

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

Topology 2 NF Profiles

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

Table 4-12 NF Profiles

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

Table 4-12 (Cont.) NF Profiles

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

Table 4-12 (Cont.) NF Profiles

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

Table 4-12 (Cont.) NF Profiles

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

4.4 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 4-13 Benchmark Testcase Summary

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

Table 4-13 (Cont.) Benchmark Testcase Summary

Benchmark Testcase Number	Description
Model D - Testcase Scenario 4	The Model D test is based on the network latency of 150 milliseconds at the rate of 400K MPS with the features enabled in the TLS enabled vCNE setup.

4.4.2 Model D - Testcase Scenario 1

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 4-14 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 4-15 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 4-15 (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 4-15 (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 • Data plane pods: – Worker: 50 – NRF Proxy: 21 – NRF OAuth: 4 – Cache: 3 – Mediation: 1
SCP Worker Pod Profile	8 vCPU and 12 Gi Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	NA
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	40K MPS
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 4-16 Result and Observation

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

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-17 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 4-18 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
Transaction rates on data nodes	2.50

4.4.3 Model D - Testcase Scenario 2

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

Objective

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

- Mediation Trigger point configuration
- Model D Cache enabled

The following table describes test bed configurations:

Table 4-19 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	72 Hours
SCP Version Tag	25.1.200
Cluster	Test Bed 4 - CNE on BareMetal. For more information, see Cluster Details
Topology	Topology 1. For information about topology, see Test Topology 1 for SCP Model D Benchmarking

Testcase Parameters

The following table describes the testcase parameters and their values:

Table 4-20 Testcase Parameters

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

Table 4-20 (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 Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	300 milliseconds
Number of SCP ingress IPs configured	2

Table 4-20 (Cont.) Testcase Parameters

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

Table 4-20 (Cont.) Testcase Parameters

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

Result and Observation

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

Table 4-21 Result and Observation

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

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-22 SCP Microservices and their Utilization

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

Observed Values of cnDBTier Services

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

Table 4-23 Observed Values of cnDBTier Services

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

4.4.4 Model D - Testcase Scenario 3

The Model D test is based on the network latency of 50 milliseconds at the rate of 400K MPS with the features enabled in the TLS enabled BareMetal CNE setup.

Objective

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

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

The following table describes test bed configurations:

Table 4-24 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	72 Hours
SCP Version Tag	25.1.200
Cluster	Test Bed 4 - 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 4-25 Testcase Parameters

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

Table 4-25 (Cont.) Testcase Parameters

Input Parameter Details	Configuration Values
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	300 milliseconds
Number of SCP ingress IPs configured	2
How many connections per published IP/FQDN producers can handle?	485
Per Egress connection max traffic in MPS	1000
Per Ingress connection max traffic in MPS	1000
Average Request and Response message size	• Average HTTP Request Packet Size: 4500 Bytes • Average HTTP Response Packet Size: 5000 Bytes
How many consumers can initiate towards per SCP IP?	640
Percentage of alternate routed requests to NF due to any reason (2% to 5%)	2%
Configured audit interval and audit mode	• Configured Audit Interval: 300 seconds • Configured Audit Mode: nnrf-mgmt
Number of NRFs and NRF Sets deployed in the network	• Number of NRFs in an NFSet: 2 • Number of NRF NFSets: 3
Response time (latency) from NRF (NRF processing time)	150 milliseconds
Delegated Discovery Traffic Information	• Model D Cache: Enabled • enforceReqSpecificSvcDiscovery: Disabled • Delegated discovery traffic rate (% of delegated discovery request per interface wise): 20% • Provide the list of discovery parameters for every 3GPP interface • ValidityPeriod value in discovery response (cache TTL): – 4 seconds (10% of Delegated Discovery traffic) – 10 seconds (10% of Delegated Discovery traffic)
NF Discovery response size and Info	Largest number of NF services in each NF profile in discovery response: 4
Egress and Ingress Configurations	NA
Mediation Configurations	• Traffic rate at mediation service (% of traffic requiring mediation): 12% • Number of rules configured at mediation: 630 • Number of groups: 50 • Number of rules within a group: 12 • Distribution among message mediation actions in mediation rules configuration – % (number) Header manipulation 70% – % (number) JSON IE manipulation 30%
Mediation Trigger point configuration	Number of Mediation Trigger Points: 367
Secured HTTPs connection - % of message on HTTPs?	100
DNS SRV configuration and response time	NA
Roaming traffic details	NA

Table 4-25 (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: 55 – NRF Proxy: 15 – NRF OAuth: 0 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • Frequency of OCI header received with changed values: 15 seconds • Number of NF/NFService Instances reporting OCI: 70

Result and Observation

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

Table 4-26 Result and Observation

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

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-27 SCP Microservices and their Utilization

SCP Microservices	CPU		Memory	
	Max	Avg	Max	Avg
scp-worker	7.796	7.619	7.24 GB	7.24 GB
scpc-notification	1.268	1.193	1.68 GB	1.67 GB
scpc-audit	0.013	0.009	576 MB	576 MB
scpc-configuration	0.02	0.017	757 MB	757 MB
scpc-subscription	0.027	0.02	508 MB	508 MB
scp-cache	0.016	0.014	571 MB	570 MB
scp-nrfpproxy	2.351	2.239	4.33 GB	4.33 GB
scp-mediation	5.832	5.657	1.83 GB	1.78 GB
scp-loadmanager	0.133	0.12	523 MB	522 MB
scp-alternate-resolution	0.009	0.008	500 MB	499 MB

Observed Values of cnDBTier Services

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

Table 4-28 Observed Values of cnDBTier Services

cnDBTier Services	Value
Memory usage of data nodes	4.9%
CPU usage of data nodes	0.8%
Write operations per second	14.1
Read operations per second	560
Transaction rates on data nodes	31.6

4.4.5 Model D - Testcase Scenario 4

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

Objective

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

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

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

The following table describes test bed configurations:

Table 4-29 Input Parameter Details

Input Parameter Details	Configuration Values
Duration of Test	12 Hrs
SCP Version Tag	25.1.200
Cluster	Test Bed 5 - 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 4-30 Testcase Parameters

Input Parameter Details	Configuration Values
Maximum SCP system wide traffic rate (in MPS)	400K MPS
Network deployment diagram	Topology 2. For information about topology, see Test Topology 2 for SCP Model D Benchmarking
Mode of Network deployment (Model-C or Model-D)	Model D

Table 4-30 (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 Profiles**: 480 • **NF Services per NF instance**: – UDM profile has 4 service types such as nudm-uecm, nudm-sdm, nudm-ee, and nudm-ueau, each service type has one instance. 1 UDM profile has 4 service instances. – AUSF profile has 1 service types such as nausf-auth, each service type has two instances. 1 AUSF profile has 1 service instance. – PCF profile has 5 services type (npcf-bdtpolicycontrol, npcf-policyauthorization, npcf-ue-policy-control, npcf-am-policy-control, npcf-smpolicycontrol), each service type has one instance. 1 PCF profile has 5 service instances. – BSF profile has 1 services type (nbsf-management), each service type has one instance. 1 BSF profile has 1 service instance. – CHF profile has 2 service types (nchf-spendinglimitcontrol,nchf-convergedcharging), each service type has one instance. 1 CHF profile has 2 service instances. – SMF profile has 2 service types (nsmf-pdusession,nsmf-event-exposure), each service type has one instances.1 SMF profile has 2 service instances. – SLF profile has 1 services type (nudr-group-id-map), each service type has one instance. 1 SLF profile has 1 service instance. – AMF profile has 2 services type (namf-comm, namf-loc), each service type has one instances. 1 AMF profile has 2 service instances. – UDR profile has 1 services type (nudr-dr), each service type has one instance. 1 UDR profile has 1 service instance. • **IP/FQDN per service**: Each service instance has a single unique IPendpoint within a service type, which is repeated across multiple service types within an NF profile.
NF Status Information	• Add or Modify or Delete 10 notifications every 15 minutes • Profile notification updates were run every 15 minutes along with traffic run • Notifications could come with the following updates: – The priority of NF services has changed. – The capacity of the NF services has changed. – The priority and capacity of NF services have changed. – The load of NF has changed. – Service instances are removed from the profiles.
NF Profile - Priority, Capacity, Load value same in all services of same kind? (Yes, No)	No
LAN latency in intra-SCP services and 5G NF communication (between SCP data and control plane services, SCP and other NFs) in millisecond	150 milliseconds
WAN latency in SCP services and 5G NF communication (SCP to NFs in other regions) in millisecond	300 milliseconds
Number of SCP ingress IPs configured	1

Table 4-30 (Cont.) Testcase Parameters

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

Table 4-30 (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: 55 – NRF Proxy: 15 – NRF OAuth: 0 – Cache: 3 – Mediation: 2 – Load-manager: 3
SCP Worker Pod Profile	12 vCPU and 24 GB Memory
Oracle Communications Network Analytics Data Director Configurations	NA
LCI Configurations	• SCP LCI Conveyance: Enabled • Frequency of LCI header received with changed values: 5 seconds • Configured minimum peer LCI change: 5 • Number of NF/NFService Instances reporting LCI: 480
Processing latency(processing time) per producer NF	Upstream Network Latency: 150 milliseconds
Number of entries expected in CCA certificate	NA
OAuth Traffic Rate	NA
OCI Configurations	• SCP OCI Conveyance is enabled • Frequency of OCI header received with changed values: 15 seconds • Number of NF/NFService Instances reporting OCI: 70

Result and Observation

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

Table 4-31 Result and Observation

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

SCP Microservices and their Utilization

The following table describes SCP microservices and their utilization:

Table 4-32 SCP Microservices and their Utilization

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

Observed Values of cnDBTier Services

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

Table 4-33 Observed Values of cnDBTier Services

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