Oracle® Communications

Cloud Native Core, Network Slice Selection Function User Guide

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Oracle Communications Cloud Native Core, Network Slice Selection Function User Guide, Release 23.4.0

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Contents

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What's New in This Guide

This section lists the documentation updates for Release 23.4.x in Oracle Communications Cloud Native Core, Network Slice Selection Function User Guide.

Release 23.4.0- F86968-01, December 2023

- Updated release number to 23.4.0 throughout the document.
- Updated the following parameter details for Initial Registration in Network Slice Selection Service and NSSF Architecture sections:
  - The Requested NSSAI, previously marked as a mandatory parameter, is now marked as an optional parameter.
- Added the following new features in NSSF Supported Features chapter:
  - LCI and OCI Headers
  - Server Header in NSSF
- Updated Support for User-Agent Header feature to:
  - Correct the User-Agent Header syntax and examples. Updated syntax from `<NF Type>-<Instance-Id>-<FQDN>` to `<NF Type>-<Instance-Id> <FQDN>` by removing the incorrect hyphen (-) symbol between `<Instance-Id>` and `<FQDN>`.
  - Add a note that the onus is on operator to configure values correctly as defined in the syntax.
- Updated DNS SRV Based Selection of SCP in NSSF feature to make the following changes:
  - Removed `global.alternateRouteServiceEnable`, `scpRerouteEnabled`, and `configureDefaultRoute` parameters as it is no longer present in `ocnssf_custom_values_23.4.0.yaml` file.
  - Updated the procedure to enable and configure the feature as it now enabled by default when NSSF is installed.

Acronyms

The following table provides information about the acronyms used in the document:

Table Acronyms and Terminologies

Field	Description
3GPP	3rd Generation Partnership Project
5GC	5G Core Network
5GS	5G System
Allowed NSSAI	NSSAI provided by the serving PLMN during a registration procedure, indicating the S-NSSAIs values the UE could use in the serving PLMN for the current registration area.
AMF	Access and Mobility Management Function
API	Application Programming Interface
ASM	Aspen Service Mesh
CNC	Cloud Native Core
Configured NSSAI	NSSAI provisioned in the UE applicable to one or more PLMNs.
DB	Database
DNN	Data Network Name
EANAN	Empty Authorized NSSAI Availability Notification
EGW	Egress Gateway
eMBB	enhanced Mobile Broadband
EPC	Evolved Packet Core. It is a framework for providing converged voice and data on a 4G Long-Term Evolution (LTE) network.
EPS	Evolved Packet System. It is a Mobility Management (EMM) protocol that provides procedures for the control of mobility when the User Equipment (UE) uses the Evolved UMTS Terrestrial Radio Access Network (E-UTRAN). EPS is a combination of E-UTRAN, EPC and UE.
FQDN	Fully Qualified Domain Name
GR	Georedundant
H-NSSF	Home NSSF
HPLMN	Home Public Land Mobile Network
HTTPS	Hypertext Transfer Protocol Secure
IE	Information Element
KPI	Key Performance Indicator
MIoT	Massive Internet of Things
NF	Network Function
NRF	Oracle Communications Cloud Native Core, Network Repository Function
NS	Network Slice. A logical network that provides specific network capabilities and network characteristics.
NSI	Network Slice Instance
NSI ID	Network Slice Instance Identifier
NSS	Network Switching Subsystem
NSSAI	Network Slice Selection Assistance Information

Table (Cont.) Acronyms and Terminologies

Field	Description
NSSF	Oracle Communications Cloud Native Core, Network Slice Selection Function
NWDAF	Network Data Analytics Function
ONSSAI	Optimized NSSAI Availability Data Encoding feature
PEI	Permanent Equipment Identifier
PLMN	Public Land Mobile Network
PDU	Protocol Data Unit
RAN	Radio Access Network
Requested NSSAI	NSSAI provided by the UE to the serving PLMN during registration.
Restricted S-NSSAI	This is an information element (IE) that contains restricted S-NSSAI(s) per PLMN for a Tracking Area(TA). If the restricted SNssai is not present, no restricted S-NSSAI is applicable to the TA. If present, this IE (restrictedSnssai) is included only by the NSSF.
SCP	Oracle Communications Cloud Native Core, Service Communication Proxy
SEPP	Oracle Communications Cloud Native Core, Security Edge Protection Proxy
SBA	Service Based Architecture
SBI	Service Based Interface
SSC	Session and Service Continuity
SST	Slice or Service type
SD	Slice Differentiator
SMF	Session Management Function
S-NSSAI	Single Network Slice Selection Assistance Information
SUMOD	Subscription Modification
Subscribed S-NSSAI	5G uses this as a default when the UE does not send a Requested NSSAI
SUPI	Subscription Permanent Identifier
TA	Tracking Area
TAC	Tracking Area Code
TAI	Tracking Area Identifier
UDM	Unified Data Management
UDR	Oracle Communications Cloud Native Core, Unified Data Repository
UE	User Equipment
URLLC	Ultra-Reliable Low Latency Communications
V-NSSF	Visited NSSF
VPLMN	Visited Public Land Mobile Network

1 Introduction

1.1 Overview

This section describes the role of Oracle Communications Network Slice Selection Function (NSSF) in the 5G Service Based Architecture (SBA).

Network slices enable the users to select customized networks with different functionalities (such as mobility) and performance requirements (such as latency, availability and reliability). Network slices differ in features supported and network function optimizations. In such cases, network slices may have different S-NSSAIs with different slice and service types. The user can deploy instances of multiple network slices delivering the same features but for different groups of User Equipments (UEs). These instances deliver different committed services as they are dedicated to a customer, the network slices may have different S-NSSAIs with the same slice or service type but different slice differentiators. The NSSF fulfills the requirement for determining the individual network function pertaining to a slice.

> **Note**
>
> The performance and capacity of the NSSF system may vary based on the call model, Feature or Interface configuration, and underlying CNE and hardware environment.

NSSF is a functional element that supports the following functionalities:

- NSSF enables the Access and Mobility Management Function (AMF) to perform initial registration and Protocol Data Unit (PDU) session establishment.
- AMF can retrieve NRF, NSI ID, and target AMFs as part of UE initial registration and PDU establishment procedure.
- NSSF uses an NF Service Consumer (AMF) to update the S-NSSAI(s) that AMF supports and notifies of any changes in the status.
- NSSF selects the network slicing instance (NSI) and determines the authorized Network Slice Selection Assistance Information (NSSAIs) and AMF to serve the UE.
- NSSF interaction with NRF allows retrieving specific NF services to be used for registration request.

NSSF provides the following information when queried by the AMF:

- Allowed NSSAIs
- Configured NSSAIs
- Restricted NSSAIs
- Candidate AMF List (in case of registration)
- Network Slice instance ID (for PDU session establishment)
- Slice-level NRF information (for PDU Connectivity)

NSSF supports the above functions through the following NSSF services:

- **NSSelection service** (*Nnssf_NSSelection*): This service is used by an NF Service Consumer (AMF) to retrieve the information related to network slice. It enables network slice selection in the serving Home Public Land Mobile Network (HPLMN).
- **NSAvailability Service** (*Nnssf_NSAvailability*): This service stores and maintains list of supported S-NSSAIs per TA. It allows NF service Consumer (AMF) to update and subscribe the above data and get notifications for any addition or deletion of supported S-NSSAIs.

NSSF Availability

Oracle Communications Cloud Native Core, Network Slice Selection Function (NSSF) availability is dependent on many factors. NSSF applications are designed to achieve 99.999% availability, according to the applicable Telecommunications Industry Association TL9000 standards, with the following deployment requirements:

- Deploy on a Cloud Native Environment with at least 99.999% Availability.
- Deploy with n + k application redundancy, where k is greater than or equal to one.
- Maintain production software within n-3 software releases, where n is the current general availability release.
- Apply bug fixes, critical patches, and configuration recommendations provided by Oracle promptly.
- Maintain fault recovery procedures external to the applications for the reconstruction of lost or altered files, data, programs, or Cloud Native environment.
- Install, configure, operate, and maintain NSSF as per Oracle's applicable installation, operation, administration, and maintenance specifications.
- Maintain an active support contract and provide access to the deployed NSSF and your personnel to assist Oracle in addressing any outage.

NSSF availability is measured for each calendar year and is calculated as follows:

Table 1-1 Measuring NSSF Availability

Availability	Description
Planned Product Availability	(Product available time in each month) less (Excluded Time (defined below) in each month).
Actual Product Availability	(Planned Product Availability) less (any Unscheduled Outage).
Product Availability Level	(Actual Product Availability across all Production instances divided by Planned Product Availability across all Production instances) x 100.

> **Note**
>
> **Excluded Time means**:
>
> - Scheduled maintenance time.
> - Lack of power or backhaul connectivity, except to the extent that such lack of backhaul connectivity was caused directly by the CNC NF.
> - Hardware failure.
> - Issues arising out of configuration errors or omissions.
> - Failures caused by third-party equipment or software not provided by Oracle.
> - Occurrence of any event under Force Majeure.
> - Any time associated with failure to maintain the recommended architecture and redundancy model requirements above.

1.2 References

- *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, Network Slice Selection Function Network Impact Report*
- *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*
- *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, Automated Testing Suite Guide*
- *Oracle Communications Cloud Native Core, cnDBTier User Guide*
- *Oracle Communications Cloud Native Core, Data Collector User Guide*

2
NSSF Supported Services

This chapter includes information about the services supported by NSSF.

> **Note**
>
> The performance and capacity of the NSSF system may vary based on the call model, Feature or Interface configuration, and underlying CNE and hardware environment.

2.1 Network Slice Selection Service

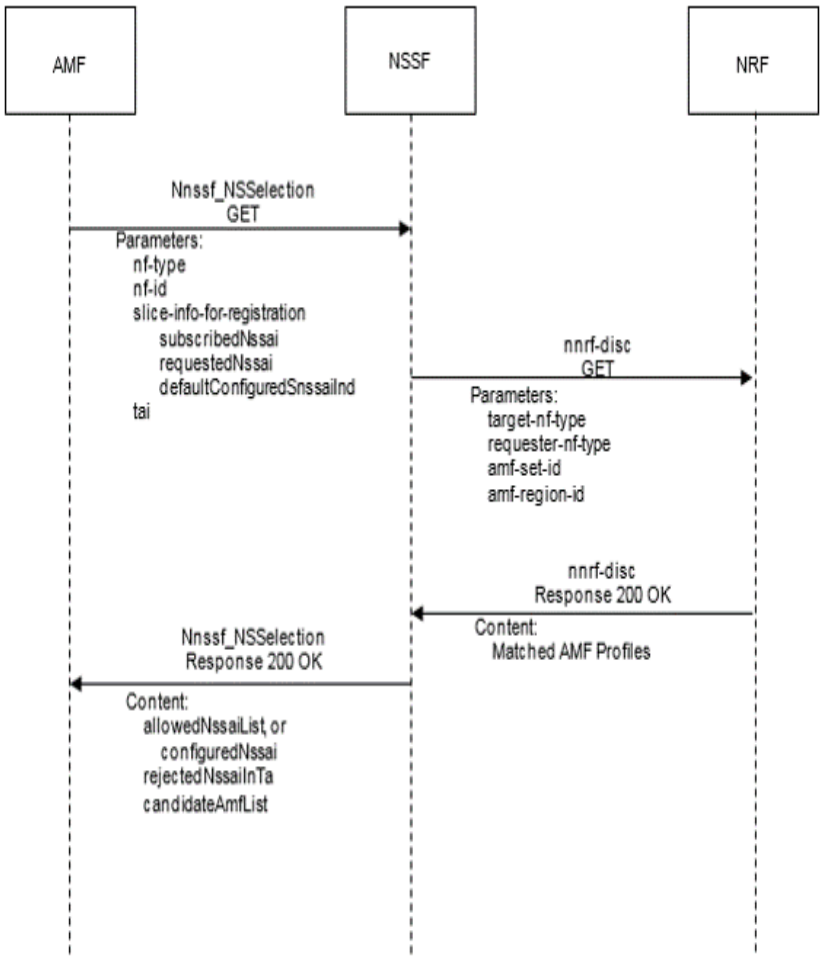
The Network Slice Selection service is identified by the service operation name, *Nnssf_NSSelection*. This service supports the GET request during the following procedures by UE:

Initial Registration:

When NSSF is able to find authorized network slice information for the requested network slice, the response includes a payload containing at least the Allowed NSSAI, target AMF Set, or the list of candidate AMF(s).

Following diagram illustrates the procedure of initial registration:

Figure 2-1 Initial Registration



- The AMF sends a GET request to the NSSF.

  The AMF GET request must include:

  – Subscribed S-NSSAIs (with an indication if marked as default S-NSSAI)

  – Any Allowed NSSAI

  The query parameters may also contain:

  – Requested NSSAI

  – Mapping of requested NSSAI to configured NSSAI for the HPLMN

  – Mapping to the Configured NSSAI for the HPLMN

  – PLMN ID of the Subscription Permanent Identifier (SUPI)

  – UE's current Tracking Area

  – NF type of the NF service consumer

  – AMF ID

- Based on the query parameters mentioned above, local configuration, and locally available information, including Radio Access Network (RAN) capabilities obtained by the current Tracking Area for the UE, NSSF does the following:

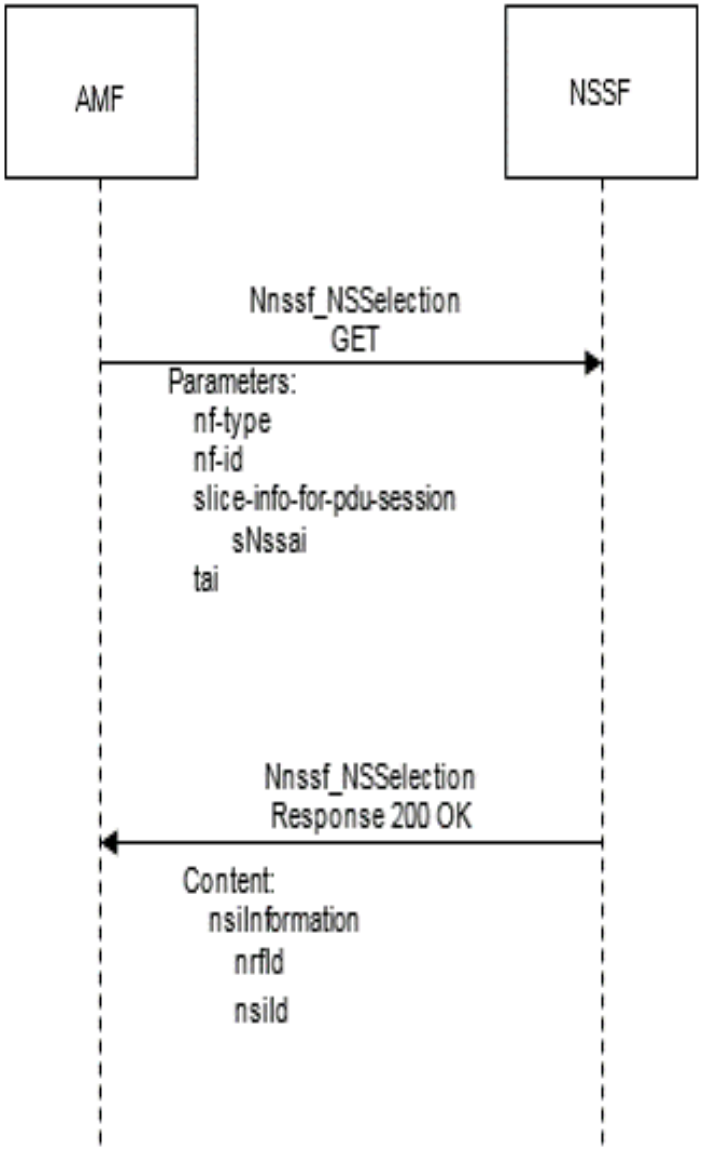
  - It selects the Network Slice instance(s) to serve the UE. When multiple Network Slice instances in the UE's Tracking Areas are able to serve a given S-NSSAI (based on operator's configuration), NSSF selects one slice to serve the UE, or defer the selection of the Network Slice instance until a NF or service within the Network Slice instance needs to be selected.
  - It determines the target AMF set to be used to serve the UE or based on configuration, the list of candidate AMF(s), possibly after querying the NRF.
  - It determines the Allowed NSSAI(s) for the applicable Access Type(s), taking also into account the availability of the Network Slice instances that are able to serve the S-NSSAI(s) in the Allowed NSSAI and the current UE's tracking areas.
  - Based on operator configuration, the NSSF determines the NRF(s) to be used to select NFs or services within the selected Network Slice instance(s).
- When the NSSF locates the authorized network slice information for the requested network, NSSF sends Discovery Request for AMF to NRF.
- The NRF responds with the list of all candidate AMFs to NSSF.
- The NSSF returns to the current AMF the Allowed NSSAI for the applicable Access Type(s), the target AMF Set, or the list of candidate AMF(s) based on configuration.
  - NSSF returns the NRF(s) to be used to select NFs/services within the selected Network Slice instance(s) and the NRF to be used to determine the list of candidate AMF(s) from the AMF Set.
  - NSSF returns NSI ID(s) to be associated to the Network Slice instance(s) corresponding to certain S-NSSAIs.
  - NSSF also returns the rejected S-NSSAI(s) and the Configured NSSAI for the Serving PLMN.

PDU Session Establishment:

When the NSSF receives a PDU-Session establishment request from the NF consumer, it determines the network slice that can serve the requested S-NSSAI based on the user configured policies, and responds with the URL of the NRF that manages the Slice and Slice ID of the matching Network slice computed.

The PDU session establishment in a Network Slice to a Data Network (DN) allows data transmission in a Network Slice. A PDU Session is associated with a S-NSSAI and a Data Network Name (DNN). Following diagram illustrates the procedure of PDU Session Establishment:

Figure 2-2 PDU Session Establishment



The following is performed for PDU Session Establishment:

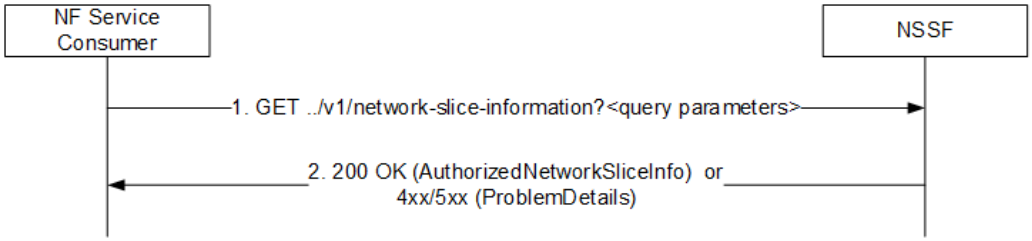
- If the AMF is not able to determine the appropriate NRF to query for the S-NSSAI provided by the UE, the AMF sends a GET request to the NSSF. The AMF queries the NSSF with this specific S-NSSAI, the NF type of the NF service consumer, Requester ID, PLMN ID of the SUPI, and the location information.
- The NSSF determines and returns the appropriate NRF to be used for selecting NFs or services within the selected Network Slice instance. The NSSF may also return an NSI ID identifying the Network Slice instance to use for this S-NSSAI.
  When a PDU Session for a given S-NSSAI is established using a specific Network Slice instance, the cloud native provides the RAN with S-NSSAI corresponding to this Network Slice instance, which enables the RAN to perform access specific functions.

UE-Config-Update:

When the UDM updates the Subscribed S-NSSAI(s) to the serving AMF, based on configuration in the AMF, the NSSF determines the mapping of the Configured NSSAI for the serving PLMN and Allowed NSSAI to the Subscribed S-NSSAI(s).

Following diagram illustrates the procedure of UE-Config-Update:

Figure 2-3 UE-Config-Update



The following is performed for UE-Config-Update:

- The AMF sends a UE-Config-Update (GET) request to NSSF. NSSF checks and validates the Subscribed S-NSSAI(s), Requested S-NSSAI(s), PLMN ID of the SUPI, TAI, NF type, and NF instance ID. If message is valid, NSSF searches for Allowed S-NSSAI list based on policy configuration and input parameters.
- NSSF responds with "200 OK with AuthorizedNetworkSliceInfo" if it finds a match.
- NSSF responds with "200 OK with empty AuthorizedNetworkSliceInfo" if a match is not found.
- NSSF responds with error code if it finds incorrect parameter validation.

2.2 NSSAI Availability Service

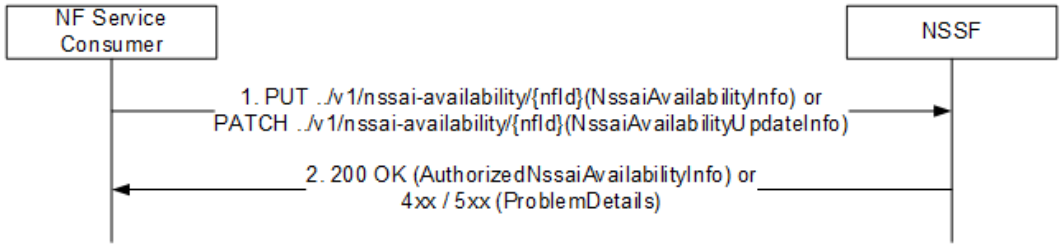
The NSSAI Availability service is identified by the service name, `Nnssf_NSSAIAvailability`. The following operations are defined for this service:

- Update Service Operation
- Subscribe Service Operation
- Unsubscribe Service Operation
- Notify Service Operation
- Delete Service Operation

1. **Update Service Operation**

   The AMF uses this operation to update the NSSF with the supported S-NSSAI(s) on a per TA basis and to get informed on the S-NSSAIs available per TA (unrestricted) and the restricted S-NSSAI(s) per PLMN in that TA in the serving PLMN of the UE.

Figure 2-4 Update the S-NSSAIs the AMF supports per TA



- The NF service consumer (For example: AMF) sends a PUT request to NSSF with NSSAI availability information, identified by `{nfId}`, with `NssaiAvalabilityInfo`. The message contains a list of S-NSSAIs supported by AMF on a per TA basis.
- Supports HTTP PATCH for NSAvailability Update.
- On receiving a PUT or PATCH message, NSSF stores/updates the list in the session database.
- The NSSF authorizes the list based on NSSAI Auth rules and responds with the list of allowed S-NSSAIs for that AMF on a per TAI basis as per the request.

2. **Subscribe Service Operation**

The Subscribe operation is used by NF Service Consumer (AMF) to get the notifications for any change in NSSAI availability information.

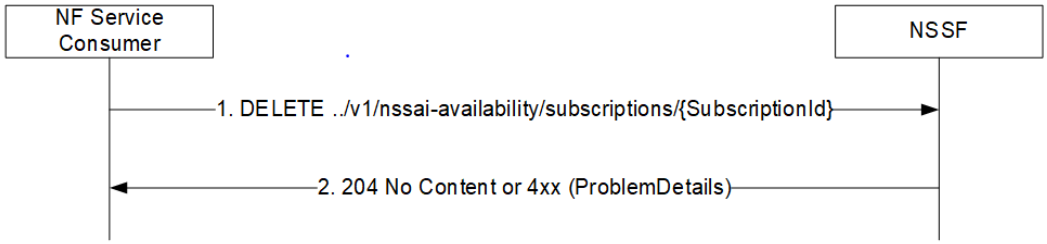
Figure 2-5 Subscription creation

- AMF sends a POST request to NSSF with notification URL and a list of TAIs as JSON body.
- NSSF stores the subscription request and responds with the list of allowed S-NSSAI(s) per TAI in the request. NSSF also returns a subscription-id and expiry (duration up to which NSSF sends notifications for any change in the status of Grant of S-NSSAI for subscribed TAI(s)).

3. **Unsubscribe Service Operation**

   The Unsubscribe service operation is used by AMF to unsubscribe to a notification of any previously subscribed changes to the NSSAI availability information.

Figure 2-6 Unsubscribe a Subscription

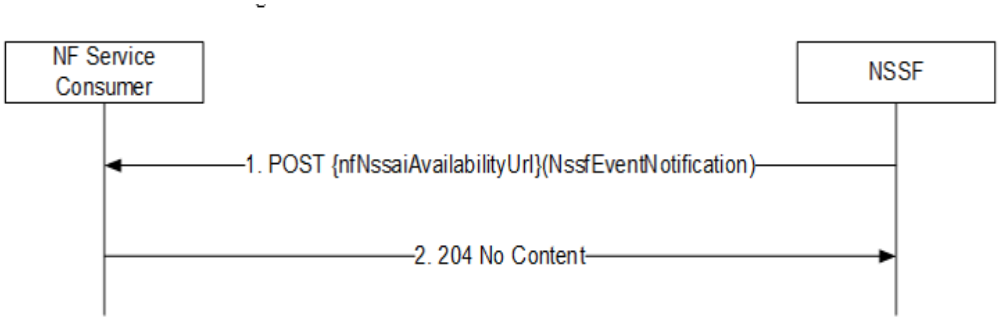


- AMF sends a Delete request to NSSF with subscription-id.
- NSSF checks for active subscription with the id and if found, deletes the subscription and responds with the message 204.

4. **Notify Service Operation**

   The Notify service operation is used by the NSSF to update the AMF with any change in status, on a per TA basis, of the S-NSSAIs available per TA (unrestricted) and the S-NSSAIs restricted per PLMN in that TA in the serving PLMN of the UE.

Figure 2-7 Update the AMF with any S-NSSAI restricted per TA

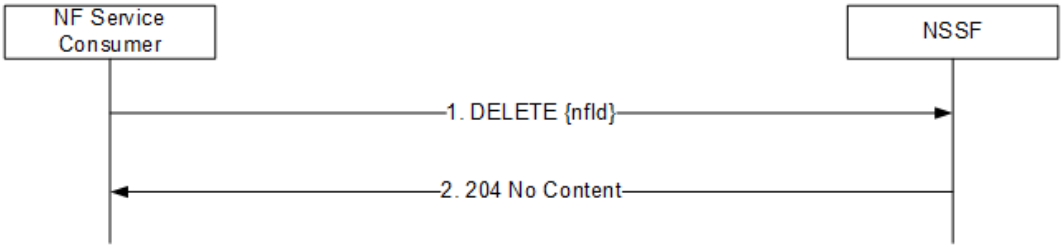


- NSSF sends notification to subscribed AMF when one or more following conditions are true:
  - There is change at Grant rules on S-NSSAI corresponding to one or more of TAIs subscribed by AMF.
  - An S-NSSAI has been added or deleted for one or more of TAIs subscribed by AMF.

5. **Delete Service Operation**

   The AMF uses this operation to delete the NSSAI Availability information stored for that AMF in the NSSF.

Figure 2-8 Delete the NSSAI Availability Information at NSSF

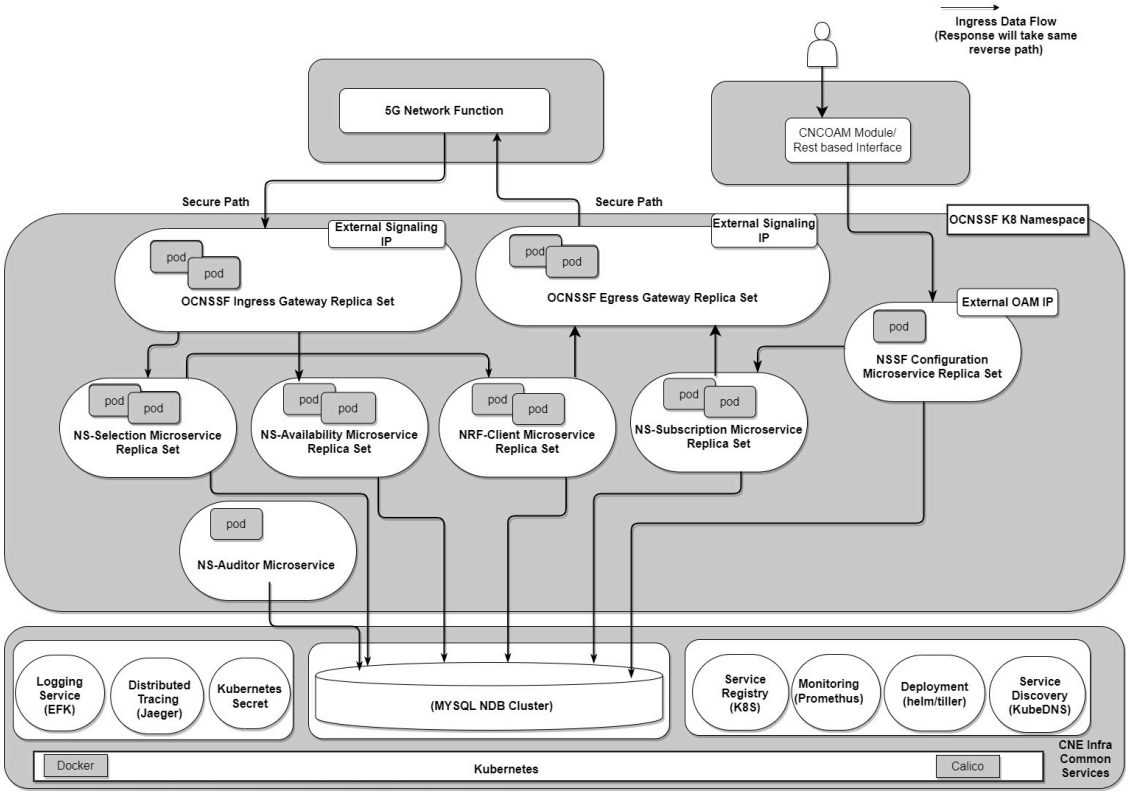


- The NF service consumer (For example: AMF) sends a DELETE request to NSSF with `nfId`.
- The NSSF searches in session database for the NSAvailability data corresponding to `nfId` and deletes them.

3
NSSF Architecture

NSSF comprises of various microservices deployed in Kubernetes based Cloud Native Environment (CNE), for example: Oracle Communications Cloud Native Core, Cloud Native Environment (CNE). CNE provides some common services like logs, metrics data collection, analysis, graphs, and charts visualization, etc. The microservices integrate with these common services and provide them with the necessary data.

The following diagram describes the overall architecture of the NSSF:



The architecture has the following components:

1. **NSSelection Service**
   The Network Slice Selection service is identified by the service operation name, Nnssf_NSSelection. This service supports the GET request during the following procedures by UE:

   a. **Initial Registration:**
      When the NSSF is able to find authorized network slice information for the requested network slice, the response body includes a payload body containing at least the Allowed NSSAI, target AMF Set, or the list of candidate AMF(s).

      - The AMF sends a GET request to the NSSF. The AMF GET request must include:
        - Subscribed S-NSSAIs (with an indication if marked as default S-NSSAI)
        - Any Allowed NSSAI
      - The query parameters may also contain:

- Requested NSSAI
- Mapping of requested NSSAI to configured NSSAI for the HPLMN
- Mapping to the Configured NSSAI for the HPLMN
- PLMN ID of the Subscription Permanent Identifier (SUPI)
- UE's current Tracking Area
- NF type of the NF service consumer
- AMF ID

- Based on the query parameters mentioned above, local configuration, and other locally available information including Radio Access Network (RAN) capabilities made available by the current Tracking Area for the UE, the NSSF does the following:
  - It selects the Network Slice instance(s) to serve the UE. When multiple Network Slice instances in the UE's Tracking Areas are able to serve a given S-NSSAI, based on operator's configuration, the NSSF may select one of them to serve the UE, or the NSSF may defer the selection of the Network Slice instance until a NF or service within the Network Slice instance needs to be selected.
  - It determines the target AMF set to be used to serve the UE or based on configuration, the list of candidate AMF(s), possibly after querying the NRF.
  - It determines the Allowed NSSAI(s) for the applicable Access Type(s), taking also into account the availability of the Network Slice instances that are able to serve the S-NSSAI(s) in the Allowed NSSAI in the current UE's tracking areas.
  - Based on operator configuration, the NSSF may determine the NRF(s) to be used to select NFs or services within the selected Network Slice instance(s).
- When the NSSF is able to find authorized network slice information for the requested network, NSSF sends Discovery Request for AMF to NRF.
- The NRF responds with list of candidate AMFs to NSSF.
- The NSSF returns to the current AMF the Allowed NSSAI for the applicable Access Type(s), the target AMF Set, or, based on configuration, the list of candidate AMF(s).
  - NSSF returns the NRF(s) to be used to select NFs/services within the selected Network Slice instance(s) and the NRF to be used to determine the list of candidate AMF(s) from the AMF Set.
  - NSSF returns NSI ID(s) to be associated to the Network Slice instance(s) corresponding to certain S-NSSAIs.
  - NSSF also returns the rejected S-NSSAI(s) and the Configured NSSAI for the Serving PLMN.

b. **PDU Session Establishment:**
When the NSSF receives PDU-Session establishment request from the NF consumer, NSSF determines the network slice which can serve the requested S-NSSAI, based on the user configured policies, and responds with the URL of NRF which manages to the Slice and/or Slice ID of the matching Network slice computed.

The PDU session establishment in a Network Slice to a Data Network (DN) allows data transmission in a Network Slice. A PDU Session is associated with a S-NSSAI and a Data Network Name (DNN).

The following is performed for PDU Session Establishment:

- If the AMF is not able to determine the appropriate NRF to query for the S-NSSAI provided by the UE, the AMF sends a GET request to the NSSF. The AMF queries the NSSF with this specific S-NSSAI, the NF type of the NF service consumer, Requester ID, PLMN ID of the SUPI, and the location information.
- The NSSF determines and returns the appropriate NRF to be used to select NFs or services within the selected Network Slice instance. The NSSF may also return an NSI ID identifying the Network Slice instance to use for this S-NSSAI.
  When a PDU Session for a given S-NSSAI is established using a specific Network Slice instance, the cloud native provides to the RAN the S-NSSAI corresponding to this Network Slice instance to enable the RAN to perform access specific functions.

c. **UE-Config-Update**:
   When the UDM updates the Subscribed S-NSSAI(s) to the serving AMF, based on configuration in this AMF, the NSSF determines the mapping of the Configured NSSAI for the serving PLMN and Allowed NSSAI to the Subscribed S-NSSAI(s).

   The following is performed for UE-Config-Update:

   - The AMF sends a UE-Config-Update (GET) request to NSSF. NSSF checks and validates the Subscribed S-NSSAI(s), Requested S-NSSAI(s), PLMN ID of the SUPI, TAI, NF type, and NF instance ID. If message is valid, NSSF searches for Allowed S-NSSAI list based on policy configuration and input parameters.
   - NSSF responds with 200 OK with AuthorizedNetworkSliceInfo in case NSSF finds a match.
   - NSSF responds with 200 OK with empty AuthorizedNetworkSliceInfo in case there is no match found.
   - NSSF responds with error code in case of incorrect parameter validation.

2. **NS Availability Service**
   This microservice supports NSAvailability service of NSSF as per 29.531. This microservice stores subscriptions and AMF data.

   The NSSAI Availability service is identified by the service name, Nnssf_NSSAIAvailability. For the Nnssf_NSSAIAvailability service the following service operations are defined:

   - Update Service Operation
   - Subscribe Service Operation
   - Unsubscribe Service Operation
   - Delete Service Operation

3. **NS Subscription Service**
   This micro-service sends notifications based on Subscribed Events through NSAvailability.

   Notifications are sent to Subscribed AMFs to signify changes in Authorization state with respect to S-NSSAIs on TAI as per 3GPP TS 29.531

   The Notify operation is used by the NSSF to update the AMF with any change in status, on a per TA basis, of the S-NSSAIs available per TA (unrestricted) and the S-NSSAIs restricted per PLMN in that TA in the serving PLMN of the UE.

   - NSSF sends notification to subscribed AMF when one or more following conditions are true:
     - There is change at Grant rules on S-NSSAI corresponding to one or more of TAIs subscribed by AMF.
     - An S-NSSAI has been added or deleted for one or more of TAIs subscribed by AMF.

4. **NS Auditor Service**
   This microservice is a timed auditor, which removes stale records from NSSF.

   What is a stale record?

   In georedundant scenarios, tables in State Database (stateDB) maintain a column siteId, which identifies owner site of that record. There could be georedundancy scenarios when similar records can be owned by two sites, where the older record is termed as the stale record.

   NS Auditor is used in georedundancy scenarios where subscription is owned by one site, but the Patch is received on other site. This leads to creation of two records for same subscription owned by each site. Ns-Auditor detects this and removes the old stale record to ensure subscription is owned at a singe site only.

   For example:

   - Site-1 receives Subscription POST.
   - Site-1 creates a record, rec-1, for subscription with owner as site-1.
   - If AMF gets disconnected with the site-1, site-1 goes down, or SCP makes a routing decision based on congestion, the subscription PATCH is received on site-2.
   - Site-2 creates a new record, rec-2, for subscription with new owner as site-2.
   - Now, rec-2 for site-2 is same as rec-1 for site1.
   - NS Auditor detects this and deletes rec-1.
   - Site-2 becomes the owner of the subscription, and receives the latest patch.

5. **NS Configuration Service**
   This microservice is responsible for configuring policy rules. It implements a REST messaging server that receives configuration HTTP messages, validates and stores the configuration in the database.

6. **NRF Client Service**
   This microservice registers with the NRF and sends periodic heartbeats, also maintains subscriptions with NRF for AMF sets.

   - NRF Registration and Heartbeat: Once NSSF is registered with NRF, NSSF contacts the NRF periodically. First the registration profile is configured using helm. Then the performance service calculates load and capacity of NF. NS registration requests the load and capacity from performance service and sends it to NRF with heartbeat.
   - NRF Subscription: NSSF subscribes to NRF for AMF based on the Target AMF Set and Region ID for registration and deregistration and load update.

7. **Ingress Gateway Service**
   This microservice is an entry point for accessing NSSF supported service operations and provides the functionality of an OAuth validator.

8. **Egress Gateway Service**
   This microservice is responsible to route NSSF initiated egress messages to other NFs.

> **Note**
>
> For more information on Ingress and Egress Gateway, see *Oracle Communications Cloud Native Core, Cloud Native Environment User Guide*.

4 NSSF Supported Features

This section explains about the NSSF supported features.

> **Note**
>
> The performance and capacity of the NSSF system may vary based on the call model, Feature or Interface configuration, and underlying CNE and hardware environment.

4.1 LCI and OCI Headers

Within the complex 5G architecture, network overload scenarios are common. The exchanges of data between producer and consumer Network Functions (NFs) often involve significant message and notification volumes, necessitating a precise approach to load balancing. This is imperative to prevent network failures triggered by overload conditions.

In such demanding scenarios, it becomes crucial for consumer NFs to be promptly informed when the producer NF approaches an overloaded state. This awareness enables consumer NFs to implement corrective actions proactively.

To address these challenges, the introduction of LCI and OCI Headers plays a pivotal role in optimizing communication between NSSF and its consumer NFs. They provide consumer NFs with real-time insights into the operational status of the NSSF resources, facilitating efficient traffic management.

These headers provide essential load and overload information for consumer NFs to optimize traffic distribution and take proactive measures during network overload scenarios.

The headers are integrated into outgoing responses, based on load levels at the Ingress Gateway. Serving as communication tools, they allow Network Functions (NFs) to share crucial load information, ensuring an architecture where 5G Core Network remains stable and high performing even during heavy load conditions.

LCI Header

The LCI header comprises overall load related information such as the timestamp of load data generation, the current load of the NF, and the scope of the load information. For example, there are two LCI headers:

- NF scope LCI header
- NF-service scope LCI header

Examples of LCI Headers

NF Scope LCI Header:

```
3gpp-sbi-lci: Timestamp: "Tue, 19 Sep 2023 13:47:41 UTC"; Load-Metric: 1%; NF-
Instance: 9faf1bbc-6e4a-4454-a507-aef01a101a01
```

Service Scope LCI Header:

```
3gpp-sbi-lci: Timestamp: "Mon, 25 Sep 2023 11:30:17 UTC"; Load-Metric: 0%; NF-Service-Instance: ae870316-384d-458a-bd45-025c9e748976
```

OCI Header

The OCI header communicates information about overload conditions. This information encompasses the timestamp at which the overload condition was detected, the type of overload condition (such as, resource exhaustion), and the recommended action to be taken. For example, reducing the number of requests.

Both the LCI and OCI headers are incorporated in HTTP response messages without triggering additional signaling, ensuring a more efficient communication process. Here is how they help:

- The LCI header conveys the overall load of an NF, assisting in decisions regarding the acceptance or rejection of new requests to prevent further overload.
- In contrast, the OCI header communicates specific overload conditions, helping NFs take informed actions to mitigate these conditions.
- The LCI and OCI headers complement each other, allowing an NF to reduce the number of requests it sends to other NFs in response to an OCI header, even if its overall load is not yet overloaded.
- This proactive measure prevents overload conditions from spreading.

Examples of OCI Headers

NF Scope OCI Header:

```
3gpp-Sbi-Oci:Timestamp: "Mon, 02 May 2022 07:43:48 UTC"; Period-of-Validity: 30s; Overload-Reduction-Metric: 5.0%; NF-Instance: 5a7bd676-ceeb-44bb-95e0-f6a55a328b03
```

Service Scope OCI Header:

```
3gpp-Sbi-Oci:Timestamp: "Mon, 02 May 2022 07:43:48 UTC"; Period-of-Validity: 30s; Overload-Reduction-Metric: 5.0%; NF-Service-Instance: 5a7bd676-ceeb-44bb-95e0-f6a55a328b03
```

Use Cases

- As of now, LCI and OCI Headers are supported at the Ingress Gateway only; not at the Egress Gateway.
- NSSF can utilize the LCI header to signal its load information to the AMF (Access and Mobility Management Function). This information allows the AMF to make informed decisions about directing new User Equipment (UE) connections to the NSSF.
- Conversely, the NSSF can employ the OCI header to notify the Radio Access Network (RAN) of overload conditions, enabling the RAN to reduce the number of UEs it routes to NSSF.

Managing LCI and OCI Headers

Enable:

You can enable LCI and OCI Headers by performing the following Helm configurations globally and at the Ingress Gateway:

- **Global Helm Configuration**

- **Enable**: You can enable LCI and OCI Headers globally at the Network Function (NF) level by setting the values of `nssfLciEnabled` and `nssfOciEnabled` parameters as `true`, respectively.

```
global:
#======================LCI/OCI header Global
Values==========================================
  #Enabling LCI
  nssfLciEnabled: &lcienable true
  #Enabling OCI
  nssfOciEnabled: &ocienable true
 #====================================================================
```

- **Ingress Gateway Helm Configuration**
  - **Enable**: You can enable LCI and OCI Headers globally at Ingress Gateway level by setting the `lciHeaderConfig.enabled` and `ociHeaderConfig.enabled` parameters as `true`, respectively.
  - **Configure**: You can configure LCI and OCI Headers at Ingress Gateway using the Helm based configuration:

```
## This is mandatory for LCI and OCI feature as this is required by
perf-info service to get the load information of the services from
prometheus
perf-info:
  configmapPerformance:
      prometheus: http://occne-prometheus-server.occne-infra


ingress-gateway:
 #To remove the Producer header from Ingress Response when LCI is
enabled
  globalRemoveResponseHeader:
  - name: *producer
  # ********  Sub-Section Start: LCI/OCI Ingress Gateway Parameters
************

#*********************************************************************
***

  # Engineering Parameter Start
  global:
    lciHeaderConfig:
      enabled: *lcienable
      # difference between previous threshold and current threshold for
lci header will be added when the difference crosse the mentioned value
      loadThreshold: 30
      # Validity period after which lci header will be added to reponse
header if delta of threshold is not breached
      localLciHeaderValidity: 60000 #(value in milliseconds)
      ## This header needs to be same which is being sent along with
request in microservice
      producerSvcIdHeader: *producer

    ociHeaderConfig:
      enabled: *ocienable
```

```
      ## This header needs to be same which is being sent along with
reuest  microservice
      producerSvcIdHeader: *producer
      validityPeriod: 10000 #(value in milliseconds)
      ## The range of the cpu load for which the ingress gateway will
get notified regarding the criticality of the load.
      overloadConfigRange: #Note - minor, major and critical conditions
should cover complete range of 0 to 100 both inclusive for it to be a
valid config
        minor: "[75-80]"
        major: "[81-90]"
        critical: "[91-100]"
      ## The range of the cpu load which needs to be decreased from the
consumer when a particular criticality has reached.
      reductionMetrics:
        minor: 5  #(Possible values 1 to 9 both inclusive)
        major: 15  #(Possible values 5 to 15 both inclusive)
        critical: 25 #(Possible values 10 to 50 both inclusive)

    nfInstanceId:  "9faf1bbc-6e4a-4454-a507-aef01a101a01"
      ## This is a mapping for service name to service instance id for
which service the LCI and OCI headers needs to be enabled. Default
values are given with 'ocnssf' as release name. It must be  configured
by operator in case release name is changed.
      ## only nsselection and nsavailability services should be
configured. As these are the two services for which  LCI/OCI headers is
supported.
      ## Format is <releaseName>-<serviceName> . Eg: if release name is
given 'ocnssf-test' then svc name should be 'ocnssf-test-nsselection'
and 'ocnssf-test-nsavailability'
    svcToSvcInstanceIdMapping:
      - svcName: ocnssf-nsselection
        serviceInstanceId: "ae870316-384d-458a-bd45-025c9e748976"
      - svcName: ocnssf-nsavailability
        serviceInstanceId: "ae870316-384d-458a-bd45-025c9e748996"

    perfInfoConfig:
      ## the interval when perf-info will fetch the cpu load from
prometheus
      pollingInterval: 5000 #(value in milliseconds)
      serviceName: "ocnssf-perf-info"
      port: 5905
      perfInfoRequestMap: "/load"
  # Engineering Parameter End

  # ********  Sub-Section End: LCI/OCI Ingress Gateway Parameters
************

  # ********  Sub-Section Start: DB credentials Ingress Gateway
Parameters ************

#*********************************************************************
***
  dbConfig:
    dbHost: *dbHost
    dbPort: *dbPort
```

```
    secretName: *privDbSecret
    dbName: *provDB
    # Name of the Key configured for "DB Username" in Secret with
following name: "<dbConfig.secretName>"
    dbUNameLiteral: mysql-username
    # Name of the Key configured for "DB Password" in Secret with
following name: "<dbConfig.secretName>"
    dbPwdLiteral: mysql-password
    # Default is NDBCLUSTER
    dbEngine: *dbEngine

  # ********  Sub-Section End: DB credentials Ingress Gateway
Parameters ************

#*********************************************************************
***
```

For more information about the Helm parameters, see "Customizing NSSF" section in *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation, Upgrade, and Fault Recovery Guide*.

Observe

Metrics

There are no new metrics for this feature.

KPIs

There are no new KPIs for this feature.

Alerts

There are no alerts generated for this feature.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.2 Server Header in NSSF

One of the core functionalities of the Network Slice Selection Function (NSSF) is to manage the security aspects of the 5G network. As part of this role, NSSF handles various requests from other network functions (NFs) and network entities over the HTTP protocol. On receiving these requests, NSSF validates and processes them before issuing responses to the requesting NFs or network entities.

In such scenarios, NFs and other network entities may encounter issues resulting in error responses. It becomes imperative for consumer NFs to pinpoint the source of the error, so they can undertake troubleshooting and corrective measures. The integration of this feature at NSSF helps to determine the originator of the error response.

This feature offers the support for Server Header in NSSF responses, which contain crucial information about the origin of an error response and the type of the error encountered. Thus, the Server Header enhances the behavior of NSSF while responding to requests, particularly the error responses.

> **Note**
>
> This feature is applicable in scenarios where NSSF generates error responses. It does not affect normal response behavior.

A Server Header starts with the value of NF Type, followed by a "-" and any other specific information, if needed, afterward. It is expected to be present in all NSSF responses in the following format:

`<NF Type>-<Instance-Id>`
Where,

- `<NF Type>` is the type of the NF.
- `<NF Instance-Id>` is the unique identifier of the NF instance generating the response.

For example, the following combinations are applicable to NSSF:

`NSSF-<NSSF's Instance-Id>`

Where,

- `NSSF` is the <NF Type>.
- `<NSSF's Instance-Id>` is the unique identifier of the NSSF instance generating the response.

Managing Server Header in NSSF

Enable:

By default, this feature is disabled. To enable it, REST API needs to be invoked and the `enabled` flag needs to be updated to `true` in the following URI:

/{nfType}/nf-common-component/v1/{serviceName}/serverheaderdetails

Example

Example of Request or Response Body to Enable Server Header:

```
{
  "enabled": true,
  "errorCodeSeriesId": "E1",
  "configuration": {
    "nfType": "NSSF",
    "nfInstanceId": "9faf1bbc-6e4a-4454-a507-aef01a101a01"
  }
}
```

Example of Request or Response Body to Disable Server Header:

```
{
  "enabled": false,
```

```
  "errorCodeSeriesId": "E1",
  "configuration": {
    "nfType": "NSSF",
    "nfInstanceId": "9faf1bbc-6e4a-4454-a507-aef01a101a01"
  }
}
```

> **Note**
>
> - `enabled` is used to enable or disable the feature.
> - `nfType` and `nfInstanceId` are used to form Server Header.
> - In the mentioned configuration, when sending a response to AMF, the Server Header will be appended by the NSSF with the value "`NSSF-9faf1bbc-6e4a-4454-a507-aef01a101a01`"
> - The values in the above example are samples. Ensure that you update the values of the following parameters according to your deployment:
>   - `nfType` must be NSSF.
>   - `errorCodeSeriesId`: A valid configured value.
>   - `nfInstanceId`: NSSF's valid instance value. It must be same as NSSF's instance ID.

Configure

Perform the REST API configurations in the following sequence to configure this feature:

1. Configure **serverheaderdetails** to enable the feature.
2. Configure **routesconfiguration** to map route ID and its corresponding route-level configuration.
3. Configure **errorcodeserieslist** to update the **errorcodeserieslist** that are used to list the configurable exception or error for an error scenario in Ingress Gateway.

For more details about REST APIs, see "REST API Configurations for Server Header Feature" in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

Observe

Metrics

There are no new metrics for this feature.

KPIs

There are no new KPIs for this feature.

Alerts

There are no alerts generated for this feature.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.3 Support for User-Agent Header

In 5G networks, producer Network Functions (NFs) cannot identify or validate a consumer on their own. To overcome this, 3GPP has introduced User-Agent headers, which are added to consumer service requests. This field is included in the HTTP (Hypertext Transfer Protocol) request that a consumer sends to the producer to identify itself and provide information about the NF making the request.

This feature enables the usage of the User-Agent Header in NSSF.

NSSF support the following inter-NF communication and service request functionalities:

- NSSF sends notifications to AMF.
- NSSF sends registration and heartbeat request to NRF.

This enhancement enables NSSF to include the User-Agent Header in every HTTP/2 request that it sends over any Service Based Interface (SBI) to a producer NF (for example, AMF and NRF). The User-Agent Header in NSSF's HTTP/2 requests helps a producer NF to identify NF type of client that has sent a request. Here, it helps:

- AMF in identifying the NSSF that sent the notification.
- NRF in identifying the NSSF that sent the subscription, registration, or heartbeat request to NRF.

Structure of an User-Agent Header

An User-Agent Header starts with the value of NF type, followed by a "-" and any other specific information, if needed afterwards. It is expected to be present in all the service requests and notification in the following formats:

- <NF Type>
- <NF Type>-<Instance-Id>
- <NF Type>-<Instance-Id> <FQDN>

Where,

- <NF Type> is the type of the NF.
- <Instance-Id> is the instance ID of the NF.
- <FQDN> is the FQDN of the NF.

For example: The following combinations are applicable to NSSF:

NSSF

NSSF-<NSSF's Instance-Id>

NSSF-<NSSF's Instance-Id> <NSSF's FQDN>

When the User-Agent Header is not included in the incoming requests sent to AMF or NRF, the corresponding metric cannot gather information about the origin of the service request. Nevertheless, the request is still processed successfully without any problems, but the AMF or NRF are not able to identify the NSSF from which the request has originated.

> **Note**
>
> The onus is on operator to configure the values correctly as defined in the syntax explained above.

Managing the Support for User-Agent Header

Enable:

1. Use the following API path:
   /{nfType}/nf-common-component/v1/{serviceName}/useragentheader
2. Set enabled as `true`.
3. Run the API using PUT method with the proposed values given in the Rest API. For more information about API path, see "Configurations to Enable or Disable User-Agent Header" section of "Egress Gateway REST APIs" in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.
   Given below is a sample REST API configuration to enable this feature:

```
{
   "enabled": true,
   "nfType": "NSSF",
   "nfInstanceId": "9faf1bbc-6e4a-4454-a507-aef01a101a01",
"nfFqdn": "nssf.oracle.com",
"addFqdnToHeader": true,
 "overwriteHeader": true
}
```

> **Note**
>
> - In the mentioned configuration, when sending notifications to AMF, the User-Agent Header will be appended by the NSSF with the value `NSSF-9faf1bbc-6e4a-4454-a507-aef01a101a01 nssf.oracle.com`.
> - The `nfInstanceId` and `nfFqdn` values in the above example are samples. Ensure that you update the values of the `nfInstanceId` and `nfFqdn` parameters accordingly.

Observe

Metrics

The following metric is used to provide information about this feature:

- `oc_egressgateway_user_agent_consumer_total`: This metric is applicable whenever the feature is enabled and User-Agent Header is getting generated.

For information about the metrics, see Egress Gateway Metrics.

Alerts

There are no alerts generated for this feature.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.4 Ingress Gateway Pod Protection

This feature protects the Ingress Gateway pods from overloading due to uneven traffic distribution, traffic bursts, or congestion. During overload conditions, the Ingress Gateway pods may undergo stability issues. As a front end microservice for HTTP traffic, it is important for Ingress Gateway to have pod protection implemented.

The pod protection is performed based on the CPU consumption of the Ingress Gateway Pods as explained in the Congestion State Parameters. It is measured at different load states mentioned in the Ingress Gateway Load States.

Congestion State Parameters

In the Pod Protection feature, each Ingress Gateway microservice pod monitors its congestion state. This state is tracked in terms of CPU consumption, measured in nanoseconds, using Kubernetes cgroup (cpuacct.usage).

It is periodically monitored and calculated using the following formula. Then, it is compared against the CPU thresholds configured through the Rest API to determine the congestion state. For more information about the parameters, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

$$\frac{\frac{\text{CurrentCpuUsage - LastCpuUsage}}{\text{CurrentTime - LastSampleTime}} \times 100}{\text{CPUs}}$$

Where,

CurrentCpuUsage is the counter reading at current periodic cycle.

LastCpuUsage is the counter reading at previous periodic cycle.

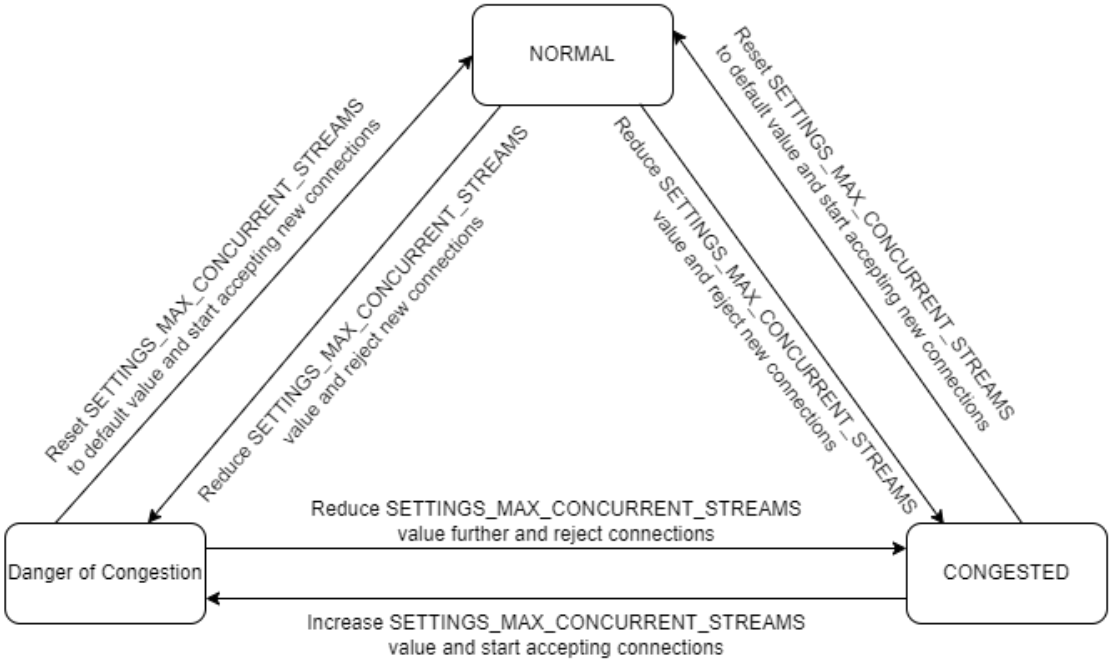
CurrentTime is the current time snapshot.

LastSampletime is the previous periodic cycle time snapshot.

CPUs is the total number of CPUs for a given pod.

Ingress Gateway Load States

The following states are used to detect overload conditions. This ensures the protection and mitigation of pods from entering an overload condition, while also facilitating necessary actions for recovery.



> **Note**
>
> The transition can occur between any states based on the congestion parameters. The threshold for these congestion parameters is preconfigured and must not be changed.

- **Congested State**: This is the upper bound state where the pod is congested. This means one or more congestion parameters are above the configured thresholds for the congested state. For more information about the configuration using REST API, see Oracle Communications Cloud Native Core, Network Repository Function REST Specification Guide. The pod can be transitioned to the Congested State either from the Normal State or the DoC state. When the pod reaches this state, the following actions are performed:
  - new incoming HTTP2 connection requests are not accepted.
  - the pod gradually decrements the number of concurrent streams by updating SETTINGS_MAX_CONCURRENT_STREAMS parameter in a SETTINGS frame to the configured `maxConcurrentStreamsPerCon` value at a regular interval. The concurrent streams are decremented based on the value configured in `decrementBy` parameter. And, the regular interval is configured in the `decrementSamplingPeriod` parameter.
- **Danger of Congestion (DOC)**: This is the intermediate state where the pod is approaching a congested state. This means if CPU is above the configured thresholds for the DoC state.
  - any new incoming HTTP2 connection requests are not accepted.
  - if the pod is transitioning from the Normal State to the DoC state, the pod gradually decrements the number of concurrent streams by updating SETTINGS_MAX_CONCURRENT_STREAMS parameter in a SETTINGS frame to the configured `maxConcurrentStreamsPerCon` value at a regular interval. The concurrent

streams are decremented based on the value configured in `decrementBy` parameter. And, the regular interval is configured in the `decrementSamplingPeriod` parameter.

  - if the pod is transitioning from the Congested State to the DoC state, the pod gradually increments the number of concurrent streams by updating SETTINGS_MAX_CONCURRENT_STREAMS parameter in a SETTINGS frame to the configured `maxConcurrentStreamsPerCon` value at a regular interval. The concurrent streams are incremented based on the value configured in `incrementBy` parameter. And, the regular interval is configured in the `incrementSamplingPeriod` parameter.

- **Normal State**: This is the lower bound state where all the congestion parameters for the pod are below the configured thresholds for DoC and Congested states. When the pod reaches this state, the following actions are performed:
  - the pod will continue accepting new incoming HTTP2 connection requests.
  - the pod will continue accepting requests on the existing HTTP2 connections.
  - in case the pod is transitioning from the Congested or DoC state to Normal state, the pod gradually increments the number of concurrent streams by updating SETTINGS_MAX_CONCURRENT_STREAMS parameter in a SETTINGS frame to the configured `maxConcurrentStreamsPerCon` value at a regular interval. The concurrent streams are incremented based on the value configured in `incrementBy` parameter. And, the regular interval is configured in the `incrementSamplingPeriod` parameter.

To avoid toggling between these states due to traffic pattern, it is required for the pod to be in a particular state for a given period before transitioning to another state. The below configurations are used to define the period till which the pod has to be in a particular state:

- `stateChangeSampleCount`
- `monitoringInterval`

Formula for calculating the period is as follows:

```
(stateChangeSampleCount * monitoringInterval)
```

For more information about the configuration using REST API, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

Managing Ingress Gateway Pod Protection

This section explains the procedure to enable and configure the feature.

Enable:

You can enable this feature using REST API. Perform the REST API configurations as explained below:

1. Use the API path as *{apiRoot}/nf-common-component/v1/{serviceName}/podprotection*.
2. Set enabled as `true`.
3. Set `congestionControl.enabled` to `true`.
4. Run the API using PUT method with the proposed values given in the Rest API. For more information about API path, see "Configurations to enable Ingress Gateway Pod Protection" section of "Ingress Gateway REST APIs" in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.
   Given below is a sample REST API configuration to enable this feature:

```
{
        "enabled": true,
```

```
"monitoringInterval": 100,
"congestionControl": {
    "enabled": true,
    "stateChangeSampleCount": 10,
    "actionSamplingPeriod": 3,
    "states": [
        {
            "name": "Normal",
            "weight": 0,
            "entryAction": [
                {
                    "action": "MaxConcurrentStreamsUpdate",
                    "arguments": {
                        "incrementBy": 30,
                        "incrementByActionSamplingPeriod": 3,
                        "maxConcurrentStreamsPerCon": 100
                    }
                },
                {
                    "action": "AcceptIncomingConnections",
                    "arguments": {
                        "accept": true
                    }
                }
            ]
        },
        {
            "name": "DoC",
            "weight": 1,
            "resourceThreshold": {
                "cpu": 60,
                "memory": 60,
                "pendingMessage": 5000
            },
            "entryAction": [
                {
                    "action": "AcceptIncomingConnections",
                    "arguments": {
                        "accept": false
                    }
                },
                {
                    "action": "MaxConcurrentStreamsUpdate",
                    "arguments": {
                        "incrementBy": 30,
                        "incrementByActionSamplingPeriod": 3,
                        "decrementBy": 30,
                        "decrementByActionSamplingPeriod": 1,
                        "maxConcurrentStreamsPerCon": 50
                    }
                }
            ]
        },
        {
            "name": "Congested",
            "weight": 2,
```

```
                        "resourceThreshold": {
                            "cpu": 75,
                            "memory": 75,
                            "pendingMessage": 7000
                        },
                        "entryAction": [
                            {
                                "action": "AcceptIncomingConnections",
                                "arguments": {
                                    "accept": false
                                }
                            },
                            {
                                "action": "MaxConcurrentStreamsUpdate",
                                "arguments": {
                                    "decrementBy": 30,
                                    "decrementByActionSamplingPeriod": 1,
                                    "maxConcurrentStreamsPerCon": 5
                                }
                            }
                        ]
                    }
                ]
            }
    }
```

Observe

Metrics

The following metrics are used to provide information about this feature:

- `oc_ingressgateway_pod_congestion_state`: It is used to track congestion state of a pod.
- `oc_ingressgateway_pod_resource_stress`: It tracks CPU, memory, and queue usage (as percentages) to determine the congestion state of the POD that is performing the calculations.
- `oc_ingressgateway_pod_resource_state`: It tracks the congestion state of individual resources, which is calculated based on their usage and the configured threshold.
- `oc_ingressgateway_incoming_pod_connections_rejected_total`: It tracks the number of connections dropped in the congested or Danger Of Congestion (DOC) state.

For information about the metrics, see Ingress Gateway Metrics.

Alerts

The following alerts generated for this feature:

- OcnssfIngressGatewayPodCongestionStateWarning
- OcnssfIngressGatewayPodCongestionStateMajor
- OcnssfIngressGatewayPodResourceStateWarning
- OcnssfIngressGatewayPodResourceStateMajor

For more information about alerts, see NSSF Alerts.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.5 Monitoring the Availability of SCPs using SCP Health APIs

With the introduction of this feature, NSSF determines the availability and reachability status of all the SCPs configured either statically by the operator or through DNS SRV based selection of the SCP sets. With this feature, NRF determines the availability and reachability status of all SCPs irrespective of the configuration types. This feature is an enhancement to the existing SBI routing functionality. Egress Gateway microservice interacts with SCP on their health API endpoints using HTTP2 OPTIONS method. It monitors the health of configured SCP peers to ensure that the traffic is routed directly to the healthy peers. This enhancement avoids routing or rerouting towards unhealthy peers, thus minimizing the latency time.

Egress Gateway microservice maintains the health status of all available and unavailable SCPs. It maintains the latest health of SCPs by periodically monitoring and uses this data to route egress traffic to the healthy SCP.

> **Note**
>
> - This is not a standalone feature but an add-on to the existing SBI Routing feature, which means this feature is activated only if the SBI Routing feature is enabled.
> - Health monitoring can only be enabled for the peers which belong to a peerset associated with a SBI Routing filter.

Managing Monitoring the Availability of SCPs using SCP Health APIs

Prerequisites

1. This feature works only when the SBI Routing feature is enabled. Health monitoring can only be enabled for the SCP peers which belong to a peer set associated with a SBI Routing filter. Not all peers are eligible for peer health monitoring.

   > **Note**
   >
   > For more information, see DNS SRV based selection of the SCP sets.

2. Set the value of `sbiRoutingDefaultScheme` as `http`.
3. Configure `peerconfiguration` to define the list of peers to which Egress Gateway can send request.
4. Configure `peerSetConfiguration` to logically group the peers into sets.

> **Note**
>
> - `peerIdentifier` must be the value of SCP peer configured in `peerConfiguration`.
> - You cannot configure multiple virtual hosts as peers in the same peer set.

5. Configure or update `errorcriteriasets`.
6. Configure or update `erroractionsets`.
7. Configure the `priority` for each SCP peer in the set. Depending on the priority, it selects the primary, secondary, or tertiary SCP peers to route requests.
8. Configure `RoutesConfiguration` to add or update list of routes.

> **Note**
>
> - The ID of each route must match the route ID present in Helm chart only if `routeConfigMode` is configured as HELM and `sbiRoutingConfigMode` is configured as REST.
> - The configuration under `sbiRoutingConfiguration` corresponds to the SBI-Routing specific configuration.

9. After above configurations, configure `peermonitoringconfiguration` to enable peer monitoring.

> **Note**
>
> By default, `peermonitoringconfiguration` is set to `false` in `ocnssf_custom_values_23.4.0.yaml` file. Configure the value as `true` through REST API to enable peer monitoring.

> **Note**
>
> For more information about the parameters, see "Egress Gateway Parameters" under "Customizing NSSF" in *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation, Upgrade, and Fault Recovery Guide*, or see "Egress Gateway REST APIs" in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide* for REST API based configurations.

Configure or Enable

Configure Using Helm

To enable this feature using Helm, configure the following Helm parameters in the `ocnssf_custom_values_23.4.0.yaml` file:

- `peerConfiguration.healthApiPath`
- `peerMonitoringConfiguration.enabled`
- `peerMonitoringConfiguration.timeout`

- `peerMonitoringConfiguration.frequency`
- `peertMonitoringConfiguration.failureThreshold`
- `peerMonitoringConfiguration.successThreshold`

Here is a snippet from the `ocnssf_custom_values_23.4.0.yaml` file for configuring this feature:

```
peerConfiguration:
      - id: peer1
        host: ocats-amf-stubserver.changeme-ocats
        port: 8080
        apiPrefix: "/"
        healthApiPath: "/health/v1"
...
peerMonitoringConfiguration:
     enabled: true
     timeout: 1000
     frequency: 20000
     failureThreshold: 3
     successThreshold: 4
```

> **⚠ Caution**
>
> If you have enabled `peermonitoringconfiguration` using Helm by setting its value as `true` in the `ocnssf_custom_values_23.4.0.yaml` file, you cannot make any REST API configurations related to this feature.

For more information about the Helm parameters, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation, Upgrade, and Fault Recovery Guide*.

Configure Using REST API

You can also enable this feature using the REST API configurations in the following sequence:

1. This feature works only when the SBI Routing feature is enabled. Health monitoring can only be enabled for the SCP peers which belong to a peer set associated with a SBI Routing filter. Not all peers are eligible for peer health monitoring.

   > **ⓘ Note**
   >
   > For more information, see DNS SRV based selection of the SCP sets.

2. Configure `peerconfiguration` to define the list of peers to which Egress Gateway can send request.

   > **ⓘ Note**
   >
   > `peerconfiguration` must consist of `healthApiPath` even though `peermonitoringconfiguration` is set to `false` in `ocnssf_custom_values_23.4.0.yaml` file by default.

3. Configure `peersetconfiguration` to logically group the peers into sets.

> **Note**
>
> `peerIdentifier` must be the value of SCP peer configured in `peerconfiguration`.

4. Configure the `priority` for each SCP peer in the set. Depending on the priority, it selects the primary, secondary, or tertiary SCP peers to route requests.
5. Configure or update `errorcriteriasets`.
6. Configure or update `erroractionsets`.
7. Configure `routesconfiguration` to add or update list of routes.

> **Note**
>
> - The ID of each route must match the route ID present in Helm chart only if `routeConfigMode` is configured as HELM and `sbiRoutingConfigMode` is configured as REST.
> - The configuration under `sbiRoutingConfiguration` corresponds to the SBI-Routing specific configuration.

8. After above configurations, configure `peermonitoringconfiguration` as `true` to enable peer monitoring. By default, `peermonitoringconfiguration` is set to `false` in Helm.

For more information about REST API configurations, see "Egress Gateway REST APIs" in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

Observe

Metrics

The following metrics are used to provide information about this feature:

- `oc_egressgateway_peer_health_status`
- `oc_egressgateway_peer_health_ping_request_total`
- `oc_egressgateway_peer_health_ping_response_total`
- `oc_egressgateway_peer_health_status_transitions_total`
- `oc_egressgateway_peer_count`
- `oc_egressgateway_peer_available_count`

For information about the metrics, see NSSF Metrics.

Alerts

The following alerts are applicable for this feature:

- OcnssfScpMarkedAsUnavailable
- OcnssfAllScpMarkedAsUnavailable

For more information about the alerts, see NSSF Alerts.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.6 Support for Kubernetes Resource

4.6.1 Network Policies

Network Policies are an application-centric construct that allows you to specify how a pod is allowed to communicate with various network entities. To control communication between the cluster's pods and services and to determine which pods and services can access one another inside the cluster, it creates pod-level rules.

Previously, NSSF had the privilege to communicate with other namespaces, and pods of one namespace could communicate with others without any restriction. Now, namespace-level isolation is provided for the NSSF pods, and some scope of communications is allowed between the NSSF and pods outside the cluster. The network policies enforces access restrictions for all the applicable data flows except communication from Kubernetes node to pod for invoking container probe.

Managing Support for Network Policies

Enable

To use this feature, network policies need to be applied to the namespace in which NSSF is deployed.

Configure

You can configure this feature using Helm. For information about configuring Network Policy, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation, Upgrade, and Fault Recovery Guide*.

Observe

here is no specific metrics and alerts required for the Network Policy feature.

4.7 Validation of WWW-Authenticate Response Header 4xx with NSSF

When access token validation is enabled, NSSF performs access-token validation of the access token that comes with service requests to it. With this enhancement, NSSF has added supports 3GPP specified 4XX application error codes for these access token checks.

The access token validation include the following checks:

1. **Validating if access token is present in the service request**: If the access token is not present, NSSF returns 401 unauthorized error code together with the "WWW-Authenticate" header as specified in 3GPP 16.5 29.531.

2. **Validating if access token does not have the required scopes to invoke the service operation**: NSSF validates the scope IE in `AccessTokenClaims` (which is the name of the NSSF services for which the access token is authorized) against the NSSF Service that are accessed in this service request. If the validation fails, NSSF returns a 403 Forbidden error code together with the "WWW-Authenticate" header as specified in 3GPP 16.5 29.531.

Managing Validation of WWW-Authenticate Response Header 4xx with NSSF

Enable

This feature does not require any configuration. It is enabled by default when the NSSF is installed.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.8 Deleting Subscription on 404 SUBSCRIPITON_NOT_FOUND Response from AMF

This feature is an enhancement to the existing behavior of NSSF Notify Service Operation, which is used to update the NF Service Consumer (for example, AMF) of any change in status. It is done on a per TA basis for the S-NSSAIs available (unrestricted and restricted) per PLMN in the TA of a UE's serving PLMN.

Upon receiving a failure, the NF service consumer (AMF) returns some HTTP status codes and NSSF retries the notification until it reaches the value of the `httpMaxRetries` or a success response is received from the AMF. However, this behavior is not suitable when it comes to '404 Subscription Not Found' failure. Waiting for the value of the `httpMaxRetries` to get exhausted will only create an unproductive delay.

When this feature is enabled, it eliminates the delay by simply logging the error and deleting the subscription when the AMF sends a '404 Subscription Not Found' response.

> **Note**
>
> This behavior is applicable only when AMF responds with the '404 Subscription Not Found' error. It is not applicable to other failure scenarios.

Managing Deleting Subscription on 404 SUBSCRIPITON_NOT_FOUND Response from AMF

Enable

To enable this feature, set the value of `deleteOnSubscriptionNotFound` parameter to `true` under the `NSSubscription` section in the ocnssf_custom_values_23.4.0.yaml file.

Observe

Metrics

The following metrics are used to provide information about this feature:

- `ocnssf_nssaiavailability_notification_delete_on_subscription_not_found`
- `ocnssf_nssaiavailability_notification_db_error`

For information about the Metrics, see NSSF Metrics.

Error Scenarios

The following error logs are generated for this feature:

Table 4-1 Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title	Log Snippet

Parameter deleteOnSubscriptionNotFound is true but unable to delete NssaiSubscription	NsSubscription	/nnssf-nssubscription/v1/nssai-availability/autoconfignotifications
		/nnssf-nssubscription/v1/nssai-availability/notifications
			404 SUBSCRIPTION_NOT_FOUND	{
				"instant": {
				"epochSecond": 1661327119,
				"nanoOfSecond": 10456886
				},
				"thread": "thread-1",
				"level": "ERROR",
				"loggerName": "com.oracle.cgbu.cne.nssf.nsselection.service.NsSubscriptionServiceImpl",
				"message": "Failed to delete NssaiSubscribtion with ID: 1830762826",
				"endOfBatch": false,
				"loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger",
				"contextMap": {},
				"threadId": 54,
				"threadPriority": 5,
				"ts": "2022-08-24 07:45:19.010+0000",
				"ocLogId": "${ctx:ocLogId}",
				"pod": "ocnssf-nssubscription-5f7bbbffbc-hxsfc",
				"processId": "1",
				"vendor": "Oracle",
				"application": "ocnssf",
				"engVersion": "22.3.0",
				"mktgVersion": "22.3.0.0.0",
				"microservice": "nssubscription",
				"namespace": "ocnssf",
				"node_name": "jazz-k8s-node-8"
				}

Table 4-1 (Cont.) Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title	Log Snippet
NsSubcription recieves 404 SUBSCRIPTION_NOT_FOUND from client, Param deleteOnSubscriptionNotFound is true hence NssaiSubscription is deleted	NsSubscription	/nnssf-nssubscription/v1/nssai-availability/autoconfignotifications OR /nnssf-nssubscription/v1/nssai-availability/notifications	404 SUBSCRIPTION_NOT_FOUND	{ "instant": { "epochSecond": 1679654802, "nanoOfSecond": 234222276 }, "thread": "task-3", "level": "ERROR", "loggerName": "com.oracle.cgbu.cne.nssf.nssubscription.service.NsSubscriptionService", "message": "Recieved 404 SUBSCRIPTION_NOT_FOUND from http://ocats-amf-stubserver.ocnssf:8080/notification/amf404/, subscriptionId = 402778803, deleteOnSubscriptionNotFound = true, response = NssfRestClientResponse{response=Response{protocol=h2_prior_knowledge, code=404, message=, url=http://ocnssf-egress-gateway:8080/OC_Notify/notification/amf404/}, responseBody='{\"type\": \"NOT_FOUND\", \"title\": \"SUBSCRIPTION_NOT_FOUND\", \"status\": 404, \"detail\": \"subscription not found\", \"cause\": \"SUBSCRIPTION_NOT_FOUND\" }', messageCode=REMOTE_SERVER_EXCEPTION, eventTriggerSubMapId=0, attemptNum=0}", "endOfBatch": false, "loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger",

Table 4-1 (Cont.) Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title	Log Snippet

				"contextMap": {},
				"threadId": 760,
				"threadPriority": 5,
				"ts": "2023-03-24 10:46:42.234+0000",
				"ocLogId": "${ctx:ocLogId}",
				"pod": "ocnssf-nssubscription-6d86c4d686-jbxjz",
				"processId": "1",
				"vendor": "Oracle",
				"application": "ocnssf",
				"engVersion": "23.1.1-rc.2",
				"mktgVersion": "23.1.1-rc.2.0.0",
				"microservice": "nssubscription",
				"namespace": "ocnssf",
				"node_name": "100.77.28.82"
				} {
				"instant": {
				"epochSecond": 1679654802,
				"nanoOfSecond": 408253432
				},
				"thread": "XNIO-1 task-1",
				"level": "INFO",
				"loggerName": "com.oracle.cgbu.cne.nssf.nssubscription.helper.HelperFunctions",
				"message": "Successfully deleted Subscription with ID: 402778803",
				"endOfBatch": false,
				"loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger",
				"contextMap": {},
				"threadId": 39,
				"threadPriority": 5,

Table 4-1 (Cont.) Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title	Log Snippet
				"ts": "2023-03-24 10:46:42.408+0000", "ocLogId": "${ctx:ocLogId}", "pod": "ocnssf-nssubscription-6d86c4d686-jbxjz", "processId": "1", "vendor": "Oracle", "application": "ocnssf", "engVersion": "23.1.1-rc.2", "mktgVersion": "23.1.1-rc.2.0.0", "microservice": "nssubscription", "namespace": "ocnssf", "node_name": "100.77.28.82" }

Table 4-1 (Cont.) Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title	Log Snippet

NsSubcription recieves 404 SUBSCRIPTION_NOT_FOUND from client, Param deleteOnSubscriptionNotFound is false hence NssaiSubscription is not deleted	NsSubscription	/nnssf-nssubscription/v1/nssai-availability/autoconfignotifications OR /nnssf-nssubscription/v1/nssai-availability/notifications	404 SUBSCRIPTION_NOT_FOUND	{
				"instant": {
				"epochSecond": 1679655373,
				"nanoOfSecond": 880206537
				},
				"thread": "task-1",
				"level": "ERROR",
				"loggerName": "com.oracle.cgbu.cne.nssf.nssubscription.service.NsSubscriptionService",
				"message": "Recieved 404 SUBSCRIPTION_NOT_FOUND from http://ocats-amf-stubserver.devnssf-hrithik:8080/notification/amf404/, subscriptionId = 1871925794, deleteOnSubscriptionNotFound = false, response = NssfRestClientResponse{response=Response{protocol=h2_prior_knowledge, code=404, message=, url=http://ocnssf-egress-gateway:8080/OC_Notify/notification/amf404/}, responseBody='{\"type\": \"NOT_FOUND\", \"title\": \"SUBSCRIPTION_NOT_FOUND\", \"status\": 404, \"detail\": \"subscription not found\", \"cause\": \"SUBSCRIPTION_NOT_FOUND\"}', messageCode=REMOTE_SERVER_EXCEPTION, eventTriggerSubMapId=0, attemptNum=0}",
				"endOfBatch": false,
				"loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger",

Table 4-1 (Cont.) Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title	Log Snippet

				<pre>"contextMap": {},
				"threadId": 40,
				"threadPriority": 5,
				"ts": "2023-03-24 10:56:13.880+0000",
				"ocLogId": "${ctx:ocLogId}",
				"pod": "ocnssf-nssubscription-9f68d8bc9-xsm22",
				"processId": "1",
				"vendor": "Oracle",
				"application": "ocnssf",
				"engVersion": "23.1.1-rc.2",
				"mktgVersion": "23.1.1-rc.2.0.0",
				"microservice": "nssubscription",
				"namespace": "ocnssf",
				"node_name": "100.77.50.225"
				} {
				"instant": {
				"epochSecond": 1679655373,
				"nanoOfSecond": 908894025
				},
				"thread": "XNIO-1 task-1",
				"level": "ERROR",
				"loggerName": "com.oracle.cgbu.cne.nssf.nssubscription.service.NsSubscriptionService",
				"message": "Not deleted NssaiSubscribtion with ID: 1871925794",
				"endOfBatch": false,
				"loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger",
				"contextMap": {},
				"threadId": 39,
				"threadPriority": 5,
				"ts": "2023-03-24</pre>

Table 4-1 (Cont.) Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title	Log Snippet
				10:56:13.908+0000", "ocLogId": "$ {ctx:ocLogId}", "pod": "ocnssf- nssubscription-9f68d8bc9- xsm22", "processId": "1", "vendor": "Oracle", "application": "ocnssf", "engVersion": "23.1.1- rc.2", "mktgVersion": "23.1.1-rc.2.0.0", "microservice": "nssubscription", "namespace": "ocnssf", "node_name": "100.77.50.225" }

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.9 DNS SRV Based Selection of SCP in NSSF

NSSF selects Service Communication Proxy (SCP) for indirect communication of notifications using the static configurations done by the operator. This enhancement enables NSSF to learn SCP configuration from DNS SRV based FQDN, in addition to the already existing static manual configuration by the operator.

Egress Gateway (Egress Gateway) supports AlternateRoute Service, which NSSF is using to support DNS SRV based selection of SCP. It enables NSSF to resolve FQDN or Virtual FQDN to alternate FQDNs of SCP. Egress Gateway uses the virtual FQDN of SCP instances to query the AlternateRoute Service and get the list of alternate FQDNs with priorities assigned to each of them. Based on the priorities, Egress Gateway picks up the SCP instances for rerouting attempts.

The AlternateRoute Service allows the configuration of multiple sets of SCP instances in NSSF in contrast to only one static configuration in the previous scenario.

Managing DNS SRV Based Selection of SCP in NSSF

Enable

To enable DNS SRV, set the `dnsSrvEnabled` parameter to `true` under the `alternate-route` section in the `ocnssf_custom_values_23.4.0.yaml` file.

Configure

Configure Using Helm Parameters:

DNS SRV is enabled using the Helm configurations in the `ocnssf_custom_values_23.4.0.yaml` as shown below:

- `dnsSrvEnabled: true`
- `dnsSrvFqdnSetting.enabled: false`

> **Note**
>
> Flag to enable or disable the usage of custom patterns for the FQDN while triggering DNS-SRV query.

- `dnsSrvFqdnSetting.pattern: "_{scheme}._tcp.{fqdn}."`
- `sbiRoutingConfigMode: HELM`
- `routeConfigMode: HELM`

> **Note**
>
> By default, the values of `sbiRoutingConfigMode` and `routeConfigMode` are set to `REST` in the `ocnssf_custom_values_23.4.0.yaml` file. To configure this feature using Helm, ensure that the values are set to `HELM` as shown above.

For more information about Helm parameters to configure DNS SRV and Alternate Routing Service, see "Alternate Route Microservice Parameters section" in *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation, Upgrade, and Fault Recovery Guide*.

Configure Using REST API:

The feature related REST API configurations are performed at NSSF and Egress Gateway.

1. Ensure that the value of `routeConfigMode` and `sbiRoutingConfigMode` is set to `REST` in the `ocnssf_custom_values_23.4.0.yaml` file, as shown below:

```
sbiRoutingConfigMode: REST
routeConfigMode: REST
```

> **Note**
>
> By default, it is set to `REST`.

2. Perform REST API configurations at Egress Gateway in the following sequence:
   a. Configure `peerconfiguration` to define the list of peers to which Egress Gateway can send request.

      > **Note**
      >
      > It is mandatory to configure `peerconfiguration` with `healthApiPath` if you want to enable `peermonitoringconfiguration`.

   b. Configure `virtualHost` under `peerconfiguration` where the AMF query is sent.
   c. Configure `peersetconfiguration` to logically group the peers into sets. `peerIdentifier` must be the value of peer configured in `peerconfiguration`

      > **Note**
      >
      > You cannot configure multiple virtual hosts as peers in the same peer set.

   d. Configure the `Priority` for each peer in the set. Depending on the priority, it selects the primary, secondary, or tertiary peers to route requests.
   e. Configure or update `errorcriteriasets`.
   f. Configure or update `erroractionsets`.
   g. Configure `routesconfiguration` to define the route and reroute parameters. If SBIRouting functionality is required, then configure `SBIRoutingFilter`. If reroute mechanism is required for that route, then configure `SBIReroute` filter with retries, methods, and statuses.

      > **Note**
      >
      > `peerSetIdentifier` must be the value configured during `peersetconfiguration`.

   h. Set the value of `enabled` under `sbiRoutingConfiguration` to `true` to route the AMF queries through SCP configured in the `id` attribute.

      > **Note**
      >
      > `peerconfiguration` and `peersetconfiguration` can be either set to empty list or populated with values. These attributes are used for routing only if `sbiRoutingConfiguration` is enabled for a particular route.

   i. <Optional> You can also configure `peermonitoringconfiguration` using REST API. For more information about enabling or configuring `peermonitoringconfiguration`, see Monitoring the Availability of SCPs using SCP Health APIs.

> **Note**
>
> It is mandatory to configure `peerconfiguration` with `healthApiPath` if `peermonitoringconfiguration` is enabled.

3. Perform the following REST API configurations at NSSF:
   a. Configure the `nssaiauth` Managed Object to enable the configuration of network slice authentication rules by configuring Grant status (Allowed_PLMN, Rejected_PLMN, or Rejected_TAC) for S-NSSAI on a per TAI basis.

For more information about REST API parameters and configuration, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

Observe

Metrics

No new Metrics or KPIs were added to NSSF. However, the following Egress Gateway metrics for Alternate Route Service are used to provide the information about this feature:

- `oc_fqdn_alternate_route_total`
- `oc_dns_srv_lookup_total`
- `oc_alternate_route_resultset`
- `oc_configclient_request_total`
- `oc_configclient_response_total`

For information about the Metrics, see Egress Gateway Metrics in NSSF Metrics.

Error Scenarios

No new logs are generated for this feature. However, it uses the following Egress Gateway error scenarios:

Table 4-2 Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title	Log Snippet

Sending Subscription notification failed due to UnknownHost exception	ocnssf-egress-gateway	/nnssf-configuration/v1/nssaiauth	503
			Service Unavailable
			Encountered unknown host exception at Egress Gateway
				<pre>{
				  "instant": {
				  "epochSecond": 1676964069,
				  "nanoOfSecond": 986866249
				  },
				  "thread": "@6c8fe7a4-217",
				  "level": "ERROR",
				  "loggerName": "ocpm.cne.gateway.jettyclient.DnsResolver",
				  "message": "UnExpected error occured :: {}",
				  "thrown": {
				  "commonElementCount": 0,
				  "localizedMessage": "ocats-amf-stubserver.ocnssf: Name or service not known",
				  "message": "ocats-amf-stubserver.ocnssf:Name or service not known",
				  "name": "java.net.UnknownHostException",
				  "extendedStackTrace": [
				  {
				  "class": "java.net.Inet6AddressImpl",
				  "method": "lookupAllHostAddr",
				  "file": "Inet6AddressImpl.java",
				  "line": -2,
				  "exact": false,
				  "location": "?",
				  "version": "?"
				  },
				  {
				  "class": "java.net.InetAddress$PlatformNameService",</pre>

Table 4-2 (Cont.) Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title	Log Snippet
				"method": "lookupAllHostAddr", "file": "InetAddress.java", "lin e": 933, "exact": false, "location": "?", "version": "?" }] }, "endOfBatch": false, "loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger", "contextMap": {}, "threadId": 217, "thread Priority": 5, "messageTimestamp": "2023-02-21T07:21:09.986+0000", "ocLogId": "${ctx:ocLogId}", "pod": "${ctx:hostname}", "processId": "1", "instanceType": "prod", "egressTxId": "${ctx:egressTxId}" }

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.10 OAuth Access Token Based Authorization

NSSF supports Oauth 2.0, which is a security feature that NSSF uses to validate and authorize requests from allowed or valid consumers NFs. The consumer NF requests for access token from the issuer NRF, and uses this access token to send the request to NSSF. NSSF validates

the requests and approves or discards it based on access token authorization received in the request. The access token is validated with the configured public key certificate in NSSF.

Before this enhancement, NSSF used NRF Instance ID to validate the access token, where Ingress Gateway stored public keys against NRF instance Id. This enhancement allows NSSF to use multiple public certificates for validating access tokens by adding support for Key-ID (K-ID) based access token validation, in addition to the existing NRF Instance ID based access token validation.

This enhancement now allows Ingress Gateway to operate in the following three different modes:

1. K-ID based ONLY
   a. Ingress Gateway validates access token based on public keys indexed with key-id only.
2. Instance ID based ONLY ***(DEFAULT)***
   a. Ingress Gateway validates access token based on public keys indexed with NRF Instance ID in the issuer field.
3. K-ID based with Instance ID based as fallback (KID_PREFERRED)
   a. Ingress Gateway validates access token based on public keys indexed with Key-ID. If Key-ID is not FOUND in Access token, Ingress Gateway attempts token validation using public keys indexed with NRF instance ID in the issuer field.
   b. Fallback happens only if the received access token is structured as follows:
      i. Does not contain Key-ID
      ii. Contains Key-ID but does not have public keys configured against the Key-ID

Managing OAuth Access Token Based Authorization Using Key-ID and NRF Instance ID

Prerequisites

This section describes the configurations required to enable access tokens before deploying NSSF.

Generating KeyPairs for NRF Instances

> **Note**
>
> It is at the discretion of the user to create private keys and certificates, and it is not in the scope of NSSF. This section lists only samples to create KeyPairs.

Using the OpenSSL tool, the user can generate private key and public certificates. The commands to generate the KeyPairs are as follows:

Example Command to generate KeyPair for NRF Instance

```
openssl ecparam -genkey -name prime256v1 -noout -out ec_private_key1.pem

openssl pkcs8 -topk8 -in ec_private_key1.pem -inform pem -out
ec_private_key_pkcs8.pem -outform pem -nocrypt

openssl req -new -key ec_private_key_pkcs8.pem -x509 -nodes -days 365 -out
```

```
4bc0c762-0212-416a-bd94-b7f1fb348bd4.crt -subj "/C=IN/ST=KA/L=BLR/O=ORACLE/
OU=CGBU/CN=ocnrf-endpoint.ocnrf.svc.cluster.local"
```

> **Note**
>
> For ATS configuration details, see **Configurations to Enable Access Token** in **Preinstallation Tasks** of *Cloud Native Core Network Slice Selection Function Installation and Upgrade* Guide.

Enabling and Configuring Access Token

To enable access token validation, configure both Helm-based and REST-based configurations on Ingress Gateway.

Configuration using Helm:

For Helm-based configuration, perform the following steps:

1. Create a secret that stores NRF public key certificates using the following commands:

   ```
   kubectl create secret generic <secret name> --from-file=<filename.crt> -n
   <Namespace>
   ```

   For Example:

   ```
   kubectl create secret generic oauthsecret --from-file=4bc0c762-0212-416a-
   bd94-b7f1fb348bd4.crt -n ocnssf
   ```

   > **Note**
   >
   > In the above command:
   >
   > - `oauthsecret` is the secret name
   > - `ocnssf` is the namespace
   > - `4bc0c762-0212-416a-bd94-b7f1fb348bd4.crt` is the public key certificate

2. Enable the `oauthValidatorEnabled` parameter on Ingress Gateway by setting its value to `true`. Further, configure the secret and namespace on Ingress Gateway in the OAUTH CONFIGURATION section of the `ocnssf_custom_values_23.4.0.yaml` file using the following fields:
   - `oauthValidatorEnabled`
   - `nfType`
   - `nfInstanceId`
   - `producerScope`
   - `allowedClockSkewSeconds`
   - `enableInstanceIdConfigHook`
   - `nrfPublicKeyKubeSecret`

- nrfPublicKeyKubeNamespace
- validationType
- producerPlmnMNC
- producerPlmnMCC
- oauthErrorConfigForValidationFailure
- oauthErrorConfigForValidationFailure.errorCode
- oauthErrorConfigForValidationFailure.errorTitle
- oauthErrorConfigForValidationFailure.errorDescription
- oauthErrorConfigForValidationFailure.errorCause
- oauthErrorConfigForValidationFailure.redirectUrl
- oauthErrorConfigForValidationFailure.retryAfter
- oauthErrorConfigForValidationFailure.errorTrigger
- oauthErrorConfigForValidationFailure.errorTrigger.exceptionType

> **Note**
>
> `4bc0c762-0212-416a-bd94-b7f1fb348bd4.crt` is the public key certificate and we can have any number of certificates in the secret.

The following snippet represents the location of the mentioned parameter in the Helm file:

> **Note**
>
> The following snippet represents only the sample values. For more information on parameters and their supported values, see **Ingress Gateway Parameters** from **Customizing NSSF** chapter in *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation, Upgrade, and Fault Recovery Guide*.

```
#OAUTH CONFIGURATION

  oauthValidatorEnabled: true

  nfType: NSSF

  nfInstanceId: 9faf1bbc-6e4a-4454-a507-aef01a101a01

  producerScope: nnssf-configuration

  allowedClockSkewSeconds: 0

  enableInstanceIdConfigHook: true

  nrfPublicKeyKubeSecret: oauthsecret

  nrfPublicKeyKubeNamespace: ocnssf
```

```
  validationType: strict
  producerPlmnMNC: 14
  producerPlmnMCC: 310
  oauthErrorConfigForValidationFailure:
    errorCode: 401
    errorTitle: "Validation failure"
    errorDescription: "UNAUTHORIZED"
    errorCause: "oAuth access Token validation failed"
    redirectUrl:
    retryAfter:
    errorTrigger:
    - exceptionType: OAUTH_CERT_EXPIRED
      errorCode: 408
      errorCause: certificate has expired
      errorTitle:
      errorDescription:
      retryAfter:
      redirectUrl:- exceptionType: OAUTH_MISMATCH_IN_KID
      errorCode: 407
      errorCause: kid configured does not match with the one present in
the token
      errorTitle:
      errorDescription:
      retryAfter:
      redirectUrl:
    - exceptionType: OAUTH_PRODUCER_SCOPE_NOT_PRESENT
      errorCode: 406
      errorCause: producer scope is not present in token
      errorTitle:
```

```
      errorDescription:

      retryAfter:

      redirectUrl:

    - exceptionType: OAUTH_PRODUCER_SCOPE_MISMATCH

      errorCode: 405

      errorCause: produce scope in token does not match with the
configuration

      errorTitle:

      errorDescription:

      retryAfter:

      redirectUrl:

    - exceptionType: OAUTH_MISMATCH_IN_NRF_INSTANCEID

      errorCode: 404

      errorCause: nrf id configured does not match with the one present in
the token

      errorTitle:

      errorDescription:

      retryAfter:

      redirectUrl: - exceptionType: OAUTH_PRODUCER_PLMNID_MISMATCH

      errorCode: 403

      errorCause: producer plmn id in token does not match with the
configuration

      errorTitle:

      errorDescription:

      retryAfter:

      redirectUrl:

    - exceptionType: OAUTH_AUDIENCE_NOT_PRESENT_OR_INVALID

      errorCode: 402

      errorCause: audience in token does not match with the configuration
```

```
      errorTitle:

      errorDescription:

      retryAfter:

      redirectUrl:

    - exceptionType: OAUTH_TOKEN_INVALID

      errorCode: 401

      errorCause: oauth token is corrupted

      errorTitle:

      errorDescription:

      retryAfter:

  redirectUrl:oauthErrorConfigOnTokenAbsence:

     errorCode: 400

     errorTitle: "Token not present"

     errorDescription: "UNAUTHORIZED"

     errorCause: "oAuth access Token is not present"

     redirectUrl:

     retryAfter:
```

Configuration using REST API

After Helm configuration, send the REST requests to use configured public key certificates. Using REST-based configuration, you can distinguish between the certificates configured on different NRFs and can use these certificates to validate the token received from a specific NRF.

For more information about REST API configuration, see **OAuth Validator Configuration** section in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

Observe

- Added the following success measurements:
  - `oc_oauth_nrf_request_total`
  - `oc_oauth_nrf_response_success_total`
  - `oc_oauth_token_cache_total`
  - `oc_oauth_validation_successful_total`
  - `oc_oauth_cert_expiryStatus`
  - `oc_oauth_cert_loadStatus`

  - `oc.oauth.keyid.count`
- Added the following error measurements:
  - `oc_oauth_nrf_response_failure_total`
  - `oc_oauth_request_failed_internal_total`
  - `oc_oauth_request_invalid_total`
  - `oc_oauth_validation_failure_total`
  - `oc.oauth.request.failed.cert.expiry`

For information on Metrics and KPIs of NSSF, see NSSF Metrics and NSSF KPIs sections respectively.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.11 Overload Control based on Percentage Discards

The Overload Control feature protects the system from overload and maintains the overall health of NSSF. The system needs to not only detect overload conditions but also protect against the same. Further, it needs to mitigate against and avoid the system from entering into an overload condition by taking necessary actions for recovering from overload.

NSSF provides the following means for overload management:

- Predefined threshold load levels
- Tracks number of pending messages
- Tracks CPU and memory usage
- Enforce load shedding during various overload levels

Perf-info performs overload calculations based on the indicators:

- CPU Utilization
- Memory Utilization
- Pending Message Count
- Failure Count

The overload level is configured for the following NRF microservices:

- NSSelection
- NSAvailability

The Overload Manager module in Perf-info is configured or updated with the threshold value for services. A configurable flag is available for sampling interval as `ocPolicyMapping.samplingPeriod` based on which Ingress Gateway calculates rate per service in the current sampling period and applies appropriate discard policies and actions in the subsequent sampling period.

Overload Manager triggers Rate Calculator to start calculating the rate of incoming requests per service per sampling period. Ingress Gateway receives a notification event per service with the calculated rates to the Overload Manager filter at the end of every sampling period. It applies an appropriate configured discard policy for a particular service based on the rate of requests.

Ingress Gateway calculates the number of requests to be dropped in the current sampling period based on configured percentage discard.

Overload Thresholds for each service is evaluated based on four metrics namely `cpu`, `svc_failure_count`, `svc_pending_count`, and `memory`. Overload control is triggered if the thresholds for any one metrics are reached.

Managing Overload Control based on Percentage Discards

Enable

To enable this feature, set the `global.performanceServiceEnable` parameter to `true` in the `ocnssf_custom_values_23.4.0.yaml` file.

The following snippet represents the location of the mentioned parameter in the Helm file:

```
#Flag to Enable or Disable Performance Service. The flag is set to true to
enable the overload control feature by default.
  performanceServiceEnable: true
```

Configure

Configure using Helm Parameters:

1. Set the `perf-info.overloadManager.enabled` parameter to `true` in the `ocnssf_custom_values_23.4.0.yaml` file.
   The following snippet represents the location of the mentioned parameter in the Helm file:

   ```
   overloadManager:
      ingressGatewayPort: *httpSignalPort
      #Flag to Enable or Disable overloadManager
      enabled: true
   ```

2. Configure the Prometheus URI in `perf-info.configmapPerformance.prometheus`
   The following snippet represents the location of the mentioned parameter in the Helm file:

   ```
   perf-info
     configmapPerformance:
       prometheus: http://occne-prometheus-server.occne-infra:80
   ```

3. Save the `ocnssf_custom_values_23.4.0.yaml` file.
4. Run helm upgrade, if you are enabling this feature after NSSF deployment. For more information on upgrade procedure, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation and Upgrade Guide*.

Configure using REST API:

The Overload Control feature related configurations are performed at Ingress Gateway and Perf-info. For more information about APIs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*

> **Note**
>
> There are no REST configurations required at NSSF.

Configure using CNC Console:

There are no CNC Console configurations for this feature.

Observe

Metrics

No new metrics added to NSSF for the Overload Control feature. However, the following Perf-info metrics are used to provide the information about overload control feature:

- `cgroup_cpu_nanoseconds`
- `cgroup_memory_bytes`
- `load_level`

For information about Metrics, see Perf-info metrics for Overload Control in NSSF Metrics.

For information on Metrics and KPIs of NSSF, see NSSF Metrics and NSSF KPIs sections respectively.

Alerts

The following alerts are added for the Overload Control feature:

- OcnssfOverloadThresholdBreachedL1
- OcnssfOverloadThresholdBreachedL2
- OcnssfOverloadThresholdBreachedL3
- OcnssfOverloadThresholdBreachedL4

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.12 Autopopulation of Configuration Using NRF Content

NSSF responds with `CandidateAMFList` (list of possible AMFs) to Initial Registration request. Currently, the computation of active AMFs in AMF Set is done by one of the following methods:

- **Discovery**: For each registration NSSF sends a discovery message to NRF to get all active AMFs in a AMF-Set.
- **Operator configuration**: The operator has to ensure that all active AMFs are mapped to the AMF Set.

NSSF must maintain the information about AMF Set to AMF mapping in the database as it uses this information while responding to NSSelection initial registration query.

Before this enhancement, the operator was required to maintain this information manually in the database. This enhancement removes the need for the manual configuration by allowing NSSF to autoconfigure AMF information using NRF (Network Repository Function) whenever there is an update in the AMF Set data. NSSF automatically determines AMF information in a AMF-Set and autopopulate NSSF configuration using the information from NRF.

1. For each initial registration, NSSF sends a discovery message to NRF to get AMFs in a AMF-Set.
2. NSSF maintains AMF-Set (MCC-MNC-SetId-RegionId) to AMF list (List of AMFs, which belong to a AMF-Set in NSSF DB) mapping.
    a. **Subscription based on AMF-Set**: NSSF sends a discovery and subscribe request to NRF based ontheAMF-Set configured by the operator and maintain AMF-Set to AMFs mapping in NSSF Database.

Hence, operator is now required to configure only AMF set. The information about active amfs are maintained by NSSF, as it is autoconfigured using NRF content. This resolves the issue of stale configuration and NSSF does not have to send discovery for each initial registration request, saving CPU and network bandwidth.

Managing Autopopulation of Configuration Using NRF Content

Enable

This section provides the procedure to enable this feature:

1. Set the `nsconfig.nrf.subscription` parameter to `true` in the `ocnssf_custom_values_23.4.0.yaml` file.
   The following snippet represents the location of the mentioned parameter in the Helm file:

```
nsconfig:
    nrf:
    subscription: false # Flag to enable Subscriptions towards NRF for
AmfSet
```

2. Set the `nsselection.features.candidateResolution` parameter to true in the `ocnssf_custom_values_23.4.0.yaml` file.
   The following snippet represents the location of the mentioned parameter in the Helm file:

```
nsselection:
    features:
    candidateResolution : false #Flag to true and false to enable or
disable Candidate Resolution feature
```

> **Note**
>
> - When this feature is set to `false`, NSSF returns `TargetAMFSetId` and `TargetAMFRegionId` for NSSelection GET request for Initial Register message and UE-Config update.
> - When this feature is set to `true`, NSSF computes and returns Candidate AMF list for NSSelection GET request for Initial Register message and UE-Config update.

Configure

Configure using Helm Parameters:

No additional helm configuration is required to enable this feature.

Configure using REST API:

There is no option to enable or disable this feature using REST API configuration.

However, this feature will use existing AMF set and NSI-Profile REST APIs configurations if `nsconfig.nrf.subscription` is set to `true` in the `ocnssf_custom_values_23.4.0.yaml` file.

> **Note**
>
> - When `nsconfig.nrf.subscription` is set to `true` `ocnssf_custom_values_23.4.0.yaml` file, even if corresponding AMF set is not configured for an NSI-Profile, this feature will work.
> - For more information on REST APIs, see *Oracle Communications Cloud Native Core, REST API Guide*.

Configure using CNC Console:

There are no CNC Console configurations for this feature.

Observe

Metrics

Added the following success measurements:

- `ocnssf_nsconfig_nrf_disc_success`
- `ocnssf_subscription_nrf_tx`

Added the following error measurements:

- `ocnssf_nsconfig_nrf_disc_error`
- `ocnssf_discovery_nrf_tx_failed`
- `ocnssf_subscription_nrf_tx_failed`

For information on Metrics and KPIs of NSSF, see NSSF Metrics and NSSF KPIs sections respectively.

Alerts

There are no new alerts for this feature.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.13 Auto-Population of Configuration Based on NSAvailability Update

AMF updates supported S-NSSAI for NSSF on a per TA basis using NSAvailability data. NSSF uses this data to update its configuration as per operator's configuration.

Currently, the data received from `Nnssf_NSSAIAvailability` update is not replicated to the provisional configuration (site-specific database). However, the data are crucial, as they are used in `Nnssf_NSSelection` service's operations. It is mandatory for an operator to configure NSAvailability data for each location that NSSF supports, or all S-NSSAIs that NSSF supports or restricts. The operator is required to configure not only the allowed S-NSSAI information from the AMF but also the restricted S-NSSAIs per TAC per PLMN. It can be done using CNC Console or REST based methods.

After this enhancement, the operator need not to configure the allowed S-NSSAIs, as it will be updated automatically based on the NSAvailability update from the AMF. However, the operator still needs to configure the restricted S-NSSAI information per TAC per PLMN, as it is not a part of the NSAvailability update.

Further, it allows NSSF to do following tasks in the NSAvailability update:

- **Configure `nssai_auth`**: If S-NSSAI is not already configured in `nssai_auth` table for that TAI, irrespective of the Grant Allowed, NSSF creates S-NSSAI entry on `nssai_auth` table.
- **Configure `nss_rule`**: If S-NSSAI is supported in one TAI, NSSF it configures an `nssai_auth`. Otherwise, NSSF configures an `nss_rule` for the accessType 3GPP.
- **Delete S-NSSAI entry**: When an AMF sends a delete request on NSAvailability update, NSSF checks if the AMF in the particular region supports the given S-NSSAI. If no AMFs in the particular geographical region supports a given S-NSSAI, NSSF deletes the corresponding `nssai_auth` and all `nss_rule` corresponding to that `nssai_auth`.

NSSF adds `nssai_auth` and the only one kind of `nss_rule`, which is accessType 3GPP. If an operator needs to support an S-NSSAI for a accessType Non 3GPP, then they must add an `nss_rule`.

Managing Auto-Population of Configuration Based on NSAvailability Update

Enable

There is no option to enable or disable this feature. If all the prerequisites are met, it will be autoenabled at the time of installation or after upgrade to the target version.

Configure

Operator must configure the following for this feature to work:

- Configure **PLMN Level NSI Profile** for each supported PLMN, as `nssai_auth` autoconfiguration happens only when default profile is configured for the PLMN. For more information on REST based configuration, see **PLMN Level NSI Profile** in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.* For more information on CNC Console based configuration, see PLMN Level NSI Profile in 'Configuring NSSF using CNC Console'.
- Configure `nss_rule` for SNSSAIs supported for Non 3GPP accessType. For more information on REST based configuration, see **NSS Rule** in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.* For more

information on CNC Console based configuration, see NSS Rule in 'Configuring NSSF using CNC Console'.

Observe

No new metrics or KPIs are generated for this feature. For information on other Metrics and KPIs of OCNSSF, see OCNSSF Metrics and OCNSSF KPIs sections respectively.

Error Scenarios

For Auto-Population of Configuration Based on NSAvailability Update, logs are generated for NSAvailability, when error is due to configuration in the PLMN Level NSI Profile.

Table 4-3 Error Scenarios

Scenario	Microservice	Response Code/ Error Title	Log Snippet

PLMN Level NSI Profile is not configured	Nnssf_NSSAIAvailability	Configuration issue: PLMN Level Profile is not configured for <MCC> <MNC> Unable to process nsavailability request
		500 Response with details missing configuration.
		Unable to find PLMN level profile for <MCC> <MNC>
			{
			"instant": {
			"epochSecond": 1661325081,
			"nanoOfSecond": 495990110
			},
			"thread": "XNIO-1 task-1",
			"level": "ERROR",
			"loggerName": "com.oracle.cgbu.cne.nssf.nsavailability.dataservicehelper.AmfTaiSnssaiMapDataPopulation",
			"message": "CONFIGURATION_ERROR: Unable to find Plmn Level Profile",
			"endOfBatch": false,
			"loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger",
			"contextMap": {
			"ocLogId": "1661325081404_2998_ocnssf-ingress-gateway-fd65885d6-lppss"
			},
			"threadId": 234,
			"threadPriority": 5,
			"ts": "2022-08-24 07:11:21.495+0000",
			"ocLogId": "1661325081404_2998_ocnssf-ingress-gateway-fd65885d6-lppss",
			"pod": "ocnssf-nsavailability-65466b5f48-xtvgz",
			"processId": "1",
			"vendor": "Oracle",
			"application": "ocnssf",
			"engVersion": "22.2.0",
			"mktgVersion": "22.2.0.0.0",
			"microservice": "nsavailability",
			"namespace": "ocnssf",
			"node_name": "k8s-node-8.bulkhead.lab.us.oracle.com"
			}

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.14 Handover from EPS to 5G

The current market retains a broad mix of UEs in both 4G and 5G networks. These UEs move from one network to another network in multiple ways:

1. From one 5G PLMN to another 5G PLMN (VPLMN), that is from one 5G network to another 5G network (also known as 5G to 5G roaming).
2. From 4G network to 5G network inside the same "PLMN" (also known as EPS to 5G).

In both the scenarios, a slice mapping mechanism is required on the NSSF of a visited PLMN (VPLMN). This feature implements the support for EPS to 5G slice mapping in NSSF, that is the second case in the list given above.

When a UE moves from 4G network to a 5G network (EPS to 5G), a registration of UE is triggered in the 5G network. The AMF, which caters to UE in 4G, requests to MAP and figure out Authorized 5G S-NSSAIs for the UE. However, the EPS to 5G move is only possible when there are converged 4G-5G nodes on operator network.

Following are high-level scenarios for EPS to 5G movement of a UE:

Scenario 1: UE is moving from EPS to 5G of a VPLMN (For example: Customer of Network-1 is moving from EPS of Network-2 to 5G of Network-2).

Scenario 2: UE is moving from EPS to 5G of the UE's HPLMN (For example: Customer of Network-1 is moving from EPS of Network-1 to 5G of Network-1).

This movement of UE from EPS to 5G is similar to that of a roaming handover, because there is a change in PLMN in both the scenarios.

The following call flow takes places in the entire process of EPS to 5G handover:

1. AMF sends a **`SliceInfoForRegistration`** GET request to NSSF. Only the following three parameters are considered for this feature when `requestMapping` is set to true:
   - `sNssaiForMapping`
   - `requestedNssai`
   - `requestMapping`
2. The query parameters may also contain:
   - Mapping to the Configured NSSAI for the HPLMN
   - PLMN ID of the Subscription Permanent Identifier (SUPI)
   - UE's current Tracking Area
   - NF type of the NF service consumer
   - AMF ID
3. NSSF identifies from the messages if AMF or UE requires EPS to 5G handover.
4. If yes, NSSF sends selected NSSAI based on below conditions:
   a. If mapping is already provided, NSSF uses the mapped S-NSSAI and applies the policy.

b. If `requestMapping` is enabled, NSSF takes the 4G slice and maps it to 5G S-NSSAI by sending the corresponding NSSAI in the `allowedNssaiList` after policy check and confirms the same by responding with `AuthorizedNetworkSliceInfo`.

c. If the mapping is not available, the NSSF responds with 4XX status.

The following tables provide the details of the request (`SliceInfoForRegistration`) and the response (`AuthorizedNetworkSliceInfo`), respectively:

Table 4-4 Request: `SliceInfoForRegistration`

Attribute name	Data type	Description
`sNssaiForMapping`	array(Snssai)	This IE is included if the `requestMapping` IE is set to `true`. When included, the IE may contain any of the following: • The set of S-NSSAIs obtained from PGW+SMF in the HPLMN for PDU sessions that are handed over from EPS to 5GS. • The set of HPLMN S-NSSAIs obtained from source AMF during handover procedure within 5GS. • The S-NSSAIs for the HPLMN received from the UE during EPS to 5GS idle mode Mobility Registration Procedure using N26 interface or idle state mobility registration procedure in 5GS.
`requestedNssai`	array(Snssai)	This IE contains the set of S-NSSAIs requested by the UE. • During EPS to 5GS handover procedure using N26 interface, this IE contains the set of S-NSSAIs in the serving PLMN obtained from PGW+SMF in VPLMN or mapped from the set of S-NSSAIs obtained from PGW+SMF in the HPLMN. • During handover procedure within 5GS, the IE contains the set of S-NSSAIs in the serving PLMN obtained from the source AMF, or mapped from the set of HPLMN S-NSSAIs obtained from source AMF.
`requestMapping`	boolean	This IE may be present when the Nnssf_NSSelection_Get procedure is invoked during EPS to 5GS Mobility Registration Procedure (Idle State) using N26 interface or during EPS to 5GS handover procedure using N26 interface. This IE may also be present when Nnssf_NSSelection_Get procedure is invoked during idle state Mobility Registration Procedure or handover procedure in 5GS. When present this IE indicates to the NSSF that the NSSF returns the VPLMN specific mapped SNSSAI values for the S-NSSAI values in the `sNssaiForMapping` IE.

Table 4-5 Response: `AuthorizedNetworkSliceInfo`

Attribute name	Data type	Description

Table 4-5 (Cont.) Response: `AuthorizedNetworkSliceInfo`

`allowedNssaiList`	array(AllowedNssai)	This IE is included one of the following conditions is true: • The NSSF received the Requested NSSAI and the subscribed S-NSSAI(s). • The `requestMapping` flag in the corresponding request is set to `true`. When present, this IE may contain any of the following: • The allowed S-NSSAI(s) authorized by the NSSF in the serving PLMN per access type if the Requested NSSAI and the Subscribed S-NSSAI(s) received. • The mapping of S-NSSAI(s) of the VPLMN to corresponding HPLMN S-NSSAI(s) if `requestMapping` flag is set to `true`. NSSF considers load level information of a Network Slice Instance, provided by the NWDAF, to exclude slices that are overloaded.

Managing Handover from EPS to 5G

Enable

This feature is driven by 3GPP specifications. There is no option to enable or disable this feature. If all the **prerequisites** are met, it will be auto enabled at the time of installation or after upgrade to the target version.

Configure

Operator must configure `MappingOfNssai` for each PLMN for this feature to work. For more information on REST based configuration, see **MappingOfNssai** in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

Observe

No new metrics or KPIs are generated for this feature. For information on other Metrics and KPIs of OCNSSF, see OCNSSF Metrics and OCNSSF KPIs sections respectively.

Error Scenarios

For the EPS to 5G Handover Feature, logs are generated for NSSelection mapping, when error is due to slice mapping determination or assignment to a UE or PDU session.

Table 4-6 Error Scenarios

Scenario	Microservice	Response Code/ Error Title	Log Snippet

Mapping is not found for any S-NSSAI in `sNssaiForMapping`.	NSSelection	No mapping 5G SNSSAI found for `SnssaiList` in PLMN
		Error: `RequestMappingFailed`
		403 Forbidden SNSSAI_NOT_SUPPORTED
			<pre>{
			  "instant": {
			    "epochSecond": 1661327119,
			    "nanoOfSecond": 10456886
			  },
			  "thread": "nf-mediation-thread-1",
			  "level": "ERROR",
			  "loggerName": "com.oracle.cgbu.cne.nssf.nsselection.service.NsPolicyServiceImpl",
			  "message": "No mapping 5G snssai found for[3:EABB03, 4:EABB04]inPlmn [mcc=100, mnc=101]",
			  "endOfBatch": false,
			  "loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger",
			  "contextMap": {},
			  "threadId": 54,
			  "threadPriority": 5,
			  "ts": "2022-08-24 07:45:19.010+0000",
			  "ocLogId": "${ctx:ocLogId}",
			  "pod": "ocnssf-nsselection-5bb7bb7799-gcs5r",
			  "processId": "1",
			  "vendor": "Oracle",
			  "application": "ocnssf",
			  "engVersion": "22.3.0",
			  "mktgVersion": "22.3.0.0.0",
			  "microservice": "nsselection",
			  "namespace": "ocnssf",
			  "node_name": "jazz-k8s-node-8"
			}</pre>

Table 4-6 (Cont.) Error Scenarios

Scenario	Microservice	Response Code/ Error Title	Log Snippet

Mapping not found for one or more S-NSSAIs and found for others.	NSSelection	NSSF logs error for S-NSSAI for which mapping is not found	{
			"instant": {
			"epochSecond": 1661327653,
			"nanoOfSecond": 516132707
			},
			"thread": "nf-mediation-thread-2",
			"level": "ERROR",
			"loggerName": "com.oracle.cgbu.cne.nssf.nsselection.service.NsPolicyServiceImpl",
			"message": "No mapping 5G snssai found for3:EABB03",
			"endOfBatch": false,
			"loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger",
			"contextMap": {},
			"threadId": 55,
			"threadPriority": 5,
			"ts": "2022-08-24 07:54:13.516+0000",
			"ocLogId": "${ctx:ocLogId}",
			"pod": "ocnssf-nsselection-5bb7bb7799-gcs5r",
			"processId": "1",
			"vendor": "Oracle",
			"application": "ocnssf",
			"engVersion": "22.3.0",
			"mktgVersion": "22.3.0.0.0",
			"microservice": "nsselection",
			"namespace": "ocnssf",
			"node_name": "jazz-k8s-node-8"
			}

Table 4-6 (Cont.) Error Scenarios

Scenario	Microservice	Response Code/ Error Title	Log Snippet

No allowed S-NSSAI are found for accessType = 3GPP	NSSelection	**Error**: RequestMappingFailed
		403 Forbidden SNSSAI_NOT_SUPPORTED
			{
			"instant": {
			"epochSecond": 1661327653,
			"nanoOfSecond": 609737045
			},
			"thread": "nf-mediation-thread-2",
			"level": "ERROR",
			"loggerName": "com.oracle.cgbu.cne.nssf.nsselection.service.NsPolicyServiceImpl",
			"message": "No allowed snssai with access type 3GPP for request mapping=true. Throwing ForbiddenException.",
			"endOfBatch": false,
			"loggerFqcn": "org.apache.logging.log4j.spi.AbstractLogger",
			"contextMap": {},
			"threadId": 55,
			"threadPriority": 5,
			"ts": "2022-08-24 07:54:13.609+0000",
			"ocLogId": "${ctx:ocLogId}",
			"pod": "ocnssf-nsselection-5bb7bb7799-gcs5r",
			"processId": "1",
			"vendor": "Oracle",
			"application": "ocnssf",
			"engVersion": "22.3.0",
			"mktgVersion": "22.3.0.0.0",
			"microservice": "nsselection",
			"namespace": "ocnssf",
			"node_name": "jazz-k8s-node-8"
			}

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.15 Feature Negotiation

This feature negotiates optional features applicable between NSSF and NF Service Consumer (AMF/V-NSSF) for the NSSF supported services. The NF Service Consumer indicates the optional features it supports for the Nnssf_NSSAIAvailability or Nnssf_NSSElection service by including the supported feature attributes.

The following optional supported features are defined for NSSF as per 3GPP:

1. **Nnssf_NSSAIAvailability service supportedFeatures attributes:**
   - **Subscription Modification (SUBMOD)**: This feature allows the operator to modify subscriptions by supporting HTTP Patch on NSAvailability (/nssai-availability/subscriptions/). When Subscription Modification in Subscribe Service Operation (SUMOD) is supported, the operator can modify the subscription of NSSAI availability by implementing the HTTP Patch method.
   - **Empty Authorized NSSAI Availability Notification (EANAN)**: When this feature is supported, an NF Consumer that supports EANAN accepts an empty array of Authorized NSSAI Availability Data in a notification from NSSF and deletes locally stored Authorized NSSAI Availability Data that was received previously.
   - **Optimized NSSAI Availability Data Encoding (ONSSAI)**: ONSSAI is one of the optional features supported by NSSF. NSSF, this feature is described in 3GPP TS 29.531. When ONSSAI is supported by AMF and NSSF, NSSAI Availability data may be signaled per list or per range(s) of Tracking Area Identifiers(TAIs).

Supported Feature Information Element (IE): Supported Feature is a hexadecimal string that contains a bitmask indicating supported features. Each character in the string can take a value of "0" to "9", "a" to "f" or "A" to "F". The character representing the highest-numbered features appears first in the string, and the character representing features 1 to 4 appears last in the string. The list of features and their numbering (starting with 1) are defined separately for each API. If the string contains a lower number of characters, then there are defined features for an API.

> **Note**
>
> Features represented by the characters that are not present in the string are not supported.

Table 4-7 SupportedFeatures for NSAvailability

Supported Feature based on supported feature set	ES3XX	EANAN	SUMOD	ONSSAI
"0"	no	no	no	no
"1"	no	no	no	yes
"2"	no	no	yes	no
"3"	no	no	yes	yes
"4"	no	yes	no	no
"5"	no	yes	no	yes
"6"	no	yes	yes	no
"7"	no	yes	yes	yes

Table 4-7 (Cont.) SupportedFeatures for NSAvailability

Supported Feature based on supported feature set	ES3XX	EANAN	SUMOD	ONSSAI
"8"	yes	no	no	no
"9"	yes	no	no	yes
"A"	yes	no	yes	no
"B"	yes	no	yes	yes
"C"	yes	yes	no	no
"D"	yes	yes	no	yes
"E"	yes	yes	yes	no
"F"	yes	yes	yes	yes

Table 4-8 SupportedFeatures for NSSelection

Supported Feature based on supported feature set	ES3XX
"0"	no
"1"	yes

Managing Feature Negotiation

Enable

To enable this feature, set the `global.SupportedFeatureNegotiationEnable` parameter to `true` under the `global` section in the `ocnssf_custom_values_23.4.0.yaml` file.

The following snippet represents the location of the mentioned parameter in the Helm file:

```
global:
 SupportedFeatureNegotiationEnable: true
```

Configure

There are no additional configurations required.

Observe

No new metrics or KPIs are generated for this feature. For information on other Metrics and KPIs of OCNSSF, see OCNSSF Metrics and OCNSSF KPIs sections respectively.

Error Scenarios

Table 4-9 Error Scenarios

Scenario	Helm Configuration	Output
NSSelection Get with supported feature. That is, '1'	SupportedFeatureNegotiationEnable:"true" 3gppFeatures: NsSelection: ES3XX: "true" NsAvailability: ONSSAI: "true" SUMOD: "true" EANAN: "true" ES3XX: "true"	Response with supported feature i.e. '1'
NSSelection Get with supported feature. That is, '2'	SupportedFeatureNegotiationEnable:"true" 3gppFeatures: NsSelection: ES3XX: "true" NsAvailability: ONSSAI: "true" SUMOD: "true" EANAN: "true" ES3XX: "true"	Response without supported feature Unsupported value provided for the Supported Feature. Maximum supportedFeatured value is : 1
NSAvailability request with supported feature. That is, '2'	SupportedFeatureNegotiationEnable:"true" 3gppFeatures: NsSelection: ES3XX: "true" NsAvailability: ONSSAI: "true" SUMOD: "true" EANAN: "true" ES3XX: "true"	Response with supported feature i.e. '2'

Table 4-9 (Cont.) Error Scenarios

Scenario	Helm Configuration	Output
NSAvailability request with supported feature. That is, '2'	`SupportedFeatureNegotiationEnable:" true" 3gppFeatures: NsSelection: ES3XX: "true" NsAvailability: ONSSAI: "true" SUMOD: "false" EANAN: "true" ES3XX: "true"`	Bad request 400 Error: All requested supported features are not enabled on NSSF. Enable features from NSSF are:ONSSAI,EANAN,ES3XX
NSAvailability request with supported feature. That is, '7'	`SupportedFeatureNegotiationEnable:" true" 3gppFeatures: NsSelection: ES3XX: "true" NsAvailability: ONSSAI: "false" SUMOD: "true" EANAN: "false" ES3XX: "false"`	Bad Request 400 Error: All requested supported features are not enabled on NSSF. Enable features from NSSF are:SUMOD

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.16 Subscription Modification Feature

This feature allows operator to modify subscription by supporting HTTP Patch on NsAvailability subscribe service operation (/nssai-availability/subscriptions/). Supported operations on HTTP Patch are ADD, REMOVE, and REPLACE. Whereas, COPY, MOVE, and TEST are not supported.

Managing Subscription Modification

Enable

To enable this feature, set the `global.SupportedFeatureNegotiationEnable` and `global.threegppFeatures.NsAvailability.SUMOD` parameters to `true` under the `global` section in the `ocnssf_custom_values_23.4.0.yaml` file.

The following snippet represents the location of the mentioned parameters in the Helm file:

```
global:
 SupportedFeatureNegotiationEnable: true
 threegppFeatures:
   NsAvailability:
   SUMOD: true
```

Configure

There are no additional configurations required.

Observe

- Added the following success measurements:
  - ocnssf_nssaiavailability_submod_rx
  - ocnssf_nssaiavailability_submod_success_response_tx
- Added the following error measurements:
  - ocnssf_nssaiavailability_submod_error_response_tx
  - ocnssf_nssaiavailability_submod_unimplemented_op
  - ocnssf_nssaiavailability_submod_patch_apply_error

For information about other Metrics and KPIs of NSSF, see NSSF Metrics and NSSF KPIs sections respectively.

Error Scenarios

Table 4-10 Error Scenarios

Scenario	Microservice	Request URL	Response Code/ Error Title
Patch request processing failed due to invalid path	Nnssf_NSSAIAvailability	nnssf-nssaiavailability/v1/nssai-availability/subscriptions/	422 Bad Request Error Jason "Patch Req processing failed"
Subscription with HTTP Patch (Option ADD). Subscription present and TAI addition not supported in PLMN.	Nnssf_NSSAIAvailability	nnssf-nssaiavailability/v1/nssai-availability/subscriptions/	HTTP 403 Unsupported PLMN Error Details must specify supported PLMN list
SUBMOD is set to false	Nnssf_NSSAIAvailability	nnssf-nssaiavailability/v1/nssai-availability/subscriptions/	HTTP 405 Method not allowed
Subscription ID is not found	Nnssf_NSSAIAvailability	nnssf-nssaiavailability/v1/nssai-availability/subscriptions/	HTTP 404 Not Found

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.17 Empty Authorized NSSAI Availability Notification

Empty Authorized NSSAI Availability Notification (EANAN) feature provides support for sending an empty array of Authorized NSSAI Availability Data when a notification trigger leads to a situation of no Tracking Area (TA) with Authorized NSSAI by the NSSF. An Access and Mobility Management Function (AMF) that supports this feature accepts the empty array of Authorized NSSAI Availability Data in a notification from NSSF and deletes locally stored Authorized NSSAI Availability Data that was received previously.

Managing EANAN

Enable

To enable this feature, set the `global.SupportedFeatureNegotiationEnable` and `global.threegppFeatures.NsAvailability.EANAN` parameters to `true` under the `global` section in the `ocnssf_custom_values_23.4.0.yaml` file.

The following snippet represents the location of the mentioned parameters in the Helm file:

```
global:
 SupportedFeatureNegotiationEnable: true
 threegppFeatures:
  NsAvailability:
    EANAN: true
```

Configure

There are no additional configurations required.

Observe

No new metrics or KPIs are generated for this feature. For information on other Metrics and KPIs of OCNSSF, see OCNSSF Metrics and OCNSSF KPIs sections respectively.

Scenarios

Table 4-11 Scenarios

Scenario	Helm Configuration	Subscription Details	Output

Send empty notification when EANAN is supported by both NSSF and Consumer NF for delete as notification trigger	`global.SupportedFeatureNegotiationEnable : true`
	
	`global.threegppFeatures.NsAvailability.EANAN : true`
		1. Configure nssai_auth to allow S-NSSAI-1 in TAI-1
		2. Send a subscribe for TAI-1 with supportedFeatures flag with EANAN bit set to true
		3. Delete nssai_auth
			1. Configuration of nssai_auth must be successful
			2. Subscription response must contain Authorized NSSAI Availability Data as S-NSSAI-1 for Tai-1 with EANAN bit in supportedFeatures set to true
			3. a. Delete nssai_auth must be done
			b. Notification from NSSF must contain empty Authorized NSSAI Availability Data

Do not send empty notification when EANAN is supported by NSSF and not by Consumer NF	`global.SupportedFeatureNegotiationEnable : true`
	
	`global.threegppFeatures.NsAvailability.EANAN : true`
		1. Configure nssai_auth to allow S-NSSAI-1 in TAI-1
		2. Send a subscribe for TAI-1 with supportedFeatures flag with EANAN bit set to false
		3. Delete nssai_auth
			1. Configuration of nssai_auth must be successful
			2. Subscription response must contain Authorized NSSAI Availability Data as S-NSSAI-1 for Tai-1 with EANAN bit in supportedFeatures set to false
			3. Delete nssai_auth must be done.

Table 4-11 (Cont.) Scenarios

Scenario	Helm Configuration	Subscription Details	Output

Do not send empty notification when EANAN is not supported by NSSF and supported by Consumer NF	`global.SupportedFeatureNegotiationEnable : true`
	
	`global.threegppFeatures.NsAvailability.EANAN : false`
		1. Configure nssai_auth to allow S-NSSAI-1 in TAI-1
		2. Send a subscribe for TAI-1 with supportedFeatures flag with EANAN bit set to true
		3. Delete nssai_auth
			1. Configuration of nssai_auth must be successful
			2. Subscription response must contain Authorized NSSAI Availability Data as S-NSSAI-1 for Tai-1 with EANAN bit in supportedFeatures set to false
			3. Delete nssai_auth must be done

Do not send empty notification when EANAN is not supported by NSSF and supported by Consumer NF	`global.SupportedFeatureNegotiationEnable : true`
	
	`global.threegppFeatures.NsAvailability.EANAN : false`
		1. Configure nssai_auth to allow S-NSSAI-1 in TAI-1
		2. Send a subscribe for TAI-1 with supportedFeatures flag with EANAN bit set to true
		3. Delete nssai_auth
			1. Configuration of nssai_auth must be successful
			2. Subscription response must contain Authorized NSSAI Availability Data as S-NSSAI-1 for Tai-1 with EANAN bit in supportedFeatures set to false
			3. Delete nssai_auth must be done

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.18 Optimized NSSAI Availability Data Encoding and TAI Range

Support for TAI range and Optimized NSSAI Availability Data Encoding(ONSSAI) is introduced in NSSF as per 3GPP TS 29.531 (Release 16):

NSSF supports Optimized NSSAI Availability Data Encoding (ONSSAI), which further extends support for TAI ranges. These two features work together to provide multiple benefits to NSSF. Listed below are the benefits of this feature:

Support for ONSSAI as per 3GPP Specifications 29.531 release 16

ONSSAI is one of the 3GPP Specification 29.531 supported optional features that NSSF negotiates using Feature Negotiation. When ONSSAI is supported by AMF and NSSF, NSSAI Availability data may be signaled per list or per range(s) of Tracking Area Identifiers(TAIs).

The feature bit of ONSSAI is exchanged between NSSF and NF Service Consumer, indicating the support for `taiList` and `taiRangeList`. With this support, NSSF and NF Service Consumers can exchange the capabilities in which the support of `taiList` and `taiRangeList` is also communicated. NSSF can now expose APIs and store the supported NSSAIs with respect to `taiList` and `taiRangeList`. This enables the operator to provide data with minimal entries, which reduces the effort while system configuration.

Support for TAI range in NSSF.

With the advent of 5G and the three types of 5G network slices (MIoT, eMBB, and URLLC), there could be millions of TAIs (and TACs) in a PLMN. As per current standards, the maximum number of slice instances in a 5G network can reach hundreds. Although the number of slice identifiers (SNSSAIs) in a PLMN is operator-dependent, there is a scope to scale this in thousands, and corresponding slice instance (NSI) in tens of thousands. Since there is a many-to-many mapping between TAIs and SupportedSNSSAIs, and this information is shared and authorized between NSSF and NF Service Consumer of `nssai_availability` service, the number of TAIs supported by an AMF can range in millions. This can lead to a massive increase in the number of messages with replicated data across NSSF and AMF.

The support for TAI ranges reduces the memory consumption at NSSF by eliminating the need for redundant data storage. Apart from this, the size of supported NSSAI towards NF Service Consumer is also reduced, which further improves the overall network throughput.

For Example:

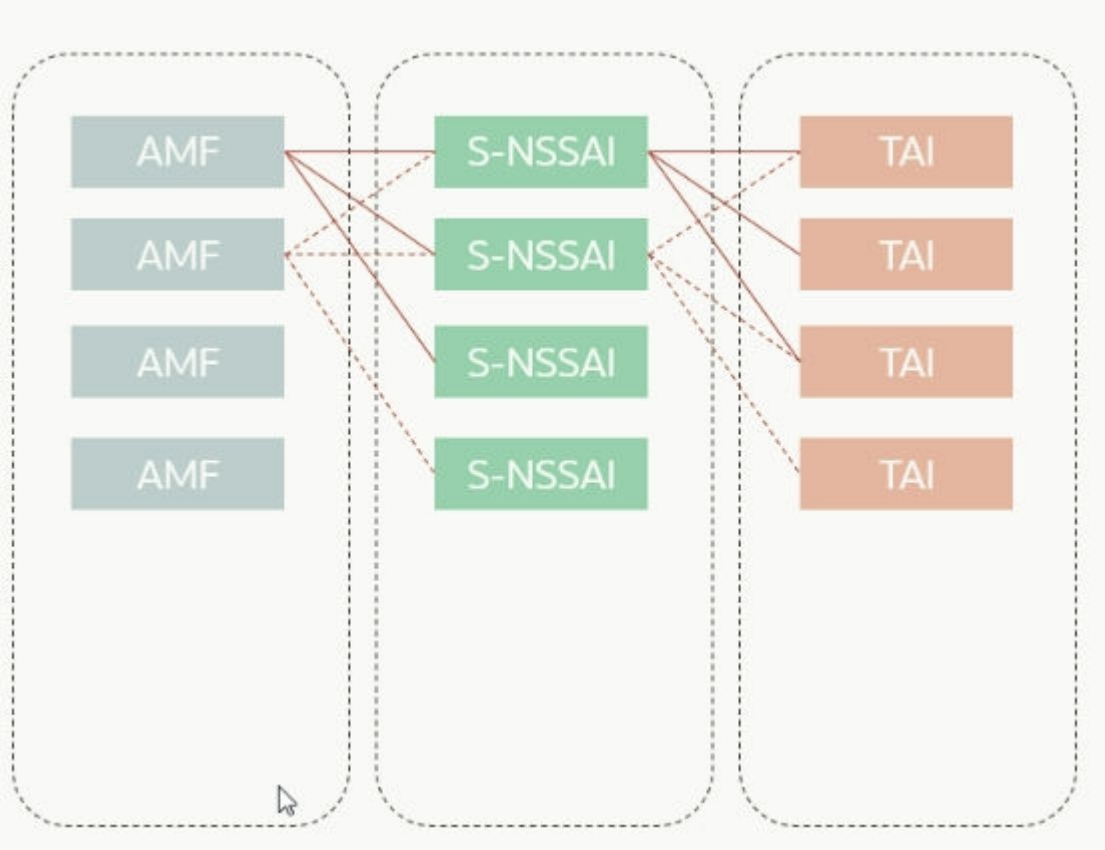
Consider a case with PLMN 100,101, which constitutes of 1000000 TACs; (1,10,00,000).

If the AMF Supports 300000 TACs, for TAC (1 - 300000):

- Supported SNSSAIs in TAC (1 -100000) are SNSSAI-1,SNSSAI-2,SNSSAI-3,
- supported SNSSAIs in TAC (100001 - 200000) are SNSSAI-2,SNSSAI-3,SNSSAI-4, and
- supported SNSSAIs in TAC (200001 - 300000) are SNSSAI-3, SNSSAI-4, SNSSAI-5.

Each AMF supports multiple TAIs and S-NSSAIs, as shown in the diagram below:

Figure 4-1 Association of AMF and TAI with S-NSSAI



The list of supported TAIs will be almost the same, but for different S-NSSAIs, NSSF requires huge storage space for the redundant data. This results in a substantial increase in the size of the notifications and hassles for managing such a huge configuration, as explained below:

Case 1: nssaiAvailabilityInfo without ONSSAI

Here, the list size of supportedNssaiAvailabilityData would be 300,000 with 3 unique and 299997 repeated SNSSAI list, here is a sample snippet:

```
{
    "supportedNssaiAvailabilityData": [
        {
            "tai": {
                "plmnId": {
                    "mcc": "100",
                    "mnc": "101"
                },
                "tac": "000001"
            },
            "supportedSnssaiList": [
                {
                    "sd": "000001",
                    "sst": 1
                },
                {
                    "sd": "000002",
```

```
                    "sst": 1
                },
                {
                    "sd": "000003",
                    "sst": 1
                }
            ]
        },
        {
            "tai": {
                "plmnId": {
                    "mcc": "100",
                    "mnc": "101"
                },
                "tac": "000002"
            },
            "supportedSnssaiList": [
                {
                    "sd": "000001",
                    "sst": 1
                },
                {
                    "sd": "000002",
                    "sst": 1
                },
                {
                    "sd": "000003",
                    "sst": 1
                }
            ]
        }...the list will go on for 3 unique and 299997 repeated SNSSAI list.
    ]
}
```

Case 2: nssaiAvailabilityInfo with ONSSAI

With the support for TAI range, there is an overlapping of TAIs. So, a TAI list of size 3 is enough to contain all 300,000 SNSSAI lists.

Following is a sample snippet:

```
{
    "supportedNssaiAvailabilityData": [
        {
            "tai": {
                "plmnId": {
                    "mcc": "100",
                    "mnc": "101"
                },
                "tac": "000001"
            },
            "supportedSnssaiList": [
                {
                    "sd": "000001",
                    "sst": 1
                },
```

```
                {
                    "sd": "000002",
                    "sst": 1
                },
                {
                    "sd": "000003",
                    "sst": 1
                }
            ],
            "taiRangeList":[
                {
                    "plmnId": {
                    "mcc": "100",
                    "mnc": "101"
                },
                "tacRangeList":[
                    {
                    "start": "000001",
                    "end": "100000"
                    }
                    ]

                }
                ]
        },
         {
            "tai": {
                "plmnId": {
                    "mcc": "100",
                    "mnc": "101"
                },
                "tac": "000001"
            },
            "supportedSnssaiList": [
                {
                    "sd": "000002",
                    "sst": 1
                },
                {
                    "sd": "000003",
                    "sst": 1
                },
                {
                    "sd": "000004",
                    "sst": 1
                }
            ],
            "taiRangeList":[
                {
                    "plmnId": {
                    "mcc": "100",
                    "mnc": "101"
                },
                "tacRangeList":[
                    {
                    "start": "100001",
```

```
                        "end": "200000"
                        }
                        ]

                    }
                    ]
            },
            {
                "tai": {
                    "plmnId": {
                        "mcc": "100",
                        "mnc": "101"
                    },
                    "tac": "000001"
                },
                "supportedSnssaiList": [
                    {
                        "sd": "000003",
                        "sst": 1
                    },
                    {
                        "sd": "000004",
                        "sst": 1
                    },
                    {
                        "sd": "000005",
                        "sst": 1
                    }
                ],
                "taiRangeList":[
                    {
                        "plmnId": {
                        "mcc": "100",
                        "mnc": "101"
                    },
                    "tacRangeList":[
                        {
                        "start": "200001",
                        "end": "300000"
                        }
                        ]

                    }
                    ]
            }
        ]
}
```

Managing ONSSAI and TAI Range

Enable

To enable ONSSAI, set the `global.SupportedFeatureNegotiationEnable` and `global.threegppFeatures.NsAvailability.ONSSAI` parameter to `true` under the `global` section in the `ocnssf_custom_values_23.4.0.yaml` file.

The following snippet from the yaml file represents the location of the mentioned parameters in the Helm file:

```
global:
 SupportedFeatureNegotiationEnable: true
 threegppFeatures:
  NsAvailability:
    ONSSAI: true
```

Configure

Configuration using Helm Parameters:

There are no additional configurations required in the helm parameters.

Configuration using Managed Objects:

`TacRange` managed object, and `tacrange` parameter under `NSSAI Auth` and `NSS Rules` provide the support required to use TAI range feature. To perform the feature configuration, see `NssRule`, `NssaiAuth`, and `TacRange` managed objects in the chapter **NSSF Managed Objects** of *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

Observe

No new metrics or KPIs are generated for this feature. For information on other Metrics and KPIs of OCNSSF, see OCNSSF Metrics and OCNSSF KPIs sections respectively.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.19 Georedundancy

NSSF supports up to three-site Georedundancy to ensure service continuity when one of the NSSF sites is down. When NSSF is deployed as georedundant NSSF instances, then:

- All the sites that register with NRF work independently and are in Active state.
- Based on the Rank, each NSSF site subscribes to NRF for any state change of other NSSF sites and gets notified when an NSSF site goes down.
- The NFs in a given site need to configure one of the georedundant NSSF as the primary NSSF and others as secondary NSSF and tertiary NSSF, respectively.
- When the primary NSSF is available, the NFs send service requests to the primary NSSF. When the NSSF at the primary site is unavailable, the NFs redirect service requests to the secondary NSSF or tertiary NSSF, until the primary NSSF's Active status is restored.
- Priority based NSSF selection (at NF Consumer or SCP) can be implemented to ensure route traffic based on which NSSF site is up.

The NSSF's data gets replicated between the georedundant sites by using DB tier's replication service.

With NSSF georedundant feature, the NSSF Services (NSSelection and NSAvailability) will continue to work as independent service operations.

Following are the prerequisites for georedundancy:

- Each site must configure remote NSSF sites as georedundant mates.
- The configurations at each site must be same. The NSSF at all sites must handle the NFs in the same manner.
- Once the Georedundancy feature is enabled on a site, it cannot be disabled.
- If the Time Of the Day (TOD) feature is enabled, georedundant sites are time synchronized.
- NFs need to configure georedundant NSSF details as Primary, Secondary, and Tertiary NSSFs.
- Georedundant sites must have REST based configuration as explained in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.
- At any given time, NFs must communicate with only one NSSF. That is, NFs must register services and maintain heartbeats with only one NSSF. The data must be replicated across the georedundant NSSFs, allowing seamless NF mobility across NSSFs as required.

Managing NSSF Georedundancy Feature

Prerequisites

Following are the prerequisites to enable georedundancy feature in NSSF:

- cnDBTier must be installed and configured for each site. For the installation procedure, see *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide.*
- The Database Replication Channels between the sites must be up.
- Configure MySQL Database, Users and Secrets. For the configuration procedure, see **Preinstallation Tasks** in *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation an Upgrade Guide.*

Enable Georedundancy Feature

Configure the following to enable the georedundancy feature:

> **Note**
>
> Configuring these attributes during deployment is mandatory before enabling the georedundancy feature. Otherwise, georedundancy cannot be enabled, and NSSF at the site will act as a stand-alone NSSF.

Helm Configuration for Database:

Configure the following parameters in the `ocnssf_custom_values_23.4.0.yaml` file for all three sites:

- `global.stateDbName`

- global.provisionDbName
- global.releaseDbName
- global.nameSpace
- global.mysql.primary.host

At Site 1:

```
global:


 # Mysql NSSF Database Names
  stateDbName: 'nssfStateDB'
  provisionDbName: &provDB 'nssfProvSite1DB'



  # Mysql Release Database Name used to maintain release version
  releaseDbName: 'ocnssfReleaseDB'



  # NameSpace where secret is deployed
  nameSpace: &ns ocnssf1


  # Database configuration
  mysql:
    primary:
      host: &dbHost "mysql-connectivity-service.site1"
```

At Site 2:

```
global:

 # Mysql NSSF Database Names
  stateDbName: 'nssfStateDB'
  provisionDbName: &provDB 'nssfProvSite2DB'

  # Mysql Release Database Name used to maintain release version
  releaseDbName: 'ocnssfRelease2DB'

  # NameSpace where secret is deployed
  nameSpace: &ns ocnssf2


  # Database configuration
  mysql:
    primary:
      host: &dbHost "mysql-connectivity-service.site2"
```

At Site 3:

```
global:

 # Mysql NSSF Database Names
  stateDbName: 'nssfStateDB'
  provisionDbName: &provDB 'nssfProvSite3DB'

  # Mysql Release Database Name used to maintain release version
  releaseDbName: 'ocnssfRelease3DB'

  # NameSpace where secret is deployed
  nameSpace: &ns ocnssf3


  # Database configuration
  mysql:
    primary:
      host: &dbHost "mysql-connectivity-service.site3"
```

Helm Configuration of Parameters:

Configure the following parameters in the `ocnssf_custom_values_23.4.0.yaml` file for all three sites:

- `global.grEnabled`
- `global.nfInstanceId`
- `global.siteId`
- If `global.grEnabled` is set to `true`, Configure the following parameters as well:
  - `global.grEnv.maxSecondsBehindRemote`
  - `global.grEnv.dbMonitorServiceUrl`
  - `global.grEnv.peerGRSitesList.siteId`
  - `global.grEnv.peerGRSitesList.nfInstanceId`

For more information about configuring the parameters, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Installation, Upgrade, and Fault Recovery Guide*.

Following is the sample configuration at Site named "**site1**" (nfInstanceId: `9faf1bbc-6e4a-4454-a507-aef01a101a01`), which is georedundant with Sites, "**site2**" (NssfInstanceId: `9faf1bbc-6e4a-4454-a507-aef01a101a02`) and "**site3**" (NssfInstanceId: `9faf1bbc-6e4a-4454-a507-aef01a101a03`):

```
global:
  #Only applicable for NSSF microservices
  #=====================================================================
  # GR params
  #tag to enable GR
  grEnabled: true
  #InstanceId of NSSF used in case of GR
  nfInstanceId: "9faf1bbc-6e4a-4454-a507-aef01a101a01"
  #SiteID of NSSF used in case of GR
  siteId: "site1"
```

```
  #All parameters under this section are valid only if grEnabled is true
  grEnv:
    #Maximum allowed seconds behind remote site for replication
    maxSecondsBehindRemote: 5
    #URL to check db-replication status
    dbMonitorServiceUrl: "http://mysql-cluster-db-monitor-svc.site1:8080/db-
tier/status/replication/realtime"
    #GR sites list
    peerGRSitesList:
      - siteId: "site2"
      - nfInstanceId: "9faf1bbc-6e4a-4454-a507-aef01a101a02"
      - siteId: "site3"
      - nfInstanceId: "9faf1bbc-6e4a-4454-a507-aef01a101a03"
```

Following is the sample configuration at Site named "**site2**" (NssfInstanceId: `9faf1bbc-6e4a-4454-a507-aef01a101a02`), which is georedundant with Sites, "**site1**" (NssfInstanceId: `9faf1bbc-6e4a-4454-a507-aef01a101a01`) and "**site3**" (NssfInstanceId: `9faf1bbc-6e4a-4454-a507-aef01a101a03`):

```
global:
   #Only applicable for NSSF microservices
  #====================================================================
  # GR params
  #tag to enable GR
  grEnabled: true
  #InstanceId of NSSF used in case of GR
  nfInstanceId: "9faf1bbc-6e4a-4454-a507-aef01a101a02"
  #SiteID of NSSF used in case of GR
  siteId: "site2"
  #All parameters under this section are valid only if grEnabled is true
  grEnv:
    #Maximum allowed seconds behind remote site for replication
    maxSecondsBehindRemote: 5
    #URL to check db-replication status
    dbMonitorServiceUrl: "http://mysql-cluster-db-monitor-svc.site2:8080/db-
tier/status/replication/realtime"
    #GR sites list
    peerGRSitesList:
      - siteId: "site1"
      - nfInstanceId: "9faf1bbc-6e4a-4454-a507-aef01a101a01"
      - siteId: "site3"
      - nfInstanceId: "9faf1bbc-6e4a-4454-a507-aef01a101a03"
```

Following is the sample configuration at Site named "**site3**" (NssfInstanceId: `9faf1bbc-6e4a-4454-a507-aef01a101a03`), which is georedundant with Sites, "**site1**" (NssfInstanceId: `9faf1bbc-6e4a-4454-a507-aef01a101a01`) and "**site2**" (NssfInstanceId: `9faf1bbc-6e4a-4454-a507-aef01a101a02`)

```
global:
  # GR params
  #tag to enable GR
  grEnabled: true
  #InstanceId of NSSF used in case of GR
  nfInstanceId: "9faf1bbc-6e4a-4454-a507-aef01a101a03"
  #SiteID of NSSF used in case of GR
```

```
  siteId: "site3"
  grEnv:
    #Maximum allowed seconds behind remote site for replication
    maxSecondsBehindRemote: 5
    #URL to check db-replication status
    dbMonitorServiceUrl: "http://mysql-cluster-db-monitor-svc.site3:8080/db-
tier/status/replication/realtime"
    #GR sites list
    peerGRSitesList:
      - siteId: "site1"
      - nfInstanceId: "9faf1bbc-6e4a-4454-a507-aef01a101a01"
      - siteId: "site2"
      - nfInstanceId: "9faf1bbc-6e4a-4454-a507-aef01a101a02"
```

Observe

No new metrics or KPIs are generated for this feature. For information on other Metrics and KPIs of OCNSSF, see OCNSSF Metrics and OCNSSF KPIs sections respectively.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.20 Time of the Day Based Network Slice Instance Selection

5G Traffic rate is not constant at all times, there might be spike in the traffic rate at certain busy hours. There can be occasional spikes based on holiday season. To manage these spikes and avoid traffic loss or over utilization of resources, operators may create network slice instance on need basis, or operators may create specific additional network slices to manage spikes in busy hours. The NSSF feature TOD (time of day based slice selection) allows operator to configure policy to select slice based on the time spans. Operator can provide date spans, day spans, time spans, or any combination of above to provide a policy to select network slice different catering to same SNSSAI based on date. This makes operator able to provide additional slices and enhances NSSF to select different slices based on another parameters. (apart from TAI + SNSSAI).

Managing Time of the Day Feature

Enable

This feature is enabled by default. If time spans are configured, NSSF selects network slice based on local NSSF. time.

Configure

Using helm parameters

If `reqnftime` flag is set to true, the time provided in `Requester-NF-Time` will the time considered. If `reqnftime` flag is set to false, local NSSF time will be considered.

Using Managed Objects

This sample configuration shows a way to configure 2 time profiles and a rule to ensure time based selection of network slice instance profile.

Table 4-12 Sample configuration

Time profile	Network Slice instance profile
Week day rush hour	NSI-PROFILE-1
Christmas	NSI-PROFILE-2
Default fall back	NSI-PROFILE-3

Sample Time Profiles

The following sample allows operator to configure a time profile for Weekdays busy hours. For more information on time profile configuration, see *Oracle Communication Cloud Native Core, Network Slice Selection Installation, Upgrade, and Fault Recovery Guide*.

```
{
    "name": "WEEKDAY_BUSY",
    "startDate": "2019-01-01",
    "endDate": "2020-12-31",
    "daysOfWeek": [
        "MONDAY",
        "TUESDAY",
        "WEDNESDAY",
        "THURSDAY",
        "FRIDAY"
    ],
    "timeSpans": [
        {
            "startTime": "07:00:00",
            "endTime": "12:00:00"
        },
        {
            "startTime": "17:00:00",
            "endTime": "22:00:00"
        }
    ]
}

{
    "name": "CHRISTMAS-DAY",
    "startDate": "2019-12-24",
    "endDate": "2019-12-25",
    "daysOfWeek": [],
    "timeSpans": []
}
```

The following time span enables user to configure a time profile for Christmas irrespective of day.

```
{
    "name": "CHRISTMAS-DAY",
    "start Date": "2019-12-24",
    "end Date": "2019-12-25",
```

```
    "weekday": [],
    "time Spans": []
}
```

Configure NSSF rule to select different profiles based on time of day

```
{
    "name": "IR-RULE-TOD",
    "amfId": "22345678-abcd-efAB-CDEF-123456789012",
    "plmnId":
    {
        "mcc": "102",
        "mnc": "102"
    },
    "tac": "100002",
    "snssai":
    {
        "sst": "1",
        "sd": "EABB01"
    },
    "salience": "0",
    "behavior":
    {
        "accessType": "3GPP_ACCESS",
        "nsiProfiles":
        [
            {
                "name": "NSI-PROFILE-2",
                "timeProfile": "CHRISTMAS_DAY",
                "salience": 3
            },
            {
                "name": "NSI-PROFILE-1",
                "timeProfile": "WEEKDAY_BUSY",
                "salience": 2
            }
            {
                "name": "NSI-PROFILE-3",
                "salience": 1
            }
        ]
    },

}
```

Note

In above rule configuration of *Salience* field for each time profile is to ensure that Christmas profile gets highest priority ("salience": 3), then Week day rush hour and then fallback which is default profile.
Network slice profiles must be preconfigured. To configure slice profiles see, *Oracle Communication Cloud Native Core, Network Slice Selection Installation, Upgrade, and Fault Recovery Guide*.

Observe

Following are the metrics related to Time of the Day feature :
ocnssf_nsselection_rx

ocnssf_nsselection_success_response_tx

ocnssf_nsselection_policy_match

ocnssf_nsselection_time_match

ocnssf_nsselection_nsi_selected

For further information about the Metrics and KPIs, see NSSF Metrics and NSSF KPIs sections respectively.

Maintain

- There must be a default fall back while configuring rule if none of the time profiles match.
- Salience of time profile within behavior section must be different for different time profiles; this it to have proper behavior if there is an overlap of time spans.

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.21 Multiple PLMN Support

This feature enables single NSSF instance to cater to multiple PLMNs. This enables operator to define slice selection policies for multiple PLMNs, and gives the option for operator to span a network slice across PLMNs.
NSSF allows the user to add the supported PLMN list which must be used for registering with NRF. Any change in supported PLMN list must trigger a Register request towards NRF with updated profile. Requests which have TAI containing other PLMN will be treated as roaming.

Managing Multiple PLMN Support

Enable

If the `global.supportedPlmnList` has valid parameter values, then multiple PLMN feature is enabled.

To enable this feature, open the `ocnssf_custom_values_23.4.0.yaml` file and set `global.supportedPlmnList` to valid values as shown the example below:

```
#Sample to enable
#Multiple PLMN support Following is the way to ensure only (100,101) and
(100,02)
  supportedPlmnList:
    - mcc: 100
      mnc: 101
    - mcc: 100
      mnc: 02
```

Disable

If the `global.supportedPlmnList` is empty, then multiple PLMN feature is disabled. To disable this feature, open the `ocnssf_custom_values_23.4.0.yaml` file and set global.supportedPlmnList to empty in Helm file, as shown the example below:

```
#Sample to disable multiple PLMN
supportedPlmnList: []
```

Observe

Following are the metrics related to Multiple PLMN Support:
ocnssf_nsselection_unsupported_plmn

ocnssf_nsavailability_unsupported_plmn

ocnssf_nsselection_rx

ocnssf_nsselection_success_response_tx

ocnssf_nsselection_policy_match

ocnssf_nsselection_time_match

ocnssf_nsselection_nsi_selected

ocnssf_nsselection_policy_not_found

For further information about the Metrics and KPIs, see NSSF Metrics and NSSF KPIs sections respectively.

Error Scenarios

Table 4-13 Error Scenarios

Scenario	Micro service and URL	Request URL	Response code / Error Title	Notes
Request comes from unknown PLMN	NSSelection	/nnssf-nsselection/v1/network-slice-information/	403 `PLMN_NOT_SUPPORTED`	No query sent to DB. Look into configured parameters and respond
Request comes from known PLMN	NSSelection	/nnssf-nsselection/v1/network-slice-information/	200 OK based on policy match	
Subscription request for unknown PLMNs only	NSAvailability	/nnssf-nssaiavailability/v1/nssai-availability/subscriptions	403 `PLMN_NOT_SUPPORTED`	No query sent to DB. as none of the PLMNs are supported

Table 4-13 (Cont.) Error Scenarios

Scenario	Micro service and URL	Request URL	Response code / Error Title	Notes
Subscription request for unknown PLMNs and known PLMNs	NSAvailability	/nnssf-nssaiavailability/v1/nssai-availability/subscriptions	204	Subscription done for TAIs for which PLMN is supported Query sent to DB only for TAIs with PLMNs which are supported by NSSF
AMF tries to store session data for unknown PLMNs only	NSAvailability	nnssf-nssaiavailability/v1/nssai-availability	403 PLMN_NOT_SUPPORTED	No query sent to DB. as none of the PLMNs are supported
AMF tries to store session data for unknown PLMNs and known PLMNs	NSAvailability	nnssf-nssaiavailability/v1/nssai-availability	200 OK based on Match	Session Data is stored only for the supported PLMNs
AMF tries to update session data for unknown PLMNs only	NSAvailability	nnssf-nssaiavailability/v1/nssai-availability	403 PLMN_NOT_SUPPORTED	No query sent to DB. as none of the PLMNs are supported
AMF tries to update session data for unknown PLMNs and known PLMNs	NSAvailability	nnssf-nssaiavailability/v1/nssai-availability	200 OK based on Match	Session Data is stored only for the supported PLMNs
Operator tries to configure nsi_auth for unsupported PLMN	NSConfig	nnssf-configuration/v1/nssaiauth/ nnssf-configuration/v1/nssrules/ /nnssf-configuration/v1/configurednssais	403 PLMN_NOT_SUPPORTED "	Currently as we are not supporting roaming scenario Operator must not be allowed to add policy configuration for unknown PLMNs

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.

2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.22 Support Indirect Communication

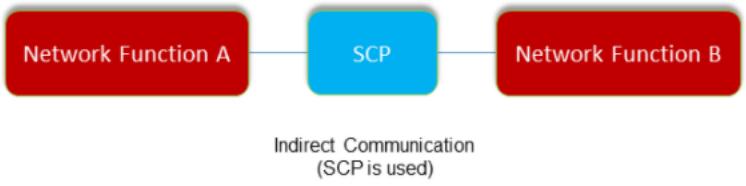
3GPP TS 29.531 Release 16 has introduced a new NF SCP which enables reliability and resiliency within network.

In indirect mode of communication consumers and producers interact through SCP. There are two communication models as described below:

Model C - Indirect communication without delegated discovery: Consumers do discovery by querying the NRF. Based on discovery result, the consumer does the selection of an NF Set or a specific NF instance of NF set. The consumer sends the request to the SCP containing the address of the selected service producer pointing to a NF service instance or a set of NF service instances. In the later case, the SCP selects an NF Service instance. If possible, the SCP interacts with NRF to get selection parameters such as Location, capacity, etc. The SCP routes the request to the selected NF service producer instance.

Model D - Indirect communication with delegated discovery: Consumers do not perform any discovery or selection. The consumer adds any necessary discovery and selection parameters required to find a suitable producer to the service request. The SCP uses the request address and the discovery and selection parameters in the request message to route the request to a suitable producer instance. The SCP can perform discovery with an NRF and obtain a discovery result

Once this feature is enabled on NSSF, it allows consumer NFs (AMF) to perform routing and rerouting to NSSF through SCP leveraging following 3GPP headers "3gpp-Sbi–Binding" and "3gpp-Sbi--Routing-Binding".



Note

- This feature's scope involves the manipulation and updating of headers and values.
- It does not mandate that Notifications must go through SCP. The responsibility for configuring SCP to route the notifications is on the operator. For more information, see DNS SRV Based Selection of SCP in NSSF.
- NSSF only supports the following pattern of 3gpp-Sbi-Binding Header:
  `bl=nf-set;`
  `nfset=set<setId>.region<regionId>.amfset.5gc.mnc<mnc>.mcc<mcc>`
- NSSF only accepts subscription with 3gpp-Sbi-Binding from AMF, provided AMF must be a part of the AMF-Set.

.

Managing Indirect Communication

Enable

To enable this feature, set the value of `indirectCommunicationSupportEnable` to `true` in the `ocnssf_custom_values_23.4.0.yaml` file.

```
# Indirect communication support
indirectCommunicationSupportEnable: true
```

The scope of this feature is Subscription and Notification flow.

When this feature is enabled:

- When AMF sends a NsAvailability Subscribe with 3gpp-Sbi-Binding header, NSSF validates if the header Supported Format is:

  ```
  bl=nf-set;
  nfset=set<setId>.region<regionId>.amfset.5gc.mnc<mnc>.mcc<mcc>
  ```

  - Only the following format is supported:

    ```
    bl=nf-set;
    nfset=set<setId>.region<regionId>.amfset.5gc.mnc<mnc>.mcc<mcc>
    ```

  - In case of a successful validation, the NSSF responds with a 201 status code. The response includes a "3gpp-Sbi-Binding" header containing NSSF's binding information.
  - The NSSF computes its binding information by matching the NSSF set details for the corresponding PLMN.
  - The NSSF stores the Binding header of the AMF set in the database.
  - When sending a notification for the subscription, the same value from the AMF's binding header is included in the notification as the "3gpp-Sbi-Routing-Binding" header.
  - Additionally, the NSSF adds a "3gpp-Sbi-Callback" header with the value `Nnssf_NSSAIAvailability_Notification`.
- If the AMF sends a NsAvailability Subscribe request without the "3gpp-Sbi-Binding" header:
  - The NSSF responds without including the "3gpp-Sbi-Binding" header in the response.
  - The NSSF does not add the "3gpp-Sbi-Routing-Binding" header in the notification.
  - The processing of the request remains unchanged, and there is no impact on the processing and response, except that the mentioned headers are not computed or included as specified above.

Disable

To disable this feature, set the value of `indirectCommunicationSupportEnable` to `false` in the `ocnssf_custom_values_23.4.0.yaml` file.

- When `indirectCommunicationSupportEnable` is set to `false`:
  - When AMF sends a NsAvailability Subscribe with 3gpp-Sbi-Binding header:
    * NSSF ignores the header and process the request.

* NSSF does not add 3gpp-Sbi-Routing-Binding header in the notification.

```
# Indirect communication support
indirectCommunicationSupportEnable: false
```

Observe

- Added the following success measurements:
  - ocnssf_nssaiavailability_indirect_communication_rx
  - ocnssf_nssaiavailability_indirect_communication_tx
  - ocnssf_nssaiavailability_notification_indirect_communication_tx
  - ocnssf_nssaiavailability_notification_indirect_communication_rx
- Added the following error measurements:
  - ocnssf_nssaiavailability_indirect_communication_subscription_failure
  - ocnssf_nssaiavailability_indirect_communication_notification_failure

For more information on above metrics and KPIs, see NSSF Metrics and NSSF KPIs.

Error Scenarios

Table 4-14 Error Scenarios

Scenario	Input Details	Output

Subscription with binding, global.indirectCommunicationSupportEnable is set to true, NSSF is part of nfSet.	**Input message:**
	Subscribe with header
	3gpp-Sbi--Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc012.mcc345
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 201 Created
		Headers
		Location: http://10.178.246.56:30075/nnssf-nssaiavailability/v1/nssai-availability/subscriptions/1
		3gpp-Sbi-Binding: bl=nf-set; nfset=set1.nssfset.5gc.mnc012.mcc345
		Notification with headers
		3gpp-Sbi-Routing-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc012.mcc345
		3gpp-Sbi-Callback: Nnssf_NSSAIAvailability_Notification

Subscription without binding, global.indirectCommunicationSupportEnable is set to true, NSSF is part of nfSet.	**Input message:**
	Subscribe without Header (Direct)
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 201 Created
		Location: http://10.178.246.56:30075/nnssf-nssaiavailability/v1/nssai-availability/subscriptions/1

Table 4-14 (Cont.) Error Scenarios

Scenario	Input Details	Output

Subscription with binding, global.indirectCommunicationSupportEnable is set to false, NSSF is part of nfSet.	**Input message:**
	Subscribe with header
	3gpp-Sbi-Routing-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc012.mcc345
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: false`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 201 Created

Subscription without binding, global.indirectCommunicationSupportEnable is set to false, NSSF is part of nfSet.	**Input message:**
	Subscribe without Header (Direct)
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: false`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 201 Created

Subscription with binding, global.indirectCommunicationSupportEnable is set to true, NSSF is not part of nfSet.	**Input message:**
	Subscribe with Header
	3gpp-Sbi-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc012.mcc345
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet:` Not part of nf-set but part of GR
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 201 Created
		Headers
		Location: http://10.178.246.56:30075/nnssf-nssaiavailability/v1/nssai-availability/subscriptions/1
		3gpp-Sbi-Routing-Binding: bl=nf-instance; nfinst=54804518-4191-46b3-955c-ac631f953ed7; backupnfinst=54804518-4191-46b3-955c-ac631f953ed8
		Notification with headers
		3gpp-Sbi-Routing-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc012.mcc345
		3gpp-Sbi-Callback: Nnssf_NSSAIAvailability_Notification
		ERROR Log

Table 4-14 (Cont.) Error Scenarios

Scenario	Input Details	Output

Subscription with binding, global.indirectCommunicationSupportEnable is set to true, NSSF is not part of nfSet.	**Input message:**
	Subscribe with Header
	3gpp-Sbi-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc012.mcc345
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet:` Not part of nf-set and not part of GR
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status 500 Internal Server Error
		Cause: CONFIGURATION_ERROR
		
		`{ "type": "INTERNAL_SERVER_ERROR", "title": "CONFIGURATION_ERROR", "status": 500, "detail": "Indirect Communication is true but NFset is null and GR is also not enabled.", "instance": "null", "cause": "CONFIGURATION_ERROR" }`

Subscription with binding, global.indirectCommunicationSupportEnable is set to true, NSSF is part of nfSet.	**Input message:**
	Subscribe with Header
	3gpp-Sbi-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc012.mcc345
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nssfApiRoot: Invalid URL(Empty)`
		Subscription Response
		Status: 500 Internal Server Error
		Cause: CONFIGURATION_ERROR
		
		`{ "type": "INTERNAL_SERVER_ERROR", "title": "INVALID_LOCATION_URL", "status": 500, "detail": "Invalid location/ nssfApiRoot url", "instance": "null", "cause": "CONFIGURATION_ERROR" }`

NSSF supports multiple PLMNSubscription with binding, global.indirectCommunicationSupportEnable is set to true, NSSF is part of nfSet. NSSF supports PLMN from which AMF is requesting	**Input message:**
	Subscribe with Header3gpp-Sbi-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc100.mcc101
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nfSet: set1.nssfset.5gc.mnc100.mcc101`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 201 Created
		Headers
		Location: http://10.178.246.56:30075/nnssf-nssaiavailability/v1/nssai-availability/subscriptions/1
		3gpp-Sbi-Binding: bl=nf-set; nfset=set1.nssfset.5gc.mnc100.mcc101
		Notification with headers
		3gpp-Sbi-Routing-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc100.mcc101
		3gpp-Sbi-Callback: Nnssf_NSSAIAvailability_Notification

Table 4-14 (Cont.) Error Scenarios

Scenario	Input Details	Output

NSSF supports multiple PLMNSubscription with binding, global.indirectCommunicationSupportEnable is set to true, NSSF is part of nfSet. NSSF do not support PLMN from which AMF is requesting	**Input message:**
	Subscribe with Header
	3gpp-Sbi-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc200.mcc201
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nfSet: set1.nssfset.5gc.mnc100.mcc101`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 403
		Cause: PLMN_NOT_SUPPORTED
		
		`{ "type": "FORBIDDEN", "title": "PLMN_NOT_SUPPORTED", "status": 403, "detail": "Unsupported PLMN/S received , supported plmn list: [Plmn [mcc=100, mnc=101], Plmn [mcc=100, mnc=02], Plmn [mcc=310, mnc=14], Plmn [mcc=345, mnc=012]]", "instance": "null", "cause": "PLMN_NOT_SUPPORTED" }`

Subscription with invalid binding header, global.indirectCommunicationSupportEnable is set to true, NSSF is part of nfSet.	**Input message:**
	Subscribe with Header
	3gpp-Sbi-Binding: bl=nfserviceset; nfset=set1.region48.amfset.5gc.mnc012.mcc345
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 400 Bad Request
		Cause: INVALID_INPUT_DATA
		
		`{ "type": "BAD_REQUEST", "title": "INVALID_INPUT_DATA", "status": 400, "detail": "Invalid 3gpp-Sbi-Binding Header, Only following pattern is supported bl=nf-set; nfset=set<setId>.region<regionId>.amfset.5gc.mnc<mnc>.mcc<mcc>", "instance": "null", "cause": "INVALID_INPUT_DATA" }`

Table 4-14 (Cont.) Error Scenarios

Scenario	Input Details	Output

Subscription with invalid binding header, global.indirectCommunicationSupportEnable is set to true, NSSF is part of nfSet.	**Input message:**
	Subscribe with Header3gpp-Sbi-Binding: bl=nf-set nfset=set1.amfset.5gc.mnc012.mcc345
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 400 Bad Request
		Cause: INVALID_INPUT_DATA
		
		`{ "type": "BAD_REQUEST", "title": "INVALID_INPUT_DATA", "status": 400, "detail": "Invalid 3gpp-Sbi-Binding Header, Only following pattern is supported bl=nf-set; nfset=set<setId>.region<regionId>.amfset.5gc.mnc<mnc>.mcc<mcc>", "instance": "null", "cause": "INVALID_INPUT_DATA" }`

Subscription with invalid binding header, global.indirectCommunicationSupportEnable is set to true, NSSF is part of nfSet.	**Input message:**
	Subscribe with Header
	3gpp-Sbi-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc8120.mcc345
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 400 Bad Request
		Cause: INVALID_INPUT_DATA
		
		`{ "type": "BAD_REQUEST", "title": "INVALID_INPUT_DATA", "status": 400, "detail": "Invalid mnc 8120 in 3gpp-Sbi-Binding Header", "instance": "null", "cause": "INVALID_INPUT_DATA" }`
		
		Description: Invalid mnc 8120 in 3gpp-Sbi-Binding Header

Table 4-14 (Cont.) Error Scenarios

Scenario	Input Details	Output

Subscription with invalid binding header, global.indirectCommunicationSupportEnable is set to true, NSSF is part of nfSet.	**Input message:**
	Subscribe with Header
	3gpp-Sbi-Binding: bl=nf-set; nfset=set1.region48.amfset.5gc.mnc8120.mcc345;
	scope=callback; scope=other-service
	Helm Parameters and Values:
	`global.indirectCommunicationSupportEnable: true`
	`global.nfSet: set1.nssfset.5gc.mnc012.mcc345`
	`global.nssfApiRoot: http://10.178.246.56:30075/`
		Subscription Response
		Status: 400 Bad Request
		Cause: INVALID_INPUT_DATA
		`{ "type": "BAD_REQUEST", "title": "INVALID_INPUT_DATA", "status": 400, "detail": "Invalid 3gpp-Sbi-Binding Header, Only following pattern is supported bl=nf-set; nfset=set<setId>.region<regionId>.amfset.5gc.mnc<mnc>.mcc<mcc>", "instance": "null", "cause": "INVALID_INPUT_DATA" }`
		Description: After 3 digits of MCC, there are other characters

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.23 IPv6 Support

Oracle supports dual-stack IPv4/IPv6 addressing. IPv6 (Internet Protocol version 6) is the sixth revision of the Internet Protocol and the successor to IPv4. It functions similarly to IPv4 in that it provides the unique IP addresses necessary for Internet-enabled devices to communicate. However, it does have one significant difference, that is, it utilizes a 128-bit IP address.

Managing IPv6 Support

Enable

To enable this feature, the following prerequisites must be satisfied:

- CNE or any CNE cloud network with IPv6 (Single stack) must be enabled.
- All cluster nodes must come with IPv6 address.

Configure

Sample configurations of IPv4 and IPv6 are given below:

> **Note**
>
> Ensure NRF, DB_Host are either in FQDN format or are in IPv6 to support IPv6.

IPv4

```
nrfclient:
  # Microservice level control if specific microservice need to be disabled
  nrf-client:
    # This config map is for providing inputs to NRF-Client
    configmapApplicationConfig:
      profile: |-
        [appcfg]
        primaryNrfApiRoot=10.75.225.191:31515
        secondaryNrfApiRoot=10.75.225.191:31515
        nrfScheme=http
        retryAfterTime=PT120S
        nrfClientType=NSSF
        nrfClientSubscribeTypes=NSSF
```

IPv6

```
nrfclient:
  # Microservice level control if specific microservice need to be disabled
  nrf-client:
    # This config map is for providing inputs to NRF-Client
    configmapApplicationConfig:
      profile: |-
        [appcfg]
        primaryNrfApiRoot=[fd00:10:96::aa0b]:31515
        secondaryNrfApiRoot=[fd00:10:96::95a]:31515
        nrfScheme=http
        retryAfterTime=PT120S
        nrfClientType=NSSF
        nrfClientSubscribeTypes=NSSF
```

Observe

NSSF behavior does not change based on underlying IP layer. If the installation and services are running, the NSSF behavior remains the same.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.24 Supports Integration with ASM

NSSF leverages the Istio or Envoy service mesh (Aspen Service Mesh) for all internal and external communication. The service mesh integration provides inter-NF communication and allows API gateway co-working with service mesh. The service mesh integration supports the services by deploying a special sidecar proxy in the environment to intercept all network communication between microservices.

See **Configuring NSSF to support ASM** in *Oracle Communication Cloud Native Core, Network Slice Selection Function Installation and Upgrade Guide* for more details on configuring ASM.

4.25 Supports Compression Using Accept-Encoding or Content-Encoding gzip

HTTP data is compressed before it is sent from the server, to improve transfer speed and bandwidth utilization.

HTTP headers let the client and the server pass additional information with an HTTP request or response.

The **Content-Encoding**, when present in response, its value indicates which encoding is applied to the entity-body. It lets the client know how to decode in order to obtain the media-type referenced by the Content-Type header.

The **Accept-Encoding** header is used to find out the encoding supported by the server. The server responds with the type of encoding used, indicated by the Accept-Encoding response header.

Syntax:

Accept-Encoding: gzip

Content-Encoding: gzip

Managing Supports Compression Using Accept-encoding/Content-encoding gzip

Enable
To enable this feature, set the value of `nsavailability.contentEncodingEnabled` to `true` in the `ocnssf_custom_values_23.4.0.yaml` file.

```
#Sample to enable gzip compression

nsavailability.contentEncodingEnabled: true
```

Configure
This sample configuration shows minimum response size over which compression of response triggers, if `contentEncodingEnabled` is set to `true`.

Helm parameter `maxRequestSize` is the acceptable size of request.

```
#Sample configuration gzip compression
  # Minimum response size required for compression to happen (size is in
bytes)
```

```
nsavailability.compressionMinimumResponseSize: 1024
# Maximum limit for request size
nsavailability.maxRequestSize: 1MB
```

Observe
The following measurements are related to *Supports compression using Accept-encoding/ Content-encoding gzip* feature:

ocnssf_nssaiavailability_options_rx

ocnssf_nssaiavailability_options_tx_status_ok

ocnssf_nssaiavailability_options_tx_status_unsupportedmediatetype

For further information about Metrics and KPIs, see NSSF Metrics and NSSF KPIs sections respectively.
Message Scenarios

Table 4-15 Message Scenarios

Scenario	Helm Parameter (server.compression.enabled)	Response code	Response in gzip ?	Response Header
AMF sends an NSAvailability PUT with Request Message size is more than max acceptable size	NA	413 (Request Entity Too Large error)	No	NA
Client sends HTTP OPTIONS with "Accept-encoding" of any value (blank or empty included) other than gzip	Yes	415 (Unsupported Media Type)	NA	Accept-Encoding: gzip Allowed Methods : POST, PUT, PATCH, DELETE Reason: Informs the client to optimize future interactions

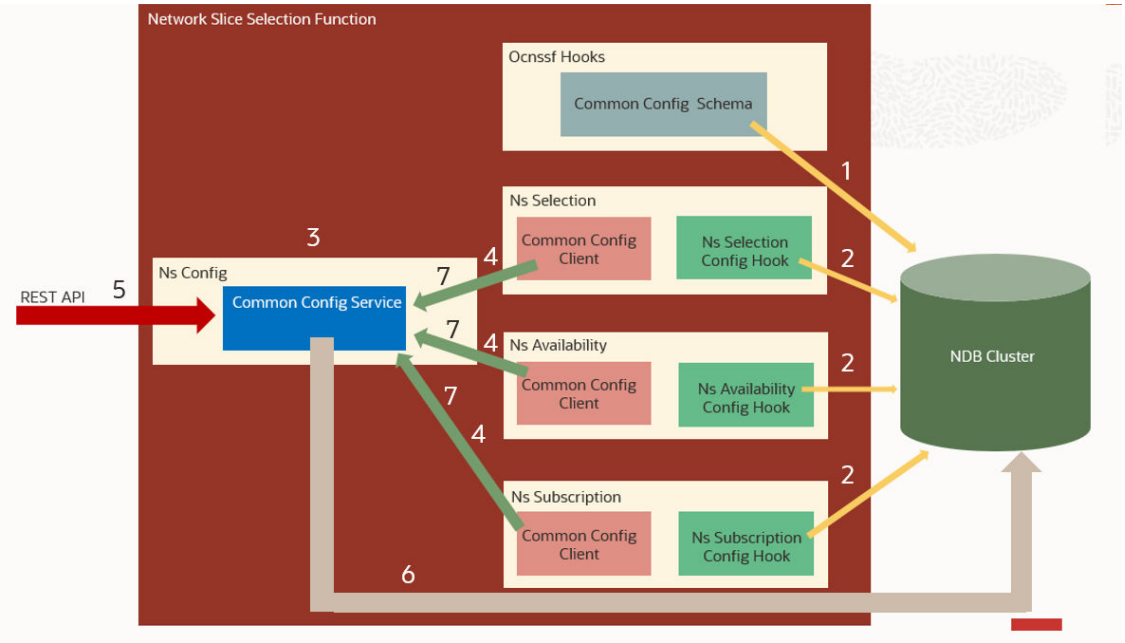
Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.26 Dynamic Log Level Update

Dynamic Log Level Update allows operator to update NSSF log level dynamically without restart.



The log level can be changed by the user at run time. NSSF use common configuration service for dynamically updating Logging Information.

Managing Dynamic Log Level Update

Enable

1. Customize the `ocnssf_custom_values_23.4.0.yaml` helm file.
2. Set `commonCfgClient.enabled` to `true` in the helm file.

Table 4-16 Parameters Configuration

Name	Default	Description
commonCfgClient.enabled	true	Enable/Disable Client.
commonCfgClient.pollingInterval	5000	Set Polling Interval in Milliseconds

Configure

For more information on REST APIs, see **Runtime Log Level Update** in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

Observe

No new metrics or KPIs are generated for this feature. For information on other Metrics and KPIs of OCNSSF, see OCNSSF Metrics and OCNSSF KPIs sections respectively.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.27 NF Authentication using TLS Certificate

HTTPS support is a minimum requirement for 5G NFs as defined in 3GPP TS 33.501 Release 15. This feature enables extending identity validation from Transport layer to the Application layer and also provides a mechanism to validate the NF FQDN presence in TLS certificate as added by the Service Mesh against the NF Profile FQDN present in the request.
HTTPS enables end to end encryption of messages to ensure security of data. HTTPS requires creation of TLS (Mutual TLS by 2 way exchange of ciphered keys).

Managing NF Authentication using TLS Certificate

Steps to Enable HTTPS in NSSF

Certificate Creation
To create certificate user must have the following files:

- ECDSA private key and CA signed certificate of NRF (if initial algorithm is ES256)
- RSA private key and CA signed certificate of NRF (if initial algorithm is RSA256)
- TrustStore password file
- KeyStore password file
- CA certificate

Secret Creation

Execute the following command to create secret:

```
$ kubectl create secret generic ocnssfaccesstoken-secret --from-
file=ecdsa_private_key_pkcs8.pem --from-file=rsa_private_key_pkcs1.pem
      --from-file=trustStorePassword.txt --from-file=keyStorePassword.txt --
from-file=ecdsa_ocnssf_certificate.crt--from-file=rsa_ocnssf_certificate.crt -
n
    ocnssf
```

Certificate and Key Exchange

Once the connection is established, both parties can use the agreed algorithm and keys to securely send messages to each other. The handshake has 3 main phases:

- Hello
- Certificate Exchange
- Key Exchange

1. **Hello:** The handshake begins with the client sending a ClientHello message. This contains all the information the server needs in order to connect to the client via SSL, including the various cipher suites and maximum SSL version that it supports. The server responds with a ServerHello, which contains similar information required by the client, including a decision based on the client's preferences about which cipher suite and version of SSL will be used.
2. **Certificate Exchange:** Now that contact has been established, the server has to prove its identity to the client. This is achieved using its SSL certificate, which is a very tiny bit like its passport. An SSL certificate contains various pieces of data, including the name of the

owner, the property (For example: domain) it is attached to, the certificate's public key, the digital signature and information about the certificate's validity dates. The client checks that it either implicitly trusts the certificate, or that it is verified and trusted by one of several Certificate Authorities (CAs) that it also implicitly trusts. The server is also allowed to require a certificate to prove the client's identity, but this only happens in very sensitive applications.

3. **Key Exchange:** The encryption of the actual message data exchanged by the client and server is done using a symmetric algorithm, the exact nature of which was agreed during the Hello phase. A symmetric algorithm uses a single key for both encryption and decryption, in contrast to asymmetric algorithms that require a public or private key pair. Both parties need to agree on this single, symmetric key, a process that is accomplished securely using asymmetric encryption and the server's public or private keys.

The client generates a random key to be used for the main, symmetric algorithm. It encrypts it using an algorithm also agreed upon during the Hello phase, and the server's public key (found on its SSL certificate). It sends this encrypted key to the server, where it is decrypted using the server's private key, and the interesting parts of the handshake are complete. The parties are identified that they are talking to the right person, and have secretly agreed on a key to symmetrically encrypt the data that they are about to send each other. HTTP requests and responses can be sent by forming a plain text message and then encrypting and sending it. The other party is the only one who knows how to decrypt this message, and so Man In The Middle Attackers are unable to read or modify any requests that they may intercept.

NSSF supports following cipher suites

```
- TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256
- TLS_DHE_RSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
```

HTTPS Encrypted Communication

Once the HTTPS handshake is complete all communications between the client and the server are encrypted. This includes the full URL, data (plain text or binary), cookies and other headers.

The only part of the communication not encrypted is what domain or host the client requested a connection. This is because when the connection is initiated an HTTP request is made to the target server to create the secure connection. Once HTTPS is established the full URL is used.

This initialization only needs to occur once for each unique connection. This is why HTTP/2 has a distinct advantage over HTTP/1.1 since it multi-plexes connections instead of opening multiple connections.

Helm Configuration to enable HTTPS on NSSF:

Sample values.yaml to enable HTTPS on NSSF:

```
 #Enabling it generates key and trust store for https support
    initssl: true       (Note: secret has to be created if its set to true)
#If true opens https port on egress gateway
   enableincominghttps: false
#Enabling it egress makes https request outside
   enableoutgoinghttps: true
 (Note: initssl should be set to true if either enableincominghttps or
enableoutgoinghttps is enabled )
#KeyStore and TrustStore related private key and Certificate configuration
(Note: The configuration names specified should be same as the     file names
```

```
specified when creating secret)

   privateKey:
   k8SecretName: accesstoken-secret
   k8NameSpace: ocnssf
   rsa:
   fileName: rsa_private_key_pkcs1.pem

   certificate:
   k8SecretName: accesstoken-secret
   k8NameSpace: ocnssf
   rsa:
   fileName: ocnssf.cer

   caBundle:
   k8SecretName: accesstoken-secret
   k8NameSpace: ocnssf
   fileName: caroot.cer

   keyStorePassword:
   k8SecretName: accesstoken-secret
   k8NameSpace: ocnssf
   fileName: key.txt

   trustStorePassword:
   k8SecretName: accesstoken-secret
   k8NameSpace: ocnssf
   fileName: trust.txt

   initialAlgorithm: RSA256
```

4.28 Protection from Distributed Denial-of-Service (DDoS) Attack through Rate Limiting

Rate limiting for Ingress and Egress messages helps to prevent the DDoS attack.

NSSF uses `Bucket4j` which uses Token Bucket algorithm to enable rate limiting.

The token bucket algorithm has following concepts:

burstCapacity: The maximum number of token the bucket can hold.

duration: The amount of time between the refills.

refillRate: The number of tokens that are added to the bucket during a refill.

(where duration: in seconds (M), burstCapacity: (C), refillRate: (N))

- N tokens are added to the bucket every M seconds.
- The bucket can hold at the most C tokens. If a token arrives when the bucket is full, it is discarded.

Ingress Rate Limiting

To avoid unexpected behavior and DOS attacks ,NSSF allows user to enable rate limiting in ingress messages. NSSF allows user to configure a cap on max number of incoming messages at a given duration. User has an option to configure a max cap on number of ingress request per service.

Steps to Enable Ingress Rate Limiting
NSSF allows at the `max of {burstCapacity}/ {refillRate}` number of messages in a duration signified by parameter {duration}.

To enable ingress rate limiting at NSSF `ingress_gateway.rateLimiting.enabled` must be set to true.

Global Ingress Rate Limiting

When `globalIngressRateLimiting.enabled` is set to true then rate limiting is applied for all ingress messages.

Route Based Rate Limiting

NSSF provides option to configure route based rate limiting and method based rate limiting which enables NSSF to throttle messages per Service per method.

In the below example NSSF allows 80 GET requests on NSSelection service for every 2 seconds.

Sample ingress rate limiting configuration:

```
#Rate limiting configuration
rateLimiting:
  enabled: true
routeRateLimiting:
  enabled: true
# Global rate limiting configuration
globalIngressRateLimiting:
  enabled: true
  duration: 2 # in seconds
  burstCapacity: 100
  refillRate: 1

routesConfig:
- id: nsselection_mapping
  uri: http://ocnssf-nsselection:5745
  path: /nnssf-nsselection/**
  order: 1
#Route level limiting configuration enabled for NSSelection
  methodRateLimiting: # specify the list of methods u have to rate limit
  - method: GET
    burstCapacity: 80
    refillRate: 1
    duration: 2
#Route level limiting configuration not enabled for NSAvailability
- id: availability_mapping
  uri: http://ocnssf-nsavailability:5745
  path: /nnssf-nssaiavailability/**
  order: 2
- id: nsconfig_mapping
  uri: http://ocnssf-nsconfig:5755
```

```
  path: /nnssf-configuration/**
  order: 3
```

Egress Rate Limiting

NSSF sends notification messages to AMF based on configuration change of supported SNSSAI/s in a TAI. Notification messages can be throttled by operator by enabling egress message rate limiting.

Steps to Enable Egress Rate Limiting
To enable rate limiting `egress-gateway.notificationRateLimit.enabled` must be set to true.

As per the below example, NSSF has a max cap on 200 notifications per second:

```
egress-gateway:
  notificationRateLimit:
    enabled: false
    duration: 1
    bucketCapacity: 200
    refillRate: 1
```

To Observe Protection from Distributed Denial-of-Service (DDoS) Attack through Rate limiting

The following are the metrics related to Distributed Denial-of-Service (DDoS) Attack through Rate limiting:

- oc_ingressgateway_global_ratelimit
- oc_ingressgateway_route_ratelimit
- oc_egressgateway_notification_ratelimit

For further details of Metrics and KPIs, see NSSF Metrics and NSSF KPIs sections respectively.

Maintain

To resolve any alerts at the system or application level, see NSSF Alerts section. If the alerts persist, perform the following:

1. **Collect the logs**: For more information on how to collect logs, see *Oracle Communications Cloud Native Core, Network Slice Selection Function Troubleshooting Guide*.
2. **Raise a service request**: See My Oracle Support for more information on how to raise a service request.

4.29 Automated Testing Suite Support

NSSF provides Automated Testing Suite for validating the functionalities. Through Automated Testing Suite (ATS), Oracle Communications aims at providing an end-to-end solution to its customers for deploying and testing its 5G-NFs. See *Oracle Communications Cloud Native Core, Automated Testing Suite Guide* for more information.

5
Configuring NSSF using CNC Console

This chapter describes how to configure different NSSF managed objects using Oracle Communications Cloud Native Configuration Console (CNCC).

5.1 Support for Multicluster Deployment

CNC Console supports both single and multiple cluster deployments by facilitating NSSF deployment in local and remote Kubernetes clusters. For more information about single and multiple cluster deployments, see *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide*.

A single instance of CNC Console can configure multiple clusters of NSSF deployments, where each cluster has an agent console installation and a NSSF installation.

5.2 CNC Console Interface

This section provides an overview of the Oracle Communications Cloud Native Configuration Console (CNCC), which includes an interface to configure the NSSF features.

To configure the NSSF services using the CNCC, log in to the CNCC application. To log into CNCC, update the hosts file available at the **C:\Windows\System32\drivers\etc location** when CNCC is hosted on a third party cloud native environment.

1. In the Windows system, open the hosts file in the notepad as an administrator and append the following set of lines at the end of the hosts file:

   ```
   <CNCC Node IP> cncc-iam-ingress-gateway.cncc.svc.cluster.local
   <CNCC Node IP> cncc-core-ingress-gateway.cncc.svc.cluster.local
   ```

   For example:

   ```
   10.75.212.88 cncc-iam-ingress-gateway.cncc.svc.cluster.local
   10.75.212.88 cncc-core-ingress-gateway.cncc.svc.cluster.local
   ```

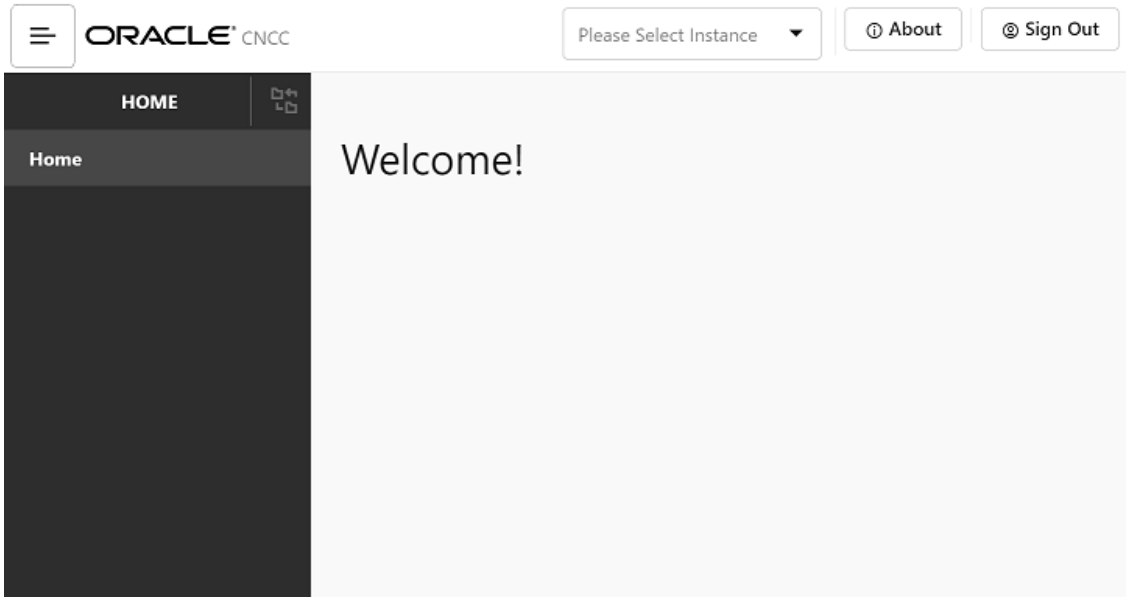
   > **Note**
   >
   > The IP Address mentioned above may change when the deployment cluster changes.

2. Save and close the hosts file.
   Before logging into CNC Console, create a CNCC user name and password. Log in to the CNC Console application using these login credentials. For information on creating a CNC Console user and password, see *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide*.

CNC Console Log in

Following is the procedure to log into CNC Console:

1. Open any web browser.
2. Enter the URL: http://<host name>:<port number>.
   where, host name is cncc-iam-ingress-ip and port number is cncc-iam-ingressport.
3. Enter valid login credentials.
4. Click **Log in**. The CNC Console interface is displayed.



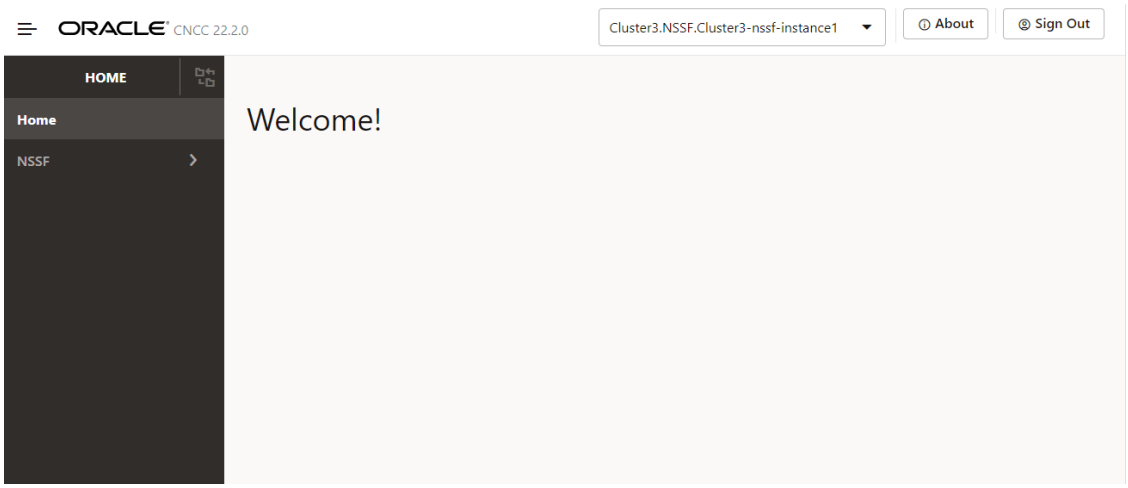
Select the required NF instance from the **Select Instance** drop-down list. The left pane displays the selected network function.

5.3 NSSF Configuration

This section describes how to configure different managed objects of NSSF using CNC Console.

On selecting NSSF instance from the drop-down list, the following screen appears:

Figure 5-1 NSSF Welcome Screen



5.3.1 AMF Resolution

Perform the following procedure to configure the AMF Resolution:

1. In the left navigation menu, navigate to **NSSF.**
2. Select **NSSF** and click **AMF Resolution**.
   The **AMF Resolution** page is displayed.
3. Click **Add** from the top right side to add **AMF Resolution** parameters.
4. Configure **AMF Resolution** fields as described in the following table:

Table 5-1 AMF Resolution Parameters

Field Name	Description
Region ID	Region ID of the target AMF list.
Set ID	Set ID of the target AMF list.
MCC	Mobile Country Code.
MNC	Mobile Network Code.
MCC-MNC-RegionID-SetID	Combination of MCC, MNC, RegionID, and SetID, separated by "-".

5. Click **Add** under **Candidate AMF Lists** to add the Candidate AMF Lists parameters. The **Add Candidate AMF Lists** pop-up window appears.
6. Enter the values for Candidate AMF Lists as described in the following table:

Table 5-2 Candidate AMF Lists Parameters

Field Name	Description
Instance ID	Instance id of the AMF.

7. Click **Save** to save or **Cancel** to discard your progress in the **Add Candidate AMF Lists** pop-up window.
8. Click **Save** to save or **Cancel** to discard your progress on the **Add AMF Resolution** page.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> Use the **Edit** or **View** icons available in the **Actions** column of the **AMF Resolution** page to update or view any preconfigured information of the AMF Resolution.

5.3.2 AMF Set

Perform the following procedure to configure the AMF Set:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **AMF Set**.
   The **AMF Set** page is displayed.
3. Click **Add** from the top right side to add **AMF Resolution** parameters.
4. Configure **AMF Set** fields as described in the following table:

Table 5-3 AMF Set Parameters

Field Name	Description
Region ID	Region ID of the target AMF list.
Set ID	Set ID of the target AMF list.
MCC	Mobile Country Code.
MNC	Mobile Network Code.
Salience	Order of importance (higher salience, more important). Default value is 0.
MCC-MNC-RegionID-SetID	Combination of MCC, MNC, RegionID, and SetID, separated by "-".

5. Click **Save** to save or **Cancel** to discard your progress on the **Add AMF Set** page.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> Use the **Edit, Delete, View** icons available in the **Actions** column of the **AMF Set** page to update, delete, or view any preconfigured information of the AMF Set.

5.3.3 Configured SNSSAI

Perform the following procedure to configure SNSSAI:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **Default Configured SNSSAI**.
   The **Configured SNSSAI** page is displayed.
3. Click **Add** from the top right side to add **Configured SNSSAI** parameters.
4. Configure **Configured SNSSAI** fields as described in the following table:

Table 5-4 Configured SNSSAI Parameters

Field Name	Description
MCC	Mobile Country Code.
MNC	Mobile Network Code.
PLMN ID	Combination of MCC and MNC, separated by "-".

5. Click **Add** under **NSSAI** to add the NSSAI parameters. The **Add NSSAI** pop-up window appears.
6. Enter the values for **Add NSSAI** parameters as described in the following table:

Table 5-5 NSSAI parameters

Field Name	Description
SST	Slice or Service Type.
SD	Slice Differentiator.

7. Click **Save** to save or **Cancel** to discard your NSSAI configuration in the **Add NSSAI** pop-up window.
8. Click **Save** to save or **Cancel** to discard your progress on the **Add Configured SNSSAI** page.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> Use the **Edit, Delete, View** icons available in the **Actions** column of the **Configured SNSSAI** page to update, delete, or view any preconfigured information of the Configured SNSSAI.

5.3.4 Georedundant Sites

Perform the following procedure to configure Georedundant Sites:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **Georedundant Sites**.
   The **Georedundant Sites** page is displayed.
3. Click **Add** from the top right side to add **Georedundant Sites** parameters.
4. Configure **Georedundant Sites** fields as described in the following table:

Table 5-6 Georedundant Sites Parameters

Field Name	Description
NF ID	Instance ID of the NSSF site.
Rank	The priority given by the operator to related georedundant sites.
Georedundant Site Status	Current status of the site or NSSF, status can be either ACTIVE or DOWN.

5. Click **Save** to save or **Cancel** to discard your progress on the **Add Georedundant Site** page.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> Use the **Edit, Delete, View** icons available in the **Actions** column of the **Georedundant Sites** page to update, delete, or view any preconfigured information of the Georedundant Sites.

5.3.5 NSI Profile

Perform the following procedure to configure NSI Profile:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **NSI Profile**.
   The **NSI Profile** page is displayed.
3. Click **Add** from the top right side to add **NSI Profile** parameters.
4. Configure **NSI Profile** fields as described in the following table:

Table 5-7 NSI Profile Parameters

Field Name	Description
Name	Network Slice Instance Profile Name.
NRF URI	URI of the Network Repository Function.
NRF NF Management URI	Management URI of Network Resource Function.
NRF Access Token URI	Access Token URI of Network Resource Function.
Network Slice Instance Identifier	Network Slice Instance Identifier code.
MCC	Mobile Country Code.
MNC	Mobile Network Code.

5. Click **Add** under **Target AMF Sets** to add the Target AMF Set parameters. The **Add Target AMF Sets** pop-up window appears.
6. Enter the values for **Add Target AMF Sets** parameters as described in the following table:

Table 5-8 Target AMF Sets parameters

Field Name	Description
Region ID	Region ID of Target AMF Set
Set ID	Set ID of Target AMF Set.
Salience	Salience of Target AMF Set.

7. Click **Save** to save or **Cancel** to discard your Target AMF Set configuration in the **Add Target AMF Set** pop-up window.
8. Click **Save** to save or **Cancel** to discard your progress on the **Add NSI Rule Profile** page.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> Use the **Edit, Delete, View** icons available in the **Actions** column of the **NSI Profile** page to update, delete, or view any preconfigured information of the NSI Profile.

5.3.6 NSSAI Auth

The configuration of NSSAI Auth denotes the mapping of allowed and restricted SNSSAI per TAI. It enables the configuration of network slice authentication rules by configuring Grant status (Allowed_PLMN, Rejected_PLMN, or Rejected_TAC) for S-NSSAI on a per TAI basis.

Query Parameters

Use **Query Parameters** to send GET or DELETE requests for the specified NSSAI Auth by providing the value of the "name" parameter of a target configured Network Slice Authentication Rule.

For example:

If a Network Slice Authentication Rule Name is "`2-AUTH-null-100001-200010-2-EABB02`", enter this value in the **Query Parameters** and Click **Get** or **Delete** respectively to fetch details of this rule or remove this configured Network Slice Authentication Rule.

> **Note**
>
> If the response data is above the configured display limit, a message is displayed stating "Response data has crossed the configured display limit (5 MB), please click on **Export** to download it as a file". Currently, the display limit cannot be modified, it is set to 5 MB.

To know more about the "name" parameter, see the table below or *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

Configuring NSSAI Auth

Perform the following procedure to configure NSSAI Auth:

1. From the left navigation menu, navigate to **NSSF.**
2. Select **NSSF** and click **NSSAI Auth**.
   The **NSSAI Auth** page is displayed.
3. Click **Add** from the top right side.
   A tabbed interface for **Response** and **Request** body appears.
4. Click on **Request** tab to configure request body parameters in JSON format.
5. Configure request body using the parameters described in the following table:

Table 5-9 NSSAI Auth Parameters

Field Name	Description
name	Network Slice Authentication Rule Name.
plmnId	Public Land Mobile Network ID (MCC:MNC).
tac	Tracking Area Code.
tacrange	Range of TAC represented by starttac and endtac. Either tac or tacrange would be present. If both are not present, then Auth corresponds to PLMN.
starttac	A 4/6 digit hexadecimal number that identifies starting value of a Tracking Area in a TAC range.
endtac	A 4/6 digit hexadecimal number that identifies ending value of a Tracking Area in a TAC range.
snssai	Single Network Slice Selection Assistance Information.
sst	Slice or Service Type
sd	Slice Differentiator
grant	Whether the requested s-NSSAI is 'ALLOWED' or 'RESTRICTED'.

6. Click **Submit** to send request with the configured request body parameters.
7. Click **Response** to see the response body of the sent request.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

Note

- Use the **Edit** and **Delete** options on the NSSAI Auth page to update or delete a request.
- Use **Get** option without providing the **Query Parameters** to view all existing Requests and corresponding Responses.
- Use **Export** option to download the response data as a JSON file.
- Use **Clear** option to clear the Request and Response panes.

5.3.7 NSS Rule

The NSS Rules Managed Object enables the configuration of policy rules. It enables an operator to allow, reject, or associate a Network slice based on NSSAI (SST and SD), PLMN (MCC and MNC), TAC, and AMF_ID. The operator can configure the salience value to prioritize rules. A higher salience value implies a higher priority of the rule.

Query Parameters

Use **Query Parameters** to send GET or DELETE requests for the specified NSS Rule by providing the value of the "name" parameter of a target configured Network Slice Selection Rule.

For example:

If a Network Slice Selection Rule Name is "TACRANGE-SNSSAI-1-RULE-4", then enter this value in the **Query Parameters** and Click **Get** or **Delete** respectively to fetch details of this rule or remove this configured Network Slice Selection Rule.

> **Note**
>
> If the response data is above the configured display limit, a message is displayed stating "Response data has crossed the configured display limit (5 MB), please click on **Export** to download it as a file". Currently, the display limit cannot be modified, it is set to 5 MB.

To know more about the "name" parameter, see the table below or *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

Configuring NSS Rule

Perform the following procedure to configure NSS Rule:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **NSS Rule**.
   The **NSS Rule** page is displayed.
3. Click **Add** from the top right side.
   A tabbed interface for **Response** and **Request** body appears.
4. Click on **Request** tab to configure request body parameters in JSON format.
5. Configure request body using the parameters described in the following table:

Table 5-10 NSS Rule Parameters

Field Name	Description
`name`	Network Slice Selection Rule Name.
`amfId`	AMF Identifier.
`plmnId`	Public Land Mobile Network ID (MCC:MNC).
`tac`	Tracking Area Code.
`tacrange`	Range of TAC represented by `starttac` and `endtac`. Either tac or tacrange would be present. If both are not present, then Auth corresponds to PLMN.
`starttac`	A 4/6 digit hexadecimal number that identifies starting value of a Tracking Area in a TAC range.
`endtac`	A 4/6 digit hexadecimal number that identifies ending value of a Tracking Area in a TAC range.
`snssai`	Single Network Slice Selection Assistance Information.
`sst`	Slice or Service Type
`sd`	Slice Differentiator
`salience`	The order of importance (higher salience, more important).
`behavior`	Behavior of the parameter.
`accessType`	"3GPP_ACCESS" or "NON_3GPP_ACCESS"
`nsiProfiles`	An array of `NsiProfile` map, which contains `name` and `salience` of the NSI Profile.

6. Click **Submit** to send request with the configured request body parameters.
7. Click **Response** to see the response body of the sent request.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> - Use the **Edit** and **Delete** options on the NSS Rule page to update or delete a request.
> - Use **Get** option without providing the **Query Parameters** to view all existing Requests and corresponding Responses.
> - Use **Export** option to download the response data as a JSON file.
> - Use **Clear** option to clear the Request and Response panes.

5.3.8 Time Profile

Perform the following procedure to configure Time Profile:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **Time Profile**.
   The **Time Profile** page is displayed.
3. Click **Add** from the top right side to add **Time Profile** parameters.
4. Configure **Time Profile** fields as described in the following table:

Table 5-11 Time Profile Parameters

Field Name	Description
Name	Time Profile Name.
Start Date	Date in the format of yy-mm-dd.
End Date	Date in the format of yy-mm-dd.
Days Of Week	Name of the day.

5. Click **Add** under **Time Spans** to add the Time Spans parameters. The **Add Time Spans** pop-up window appears.
6. Enter the values for Add Time Spans parameters as described in the following table:

Table 5-12 Time Span Parameters

Field Name	Description
Start Time	Start time in `hh:mm:ss` format.
End Time Date	End time in `hh:mm:ss` format.

7. Click **Save** to save or **Cancel** to discard your NSSAI configuration in the **Add Time Spans** pop-up window.
8. Click **Save** to save or **Cancel** to discard your progress on the **Add Time Profile** page.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> Use the **Edit, Delete, View** icons available in the **Actions** column of the **Time Profile** page to update, delete, or view any preconfigured information of the Time Profile.

5.3.9 Logging Level Options

Perform the following procedure to configure Logging Level Options:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **Logging Level Options**.
   The **Logging Level Options** page is displayed.

   This page displays a list of preconfigured log levels with the following details:

   - Service
   - Application Log Level
3. Click **View** on the right most column of a log level from the list to see the preconfigured log level details in a pop-up window named **View Log Level List**.
4. Click **X** icon to close **View Log Level List** pop-up window.
5. Click **Edit** from the top right side to edit **Logging Level Options** parameters.
6. Configure **Logging Level Options** fields as described in the following table:

Table 5-13 Logging Level Options Parameters

Field Name	Description
Service Type	Select the service type you want to configure from the drop-down list with the following options: • nsavailability • nsselection • nsaudit • nsconfig • nssubscription • egw • igw • nrf-client-nfdiscovery • nrf-client-nfmanagement
Application Log Level	Select log level for the application from the drop-down list with the following options: • DEBUG • ERROR • INFO • TRACE • WARN • FATAL
Package Log Level	This is a list of packages with corresponding log level applicable to the selected Service Type.

7. Click **Edit** under **Package Log Level** to edit the Package Log Level parameters for the selected Service Type. The **Edit Package Log Level** pop-up window appears.

8. Enter the values for **Edit Package Log Level** parameters as described in the following table:

Table 5-14 Package Log Level Parameters

Field Name	Description
Package	This field is non editable. It is preconfigured based on the selected Service Type.
Log Level	Select log level for the package from the drop-down list with the following options: • DEBUG • ERROR • INFO • TRACE • WARN • FATAL

9. Click **Save** to save or **Cancel** to discard your progress in the **Edit Package Log Level** pop-up window.
10. Click **Save** to save or **Cancel** to discard your progress on the **Edit Logging Level Options** page.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

5.3.10 PLMN Level NSI Profiles

Perform the following procedure to configure PLMN Level NSI Profiles:

1. In the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **PLMN Level NSI Profiles**.
   The **PLMN Level NSI Profiles** page is displayed.
3. Click **Add** from the top right side to add **PLMN Level NSI Profiles** parameters.
4. Configure **PLMN Level NSI Profiles** fields as described in the following table:

Table 5-15 PLMN Level NSI Profiles Parameters

Field Name	Description
Name	Name of the PLMN Level NSI Profile.
NRF URI	URI of the Network Repository Function.
NRF NF Management URI	Management URI of Network Resource Function.
NRF NF Access Token URI	Access Token URI of Network Resource Function.
Network Slice Instance Identifier	Network Slice Instance Identifier (nsid).
MCC	Mobile Country Code.
MNC	Mobile Network Code.
PLMN ID	Combination of MCC, MNC, RegionID, and SetID, separated by "-".

5. Click **Save** to save or **Cancel** to discard your progress on the **Add PLMN Level NSI Profile** page.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> Use the **Edit, Delete, View** icons available in the **Actions** column of the **PLMN Level NSI Profile** page to update, delete, or view any preconfigured information of the PLMN Level NSI Profile.

5.3.11 Mapping of Nssai

Mapping of Nssai is a mandatory Managed Object to support request mapping. It is added to support EPS to 5G handover and contains mapping of 4G S-NSSAI to 5G S-NSSAI for a given PLMN.

This Managed Object must be configured for each supported PLMN.

Query Parameters

Use **Query Parameters** to send GET, UPDATE, or DELETE requests for the specified Mapping of Nssai by providing the value of the "mcc" and "mnc" parameters is the following format.

```
mcc=<value>&mnc=<value>
```

For example:

If mcc and mnc are 100 and 101 respectively, enter these values in the Query Parameters and click Get, Edit, or Delete respectively to fetch, Update, or Delete details.

To know more about the parameters, see Table 5-16 or *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

Configuring Mapping of Nssai

Perform the following procedure to configure Mapping of Nssai:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **Mapping of Nssai**.
   The **Mapping of Nssai** page is displayed.
3. Click **Add** from the top right side.
   A tabbed interface for **Response** and **Request** body appears.
4. Click on **Request** tab to configure request body parameters in JSON format.
5. Configure request body using the parameters described in the following table:

Table 5-16 Mapping of Nssai Parameters

Field Name	Description
`mcc`	Specifies Mobile Country Code.
`mnc`	Specifies Mobile Network Code.
`mappingOfNssai`	Specifies an array of MappingOfSnssai. For more information, see Table 5-17.

Table 5-17 MappingOfSnssai

Attribute	Description
servingSnssai	This IE specifies the S-NSSAI value of serving network (5G).
homeSnssai	This IE specifies the mapped S-NSSAI value of home network (4G).

6. Click **Submit** to send request with the configured request body parameters.
7. Click **Response** to see the response body of the sent request.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> - Use the **Edit** and **Delete** options on the Mapping of Nssai page to update or delete a request.
> - Use **Get** option without providing the **Query Parameters** to view all existing requests and corresponding responses.
> - Use **Export** option to download the response data as a JSON file.
> - Use **Clear** option to clear the request and response panes.

5.3.12 NSSF Backup

This API provides the functionality to backup an existing configuration.

Configuring NSSF Backup

Perform the following procedure to configure NSSF Backup:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **NSSF Backup**.
   The **NSSF Backup** page is displayed.
3. Click **Get** from the top right side.
   A panel interface for **Response** appears, which contains the response body of the sent Get request.

For more information on REST API, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

> **Note**
>
> - Use **Export** option to download the response data as a JSON file.
> - Use **Clear** option to clear the Request and Response panes.

5.3.13 NSSF Restore

This API provides the functionality to restore an existing configuration restored as backup.

To know more about the parameters, see Table 5-18 or *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

Configuring NSSF Restore

Perform the following procedure to configure NSSF Restore:

1. From the left navigation menu, navigate to **NSSF**.
2. Select **NSSF** and click **NSSF Restore**.
   The **NSSF Restore** page is displayed.
3. Click **Add** from the top right side.
   A tabbed interface for **Response** and **Request** body appears.
4. Click on **Request** tab to configure request body parameters in JSON format.
5. Configure request body using the parameters described in the following table:

Table 5-18 NSSF Restore Parameters

Field Name	Description
`NsiProfile`	If NsiProfile is configured, this parameter contains list of NsiProfile.
`NssaiAuth`	If NssaiAuth is configured, this parameter contains list of NssaiAuth.
`TimeProfile`	If TimeProfile is configured, this parameter contains list of TimeProfile.
`NssRule`	If NssRule is configured, this parameter contains list of NssRule.
`AmfResolution`	If AmfResolution is configured, this parameter contains list of AmfResolution.
`ConfiguredSnssai`	If ConfiguredSnssai is configured, this parameter contains list of ConfiguredSnssai.

6. Click **Submit** to send request with the configured request body parameters.
7. Click **Response** to see the response body of the sent request.

For more information on parameter values, see *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide.*

Note

- Use **Export** option to download the response data as a JSON file.
- Use **Clear** option to clear the Request and Response panes.

6
NSSF Metrics, KPIs, and Alerts

This chapter includes information about Metrics, KPIs, and Alerts for Oracle Communications Cloud Native Core, Network Slice Selection Function.

> **Note**
>
> The performance and capacity of the NSSF system may vary based on the call model, Feature or Interface configuration, and underlying CNE and hardware environment.

6.1 NSSF Metrics

This section includes information about dimensions, common attributes, and metrics for NSSF.

Dimensions

The following table describes different types of metric dimensions:

Table 6-1 Dimensions

Dimension	Description	Values
retryCount	The attempt number of sending a notification.	Depends on the helm parameter httpMaxRetries (1, 2...)

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
ResponseCode	HTTP response code.	Bad Request, Internal Server Error etc. (HttpStatus.*)

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
CauseCode	It specifies the cause code of an error response.	Cause Code of the error response. For example, "SUBSCRIPTION_NOT_FOUND"

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
Message Type	This specifies the type of NS-Selection query message.	INITIAL_REGISTRATION/PDU_SESSION/UE_CONFIG_UPDATE

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
NFType	It specifies the name of the NFType.	For example: Path is /nxxx-yyy/vz/..... Where XXX(Upper Case) is NFType UNKNOWN if unable to extract NFType from the path.

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
NFServiceType	Name of the Service within the NF.	For Eg: Path is /nxxx-yyy/vz/..... Where nxxx-yyy is NFServiceType UNKNOWN if unable to extract NFServiceType from the path.

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
Host	Specifies IP or FQDN port of ingress gateway.	NA

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
HttpVersion	Specifies Http protocol version.	HTTP/1.1, HTTP/2.0

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
Scheme	Specifies the Http protocol scheme.	HTTP, HTTPS, UNKNOWN

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
ClientCertIdentity	Certificate identity of the client.	SAN=127.0.0.1,localhost CN=localhost, N/A if data is not available

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
Route_Path	Path predicate or Header predicate that matches the current	NA

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	rentrequest.	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
InstanceIdentifier	Prefix of the pod configured in helm when there are multi	Prefix configured in helm, UNKNOWN

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	pleinstancesinsamedeployment.	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
ErrorOriginator	Captures the Error Originator.	ServiceProducer, Nrf, IngresGW, None

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
quantile	Captures the latency values with ranges as 10ms, 20ms, 4	Integer values

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
		0ms, 800ms, 1000ms, 2000ms, 5000ms, 10000ms and 50000ms.

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
releaseVersion	Indicates the current release version of Egr	Picked from helm chart {{ .Chart.Version }}

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	esgateway.	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
configVersion	Indicates the configuration version that is being used	Value received from config server (1, 2...)

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	tewayiscurrentlymaintaining.	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
updated	Indicates whether the configuration is updated or not.	True, False

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
Direction	Indicates the direction of connection established, the	ingress, egressOut

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	atis, whether it is incoming or outgoing.	
AMF Instance Id	NF-Id of AMF	NA

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
Subscription- Id	Subscription-ID	NA
Operation	NSAvailabilityOperation	UPDATE/DELETE/SUBSCRIBE/UNSUBSCRIBE

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
Method	HTTP method	POST/PUT/PATCH/DELETE/GET/OPTIONS
Status	HTTP Response code	NA
query_type	Type of DB read query	applypolicy_reg/applypolicy_pdu/evaluate_amfset/evaluate_resolution

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
ConsumerNFInstanceId	NNF instance id of the NF service consumer.	NA

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
ConsumerNFType	The NF type of the NF service consumer.	NRF, UDM, AMF, SMF, AUSF, NEF, PCF, SMSF, NSSF, UDR, LMF, GMLC,5G_EIR, SEPP, UPF, N3IWF, AF, UDSF, BSF, CHF, NWDAF

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
TargetNFType	The NF type of the NF service producer.	NRF, UDM, AMF, SMF, AUSF, NEF, PCF, SMSF, NSSF, UDR, LMF, GMLC,5G_EIR, SEPP, UPF, N3IWF, AF, UDSF, BSF, CHF, NWDAF

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
TargetNFInstanceId	NF instance ID of the NF service producer	NA

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
scope	NNFservicename(s) of the NFservice producer(s), separat	NA

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	edbywhitespaces.	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
StatusCode	Status code of NRF access token request.	Bad Request, Internal Server Error etc. (HttpStatus.*)

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
issuer	NF instance ID of NRF	NA
subject	NF instance ID of service consumer	NA

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
reason	The reason contains the human readable message for oauth	NA

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	validationfailure.	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
ConfigurationType	Determines the type of configuration in place for OAuth	STATIC, DYNAMIC

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	ClientInEgressGatewayIfnrfClientQueryEnabledHe	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	Implementer initiated Client Heartbeat configuration at Egr	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	essGatewayisfalsethentheConfigurationTypeisSTAT	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
		IC, elseDYNAMIC.

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
id	DNA determines the key id or instance id that is configured	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	isPersistentConfigurationWhenNoAuthIsEnabled.	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
certificateName	DNA determines the certificate name inside the specific secr	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	ether that is configured via persistent config uration whe	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	noauthisenabled.	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
secretName	DNA determines the secret name that is configured via appersi	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	stentconfigurationwhenoauthisenabled	

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
Source	Determines if the configuration is done by the operator	OperatorConfig/LearnedConfigAMF

Table 6-1 (Cont.) Dimensions

Dimension	Description	Values
	orfetchedfromAMF.	
ERRORTYPE	Determinestheerroror.	DDB_ERROR/MISSING_CONFIGURATION/UNKNOWN

Common Attributes

The following table includes information about common attributes for NSSF.

Table 6-2 Common Attributes

Attribute	Description
application	The name of the application that the microservice is a part of.
eng_version	The engineering version of the application.
microservice	The name of the microservice.
namespace	The namespace in which microservice is running.
node	The name of the worker node that the microservice is running on.

6.1.1 NSSF Success Metrics

This section provides details about the NSSF success metrics.

Table 6-3 ocnssf_nsselection_rx

Field	Details
Description	Count of request messages received by NSSF for the Nnssf_NSSelection service.
Type	Counter
Service Operation	NSSelection
Dimension	• AMF Instance Id • Message Type • Method

Table 6-4 ocnssf_nsselection_success_tx

Field	Details
Description	Count of success response messages sent by NSSF for requests for the Nnssf_NSSelection service.
Type	Counter
Service Operation	NSSelection
Dimension	• AMF Instance Id • Message Type • Method

Table 6-5 ocnssf_nsselection_policy_match

Field	Details
Description	Count of policy matches found during processing of request messages for the Nnssf_NSSelection service.
Type	Counter
Service Operation	NSSelection
Dimension	• AMF Instance Id • Message Type • Policy Rule Name

Table 6-6 ocnssf_nsselection_time_match

Field	Details
Description	Count of time profile matches found during processing of request messages for the Nnssf_NSSelection service.
Type	Counter
Service Operation	NSSelection
Dimension	• AMF Instance Id • Message Type • Time Profile Name

Table 6-7 ocnssf_nsselection_nsi_selected

Field	Details
Description	Count of NRF discoveries performed during processing of request messages for the Nnssf_NSSelection service.
Type	Counter
Service Operation	NSSelection
Dimension	None

Table 6-8 ocnssf_nsavailability_notification_trigger_tx

Field	Details
Description	Count of notification triggers sent to NsSubscription.
Type	Counter
Service Operation	NSAvailability
Dimension	Method

Table 6-9 ocnssf_nsavailability_notification_trigger_response_rx

Field	Details
Description	Count of success response for notification trigger by NSSubscription.
Type	Counter
Service Operation	NSAvailability
Dimension	Method

Table 6-10 ocnssf_nsselection_nrf_disc_success

Field	Details
Description	Count of successful discovery results received from NRF during processing of request messages for the Nnssf_NSSelection service.
Type	Counter
Service Operation	NSSelection
Dimension	None

Table 6-11 ocnssf_nssaiavailability_rx

Field	Details
Description	Count of request messages received by NSSF for the Nnssf_NSSAIAvailability service.
Type	Counter
Service Operation	NSAvailability
Dimension	• Method • Operation

Table 6-12 ocnssf_nssaiavailability_success_tx

Field	Details
Description	Count of success response messages sent by NSSF for requests for the Nnssf_NSSAIAvailability service.
Type	Counter
Service Operation	NSAvailability
Dimension	Subscription- Id

Table 6-13 ocnssf_nssaiavailability_notification_success_response_rx

Field	Details
Description	Count of success notification response messages received by NSSF for requests for the Nnssf_NSSAIAvailability service.
Type	Counter
Service Operation	NSSubscription
Dimension	Subscription- Id

Table 6-14 ocnssf_nssaiavailability_options_rx

Field	Details
Description	Count of HTTP options received at NSAvailability service.
Type	Counter
Service Operation	NSAvailability
Dimension	None

Table 6-15 ocnssf_nssaiavailability_options_tx_status_ok

Field	Details
Description	Count of HTTP options response with status 200 OK.
Type	Counter
Service Operation	NSAvailability
Dimension	None

Table 6-16 ocnssf_nssaiavailability_notification_indirect_communication_rx

Field	Details
Description	Count of request notification messages sent by NSSF using indirect communication.
Type	Counter
Service Operation	NSAvailability
Dimension	• AMF Set Id • Subscription Id

Table 6-17 ocnssf_nssaiavailability_notification_indirect_communication_tx

Field	Details
Description	Count of notification response messages received by NSSF using indirect communication.
Type	Counter
Service Operation	NSAvailability
Dimension	• AMF Set Id • Subscription Id

Table 6-18 ocnssf_nsselection_requests_duration_seconds_sum

Field	Details
Description	Time duration in seconds taken by NSSF to process requests to NSSelection.
Type	Counter
Service Operation	NSSelection
Dimension	None

Table 6-19 ocnssf_nsselection_requests_duration_seconds_count

Field	Details
Description	Count of number of requests processed by NSSelection.
Type	Counter
Service Operation	NSSelection
Dimension	None

Table 6-20 ocnssf_nsselection_requests_duration_seconds_max

Field	Details
Description	Maximum time duration in seconds taken by NSSF to process requests to NSSelection.
Type	Counter
Service Operation	NSSelection
Dimension	None

Table 6-21 ocnssf_db_query_duration_seconds_sum

Field	Details
Description	Time duration in seconds to process dbQuery.
Type	Counter
Service Operation	NA
Dimension	query_type

Table 6-22 ocnssf_db_query_duration_seconds_count

Field	Details
Description	Count of number of dbQuery.
Type	Counter
Service Operation	NA
Dimension	query_type

Table 6-23 ocnssf_db_query_duration_seconds_max

Field	Details
Description	Maximum time duration in seconds taken to process dbQuery.
Type	Counter
Service Operation	NA
Dimension	query_type

Table 6-24 ocnssf_nssaiavailability_submod_rx

Field	Details
Description	Count of HTTP patch for subscription (SUBMOD) request messages received by NSSF for ocnssf_NSSAIAvailability service.
Type	Counter
Service Operation	NSAvailability
Dimension	• SubscriptionId • Method

Table 6-25 ocnssf_nssaiavailability_submod_success_response_tx

Field	Details
Description	Count of success response messages sent by NSSF for HTTP patch for subscription (SUBMOD) requests for ocnssf_NSSAIAvailability service.
Type	Counter
Service Operation	NSAvailability
Dimension	• SubscriptionId • Method

Table 6-26 ocnssf_notification_trigger_rx

Field	Details
Description	Count of notification triggers received by NSSF.
Type	Counter
Service Operation	NSSubscription
Dimension	• Trigger type • Method

Table 6-27 ocnssf_nsconfig_notification_trigger_tx

Field	Details
Description	Count of notification triggers sent to NsSubscription.
Type	Counter
Service Operation	NSConfig
Dimension	Method

Table 6-28 ocnssf_nsconfig_notification_trigger_response_rx

Field	Details
Description	Count of success response for notification trigger by NsSubscription.
Type	Counter
Service Operation	NSConfig
Dimension	Method

Table 6-29 ocnssf_nsconfig_nrf_disc_success

Field	Details
Description	Count of successful discovery results received from NRF during processing of configuration of amf_set in Nnssf_NSConfig service.
Type	Counter
Service Operation	NSConfig
Dimension	None

Table 6-30 ocnssf_subscription_nrf_tx

Field	Details
Description	Count of successful subscription results received from NRF during processing of configuration of amf_set in Nnssf_NSConfig service.
Type	Counter
Service Operation	NSConfig
Dimension	None

6.1.2 NSSF Error Metrics

This section provides details about the NSSF error metrics.

Table 6-31 ocnssf_configuration_database_read_error

Field	Details
Description	Count of errors encountered when trying to read the configuration database.
Type	Counter
Service Operation	NSSelection
Dimension	None

Table 6-32 ocnssf_configuration_database_write_error

Field	Details
Description	Count of errors encountered when trying to write to the configuration database.
Type	Counter
Service Operation	NSConfig
Dimension	None

Table 6-33 ocnssf_nsconfig_notification_trigger_failure_response_rx

Field	Details
Description	Count of failure response for notification trigger by NSSubscription.
Type	Counter
Service Operation	NSConfig
Dimension	Method

Table 6-34 ocnssf_nsconfig_notification_trigger_retry_tx

Field	Details
Description	Count of retry notification triggers sent to NSSubscription.
Type	Counter
Service Operation	NSConfig
Dimension	Method

Table 6-35 ocnssf_nsconfig_notification_trigger_failed_tx

Field	Details
Description	Count of failed notification triggers (all retrys failed) to NSSubscription.
Type	Counter
Service Operation	NSConfig
Dimension	Method

Table 6-36 ocnssf_nsconfig_nrf_disc_error

Field	Details
Description	Count of failed discovery results received from NRF during processing of configuration of amf_set in Nnssf_NSConfig service.

Table 6-36 (Cont.) ocnssf_nsconfig_nrf_disc_error

Field	Details
Type	Counter
Service Operation	NSConfig
Dimension	None

Table 6-37 ocnssf_discovery_nrf_tx_failed

Field	Details
Description	Count of failed discovery requests sent by NSSF to NRF during configuration of amf_set in Nnssf_NSConfig service.
Type	Counter
Service Operation	NSConfig
Dimension	None

Table 6-38 ocnssf_subscription_nrf_tx_failed

Field	Details
Description	Count of failed subscription results received from NRF during processing of configuration of amf_set in Nnssf_NSConfig service.
Type	Counter
Service Operation	NSConfig
Dimension	None

Table 6-39 ocnssf_state_data_read_error

Field	Details
Description	Count of errors encountered when trying to read the state database.
Type	Counter
Service Operation	NSSelection
Dimension	None

Table 6-40 ocnssf_state_data_write_error

Field	Details
Description	Count of errors encountered when trying to write to the state database.
Type	Counter
Service Operation	NSAvailability
Dimension	None

Table 6-41 ocnssf_nsselection_nrf_disc_failure

Field	Details
Description	Count of errors encountered when trying to reach the NRF's discovery service.
Type	Counter

Table 6-41 (Cont.) ocnssf_nsselection_nrf_disc_failure

Field	Details
Service Operation	NSSelection
Dimension	Status

Table 6-42 ocnssf_nsselection_policy_not_found

Field	Details
Description	Count of request messages that did not find a configured policy.
Type	Counter
Service Operation	NSSelection
Dimension	• AMF Instance Id • Message Type

Table 6-43 ocnssf_nsselection_unsupported_plmn

Field	Details
Description	Count of request messages that did not find mcc and mnc in the PLMN list.
Type	Counter
Service Operation	NSSelection
Dimension	Message Type

Table 6-44 ocnssf_nssaiavailability_subscription_failure

Field	Details
Description	Count of subscribe requests rejected by NSSF.
Type	Counter
Service Operation	NSAvailability
Dimension	• Operation • Method • Status

Table 6-45 ocnssf_nssaiavailability_notification_error_response_rx

Field	Details
Description	Count of failure notification response messages received by NSSF for requests by the Nnssf_NSSAIAvailability service.
Type	Counter
Service Operation	NSSubscription
Dimension	• MessageType • Method • ResponseCode • CauseCode • retryCount

Table 6-46 ocnssf_nssaiavailability_notification_failure

Field	Details
Description	Count of failure notification response messages received by NSSF for requests by the Nnssf_NSSAI Availability service.
Type	Counter
Service Operation	NSSubscription
Dimension	• Subscription- Id • Status

Table 6-47 ocnssf_nssaiavailability_options_tx_status_unsupportedmediatype

Field	Details
Description	Count of HTTP OPTIONS response with status 415 Unsupported Media type.
Type	Counter
Service Operation	NSAvailability
Dimension	None

Table 6-48 ocnssf_nsavailability_unsupported_plmn

Field	Details
Description	Count of request messages with unsupported PLMN received by NSSF for the ocnssf_NSAvailability service.
Type	Counter
Service Operation	NSAvailability
Dimension	• AMF Instance Id • Message Type • Method

Table 6-49 ocnssf_nsavailability_invalid_location_url

Field	Details
Description	Count of invalid location header.
Type	Counter
Service Operation	NSAvailability
Dimension	None

Table 6-50 ocnssf_nssaiavailability_submod_error_response_tx

Field	Details
Description	Count of error response messages sent by NSSF for HTTP patch for subscription (SUBMOD) requests for ocnssf_NSSAIAvailability service.
Type	Counter
Service Operation	NSAvailability
Dimension	• ReturnCode • SubscriptionId, • Method

Table 6-51 ocnssf_nssaiavailability_submod_unimplemented_op

Field	Details
Description	Count of HTTP patch request messages received by NSSF for ocnssf_NSSAIAvailability service for which PATCH operation (op) is not implemented.
Type	Counter
Service Operation	NSAvailability
Dimension	• ReturnCode • SubscriptionId • Method

Table 6-52 ocnssf_nssaiavailability_submod_patch_apply_error

Field	Details
Description	Count of HTTP patch request messages received by OCNSSFfor ocnssf_NSSAIAvailability service for which PATCH application returned error.
Type	Counter
Service Operation	NSAvailability
Dimension	• ReturnCode • SubscriptionId • Method

Table 6-53 ocnssf_nsavailability_notification_trigger_failure_response_rx

Field	Details
Description	Count of failure response for notification trigger by NSSubscription.
Type	Counter
Service Operation	NSAvailability
Dimension	Method

Table 6-54 ocnssf_nsavailability_notification_trigger_retry_tx

Field	Details
Description	Count of retry notification triggers sent to NSSubscription.
Type	Counter
Service Operation	NSAvailability
Dimension	Method

Table 6-55 ocnssf_nsavailability_notification_trigger_failed_tx

Field	Details
Description	Count of failed notification triggers (all retries failed) to NSSubscription.
Type	Counter
Service Operation	NSAvailability
Dimension	Method

Table 6-56 ocnssf_nssaiavailability_notification_delete_on_subscription_not_found

Field	Details
Description	Triggered when 404 Subscription with SUBSCRIPTION_NOT_FOUND is received by AMF.
Type	Counter
Service Operation	NsSubscription
Dimension	Subscription_Removed

Table 6-57 ocnssf_nssaiavailability_notification_db_error

Field	Details
Description	Triggered when DB error or exception occurs when trying to delete NssaiSubscription.
Type	Counter
Service Operation	NsSubscription
Dimension	None

6.1.3 NSSF Common metrics

This section provides details about the NSSF common metrics.

Table 6-58 http_requests_total

Field	Details
Description	This is pegged as soon as the request reaches the Ingress or Egress gateway in the first custom filter of the application.
Type	Counter
Dimension	• direction: ingress or egress • method: the method from the request line • uri: the URI from the request line • http_version: the HTTP version from the request line • host: the value of the Host header field • NFType • NFServiceType • HttpVersion • Scheme • Route_path • InstanceIdentifier • ClientCertIdentity

Table 6-59 http_responses_total

Field	Details
Description	Responses received or sent from the microservice .
Type	Counter

Table 6-59 (Cont.) http_responses_total

Field	Details
Dimension	• Status • Method • Route_path • NFType • NFServiceType • Host • HttpVersion • Scheme • InstanceIdentifier • ClientCertIdentity

Table 6-60 http_request_bytes

Field	Details
Description	Size of requests, including header and body. Grouped in 100 byte buckets.
Type	Histogram
Dimension	• direction • method • uri • http_version

Table 6-61 http_response_bytes

Field	Details
Description	Size of responses, including header and body. Grouped in 100 byte buckets.
Type	Histogram
Dimension	• direction • http_version

Table 6-62 bandwidth_bytes

Field	Details
Description	Amount of ingress and egress traffic sent and received by the microservice.
Type	Counter
Dimension	direction

Table 6-63 request_latency_seconds

Field	Details
Description	This metric is pegged in the last custom filter of the Ingress or Egress gateway while the response is being sent back to the consumer NF. It tracks the amount of time taken for processing the request. It starts as soon the request reaches the first custom filter of the application and lasts till the response is sent back to the consumer NF from the last custom filter of the application.
Type	Histogram

Table 6-63 (Cont.) request_latency_seconds

Field	Details
Dimension	• quantile • InstanceIdentifier • Route_path • Method

Table 6-64 connection_failure_total

Field	Details
Description	This metric is pegged by jetty client when the destination is not reachable by Ingress or Egress gateway. In case of Ingress gateway, the destination service will be a back-end microservice of the NF, and TLS connection failure metrics when connecting to ingress with direction as ingress. For Egress gateway, the destination is producer NF.
Type	Counter
Dimension	• Host • Port • InstanceIdentifier • Direction • error_reason

Table 6-65 request_processing_latency_seconds

Field	Details
Description	This metric is pegged in the last custom filter of the Ingress or Egress gateway while the response is being sent back to the consumer NF. This metric captures the amount of time taken for processing of the request only within Ingress or Egress gateway. It starts as soon the request reaches the first custom filter of the application and lasts till the request is forwarded to the destination.
Type	Timer
Dimension	• quantile • InstanceIdentifier • Route_path • Method

Table 6-66 jetty_request_stat_metrics_total

Field	Details
Description	This metric is pegged for every event occurred when a request is sent to Ingress or Egress gateway.
Type	Counter
Dimension	• event • client_type • InstanceIdentifier

Table 6-67 jetty_response_stat_metrics_total

Field	Details
Description	This metric is pegged for every event occurred when a response is received by Ingress or Egress gateway.
Type	Counter
Dimension	• event • client_type • InstanceIdentifier

Table 6-68 server_latency_seconds

Field	Details
Description	This metric is pegged in Jetty response listener that captures the amount of time taken for processing of the request by jetty client
Type	Timer
Dimension	• quantile • InstanceIdentifier • Method

Table 6-69 roundtrip_latency_seconds

Field	Details
Description	This metric is pegged in Netty outbound handler that captures the amount of time taken for processing of the request by netty server.
Type	Timer
Dimension	• quantile • InstanceIdentifier • Method

Table 6-70 oc_configclient_request_total

Field	Details
Description	This metric is pegged whenever config client is polling for configuration update from common configuration server.
Type	Counter
Dimension	• Release version • Config version

Table 6-71 oc_configclient_response_total

Field	Details
Description	This metrics is pegged whenever config client receives response from common configuration server.
Type	Counter
Dimension	• Release version • Config version • Updated

Table 6-72 incoming_connections

Field	Details
Description	This metric pegs active incoming connections from client to Ingress or Egress gateway.
Type	Gauge
Dimension	• Direction • Host • InstanceIdentifier

Table 6-73 outgoing_connections

Field	Details
Description	This metric pegs active outgoing connections from Ingress gateway or Egress gateway to destination
Type	Gauge
Dimension	• Direction • Host • InstanceIdentifier

Table 6-74 sbitimer_timezone_mismatch

Field	Details
Description	This metric pegs when sbiTimerTimezone is set to ANY and time zone is not specified in the header then above metric is pegged in ingress and egress gateways.
Type	Gauge
Dimension	• Route_path • Method

6.1.4 NSSF OAuth Metrics

This section provides details about the NSSF OAuth metrics.

Table 6-75 oc_oauth_nrf_request_total

Field	Details
Description	This is pegged in the OAuth client implementation if the request is sent to NRF for requesting the OAuth token. OAuth client implementation is used in Egress gateway.
Type	Counter
Dimension	• ConsumerNFInstanceId • ConsumerNFType • TargetNFType TargetNFInstanceId • scope NrfFqdn

Table 6-76 oc_oauth_nrf_response_success_total

Field	Details
Description	This is pegged in the OAuth client implementation if an OAuth token is successfully received from the NRF. OAuth client implementation is used in Egress gateway.
Type	Counter
Dimension	• ConsumerNFInstanceId • ConsumerNFType • TargetNFType • TargetNFInstanceId • scope StatusCode NrfFqdn

Table 6-77 oc_oauth_nrf_response_failure_total

Field	Details
Description	This is pegged in the OAuthClientFilter in Egress gateway whenever GetAccessTokenFailedException is captured.
Type	Counter
Dimension	• ConsumerNFInstanceId • ConsumerNFType • TargetNFType • TargetNFInstanceId • scope StatusCode NrfFqdn

Table 6-78 oc_oauth_nrf_response_failure_total

Field	Details
Description	This is pegged in the OAuthClientFilter in Egress gateway whenever GetAccessTokenFailedException is captured.
Type	Counter
Dimension	• ConsumerNFInstanceId • ConsumerNFType • TargetNFType • TargetNFInstanceId • Scope • StatusCode • ErrorOriginator • NrfFqdn

Table 6-79 oc_oauth_request_failed_internal_total

Field	Details
Description	This is pegged in the OAuthClientFilter in Egress gateway whenever InternalServerErrorException is captured.
Type	Counter

Table 6-79 (Cont.) oc_oauth_request_failed_internal_total

Field	Details
Dimension	• ConsumerNFInstanceId • ConsumerNFType • TargetNFType • TargetNFInstanceId • scope • StatusCode • ErrorOriginator • NrfFqdn

Table 6-80 oc_oauth_token_cache_total

Field	Details
Description	This is pegged in the OAuth Client Implementation if the OAuth token is found in the cache.
Type	Counter
Dimension	• ConsumerNFInstanceId ConsumerNFType • TargetNFType TargetNFInstanceId scope

Table 6-81 oc_oauth_request_invalid_total

Field	Details
Description	This is pegged in the OAuthClientFilter in Egress gateway whenever a BadAccessTokenRequestException/JsonProcessingException is captured.
Type	Counter
Dimension	• ConsumerNFInstanceId • ConsumerNFType • TargetNFType • TargetNFInstanceId • scope • StatusCode • ErrorOriginator

Table 6-82 oc_oauth_validation_successful_total

Field	Details
Description	This is pegged in OAuth validator implementation if the received OAuth token is validated successfully. OAuth validator implementation is used in Ingress gateway.
Type	Counter
Dimension	• issuer • subject • scope

Table 6-83 oc_oauth_validation_failure_total

Field	Details
Description	This is pegged in OAuth validator implementation if the validation of the received OAuth token is failed. OAuth validator implementation is used in Ingress gateway.
Type	Counter
Dimension	• issuer • subject • scope • reason

Table 6-84 oc_oauth_cert_expiryStatus

Field	Details
Description	Metric used to peg expiry date of the certificate. This metric is further used for raising alarms if certificate expires within 30 days or 7 days.
Type	Gauge
Dimension	• id • certificateName • secretName

Table 6-85 oc_oauth_cert_loadStatus

Field	Details
Description	Metric used to peg whether given certificate can be loaded from secret or not. If it is loadable then "0" is pegged otherwise "1" is pegged. This metric is further used for raising alarms when certificate is not loadable.
Type	Gauge
Dimension	• id • certificateName • secretName

Table 6-86 oc_oauth_request_failed_cert_expiry

Field	Details
Description	Metric used to keep track of number of requests with keyId in token that failed due to certificate expiry. Pegged whenever oAuth Validator module throws oauth custom exception due to certificate expiry for an incoming request.
Type	Metric
Dimension	• target nf type • target nf instance id • consumer nf instance id • nrf instance id • service name of nf • producer service key id

Table 6-87 oc_oauth_keyid_count

Field	Details
Description	Metric used to keep track of number of requests received with keyId in token. Pegged whenever a request with an access token containing kid in header comes to oAuth Validator. This is independent of whether the validation failed or was successful.
Type	Metric
Dimension	• target nf type • target nf instance id • consumer nf instance id • nrf instance id • service name of nf • producer service key id

6.1.5 Managed Objects Metrics

This section provides details about the NSSF Managed Object (MO) metrics.

Table 6-88 ocnssf_nssaiauth_req_rx

Field	Details
Description	Count of nssaiauth requests received by NSConfig. Trigger Condition: Operator configuration of the Managed Object. Operator configuration of the Managed Object. This is pegged when HTTP GET, POST, DELETE, or PUT request is received by NSSF.
Type	Counter
Service Operation	nssaiauth
Dimension	Method

Table 6-89 ocnssf_nssaiauth_res_tx

Field	Details
Description	Count of successful responses sent by NSConfig for a nssaiauth request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when a 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	nssaiauth
Dimension	Method

Table 6-90 ocnssf_nssaiauth_error_res_tx

Field	Details
Description	Count of error responses sent by NSConfig for a nssaiauth request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when non 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter

Table 6-90 (Cont.) ocnssf_nssaiauth_error_res_tx

Field	Details
Service Operation	nssaiauth
Dimension	Method Status

Table 6-91 ocnssf_nssaiauth_created

Field	Details
Description	Count of nssaiauth created in the database. Trigger Condition: Operator configuration of the Managed Object leading to storage of the Managed Object in the database and Autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source and pegged with LearnedConfigAMF when NsAvailabilityUpdate leads to storage of nssaiauth.
Type	Counter
Service Operation	nssaiauth
Dimension	Source

Table 6-92 ocnssf_nssaiauth_deleted

Field	Details
Description	Count of nssaiauth deleted in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source and pegged with LearnedConfigAMF when NSAvailability Update leads to storage of nssaiauth.
Type	Counter
Service Operation	nssaiauth
Dimension	Source

Table 6-93 ocnssf_nssaiauth_updated

Field	Details
Description	Count of nssaiauth updated in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator config is the source and pegged with LearnedConfigAMF when NSAvailability Update leads to storage of nssaiauth. **Note**: In current scenario, autoconfiguration does not update the Managed Object in the database, it only deletes and creates Managed Objects.
Type	Counter
Service Operation	nssaiauth
Dimension	Source

Table 6-94 ocnssf_nssaiauth_error

Field	Details
Description	Count of failures on Managed Object processing. Trigger Condition: Error while creating, deleting, or updating a Managed object. This is pegged when error occurs while handling a Managed Object. **Note**: This must be pegged when ocnssf_nssaiauth_error_res_tx is pegged.
Type	Counter
Service Operation	nssaiauth
Dimension	• Source • Operation • ERRORTYPE

Table 6-95 ocnssf_nsiprofile_req_rx

Field	Details
Description	Count of nsiprofile requests received by NSConfig. Trigger Condition: Operator configuration of the Managed Object. Operator configuration of the Managed Object. This is pegged when HTTP GET, POST, DELETE, or PUT request is received by NSSF.
Type	Counter
Service Operation	nsiprofile
Dimension	Method

Table 6-96 ocnssf_amfset_req_rx

Field	Details
Description	Count of amfset requests received by NSConfig. Trigger Condition: Operator configuration of the Managed Object. Operator configuration of the Managed Object. This is pegged when HTTP GET, POST, DELETE, or PUT request is received by NSSF.
Type	Counter
Service Operation	amfset
Dimension	Method

Table 6-97 ocnssf_amfset_res_tx

Field	Details
Description	Count of successful responses sent by NSConfig for a amfset request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when a 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	amfset
Dimension	Method

Table 6-98 ocnssf_amfset_error_res_tx

Field	Details
Description	Count of error responses sent by NSConfig for a amfset request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when non 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	amfset
Dimension	Method Status

Table 6-99 ocnssf_amfset_created

Field	Details
Description	Count of amfset created in the database. Trigger Condition: Operator configuration of the Managed Object leading to storage of the Managed Object in the database and Autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	amfset
Dimension	Source

Table 6-100 ocnssf_amfset_deleted

Field	Details
Description	Count of amfset deleted in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	amfset
Dimension	Source

Table 6-101 ocnssf_amfset_updated

Field	Details
Description	Count of amfset updated in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator config is the source.
Type	Counter
Service Operation	amfset
Dimension	Source

Table 6-102 ocnssf_amfset_error

Field	Details
Description	Count of failures on Managed Object processing. Trigger Condition: Error while creating, deleting, or updating a Managed object. This is pegged when error occurs while handling a Managed Object.
Type	Counter
Service Operation	amfset
Dimension	• Source • Operation • ERRORTYPE

Table 6-103 ocnssf_amfresolution_req_rx

Field	Details
Description	Count of amfresolution requests received by NSConfig. Trigger Condition: Operator configuration of the Managed Object. Operator configuration of the Managed Object. This is pegged when HTTP GET, POST, DELETE, or PUT request is received by NSSF.
Type	Counter
Service Operation	amfresolution
Dimension	Method

Table 6-104 ocnssf_amfresolution_res_tx

Field	Details
Description	Count of successful responses sent by NSConfig for a amfresolution request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when a 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	amfresolution
Dimension	Method

Table 6-105 ocnssf_amfresolution_error_res_tx

Field	Details
Description	Count of error responses sent by NSConfig for a amfresolution request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when non 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	amfresolution
Dimension	Method Status

Table 6-106 ocnssf_amfresolution_created

Field	Details
Description	Count of amfresolution created in the database. Trigger Condition: Operator configuration of the Managed Object leading to storage of the Managed Object in the database and Autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	amfresolution
Dimension	Source

Table 6-107 ocnssf_amfresolution_deleted

Field	Details
Description	Count of amfresolution deleted in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	amfresolution
Dimension	Source

Table 6-108 ocnssf_amfresolution_updated

Field	Details
Description	Count of amfresolution updated in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator config is the source.
Type	Counter
Service Operation	amfresolution
Dimension	Source

Table 6-109 ocnssf_amfresolution_error

Field	Details
Description	Count of failures on Managed Object processing. Trigger Condition: Error while creating, deleting, or updating a Managed object. This is pegged when error occurs while handling a Managed Object.
Type	Counter
Service Operation	amfresolution
Dimension	• Source • Operation • ERRORTYPE

Table 6-110 ocnssf_timeprofile_req_rx

Field	Details
Description	Count oftimeprofile requests received by NSConfig. Trigger Condition: Operator configuration of the Managed Object. Operator configuration of the Managed Object. This is pegged when HTTP GET, POST, DELETE, or PUT request is received by NSSF.
Type	Counter
Service Operation	timeprofile
Dimension	Method

Table 6-111 ocnssf_timeprofile_res_tx

Field	Details
Description	Count of successful responses sent by NSConfig for a timeprofile request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when a 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	timeprofile
Dimension	Method

Table 6-112 ocnssf_timeprofile_error_res_tx

Field	Details
Description	Count of error responses sent by NSConfig for a timeprofile request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when non 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	timeprofile
Dimension	Method Status

Table 6-113 ocnssf_timeprofile_created

Field	Details
Description	Count of timeprofile created in the database. Trigger Condition: Operator configuration of the Managed Object leading to storage of the Managed Object in the database and Autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	timeprofile
Dimension	Source

Table 6-114 ocnssf_timeprofile_deleted

Field	Details
Description	Count of timeprofile deleted in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	timeprofile
Dimension	Source

Table 6-115 ocnssf_timeprofile_updated

Field	Details
Description	Count of timeprofile updated in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator config is the source.
Type	Counter
Service Operation	timeprofile
Dimension	Source

Table 6-116 ocnssf_timeprofile_error

Field	Details
Description	Count of failures on Managed Object processing. Trigger Condition: Error while creating, deleting, or updating a Managed object. This is pegged when error occurs while handling a Managed Object.
Type	Counter
Service Operation	timeprofile
Dimension	• Source • Operation • ERRORTYPE

Table 6-117 ocnssf_defaultsnssai_req_rx

Field	Details
Description	Count of defaultsnssai requests received by NSConfig. Trigger Condition: Operator configuration of the Managed Object. Operator configuration of the Managed Object. This is pegged when HTTP GET, POST, DELETE, or PUT request is received by NSSF.
Type	Counter
Service Operation	defaultsnssai
Dimension	Method

Table 6-118 ocnssf_defaultsnssai_res_tx

Field	Details
Description	Count of successful responses sent by NSConfig for a defaultsnssai request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when a 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	defaultsnssai
Dimension	Method

Table 6-119 ocnssf_defaultsnssai_error_res_tx

Field	Details
Description	Count of error responses sent by NSConfig for a defaultsnssai request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when non 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	defaultsnssai
Dimension	Method Status

Table 6-120 ocnssf_defaultsnssai_created

Field	Details
Description	Count of defaultsnssai created in the database. Trigger Condition: Operator configuration of the Managed Object leading to storage of the Managed Object in the database and Autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	defaultsnssai
Dimension	Source

Table 6-121 ocnssf_defaultsnssai_deleted

Field	Details
Description	Count of defaultsnssai deleted in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	defaultsnssai
Dimension	Source

Table 6-122 ocnssf_defaultsnssai_updated

Field	Details
Description	Count of defaultsnssai updated in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator config is the source.
Type	Counter
Service Operation	defaultsnssai
Dimension	Source

Table 6-123 ocnssf_mappingofnssai_req_rx

Field	Details
Description	Count of mappingofnssai requests received by NSConfig. Trigger Condition: Operator configuration of the Managed Object. Operator configuration of the Managed Object. This is pegged when HTTP GET, POST, DELETE, or PUT request is received by NSSF.
Type	Counter
Service Operation	mappingofnssai
Dimension	Method

Table 6-124 ocnssf_mappingofnssai_res_tx

Field	Details
Description	Count of successful responses sent by NSConfig for a mappingofnssai request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when a 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	mappingofnssai
Dimension	Method

Table 6-125 ocnssf_mappingofnssai_error_res_tx

Field	Details
Description	Count of error responses sent by NSConfig for a mappingofnssai request. Trigger Condition: Operator configuration of the Managed Object. This is pegged when non 2xx response for HTTP GET, POST, DELETE, or PUT request is sent by NSSF.
Type	Counter
Service Operation	mappingofnssai
Dimension	Method Status

Table 6-126 ocnssf_mappingofnssai_created

Field	Details
Description	Count of mappingofnssai created in the database. Trigger Condition: Operator configuration of the Managed Object leading to storage of the Managed Object in the database and Autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	mappingofnssai
Dimension	Source

Table 6-127 ocnssf_mappingofnssai_deleted

Field	Details
Description	Count of mappingofnssai deleted in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator configuration is the source.
Type	Counter
Service Operation	mappingofnssai
Dimension	Source

Table 6-128 ocnssf_mappingofnssai_updated

Field	Details
Description	Count of mappingofnssai updated in the database. Trigger Condition: Operator configuration of the Managed Object leading to deleting of the Managed Object in the database and autoconfiguration by learning from the AMF. This is pegged as source OperatorConfig when operator config is the source.
Type	Counter
Service Operation	mappingofnssai
Dimension	Source

6.1.6 Perf-info metrics for Overload Control

This section provides details about Perf-info metrics for overload control.

Table 6-129 cgroup_cpu_nanoseconds

Field	Details
Description	Reports the total CPU time (in nanoseconds) on each CPU core for all the tasks in the cgroup.
Type	Gauge
Dimension	NA

Table 6-130 cgroup_memory_bytes

Field	Details
Description	Reports the memory usage.
Type	Gauge
Dimension	NA

Table 6-131 load_level

Field	Details
Description	Provides information about the overload manager load level.
Type	Gauge
Dimension	• service • namespace

6.1.7 Egress Gateway Metrics

This section provides details about Egress Gateway metrics.

Table 6-132 oc_fqdn_alternate_route_total

Field	Details
Description	Tracks number of registration, deregistration and GET calls received for a given scheme and FQDN. **Note**: Registration does not reflect active registration numbers. It captured number of registration requests received.
Type	Counter
Service Operation	Egress Gateway
Dimension	• type: Register/Deregister/GET • binding_value: <scheme>+<FQDN>

Table 6-133 oc_dns_srv_lookup_total

Field	Details
Description	Track number of time DNS SRV lookup was done for a given scheme and FQDN.
Type	Counter
Service Operation	Egress Gateway
Dimension	binding_value: <scheme>+<FQDN>

Table 6-134 oc_alternate_route_resultset

Field	Details
Description	Value provides number of alternate routes known for a given scheme and FQDN. Whenever DNS SRV lookup or static configuration is done, this metric provide number of known alternate route for a given pair. For example, <"http", "abc.oracle.com">: 2.
Type	Gauge
Service Operation	Egress Gateway

Table 6-134 (Cont.) oc_alternate_route_resultset

Field	Details
Dimension	binding_value: <scheme>+<FQDN>

Table 6-135 oc_configclient_request_total

Field	Details
Description	This metric is pegged whenever a polling request is made from config client to the server for configuration updates.
Type	Counter
Service Operation	Egress Gateway
Dimension	Tags: releaseVersion, configVersion. • releaseVersion tag indicates the current chart version of alternate route service deployed. • configVersion tag indicates the current configuration version of alternate route service.

Table 6-136 oc_configclient_response_total

Field	Details
Description	This metric is pegged whenever a response is received from the server to client.
Type	Counter
Service Operation	Egress Gateway
Dimension	Tags: releaseVersion, configVersion, updated. • releaseVersion tag indicates the current chart version of alternate route service deployed. • configVersion tag indicates the current configuration version of alternate route service. • updated tag indicates whether there is a configuration update or not.

Table 6-137 oc_egressgateway_peer_health_status

Field	Details
Description	It defines Egress Gateway peer health status. This metric is set to 1, if a peer is unhealthy. This metric is reset to 0, when it becomes healthy again.
Type	Gauge
Service Operation	Egress Gateway
Dimension	• peer • vfqdn

Table 6-138 oc_egressgateway_peer_health_ping_request_total

Field	Details
Description	It defines Egress Gateway peer health ping request. This metric is incremented every time Egress Gateway send a health ping towards a peer.
Type	Counter
Service Operation	Egress Gateway

Table 6-138 (Cont.) oc_egressgateway_peer_health_ping_request_total

Field	Details
Dimension	• peer • vfqdn • statusCode • cause

Table 6-139 oc_egressgateway_peer_health_ping_response_total

Field	Details
Description	Egress Gateway Peer health ping response. This metric is incremented every time a Egress Gateway receives a health ping response (irrespective of success or failure) from a peer.
Type	Counter
Service Operation	Egress Gateway
Dimension	• peer • vfqdn • statusCode • cause

Table 6-140 oc_egressgateway_peer_health_status_transitions_total

Field	Details
Description	It defines Egress Gateway peer health status transitions. Egress Gateway increments this metric every time a peer transitions from available to unavailable or unavailable to available.
Type	Counter
Service Operation	Egress Gateway
Dimension	• peer • vfqdn • from • to

Table 6-141 oc_egressgateway_peer_count

Field	Details
Description	It defines Egress Gateway peer count. This metric is incremented every time for the peer count.
Type	Gauge
Service Operation	Egress Gateway
Dimension	peerset

Table 6-142 oc_egressgateway_peer_available_count

Field	Details
Description	It defines Egress Gateway available peer count. This metric is incremented every time for the available peer count.
Type	Gauge
Service Operation	Egress Gateway

Table 6-142 (Cont.) oc_egressgateway_peer_available_count

Field	Details
Dimension	peerset

Table 6-143 oc_egressgateway_user_agent_consumer

Field	Details
Description	Whenever the feature is enabled and User-Agent Header is getting generated.
Type	Counter
Service Operation	Egress Gateway
Dimension	ConsumerNfInstanceId: ID of consumer NF (NSSF) as configured in Egress Gateway.

6.1.8 Ingress Gateway Metrics

This section provides details about Ingress Gateway metrics.

Table 6-144 oc_ingressgateway_pod_congestion_state

Field	Details
Description	It is used to track congestion state of a pod.
Type	Gauge
Service Operation	Ingress Gateway
Dimension	level = 0,1,2 • 0: Normal • 1: DOC • 2: Congested

Table 6-145 oc_ingressgateway_pod_resource_stress

Field	Details
Description	It tracks CPU, memory, and queue usage (as percentages) to determine the congestion state of the POD that is performing the calculations.
Type	Gauge
Service Operation	Ingress Gateway
Dimension	type = "PendingRequest","CPU","Memory"

Table 6-146 oc_ingressgateway_pod_resource_state

Field	Details
Description	It tracks the congestion state of individual resources, which is calculated based on their usage and the configured threshold.
Type	Gauge
Service Operation	Ingress Gateway

Table 6-146 (Cont.) oc_ingressgateway_pod_resource_state

Field	Details
Dimension	type = "PendingRequest","CPU","Memory" level = 0,1,2 • 0: Normal • 1: DOC • 2: Congested

Table 6-147 oc_ingressgateway_incoming_pod_connections_rejected_total

Field	Details
Description	It tracks the number of connections dropped in the congested or Danger Of Congestion (DOC) state.
Type	Counter
Service Operation	Ingress Gateway
Dimension	NA

6.2 NSSF KPIs

This section includes information about KPIs for Oracle Communications Cloud Native Core, Network Slice Selection Function.

The following are the NSSF KPIs:

6.2.1 NSSelection KPIs

Table 6-148 NSSF NSSelection Initial Registration Success Rate

Field	Details
Description	Percentage of NSSelection Initial registration messages with success response
Expression	sum(ocnssf_nsselection_success_tx_total{message_type=\"registration\"})/ sum(ocnssf_nsselection_rx_total{message_type=\"registration\"}))*100"

Table 6-149 NSSF NSSelection PDU establishment success rate

Field	Details
Description	Percentage of NSSelection PDU establishment messages with success response
Expression	sum(ocnssf_nsselection_success_tx_total{message_type=\"pdu_session\"})/ sum(ocnssf_nsselection_rx_total{message_type=\"pdu_session\"}))*100"

Table 6-150 NSSF NSSelection UE-Config Update success rate

Field	Details
Description	Percentage of NSSelection UE-Config Update messages with success response
Expression	sum(ocnssf_nsselection_success_tx_total{message_type=\"ue_config_update\"})/ sum(ocnssf_nsselection_rx_total{message_type=\"ue_config_update\"}))*100",

Table 6-151 4xx Responses (NSSelection)

Field	Details
Description	Rate of 4xx response for NSSelection
Expression	sum(increase(oc_ingressgateway_http_responses{Status=~"4.* ",Uri=~".*nnssf-nsselection.*",Method="GET"}[5m]))

Table 6-152 5xx Responses (NSSelection)

Field	Details
Description	Rate of 5xx response for NSSelection
Expression	sum(increase(oc_ingressgateway_http_responses{Status=~"5.* ",Uri=~".*nnssf-nsselection.*",Method="GET"}[5m])

6.2.2 NSAvailability KPIs

Table 6-153 NSSF NSAvailability PUT success rate

Field	Details
Description	Percentage of NSAvailability UPDATE PUT messages with success response
Expression	sum(ocnssf_nssaiavailability_success_tx_total{message_type=\"availability_update\"}{method=\"PUT"})/sum(ocnssf_nssaiavailability_rx_total{message_type=\"availability_update\"}{method=\"PUT"}))*100"

Table 6-154 NSSF NSAvailability PATCH success rate

Field	Details
Description	Percentage of NSAvailability UPDATE PATCH messages with success response
Expression	sum(ocnssf_nssaiavailability_success_tx_total{message_type=\"availability_update\"}{method=\"PATCH"})/sum(ocnssf_nssaiavailability_rx_total{message_type=\"availability_update\"}{method=\"PATCH"}))*100"

Table 6-155 NSSF NSAvailability Delete success rate

Field	Details
Description	Percentage of NSAvailability Delete messages with success response
Expression	sum(ocnssf_nssaiavailability_success_tx_total{message_type=\"availability_update\"}{method=\"DELETE"})/ sum(ocnssf_nssaiavailability_rx_total{message_type=\"availability_update\"}{method=\"DELETE"}))*100""

Table 6-156 NSSF NSAvailability Subscribe success rate

Field	Details
Description	Percentage of NSAvailability Subscribe messages with success response

Table 6-156 (Cont.) NSSF NSAvailability Subscribe success rate

Field	Details
Expression	sum(ocnssf_nssaiavailability_success_tx_total{message_type=\"availability_subscribe\"}{method=\"POST\"})/ sum(ocnssf_nssaiavailability_rx_total{message_type=\"availability_subscribe\"}{method=\"POST\"}))*100"

Table 6-157 NSSF NSAvailability Unsubscribe success rate

Field	Details
Description	Percentage of NSAvailability Unsubscribe messages with success response
Expression	sum(ocnssf_nssaiavailability_success_tx_total{message_type=\"availability_subscribe\"}{method=\"DELETE\"})/ sum(ocnssf_nssaiavailability_rx_total{message_type=\"availability_subscribe\"}{method=\"DELETE\"}))*100"

Table 6-158 4xx Responses (NSAvailability)

Field	Details
Description	Rate of 4xx response for NSAvailability
Expression	sum(increase(oc_ingressgateway_http_responses{Status=~"4.* ",Uri=~".*nnssf-nsavailability.*",Method="GET"}[5m]))

Table 6-159 5xx Responses (NSAvailability)

Field	Details
Description	Rate of 5xx response for NSAvailability
Expression	sum(increase(oc_ingressgateway_http_responses{Status=~"4.* ",Uri=~".*nnssf-nsavailability.*",Method="GET"}[5m]))

6.2.3 Ingress Gateway KPIs

Table 6-160 NSSF Ingress Request

Field	Details
Description	Rate of HTTP requests received at NRF Ingress Gateway
Expression	oc_ingressgateway_http_requests

6.3 NSSF Alerts

This section includes information about alerts for Oracle Communications Network Slice Selection Function.

6.3.1 System Level Alerts

This section lists the system level alerts.

6.3.1.1 OcnssfNfStatusUnavailable

Table 6-161 OcnssfNfStatusUnavailable

Field	Details
Description	'OCNSSF services unavailable'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : All OCNSSF services are unavailable.'
Severity	Critical
Condition	All the NSSF services are unavailable, either because the NSSF is getting deployed or purged. These NSSF services considered are nssfselection, nssfsubscription, nssfavailability, nssfconfiguration, appinfo, ingressgateway and egressgateway.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9001
Metric Used	'up' **Note:** This is a Prometheus metric used for instance availability monitoring. If this metric is not available, use the similar metric as exposed by the monitoring system.

Recommended Actions	The alert is cleared automatically when the NSSF services start becoming available.
	Steps:
	1. Check for service specific alerts which may be causing the issues with service exposure.
	2. Run the following command to check if the pod's status is in "Running" state:
	`kubectl –n <namespace> get pod`
	If it is not in running state, capture the pod logs and events.
	Run the following command to fetch the events as follows:
	`kubectl get events --sort-by=.metadata.creationTimestamp -n <namespace>`
	3. Refer to the application logs on Kibana and check for database related failures such as connectivity, invalid secrets, and so on. The logs can be filtered based on the services.
	4. Run the following command to check Helm status and make sure there are no errors:
	`helm status <helm release name of the desired NF> -n <namespace>`
	If it is not in "STATUS: DEPLOYED", then again capture logs and events.
	5. If the issue persists, capture all the outputs from the above steps and contact My Oracle Support.
	Note: Use Cloud Native Core Network Function Data Collector tool for capturing the logs. For more information, see *Oracle Communications Cloud Native Core, Network Function Data Collector User Guide*.

6.3.1.2 OcnssfPodsRestart

Table 6-162 OcnssfPodsRestart

Field	Details
Description	'Pod <*Pod Name*> has restarted.
Summary	'kubernetes_namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : A Pod has restarted'
Severity	Major
Condition	A pod belonging to any of the NSSF services has restarted.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9002
Metric Used	'kube_pod_container_status_restarts_total'Note: This is a Kubernetes metric. If this metric is not available, use the similar metric as exposed by the monitoring system.

Recommended Actions	The alert is cleared automatically if the specific pod is up.
	Steps:
	1. Refer to the application logs on Kibana and filter based on the pod name. Check for database related failures such as connectivity, Kubernetes secrets, and so on.
	2. Run the following command to check orchestration logs for liveness or readiness probe failures:
	`kubectl get po -n <namespace>`
	Note the full name of the pod that is not running, and use it in the following command:
	`kubectl describe pod <desired full pod name> -n <namespace>`
	3. Check the database status. For more information, see "*Oracle Communications Cloud Native Core, cnDBTier User Guide*".
	4. If the issue persists, capture all the outputs from the above steps and contact My Oracle Support.
	Note: Use Cloud Native Core Network Function Data Collector tool for capturing the logs. For more information, see *Oracle Communications Cloud Native Core, Network Function Data Collector User Guide*.

6.3.1.3 OcnssfSubscriptionServiceDown

Table 6-163 OcnssfSubscriptionServiceDown

Field	Details
Description	'OCNSSF Subscription service <*ocnssf-nssubscription*> is down'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : NssfSubscriptionServiceDown service down'
Severity	Critical
Condition	NssfSubscription services is unavailable.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9003

Table 6-163 (Cont.) OcnssfSubscriptionServiceDown

Field	Details
Metric Used	"up' **Note:** This is a Prometheus metric used for instance availability monitoring. If this metric is not available, use the similar metric as exposed by the monitoring system.

Recommended Actions	The alert is cleared when the NssfSubscription services is available.
	Steps:
	1. Check if NfService specific alerts are generated to understand which service is down.
	If the following alerts are generated based on which service is down
	OcnssfSubscriptionServiceDown
	2. Run the following command to check the orchestration log nfsubscription service and check for liveness or readiness probe failures:
	`kubectl get po -n <namespace>`
	Note the full name of the pod that is not running, and use it in the following command:
	`kubectl describe pod <specific desired full pod name> -n <namespace>`
	3. Run the following command to check if the pod's status is in "Running" state:
	`kubectl –n <namespace> get pod`
	If it is not in running state, capture the pod logs and events .
	Run the following command to fetch events:
	`kubectl get events --sort-by=.metadata.creationTimestamp -n <namespace>`
	4. Refer to the application logs on Kibana and filter based on above service names. Check for ERROR WARNING logs for each of these services.
	5. Check the database status. For more information, see "*Oracle Communications Cloud Native Core, cnDBTier User Guide*".
	6. Refer to the application logs on Kibana and check for the service status of the nssfConfig service.
	7. If the issue persists, capture all the outputs for the above steps and contact My Oracle Support.
	Note: Use Cloud Native Core Network Function Data Collector tool for capturing the logs. For more information, see *Oracle Communications Cloud Native Core, Network Function Data Collector User Guide*.

6.3.1.4 OcnssfSelectionServiceDown

Table 6-164 OcnssfSelectionServiceDown

Field	Details
Description	'OCNSSF Selection service <ocnssf-nsselection> is down'**.**
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : OcnssfSelectionServiceDown service down'
Severity	Critical
Condition	None of the pods of the NSSFSelection microservice is available.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9004
Metric Used	'up' **Note:** This is a Prometheus metric used for instance availability monitoring. If this metric is not available, use the similar metric as exposed by the monitoring system.

Recommended Actions	The alert is cleared when the nfsubscription service is available.
	Steps:
	1. Run the following command to check the orchestration logs of ocnssf-nsselection service and check for liveness or readiness probe failures:
	`kubectl get po -n <namespace>`
	Note the full name of the pod that is not running, and use it in the following command:
	`kubectl describe pod <specific desired full pod name> -n <namespace>`
	2. Refer to the application logs on Kibana and filter based on ocnssf-nsselection service names. Check for ERROR WARNING logs.
	3. Check the database status. For more information, see "*Oracle Communications Cloud Native Core, cnDBTier User Guide*".
	4. Depending on the failure reason, take the resolution steps.
	5. If the issue persists, capture all the outputs for the above steps and contact My Oracle Support.
	Note: Use Cloud Native Core Network Function Data Collector tool for capturing the logs. For more information, see *Oracle Communications Cloud Native Core, Network Function Data Collector User Guide*.

6.3.1.5 OcnssfAvailabilityServiceDown

Table 6-165 OcnssfAvailabilityServiceDown

Field	Details
Description	'Ocnssf Availability service ocnssf-nsavailability is down'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : NssfAvailability service down'

Table 6-165 (Cont.) OcnssfAvailabilityServiceDown

Field	Details
Severity	Critical
Condition	None of the pods of the OcnssfAvailabilityServiceDown microservice is available.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9005
Metric Used	'up' **Note:** This is a Prometheus metric used for instance availability monitoring. If this metric is not available, use the similar metric as exposed by the monitoring system.

Recommended Actions	The alert is cleared when the ocnssf-nsavailability service is available.
	Steps:
	1. Run the following command to check the orchestration logs of ocnssf-nsavailability service and check for liveness or readiness probe failures:
	`kubectl get po -n <namespace>`
	Note the full name of the pod that is not running, and use it in the following command:
	`kubectl describe pod <specific desired full pod name> -n <namespace>`
	2. Refer to the application logs on Kibana and filter based on ocnssf-nsavailability service names. Check for ERROR WARNING logs.
	3. Check the database status. For more information, see "*Oracle Communications Cloud Native Core, cnDBTier User Guide*".
	4. Depending on the failure reason, take the resolution steps.
	5. If the issue persists, capture all the outputs for the above steps and contact My Oracle Support.
	Note: Use Cloud Native Core Network Function Data Collector tool for capturing the logs. For more information, see *Oracle Communications Cloud Native Core, Network Function Data Collector User Guide*.

6.3.1.6 OcnssfConfigurationServiceDown

Table 6-166 OcnssfConfigurationServiceDown

Field	Details
Description	'OCNSSF Config service *nssfconfiguration* is down'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : OcnssfConfigServiceDown service down'
Severity	Critical
Condition	None of the pods of the NssfConfiguration microservice is available.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9006
Metric Used	'up' **Note:** : This is a Prometheus metric used for instance availability monitoring. If this metric is not available, use the similar metric as exposed by the monitoring system.

Table 6-166 (Cont.) OcnssfConfigurationServiceDown

Field	Details

Recommended Actions	The alert is cleared when the nssfconfiguration service is available.
	Steps:
	1. Run the following command to check the orchestration logs of nssfconfiguration service and check for liveness or readiness probe failures:
	`kubectl get po -n <namespace>`
	Note the full name of the pod that is not running, and use in the following command:
	`kubectl describe pod <specific desired full pod name> -n <namespace>`
	2. Refer the application logs on Kibana and filter based on nssfconfiguration service names. Check for ERROR WARNING logs related to thread exceptions.
	3. Check the database status. For more information, see "*Oracle Communications Cloud Native Core, cnDBTier User Guide*".
	4. Depending on the reason of failure, take the resolution steps.
	5. If the issue persists, capture all the outputs for the above steps and contact My Oracle Support.
	Note: Use Cloud Native Core Network Function Data Collector tool for capturing the logs. For more information, see *Oracle Communications Cloud Native Core, Network Function Data Collector User Guide*.

6.3.1.7 OcnssfAppInfoServiceDown

Table 6-167 OcnssfAppInfoServiceDown

Field	Details
Description	OCNSSF Appinfo service *appinfo* is down'
Summary	kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : Appinfo service down'
Severity	Critical
Condition	None of the pods of the App Info microservice is available.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9007
Metric Used	'up' **Note:** This is a Prometheus metric used for instance availability monitoring. If this metric is not available, use the similar metric as exposed by the monitoring system.

Table 6-167 (Cont.) OcnssfAppInfoServiceDown

Field	Details

Recommended Actions	The alert is cleared when the app-info service is available.
	Steps:
	1. Run the following command to check the orchestration logs of appinfo service and check for liveness or readiness probe failures:
	`kubectl get po -n <namespace>`
	Note the full name of the pod that is not running, and use it in the following command:
	`kubectl describe pod <specific desired full pod name> -n <namespace>`
	2. Refer to the application logs on Kibana and filter based on appinfo service names. Check for ERROR WARNING logs related to thread exceptions.
	3. Depending on the failure reason, take the resolution steps.
	4. If the issue persists, capture all the outputs for the above steps and contact My Oracle Support.
	Note: Use Cloud Native Core Network Function Data Collector tool for capturing the logs. For more information, see *Oracle Communications Cloud Native Core, Network Function Data Collector User Guide*.

6.3.1.8 OcnssfIngressGatewayServiceDown

Table 6-168 OcnssfIngressGatewayServiceDown

Field	Details
Description	'Ocnssf Ingress-Gateway service *ingressgateway* is down'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : OcnssfIngressGwServiceDown service down'
Severity	Critical
Condition	None of the pods of the Ingress-Gateway microservice is available.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9008
Metric Used	'up' **Note:** This is a Prometheus metric used for instance availability monitoring. If this metric is not available, use the similar metric as exposed by the monitoring system.

Table 6-168 (Cont.) OcnssfIngressGatewayServiceDown

Field	Details

Recommended Actions	The alert is cleared when the ingressgateway service is available.
	Steps:
	1. Run the following command to check the orchestration logs of ingress-gateway service and check for liveness or readiness probe failures:
	`kubectl get po -n <namespace>`
	Note the full name of the pod that is not running, and use it in the following command:
	`kubectl describe pod <specific desired full pod name> -n <namespace>`
	2. Refer to the application logs on Kibana and filter based on ingress-gateway service names. Check for ERROR WARNING logs related to thread exceptions.
	3. Depending on the failure reason, take the resolution steps.
	4. If the issue persists, capture all the outputs for the above steps and contact My Oracle Support.
	Note: Use Cloud Native Core Network Function Data Collector tool for capturing the logs. For more information, see *Oracle Communications Cloud Native Core, Network Function Data Collector User Guide*.

6.3.1.9 OcnssfEgressGatewayServiceDown

Table 6-169 OcnssfEgressGatewayServiceDown

Field	Details
Description	'OCNSSF Egress service *egressgateway* is down'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : OcnssfEgressGwServiceDown service down'
Severity	Critical
Condition	None of the pods of the Egress-Gateway microservice is available.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9009
Metric Used	'up' **Note:** This is a Prometheus metric used for instance availability monitoring. If this metric is not available, use the similar metric as exposed by the monitoring system.

Table 6-169 (Cont.) OcnssfEgressGatewayServiceDown

Field	Details

Recommended Actions	The alert is cleared when the egressgateway service is available.
	Note: The threshold is configurable in the alerts.yaml
	Steps:
	1. Run the following command to check the orchestration logs of egress-gateway service and check for liveness or readiness probe failures:
	`kubectl get po -n <namespace>`
	Note the full name of the pod that is not running, and use it in the following command:
	`kubectl describe pod <specific desired full pod name> -n <namespace>`
	2. Refer to the application logs on Kibana and filter based on egress-gateway service names. Check for ERROR WARNING logs related to thread exceptions.
	3. Depending on the failure reason, take the resolution steps.
	4. If the issue persists, capture all the outputs for the above steps and contact My Oracle Support.
	Note: Use Cloud Native Core Network Function Data Collector tool for capturing the logs. For more information, see *Oracle Communications Cloud Native Core, Network Function Data Collector User Guide*.

6.3.1.10 OcnssfTotalIngressTrafficRateAboveMinorThreshold

Table 6-170 OcnssfTotalIngressTrafficRateAboveMinorThreshold

Field	Details
Description	'Ingress traffic Rate is above the configured minor threshold i.e. 800 requests per second (current value is: {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Traffic Rate is above 80 Percent of Max requests per second(1000)'
Severity	Minor
Condition	The total Ocnssf Ingress Message rate has crossed the configured minor threshold of 800 TPS. Default value of this alert trigger point in NrfAlertValues.yaml is when Ocnssf Ingress Rate crosses 80 % of 1000 (Maximum ingress request rate).
OID	1.3.6.1.4.1.323.5.3.40.1.2.9010
Metric Used	'oc_ingressgateway_http_requests_total'

Table 6-170 (Cont.) OcnssfTotalIngressTrafficRateAboveMinorThreshold

Field	Details
Recommended Actions	The alert is cleared either when the total Ingress Traffic rate falls below the Minor threshold or when the total traffic rate crosses the Major threshold, in which case the OcnssfTotalIngressTrafficRateAboveMinorThreshold alert shall be raised. **Note:** The threshold is configurable in the alerts.yaml **Steps**: Reassess the reason why the NSSF is receiving additional traffic, for example, the mated site NSSF is unavailable in the georedundancy scenario. If this is unexpected, contact My Oracle Support. 1. Refer Grafana to determine which service is receiving high traffic. 2. Refer Ingress Gateway section in Grafana to determine an increase in 4xx and 5xx error codes. 3. Check Ingress Gateway logs on Kibana to determine the reason for the errors.

6.3.1.11 OcnssfTotalIngressTrafficRateAboveMajorThreshold

Table 6-171 OcnssfTotalIngressTrafficRateAboveMajorThreshold

Field	Details
Description	'Ingress traffic Rate is above the configured major threshold i.e. 900 requests per second (current value is: {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Traffic Rate is above 90 Percent of Max requests per second(1000)'
Severity	Major
Condition	The total Ocnssf Ingress Message rate has crossed the configured major threshold of 900 TPS. Default value of this alert trigger point in NrfAlertValues.yaml is when Ocnssf Ingress Rate crosses 90 % of 1000 (Maximum ingress request rate).
OID	1.3.6.1.4.1.323.5.3.40.1.2.9011
Metric Used	'oc_ingressgateway_http_requests_total'
Recommended Actions	The alert is cleared when the total Ingress traffic rate falls below the major threshold or when the total traffic rate crosses the critical threshold, in which case the alert shall be raised. OcnssfTotalIngressTrafficRateAboveCriticalThreshold **Note:** The threshold is configurable in the alerts.yaml **Steps**: Reassess the reason why the NSSF is receiving additional traffic, for example, the mated site NSSF is unavailable in the georedundancy scenario. If this is unexpected, contact My Oracle Support. 1. Refer Grafana to determine which service is receiving high traffic. 2. Refer Ingress Gateway section in Grafana to determine an increase in 4xx and 5xx error codes. 3. Check Ingress Gateway logs on Kibana to determine the reason for the errors.

6.3.1.12 OcnssfTotalIngressTrafficRateAboveCriticalThreshold

Table 6-172 OcnssfTotalIngressTrafficRateAboveCriticalThreshold

Field	Details
Description	'Ingress traffic Rate is above the configured critical threshold i.e. 950 requests per second (current value is: {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Traffic Rate is above 95 Percent of Max requests per second(1000)'
Severity	Critical
Condition	The total Ocnssf Ingress Message rate has crossed the configured critical threshold of 950 TPS. Default value of this alert trigger point in NrfAlertValues.yaml is when Ocnssf Ingress Rate crosses 95 % of 1000 (Maximum ingress request rate).
OID	1.3.6.1.4.1.323.5.3.40.1.2.9012
Metric Used	'oc_ingressgateway_http_requests_total'
Recommended Actions	The alert is cleared when the Ingress traffic rate falls below the critical threshold. **Note:** The threshold is configurable in the alerts.yaml **Steps**: Reassess the reason why the NSSF is receiving additional traffic, for example, the mated site NSSF is unavailable in the georedundancy scenario. If this is unexpected, contact My Oracle Support. 1. Refer Grafana to determine which service is receiving high traffic. 2. Refer Ingress Gateway section in Grafana to determine an increase in 4xx and 5xx error codes. 3. Check Ingress Gateway logs on Kibana to determine the reason for the errors.

6.3.1.13 OcnssfTransactionErrorRateAbove0.1Percent

Table 6-173 OcnssfTransactionErrorRateAbove0

Field	Details
Description	'Transaction Error rate is above 0.1 Percent of Total Transactions (current value is {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Transaction Error Rate detected above 0.1 Percent of Total Transactions'
Severity	Warning
Condition	The number of failed transactions is above 0.1 percent of the total transactions.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9013
Metric Used	'oc_ingressgateway_http_responses_total'

Table 6-173 (Cont.) OcnssfTransactionErrorRateAbove0

Field	Details
Recommended Actions	The alert is cleared when the number of failure transactions are below 0.1 percent of the total transactions or when the number of failure transactions crosses the 1% threshold in which case the OcnssfTransactionErrorRateAbove1Percent is raised. **Steps**: 1. Check the Service specific metrics to understand the specific service request errors. For example: ocnssf_nsselection_success_tx with statusCode ~= 2xx. 2. Verify the metrics per service, per method. For example: Discovery requests can be deduced from the follwing metrics: Metrics="oc_ingressgateway_http_responses_total" Method="GET" NFServiceType="ocnssf-nsselection" Route_path="/nnssf-nsselection/v2/**" Status="503 SERVICE_UNAVAILABLE" 3. If guidance is required, contact My Oracle Support.

6.3.1.14 OcnssfTransactionErrorRateAbove1Percent

Table 6-174 OcnssfTransactionErrorRateAbove1Percent

Field	Details
Description	'Transaction Error rate is above 1 Percent of Total Transactions (current value is {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Transaction Error Rate detected above 1 Percent of Total Transactions'
Severity	Warning
Condition	The number of failed transactions is above 1 percent of the total transactions.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9014
Metric Used	'oc_ingressgateway_http_responses_total'
Recommended Actions	The alert is cleared when the number failed transactions is below 1% of the total transactions or when the number of failed transactions crosses the 10% threshold in which case the OcnssfTransactionErrorRateAbove10Percent shall be raised. **Steps**: 1. Check the Service specific metrics to understand the specific service request errors. For example: ocnssf_nsselection_success_tx with statusCode ~= 2xx. 2. Verify the metrics per service, per method For example: Discovery requests can be deduced from the following metrics: Metrics="oc_ingressgateway_http_responses_total" Method="GET" NFServiceType="ocnssf-nsselection" Route_path="/nnssf-nsselection/v2/**" Status="503 SERVICE_UNAVAILABLE" 3. If guidance is required, contact My Oracle Support.

6.3.1.15 OcnssfTransactionErrorRateAbove10Percent

Table 6-175 OcnssfTransactionErrorRateAbove10Percent

Field	Details
Description	'Transaction Error rate is above 10 Percent of Total Transactions (current value is {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Transaction Error Rate detected above 10 Percent of Total Transactions'
Severity	Minor
Condition	The number of failed transactions has crossed the minor threshold of 10 percent of the total transactions.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9015
Metric Used	'oc_ingressgateway_http_responses_total'
Recommended Actions	The alert is cleared when the number of failed transactions crosses the 10% threshold of the total transactions or when the ailed transactions crosses the 25% threshold in which case the OcnssfTransactionErrorRateAbove25Percent shall be raised. **Steps**: 1. Check the Service specific metrics to understand the specific service request errors. For example: ocnssf_nsselection_success_tx with statusCode ~= 2xx. 2. Verify the metrics per service, per method For example: Discovery requests can be deduced from the following metrics: Metrics="oc_ingressgateway_http_responses_total" Method="GET" NFServiceType="ocnssf-nsselection" Route_path="/nnssf-nsselection/v2/**" Status="503 SERVICE_UNAVAILABLE" 3. If guidance is required, contact My Oracle Support.

6.3.1.16 OcnssfTransactionErrorRateAbove25Percent

Table 6-176 OcnssfTransactionErrorRateAbove25Percent

Field	Details
Description	'Transaction Error rate is above 25 Percent of Total Transactions (current value is {{ $value }})'
summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Transaction Error Rate detected above 25 Percent of Total Transactions'
Severity	Major
Condition	The number of failed transactions has crossed the minor threshold of 25 percent of the total transactions.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9016
Metric Used	'oc_ingressgateway_http_responses_total'

Table 6-176 (Cont.) OcnssfTransactionErrorRateAbove25Percent

Field	Details
Recommended Actions	The alert is cleared when the number of failed transactions crosses the 25% of the total transactions or when the number of failed transactions crosses the 50% threshold in which case the OcnssfTransactionErrorRateAbove50Percent shall be raised. **Steps**: 1. Check the Service specific metrics to understand the specific service request errors. For example: ocnssf_nsselection_success_tx with statusCode ~= 2xx. 2. Verify the metrics per service, per method For example: Discovery requests can be deduced from the following metrics: Metrics="oc_ingressgateway_http_responses_total" Method="GET" NFServiceType="ocnssf-nsselection" Route_path="/nnssf-nsselection/v2/**" Status="503 SERVICE_UNAVAILABLE" 3. If guidance is required, contact My Oracle Support.

6.3.1.17 OcnssfTransactionErrorRateAbove50Percent

Table 6-177 OcnssfTransactionErrorRateAbove50Percent

Field	Details
Description	'Transaction Error rate is above 50 Percent of Total Transactions (current value is {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Transaction Error Rate detected above 50 Percent of Total Transactions'
Severity	Critical
Condition	The number of failed transactions has crossed the minor threshold of 50 percent of the total transactions.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9017
Metric Used	'oc_ingressgateway_http_responses_total

Table 6-177 (Cont.) OcnssfTransactionErrorRateAbove50Percent

Field	Details
Recommended Actions	The alert is cleared when the number of failed transactions is below 50 percent of the total transactions. **Steps**: 1. Check for service specific metrics to understand the specific service request errors. For example: ocnssf_nsselection_success_tx with statusCode ~= 2xx. 2. Verify the metrics per service, per method For example: Discovery requests can be deduced from the following metrics: Metrics="oc_ingressgateway_http_responses_total" Method="GET" NFServiceType="ocnssf-nsselection" Route_path="/nnssf-nsselection/v2/**" Status="503 SERVICE_UNAVAILABLE" 3. If guidance is required, contact My Oracle Support.

6.3.1.18 OcnssfIngressGatewayPodCongestionStateWarning

Table 6-178 OcnssfIngressGatewayPodCongestionStateWarning

Field	Details
Description	Ingress gateway pod congestion state reached DOC
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Ingress gateway pod congestion state reached DOC'
Severity	Warning
Condition	Ingress gateway pod has moved into a state of DOC for any of the aforementioned metrics. Thresholds are configured for CPU, Pending messages count.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9027
Metric Used	oc_ingressgateway_pod_congestion_state
Recommended Actions	Reassess the reasons leading to NSSF receiving additional traffic. **Steps**: Reassess the reasons leading to NSSF receiving additional traffic. If this is unexpected, contact My Oracle Support. 1. Refer to alert to determine which service is receiving high traffic. It may be due to a sudden spike in traffic. For example: When one mated site goes down, the NFs move to the given site. 2. Check the service pod logs on Kibana to determine the reason for the errors. 3. If this is expected traffic, check in Grafana for the distribution of traffic among the Ingress gateway pods. Then the thresholds levels may be reevaluated as per the call rate and reconfigured as mentioned in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

6.3.1.19 OcnssfIngressGatewayPodCongestionStateMajor

Table 6-179 OcnssfIngressGatewayPodCongestionStateMajor

Field	Details
Description	Ingress gateway pod congestion state when reached CONGESTED
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: Ingress gateway pod congestion state when reached CONGESTED'
Severity	Major
Condition	Ingress gateway pod has moved into a state of CONGESTED for any of the aforementioned metrics. Thresholds are configured for CPU, Pending messages count.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9028
Metric Used	oc_ingressgateway_pod_congestion_state
Recommended Actions	Reassess the reasons leading to NSSF receiving additional traffic. **Steps**: Reassess the reasons leading to NSSF receiving additional traffic. If this is unexpected, contact My Oracle Support. 1. Refer to alert to determine which service is receiving high traffic. It may be due to a sudden spike in traffic. For example: When one mated site goes down, the NFs move to the given site. 2. Check the service pod logs on Kibana to determine the reason for the errors. 3. If this is expected traffic, check in Grafana for the distribution of traffic among the Ingress gateway pods. Then the thresholds levels may be reevaluated as per the call rate and reconfigured as mentioned in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

6.3.1.20 OcnssfIngressGatewayPodResourceStateWarning

Table 6-180 OcnssfIngressGatewayPodResourceStateWarning

Field	Details
Description	The ingress gateway pod congestion state reached DOC because of excessive usage of resources
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: The ingress gateway pod congestion state reached DOC because of excessive usage of resources'
Severity	Warning
Condition	The configured threshold for resource cunsumption for state DOC for Ingress gateway is breached.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9029
Metric Used	oc_ingressgateway_pod_resource_state

Table 6-180 (Cont.) OcnssfIngressGatewayPodResourceStateWarning

Field	Details
Recommended Actions	Reassess the reasons leading to NSSF receiving additional traffic. **Steps**: Reassess the reasons leading to NSSF receiving additional traffic. If this is unexpected, contact My Oracle Support. 1. Refer to alert to determine which service is receiving high traffic. It may be due to a sudden spike in traffic. For example: When one mated site goes down, the NFs move to the given site. 2. Check the service pod logs on Kibana to determine the reason for the errors. 3. If this is expected traffic, check in Grafana for the distribution of traffic among the Ingress gateway pods. Then the thresholds levels may be reevaluated as per the call rate and reconfigured as mentioned in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

6.3.1.21 OcnssfIngressGatewayPodResourceStateMajor

Table 6-181 OcnssfIngressGatewayPodResourceStateMajor

Field	Details
Description	The ingress gateway pod congestion state reached CONGESTED because of excessive usage of resources
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: The ingress gateway pod congestion state reached CONGESTED because of excessive usage of resources'
Severity	Major
Condition	The configured threshold for resource cunsumption for state CONGESTED for Ingress gateway is breached.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9030
Metric Used	oc_ingressgateway_pod_resource_state
Recommended Actions	Reassess the reasons leading to NSSF receiving additional traffic. **Steps**: Reassess the reasons leading to NSSF receiving additional traffic. If this is unexpected, contact My Oracle Support. 1. Refer to alert to determine which service is receiving high traffic. It may be due to a sudden spike in traffic. For example: When one mated site goes down, the NFs move to the given site. 2. Check the service pod logs on Kibana to determine the reason for the errors. 3. If this is expected traffic, check in Grafana for the distribution of traffic among the Ingress gateway pods. Then the thresholds levels may be reevaluated as per the call rate and reconfigured as mentioned in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

6.3.2 Application Level Alerts

This section lists the application level alerts.

6.3.2.1 ocnssfPolicyNotFoundWarning

Table 6-182 ocnssfPolicyNotFoundWarning

Field	Details
Description	'Policy Not Found Rate is above warning threshold i.e. 700 mps (current value is: {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: 'Policy Not Found Rate is above 70 Percent' rate(ocnssf_nsselection_policy_not_found_total[2m])) >= 100 < 150
Severity	Warning
Condition	Rate of messages that did not find a matching policy is above warning threshold (Threshold: <>, Current: <>).
OID	1.3.6.1.4.1.323.5.3.40.1.2.9018
Metric Used	ocnssf_nsselection_policy_not_found_total
Recommended Actions	This alert is cleared when the number of error transactions are below 70 percent of the total traffic. **Steps**: 1. Check the ocnssf_nsselection_policy_match rate. 2. Look into logs and find configuration mismatch: a. For failure scenario check TAI and SNSSAI in error logs. b. Look in configuration for corresponding nssai-auth and nss_rule. i. If entry is not found, add configuration. ii. If entry is found, check Grant_FileId and update to ALLOWED. 3. If guidance is required, contact My Oracle Support.

6.3.2.2 ocnssfPolicyNotFoundMajor

Table 6-183 ocnssfPolicyNotFoundMajor

Field	Details
Description	'Policy Not Found Rate is above major threshold i.e. 850 mps (current value is: {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: 'Policy Not Found Rate is above 85 Percent'
Severity	Major
Condition	Rate of messages that did not find a matching policy is above major threshold.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9019
Metric Used	ocnssf_nsselection_policy_not_found_total

Table 6-183 (Cont.) ocnssfPolicyNotFoundMajor

Field	Details
Recommended Actions	This alert is cleared when the number of error transactions are below 85% of the total traffic. **Steps**: 1. Check the ocnssf_nsselection_policy_match rate. 2. Look into logs and find configuration mismatch: a. For failure scenario check TAI and SNSSAI in error logs. b. Look in configuration for corresponding nssai-auth and nss_rule. i. If entry is not found, add configuration. ii. If entry is found, check Grant_FileId and update to ALLOWED. 3. If guidance is required, contact My Oracle Support.

6.3.2.3 ocnssfPolicyNotFoundCritical

Table 6-184 ocnssfPolicyNotFoundCritical

Field	Description
Description	'Policy Not Found Rate is above critical threshold i.e. 950 mps (current value is: {{ $value }})'
Summary	'timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }}: 'Policy Not Found Rate is above 95 Percent'
Severity	Critical
Condition	Rate of messages that did not find a matching policy is above critical threshold.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9020
Metric Used	ocnssf_nsselection_policy_not_found_total
Recommended Actions	This alert is cleared when the number of error transactions are below 95 percent of the total traffic. **Steps**: 1. Check the ocnssf_nsselection_policy_match rate.. 2. Look into logs and find configuration mismatch: a. For failure scenario check TAI and SNSSAI in error logs. b. Look in configuration for corresponding nssai-auth and nss_rule: i. If entry is not found, add configuration. ii. If entry is found, check Grant_FileId and update to ALLOWED. 3. If guidance is required, contact My Oracle Support.

6.3.2.4 OcnssfOverloadThresholdBreachedL1

Table 6-185 OcnssfOverloadThresholdBreachedL1

Field	Details
Description	'Overload Level of {{$labels.app_kubernetes_io_name}} service is L1'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, podname: {{$labels.kubernetes_pod_name}}: Overload Level of {{$labels.app_kubernetes_io_name}} service is L1'
Severity	Warning
Condition	NSSF Services have breached their configured threshold of Level L1 for any of the aforementioned metrics. Thresholds are configured for CPU, svc_failure_count, svc_pending_count, and memory.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9021
Metric Used	load_level
Recommended Actions	The alert is cleared when the Ingress Traffic rate falls below the configured L1 threshold. **Note**: The thresholds can be configured using REST API. **Steps**: Reassess the reasons leading to NSSF receiving additional traffic. If this is unexpected, contact My Oracle Support. 1. Refer to alert to determine which service is receiving high traffic. It may be due to a sudden spike in traffic. For example: When one mated site goes down, the NFs move to the given site. 2. Check the service pod logs on Kibana to determine the reason for the errors. 3. If this is expected traffic, then the thresholds levels may be reevaluated as per the call rate and reconfigured as mentioned in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

6.3.2.5 OcnssfOverloadThresholdBreachedL2

Table 6-186 OcnssfOverloadThresholdBreachedL2

Field	Details
Description	'Overload Level of {{$labels.app_kubernetes_io_name}} service is L2'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, podname: {{$labels.kubernetes_pod_name}}: Overload Level of {{$labels.app_kubernetes_io_name}} service is L2'
Severity	Warning
Condition	NSSF Services have breached their configured threshold of Level L2 for any of the aforementioned metrics. Thresholds are configured for CPU, svc_failure_count, svc_pending_count, and memory.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9022
Metric Used	load_level

Table 6-186 (Cont.) OcnssfOverloadThresholdBreachedL2

Field	Details
Recommended Actions	The alert is cleared when the Ingress Traffic rate falls below the configured L2 threshold. **Note**: The thresholds can be configured using REST API. **Steps**: Reassess the reasons leading to NSSF receiving additional traffic. If this is unexpected, contact My Oracle Support. 1. Refer to alert to determine which service is receiving high traffic. It may be due to a sudden spike in traffic. For example: When one mated site goes down, the NFs move to the given site. 2. Check the service pod logs on Kibana to determine the reason for the errors. 3. If this is expected traffic, then the thresholds levels may be reevaluated as per the call rate and reconfigured as mentioned in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

6.3.2.6 OcnssfOverloadThresholdBreachedL3

Table 6-187 OcnssfOverloadThresholdBreachedL3

Field	Details
Description	'Overload Level of {{$labels.app_kubernetes_io_name}} service is L3'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, podname: {{$labels.kubernetes_pod_name}}: Overload Level of {{$labels.app_kubernetes_io_name}} service is L3'
Severity	Warning
Condition	NSSF Services have breached their configured threshold of Level L3 for any of the aforementioned metrics. Thresholds are configured for CPU, svc_failure_count, svc_pending_count, and memory.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9023
Metric Used	load_level
Recommended Actions	The alert is cleared when the Ingress Traffic rate falls below the configured L3 threshold. **Note**: The thresholds can be configured using REST API. **Steps**: Reassess the reasons leading to NSSF receiving additional traffic. If this is unexpected, contact My Oracle Support. 1. Refer to alert to determine which service is receiving high traffic. It may be due to a sudden spike in traffic. For example: When one mated site goes down, the NFs move to the given site. 2. Check the service pod logs on Kibana to determine the reason for the errors. 3. If this is expected traffic, then the thresholds levels may be reevaluated as per the call rate and reconfigured as mentioned in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

6.3.2.7 OcnssfOverloadThresholdBreachedL4

Table 6-188 OcnssfOverloadThresholdBreachedL4

Field	Details
Description	'Overload Level of {{$labels.app_kubernetes_io_name}} service is L4'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, podname: {{$labels.kubernetes_pod_name}}: Overload Level of {{$labels.app_kubernetes_io_name}} service is L4'
Severity	Warning
Condition	NSSF Services have breached their configured threshold of Level L4 for any of the aforementioned metrics. Thresholds are configured for CPU, svc_failure_count, svc_pending_count, and memory.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9024
Metric Used	load_level
Recommended Actions	The alert is cleared when the Ingress Traffic rate falls below the configured L4 threshold. **Note**: The thresholds can be configured using REST API. **Steps**: Reassess the reasons leading to NSSF receiving additional traffic. If this is unexpected, contact My Oracle Support. 1. Refer to alert to determine which service is receiving high traffic. It may be due to a sudden spike in traffic. For example: When one mated site goes down, the NFs move to the given site. 2. Check the service pod logs on Kibana to determine the reason for the errors. 3. If this is expected traffic, then the thresholds levels may be reevaluated as per the call rate and reconfigured as mentioned in *Oracle Communications Cloud Native Core, Network Slice Selection Function REST Specification Guide*.

6.3.2.8 OcnssfScpMarkedAsUnavailable

Table 6-189 OcnssfScpMarkedAsUnavailable

Field	Details
Description	'An SCP has been marked unavailable'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : One of the SCP has been marked unavailable'
Severity	Major
Condition	One of the SCPs has been marked unhealthy.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9025
Metric Used	'oc_egressgateway_peer_health_status'
Recommended Actions	This alert get cleared when unavailable SCPs become available.

6.3.2.9 OcnssfAllScpMarkedAsUnavailable

Table 6-190 OcnssfAllScpMarkedAsUnavailable

Field	Details
Description	'All SCPs have been marked unavailable'
Summary	'kubernetes_namespace: {{$labels.kubernetes_namespace}}, timestamp: {{ with query "time()" }}{{ . | first | value | humanizeTimestamp }}{{ end }} : All SCPs have been marked as unavailable'
Severity	Critical
Condition	All SCPs have been marked unavailable.
OID	1.3.6.1.4.1.323.5.3.40.1.2.9026
Metric Used	'oc_egressgateway_peer_count and oc_egressgateway_peer_available_count'
Recommended Actions	NF clears the critical alarm when at least one SCP peer in a peer set becomes available such that all other SCP or SEPP peers in the given peer set are still unavailable.

6.3.3 NSSF Alert Configuration

Follow the steps below for NSSF Alert configuration in Prometheus:

> **Note**
>
> 1. By default, Namespace for NSSF is `ocnssf`, which must be updated as per the deployment.
> 2. The `ocnnsf-custom-configTemplate-23.4.0.0.0.zip` file can be downloaded from MOS. Unzip the `ocnnsf-custom-configTemplate-23.4.0.0.0.zip` file after downloading to get `ocnssf_custom_values_23.4.0.yaml` file.
> 3. Set the following parameter in the `ocnssf_alert_rules_23.4.0.yaml` file: `app_kubernetes_io_part_of="<deployment name>"`
>
>   Example: `app_kubernetes_io_part_of="ocnssf"`
>
>   Where deployment name is `'ocnssf'`.

Configuring NSSF alerts for CNE 1.8.x and previous versions

The following procedure describes how to configure NSSF alerts for CNE version 1.8.x and previous versions:

NAME: Helm Release of Prometheus

Namespace : Kubernetes Namespace in which Prometheus is installed

1. Take a backup of current configuration map of Prometheus:

   ```
   kubectl get configmaps _NAME_-server -o yaml -n _Namespace_ > /tmp/
   tempConfig.yaml
   ```

2. Check NSSF Alert file name:

```
sed -i '/etc\/config\/alertsnssf/d' /tmp/tempConfig.yaml
```

3. Add NSSF Alert file name inside Prometheus configuration map:

```
sed -i '/rule_files:/a\ \- /etc/config/alertsnssf'/tmp/tempConfig.yaml
```

4. Update configuration map with the updated file name of NSSF alert file:

```
kubectl replace configmap _NAME_-server -f /tmp/tempConfig.yaml
```

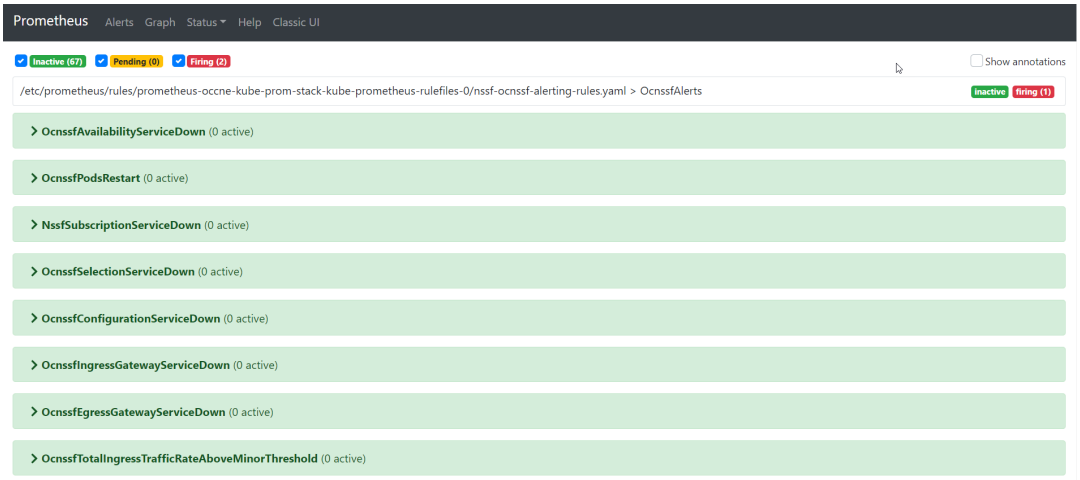
5. Add NSSF Alert rules in configuration map under file name of NSSF alert file:

```
kubectl patch configmap _NAME_-server -n _Namespace_--type merge --patch "$
(cat ~/ocnssf-<release-version>.alert-rules.yaml)"
```

Example:

```
kubectl patch configmap _NAME_-server -n _Namespace_--type merge --patch "$
(cat ~/ocnssf_alert_rules_23.4.0.yaml)"
```

6. Log in to Prometheus GUI and verify the alerts section.
The alert configuration file must be loaded as shown in the figure.



Configuring NSSF alerts for CNE 1.9.x and later versions

This section describes the measurement based Alert rules configuration for NSSF in Prometheus. Use the ocnssf_alerting_rules_promha_<release-number>.yaml file updated in NSSF Alert configuration section.

1. Run the following command to apply the prometheus rules :

```
kubectl apply -f nssfAlertRules-promha_<release-version>.yaml -n
_Namespace_
```

Example:

```
$ kubectl apply -f ocnssf_alert_rules_promha_23.4.0.yaml --namespace ocnssf
```

Sample output:

```
  prometheusrule.monitoring.coreos.com/ocnssf-alerting-rules created
```

2. Run the following command to check NSSF alert file is added to prometheusrules:

```
$ kubectl get prometheusrules --namespace <namespace>
```

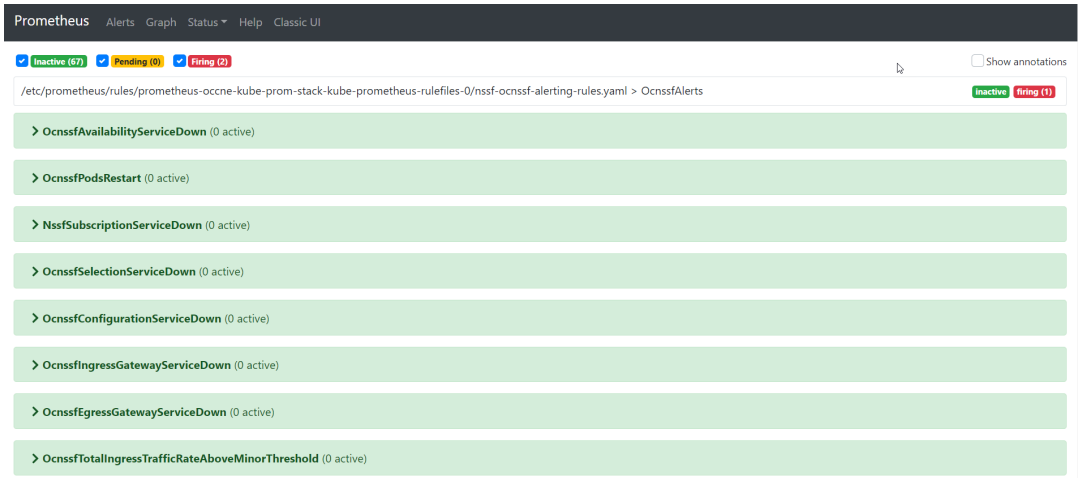
Example:

```
$ kubectl get prometheusrules --namespace ocnssf
```

Sample output:

```
NAME                            AGE
nssf-ocnssf-alerting-rules          1m
```

3. Log in to Prometheus GUI and verify the alerts section.
The alert configuration file must be loaded as shown in the figure.



> **Note**
>
> The Prometheus server takes an updated configuration map that is automatically reloaded after approximately 60 seconds. Refresh the Prometheus GUI to confirm that the NSSF Alerts have been reloaded.

Steps to Check Alerts in Prometheus

1. Run the following command to deploy Prometheus:

Go to path: ocnssf/automation/infrastructure

```
helm install stable/Prometheus occne-prometheus --namespace occne-infra -f
./components/prometheus/values.yaml -f./components/prometheus/values-
server-files.yaml --version 9.1.1
```

2. Configure the alerts by following NSSF Alert Configuration section.
3. To find Prometheus on UI:

http://_NODE_IP_:PORT_/

Here _NODE_IP_ is the machine on which Prometheus pod is running.

PORT is occne-prometheus-server port. (Use cmd :: "kubectl get svc -n occne-infra" to get port. Here occne-infra is the namespace where Prometheus is running.)

Disabling Alerts

This section explains the procedure to disable the alerts in NSSF.

Disabling Alerts for CNE 1.8.x and previous versions

1. Edit `ocnssf-.alert-rules.yaml` file to remove specific alert.
2. Remove complete content of the specific alert from the `ocnssf-.alert-rules.yaml` file.

   `ocnssf-.alert-rules.yaml`

   ```
   For example: If you want to remove OcnssfTrafficRateAboveMinorThreshold
   alert, remove the complete content:

   ## ALERT SAMPLE START##
   - alert: OcnssfTrafficRateAboveMinorThreshold
    annotations:
    description: 'NSSF traffic Rate is above the configured minor threshold
   i.e. 700 requests per second (current value is: {{ $value }})'
    summary: 'namespace: {{$labels.kubernetes_namespace}}, podname:
   {{$labels.kubernetes_pod_name}}, timestamp: {{ with query "time()" }}{{ .
   | first | value | humanizeTimestamp }}{{ end }}: Traffic Rate is above 70
   Percent of Max requests per second(1000)'
    expr:
   sum(rate(oc_ingressgateway_http_requests_total{InstanceIdentifier="nssf_ing
   ressgateway",kubernetes_namespace="nssf"}[2m])) > 0
    labels:
    severity: minor
    oid: "1.3.6.1.4.1.323.5.3.51.1.2.7001"
    namespace: ' {{ $labels.kubernetes_namespace }} '
    podname: ' {{$labels.kubernetes_pod_name}} '
   ## ALERT SAMPLE END##
   ```

3. Perform Alert configuration.

Disabling Alerts for CNE 1.9.x and later versions

1. Retrieve prometheusrule name.
   Example:

Run

```
kubectl get prometheusrule
```

Sample Output:

```
NAME AGE
ocnssf-alerting-rules 7d20h
```

2. Delete prometheusrule.
   Example:

   Run

   ```
   kubectl delete prometheusrule ocnssf-alerting-rules
   ```

   Sample Output:

   ```
   prometheusrule.monitoring.coreos.com "ocnssf-alerting-rules" deleted
   ```

3. Update alerting rules.
   Example:

   Run

   ```
   kubectl apply -f promHAalerts.yaml
   ```

   Sample Output:

   ```
   prometheusrule.monitoring.coreos.com/ocnssf-alerting-rules created
   ```