Oracle® Communications

Networks Data Analytics Function Installation, Upgrade, and Fault Recovery Guide

Release 24.2.2
F96695-05
April 2025

Oracle Communications Networks Data Analytics Function Installation, Upgrade, and Fault Recovery Guide, Release 24.2.2

F96695-05

Contents

My Oracle Support

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

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

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

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

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

Acronyms

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

Table Acronyms

Acronym	Description
3GPP	3rd Generation Partnership Project
5GC	5G Core Network
5GS	5G System
ACL	Access Control List
AF	Application Function
API	Application Programming Interface
AMF	Access and Mobility Management Function
CNC	Cloud Native Core
CNE	Oracle Communications Cloud Native Core, Cloud Native Environment
FQDN	Fully Qualified Domain Name
GRD Agent	Georedundancy Agent
GUI	Graphical User Interface
HTTPS	Hypertext Transfer Protocol Secure
KPI	Key Performance Indicator
HA	High Availability
IMSI	International Mobile Subscriber Identity
K8s	Kubernetes
ME	Monitoring Events
Network Slice	A logical network that provides specific network capabilities and network characteristics.
NEF	Oracle Communications Cloud Native Core, Network Exposure Function
NF	Network Function
NRF	Oracle Communications Cloud Native Core, Network Repository Function
NSI	Network Slice Instance. A set of Network Function instances and the required resources (such as compute, storage and networking resources) which form a deployed Network Slice.
NSSF	Oracle Communications Cloud Native Core, Network Slice Selection Function
NWDAF	Network Data Analytics Function
OAM	Operations, Administration, and Maintenance
OCI	Oracle Cloud Infrastructure
OKE	Oracle Kubernetes Engine
OCNADD	Oracle Communications Network Analytics Data Director
PLMN	Public Land Mobile Network
REST	Representational State Transfer

Table (Cont.) Acronyms

Acronym	Description
SBA	Service Based Architecture
SBI	Service Based Interface
SMF	Session Management Function
SNMP	Simple Network Management Protocol
SUPI	Subscription Permanent Identifier
UDM	Unified Data Management
UE	User Equipment
URI	Uniform Resource Identifier

What's New in This Guide

This section introduces the documentation updates for Release *24.2.x* in Oracle Communications Network Data Analytics Function (OCNWDAF) Installation and Fault Recovery Guide.

Release 24.2.2 - F96695-05, April 2025

Removed the **Configure IP Version (IPv6 or IPv4)** section as NWDAF does not support IPv6.

Release 24.2.2 - F96695-03, November 2024

The following sections are updated for this release:

- Updated the supported Kubernetes version in the Software Requirements section.
- Updated the upgrade path in the Supported Upgrade Paths section.

Release 24.2.0 - F96695-02, September 2024

Updated the stem sentence in Enable TLS 1.3 Support section as "You can configure this feature using Helm parameters. Configure the following parameters in the Ingress Gateway and Egress Gateway, required for TLS1.3".

Release 24.2.0 - F96695-01, July 2024

The following sections are updated for this release:

- Updated the release version to 24.2.0 throughout the document.
- Added the following sections to provide information about Oracle's error correction policy and open source support policies:
  - Oracle Error Correction Policy
  - Oracle Open Source Support Policies
- Updated the Acronyms section to include the terms OCI and OKE.
- Updated the References section to include reference to OCI documents.
- Updated the Overview and Installing OCNWDAF sections to include OCI information.
- Updated the software versions in the Software Requirements section.
- Updated the Docker image versions in the Pushing the Images to Customer Docker Registry section.
- Added the sections for Pushing the Images to OCI Docker Registry and Configure OCI Metrics.
- Added the following pre-installation procedures:
  - Creating an Admin User in the Database
  - Creating Secret for the Private Image Repository
  - Configuring OCNWDAF Database
- Added the step to update secrets in the *values.yaml* file in the Installing OCNWDAF Package.
- The OCNWDAF supports Upgrade from previous releases, the following upgrade procedures are added:

  - Upgrading OCNWDAF
  - Supported Upgrade Paths
  - Preupgrade Tasks
  - Upgrade Tasks
- Added the section Enable Model C Communication Support to provide information about configuring Model C communication by OCNWDAF.
- Added the sections Enable TLS 1.3 Support and TLS 1.3 Parameters to provide information about enabling the TLS 1.3 Support feature.
- Added the section Configure Prometheus Metrics to provide information about configuring the metrics from Prometheus.

1 Introduction

This document provides information on how to install Oracle Communications Network Data Analytics Function (OCNWDAF) and its microservices. It also includes information on performing fault recovery for OCNWDAF.

1.1 Overview

Oracle Communications Network Data Analytics Function (OCNWDAF) is a Network Function (NF) in the 5G core network of the 5G Network Architecture.

The OCNWDAF enables the operator to collect and analyze the data in the network. The 5G technology requires prescriptive analytics to drive closed-loop automation and self-healing networks. In a 5G network, the consumers of data are 5G NFs, Application Functions (AFs), and Operations, Administration, and Maintenance (OAM) and the data producers are NFs. The OCNWDAF supports the following functions:

- OCNWDAF collects data from Access and Mobility Management Function (AMF), Session Management Function (SMF), and Network Repository Function (NRF) in the network. The data is collected directly from the NFs.
- The OCNWDAF is designed to provide analytics information to consumer such as NFs, AFs and OAM.
- The OCNWDAF collects data from call flows across the 5G control plane through messages captured and filtered by the Oracle Communications Network Analytics Data Director (OCNADD).

A 5G network contains a vast number of devices and sensors generating an enormous amount of data. The OCNWDAF function allows the Communications Service Providers (CSPs) to efficiently monitor, manage, automate, and optimize their network operations by the data collected and analytics generated across the network. The OCNWDAF also helps the CSPs in achieving the operational efficiency and provides an enhanced service experience.

The analytics information provided by the OCNWDAF is either statistical information based on past events or predictive information. This analytics information is used to balance the resources on the network. The OCNWDAF can predict the User Equipment (UE) location and also detect if the UE is in an abnormal location. Based on the collected analytics information, the CSPs can roll out new services or modify the existing services without waiting for a maintenance window in the network. This ensures significantly fewer chances of network experiencing downtime.

An OCNWDAF consumer can avail analytics information for different analytic events. Alternatively, the consumers can subscribe or unsubscribe for specific analytics information as a one-time event or periodically get notified when a specifically defined event (for example, a threshold is breached) is detected.

The NRF discovers the OCNWDAF instances for the NF consumers in the network. The OCNWDAF information can also be locally configured on the NF consumers. The OCNWDAF selection function in the consumer NF selects an OCNWDAF instance among available OCNWDAF instances. Different OCNWDAF instances present in the 5G network can be configured to provide a specific type of analytics information. This information about the OCNWDAF instance is described in the OCNWDAF profile stored in the NRF. The consumer

NFs that need specific analytics types query the NRF and include the Analytics ID based on the required data.

OCNWDAF installation is supported over the following platforms:

- Oracle Communications Cloud Native Core, Cloud Native Environment (CNE)
- Oracle Cloud Infrastructure (OCI)
  For more information, see *Oracle Communications Networks Data Analytics Function Installation, Upgrade, and Fault Recovery Guide*.

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

1.2 References

For more information about OCNWDAF, refer to the following documents:

- *Oracle Communications Networks Data Analytics Function User Guide*
- *Oracle Communications Networks Data Analytics Function Solution Guide*
- *Oracle Communications Networks Data Analytics Function Troubleshooting Guide*
- *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, cnDBTier User Guide*
- *Oracle Communications Cloud Native Core, OCI Adaptor Deployment Guide*
- *Oracle Communications Cloud Native Core, OCI Adaptor Reference Architecture Guide*

1.3 Oracle Error Correction Policy

The table below outlines the key details for the current and past releases, their General Availability (GA) dates, the latest patch versions, and the end dates for the Error Correction Grace Period.

Table 1-1 Oracle Error Correction Policy

Release Number	General Availability (GA) Date	Latest Patch Version	Error Correction Grace Period End Date
3.24.2	July 2024	24.2.0	July 2025
3.24.1	April 2024	24.1.0	April 2025
3.23.4	December 2023	23.4.0	December 2024
2.23.3	September 2023	23.3.0.0.1	September 2024

> **Note**
>
> For a release, Sev1 and Critical Patch Unit (CPU) patches are supported for 12 months. For more information, see Oracle Communications Cloud Native Core and Network Analytics Error Correction Policy.

1.4 Oracle Open Source Support Policies

Oracle Communications Cloud Native Core uses open source technology governed by the Oracle Open Source Support Policies. For more information, see Oracle Open Source Support Policies.

2
Installing OCNWDAF

This chapter provides information about installing Oracle Communications Networks Data Analytics Function (OCNWDAF) in a cloud native environment.

OCNWDAF installation is supported over the following platforms:

- Oracle Communications Cloud Native Core, Cloud Native Environment (CNE): For more information about CNE, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.
- Oracle Cloud Infrastructure (OCI) using OCI Adaptor: For more information about OCI, see *Oracle Communications Cloud Native Core, OCI Adaptor Deployment Guide*.

2.1 Prerequisites

Before you begin with the procedure for installing OCNWDAF, ensure that the following requirements are met:

- Software Requirements
- Environment Setup Requirements
- Resource Requirements

> ⚠ **Caution**
>
> User, computer and applications, and character encoding settings may cause an issue when copy-pasting commands or any content from PDF. PDF reader version also affects the copy-pasting functionality. It is recommended to verify the pasted content especially when hyphens or any special characters are part of copied content.

2.1.1 Software Requirements

This section describes the software requirements for installing OCNWDAF.

Mandatory Software

The following software items must be installed before starting the OCNWDAF installation:

Table 2-1 Preinstalled Software

Software	Version
Kubernetes	1.28.x, 1.27.x, 1.26.x
HELM	3.1.2, 3.5.0, 3.6.3, 3.8.0, 3.9.4, 3.10.3, 3.12.0, 3.12.3
Podman	2.2.1, 3.2.3, 3.3.1, 4.4.1, 4.2.0, 4.6.1

> **Note**
>
> - OCNWDAF 24.2.0 supports CNE 24.1.x.
> - OCNWDAF 24.2.0 supports OKE managed clusters on OCI.

To verify the current Helm and Kubernetes version installed on CNE, use the following commands:

- To check Kubernetes version, run the following command:

  ```
  kubectl version
  ```

- To check the Helm version, run the following command:

  ```
  helm3 version
  ```

- Role-Based Access Control (RBAC)

  ```
  rbac.authorization.k8s.io/v1
  ```

Additional Software

Depending on your requirement, you may have to install additional software while deploying OCNWDAF. The list of additional software items, along with the supported versions and usage, is given in the following table:

Table 2-2 Additional Software

Software	App Version	Required For
elasticsearch	7.9.3	Logging
elastic-client	0.3.6	Metric Server
elastic-curator	5.5.4	Logging
elastic-exporter	1.1.0	Logging
elastic-master	7.9.3	Logging
logs	3.1.0	Logging
kibana	7.9.3	Logging
grafana	9.1.7	KPIs
prometheus	2.45.0	Metrics
prometheus-kube-state-metrics	1.9.7	Metrics
prometheus-node-exporter	1.0.1	Metrics
metalLb	0.12.1	External IP
metrics-server	0.3.6	Metrics
tracer	1.21.0	Tracing

> **Note**
>
> On OCI, the above mentioned software are not required because OCI observability and management service is used for logging, metrics, alerts, and KPIs. For more information, see *Oracle Communications Cloud Native Core, OCI Adaptor Deployment Guide*.

To verify the installed software items, run the following command:

```
helm3 ls -A
```

If you need any services related to the above software items, and if the respective software is unavailable in CNE, then install that software before proceeding.

2.1.2 Environment Setup Requirements

This section provides information about environment setup requirements for installing OCNWDAF.

Client Machine Requirements

This section describes the requirements for client machine, that is, the machine used by the user to run deployment commands.

The client machine must have:

- network access to the Helm repository and docker image repository.
- Helm repository configured on the client.
- network access to the Kubernetes cluster.
- required environment settings to run the `kubectl` and `docker` commands. The environment must have privileges to create a namespace in the Kubernetes cluster.
- Helm client installed so that the `helm install` command deploys the software in the Kubernetes cluster.

Network Access Requirements

The Kubernetes cluster hosts must have network access to the following repositories:

- **Local docker image repository**: It contains the OCNWDAF docker images. To check if the Kubernetes cluster hosts can access the local docker image repository, pull any image with an image-tag, using the following command:

  ```
  docker pull <docker-repo>/<image-name>:<image-tag>
  ```

  where:

  `docker-repo` is the IP address or host name of the docker image repository.

  `image-name` is the docker image name.

  `image-tag` is the tag assigned to the docker image used for the OCNWDAF pod.

- **Local helm repository** : It contains the OCNWDAF Helm charts. To check if the Kubernetes cluster hosts can access the local Helm repository, run the following command:

  ```
  helm repo update
  ```

Server or Space Requirement

For information about server or space requirements, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

Oracle Communications Cloud Native Environment Specification

This section is applicable only if you are installing OCNWDAF on Cloud Native Environment (CNE).

Oracle Communications Network Data Analytics Function (OCNWDAF) 24.2.0 can be installed on Oracle Communications Cloud Native Core, Cloud Native Environment (CNE) 24.1.x.

Verify the CNE version with the following command:

```
echo $OCCNE_VERSION
```

> **Note**
>
> From CNE 1.8.x and later, the container platform is Podman instead of docker. For more information about Podman installation, see *Oracle Communications Cloud Native Core, Cloud Native Environment (CNE) Installation, Upgrade, and Fault Recovery Guide*.

OCI Requirements

OCNWDAF can be deployed in OCI. While deploying OCNWDAF in OCI, the user must use the Operator instance/VM instead of Bastion Host.

For more information about OCI Adaptor, see *Oracle Communications Cloud Native Core, OCI Adaptor Reference Architecture Guide*.

cnDBTier Requirements

OCNWDAF supports cnDBTier in a virtual CNE (vCNE) environment. cnDBTier must be up and active in case of containerized CNE. For more information about the installation procedure, see the *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*.

> **Note**
>
> If the environment has cnDBTier 23.2.0 installation, follow the instruction below:
>
> - If cnDBTier 23.2.0 release is installed, set the *ndb_allow_copying_alter_table* parameter to 'ON' in the cnDBTier custom values *dbtier_23.2.0_custom_values_23.2.0.yaml* file and perform cnDBTier upgrade before install, upgrade, or any fault recovery procedure is performed for OCNWDAF. Set the parameter to its default value ('OFF') once the activity is completed and perform the cnDBTier upgrade to apply the parameter changes.
> - To perform cnDBTier upgrade, see *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*.

Oracle Communications Network Analytics Data Director (OCNADD) Requirements

Oracle Communications Network Analytics Data Director (OCNADD) serves as one of the data sources for the OCNWDAF. If OCNADD is configured as a data source, ensure the following prerequisites are met before OCNWDAF installation:

- OCNADD is setup and running.
- Access Control List (ACL) feed is enabled on OCNADD as the required data source.
- Run OCNWDAF *gen_certs* script under */scripts/gen_certs.sh*.

> **Note**
>
> Configure the ACL topic certificate from the OCNADD Kafka Cluster in the OCNWDAF Kafka Cluster to enable secure data flow between OCNADD and OCNWDAF.

For more information on configuring OCNADD, see Configuring Data Director.

CNC Console Requirements

OCNWDAF supports CNC Console 24.2.0, 24.1.x, 23.3.x, and 23.2.x to configure and manage Network Functions. For more information, see *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide*.

Analytics Database

This database is based on MySQL cluster and stores relational and time-series data. The relational data represents all the objects within the telecommunication network, such as UEs, slices, cells, NFs, and so on and their relationships with each other. The time-series data represents all the KPIs, measurements, and event data collected over time and used in streaming analytics and training ML models.

> **Note**
>
> The deployment of the Mysql Innodb cluster is based on the variable *dbConfigStatus* present in the *values.yaml* file under */helmchart*. For more information, see Configure Database Flag.

2.1.3 Resource Requirements

This section lists the resource requirements to install and run OCNWDAF.

OCNWDAF Services

The following table lists the resource requirement for OCNWDAF services:

Table 2-3 Core Microservices Resource Requirements

Microservice Name	Instances	POD Replica		CPU/POD		Memory/POD (in GB)		Ephemeral Storage	
		Min	Max	Min	Max	Min	Max	Min (Mi)	Max (GB)
ocn-nwdaf-analytics-info-service	1	1	2	1	2	1	2	200	200
nwdaf-ingress-gateway	2	2	5	1	2	2	4	200	200
nwdaf-egress-gateway	2	2	5	1	2	2	4	200	200
nwdaf-cap4c-spring-cloud-config-server	1	1	1	1	2	1	2	200	200
ocn-nwdaf-data-collection-service	1	1	3	4	4	4	4	200	200
ocn-nwdaf-data-collection-controller	1	1	2	1	2	1	2	200	200
ocn-nwdaf-subscription-service	1	1	2	1	2	1	2	200	200
ocn-nwdaf-mtlf-service	1	1	2	1	2	1	2	200	200
cap4c-configuration-manager-service	1	1	2	1	2	1	2	200	200
cap4c-model-controller	1	1	3	1	2	1	2	200	200
cap4c-model-executor	1	1	3	1	2	1	2	200	200
cap4c-stream-analytics	1	1	3	1	2	1	2	200	200
nwdaf-portal	1	1	2	0.5	1	1	2	200	200
nwdaf-portal-service	1	1	2	1	2	1	2	200	200
cap4c-scheduler-service	1	1	2	1	2	1	2	200	200
cap4c-stream-transformer	1	1	2	1	2	1	2	200	200
cap4c-api-gateway	1	1	2	1	2	1	2	200	200

Table 2-3 (Cont.) Core Microservices Resource Requirements

Microservice Name	Instances	POD Replica		CPU/POD		Memory/POD (in GB)		Ephemeral Storage	
cap4c-kafka-ingestor	1	1	3	1	2	1	2	200	200
ocn-nwdaf-cap4c-reporting-service	1	1	2	1	2	1	2	200	200
ocn-nwdaf-geo-redundacy-agent	1	1	2	1	1	1	1	200	200
nwdaf-cap4c data-replicator	1	1	1	1	1	2	4	200	200
cap4c-capex-optimization-service	1	1	2	1	2	1	2	200	200
ocn-nwdaf-analytics-decision-engine-service	1	1	2	1	2	1	2	200	200
Total	25	25	55	12.5	45	30	55	4600	4600

Simulator Microservices Resource Requirements

Table 2-4 Simulator Microservices Resource Requirements

Microservice Name	POD Replica		CPU/POD		Memory/POD (in GB)		Ephemeral Storage	
	Min	Max	Min	Max	Min	Max	Min (Mi)	Max (GB)
ocn-nrf-simulator-service	1	2	1	2	1	2	200	200
ocn-amf-simulator-service	1	2	1	2	1	2	200	200
ocn-smf-simulator-service	1	2	1	2	1	1	200	200
ocn-oam-simulator-service	1	2	2	2	4	4	200	200
mesa-simulator	1	2	1	2	1	2	200	200
Total	5	10	6	10	8	12	1000	1000

Resource Requirements for Helm Test

This section provides the details on resource requirement to install and run OCNWDAF Helm Test.

Helm Test Job
This job runs on demand when Helm test command is run. It runs the Helm test and stops after completion. These are short lived jobs, which gets terminated after the work is completed. Hence, they are not part of active deployment resource, but considered only during Helm test procedures.

Table 2-5 Helm Test Requirement

Container Type	CPU Request and Limit Per Container	Memory Request and Limit Per Container
Helm Test	Request- 1 CPU, Limit- 2 CPU	Request- 1 GB, Limit- 2 GB

Below is an example of the configurations that should be included under the global section of the *oc-nwdaf-custom-values.yaml* file.

```
global:
  testJobResources:
    limits:
      cpu: 2
      memory: 2Gi
      ephemeral-storage: 2Gi
    requests:
      cpu: 1
      memory: 1Gi
      ephemeral-storage: 200Mi
```

2.2 Installation Sequence

This section describes preinstallation, installation, and postinstallation tasks for OCNWDAF.

You are recommended to follow the steps in the given sequence for preparing and installing OCNWDAF.

2.2.1 Preinstallation Tasks

Before installing OCNWDAF, perform the tasks described in this section.

> **Note**
>
> The kubectl commands might vary based on the platform used for deploying CNC Policy. Users are recommended to replace `kubectl` with environment-specific command line tool to configure kubernetes resources through kube-api server. The instructions provided in this document are as per the CNE's version of kube-api server.

2.2.1.1 Downloading the OCNWDAF package

This section provides information about how to download OCNWDAF package.

To download the OCNWDAF package from My Oracle Support:

1. Log in to My Oracle Support using the appropriate credentials.
2. Click **Patches & Updates** to locate the patch.
3. In the **Patch Search** console, select the **Product or Family (Advanced)** option.
4. Enter `Oracle Communications Cloud Native Core Network Data Analytics Function` in the **Product** field. Select the product from the **Product** drop-down

5. From the **Release** drop-down, select "**Oracle Communications Cloud Native Core Network Data Analytics Function <release_number>**" Where, `<release_number>` indicates the required release number of OCNWDAF.
6. Click **Search**.
   The Patch Advanced Search Results displays a list of releases.
7. Select the required patch from the list. The Patch Details window appears.
8. Click **Download**. The File Download window appears.
9. Click the **<p********_<release_number>_Tekelec>.zip** file.
10. Extract the release package zip file.
    Package is named as follows:

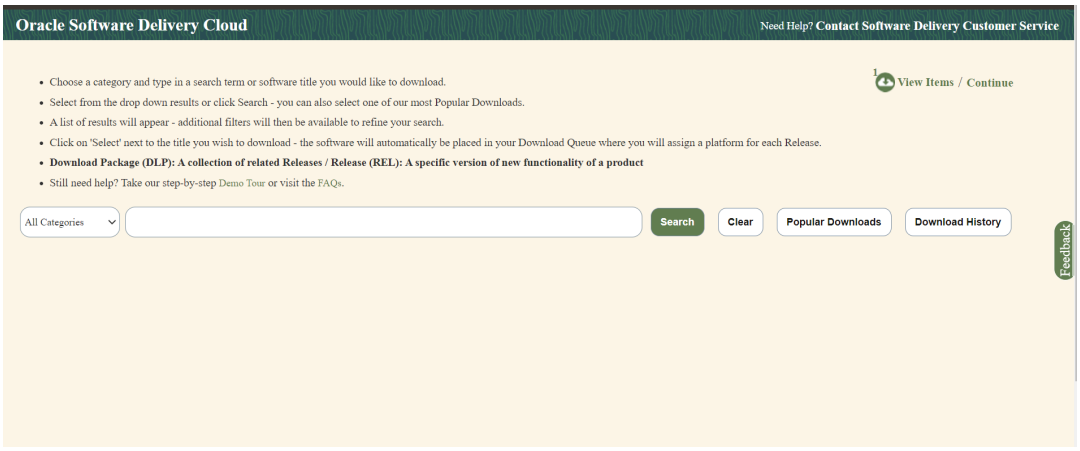
    nwdaf-pkg-<marketing-release-number>.zip

    For example: *nwdaf-pkg-24.2.0.0.zip*

To download the package from the edelivery portal, perform the following steps:

1. Login to the edelivery portal with your credentials. The following screen appears:

Figure 2-1 edelivery portal



2. Select the **Download Package** option, from **All Categories** drop down list.
3. Enter **Oracle Communications Cloud Native Core Network Data Analytics Data Function** in the search bar.
4. List of release packages available for download are displayed on the screen. Select the release package you want to download, the package automatically gets downloaded.

Untar the Package ZIP File

Run the following command to untar or unzip the OCNWDAF package zip file to the specific repository:

```
tar -xvf nwdaf-pkg-<marketing-release-number>.tgz
```

or

```
unzip  nwdaf-pkg-<marketing-release-number>.zip
```

After the package and its content is extracted, the following directory structure is displayed:

```
# Root
- images
    - tar of images
    - sha 256 of images
- troubleshooting/
    - nfDataCapture.sh
- installer/
    - ocn-nwdaf-helmChart/
        - helmChart/
            - templates/
            - charts/
            - values.yaml
            - charts.yaml
            - nwdaf-pre-installer.tar.gz
        - simulator-helmChart/
            - templates/
            - charts/
            - values.yaml
            - charts.yaml
        - custom-templates/
            - ocnwdaf_custom_values.yaml
            - ocnwdaf_simulators_custom_values.yaml
        - scripts/
            - gen_certs.sh
            - readme.txt
    - nwdaf-ats/
        - ocn-ats-nwdaf-tool
            - ngnix
            - templates
        - ocnwdaf_tests
            - data
            - features
    - scripts/
      - gen_certs.sh
      - readme.txt
```

> **Note**
>
> The *readme.txt* file under the scripts folder is for the *gen_certs.sh* script.

2.2.1.2 Pushing the Images to Customer Docker Registry

The OCNWDAF deployment package includes ready-to-use docker images (inside the images tar file) and Helm charts to help orchestrate containers in Kubernetes. The communication between service pods of OCNWDAF are preconfigured in the Helm charts.

Table 2-6 Docker Images for OCNWDAF

Service Name	Docker Image Name	Image Tag
NWDAF Analytics Info Service	ocn-nwdaf-analytics	24.2.0.0.0

Table 2-6 (Cont.) Docker Images for OCNWDAF

Service Name	Docker Image Name	Image Tag
NWDAF MTLF Service	ocn-nwdaf-mtlf-service	24.2.0.0.0
NWDAF Subscription Service	ocn-nwdaf-subscription-service	24.2.0.0.0
AMF NF Simulator Service	ocn-amf-simulator-service	24.2.0.0.0
SMF NF Simulator Service	ocn-smf-simulator-service	24.2.0.0.0
NRF NF Simulator Service	ocn-nrf-simulator-service	24.2.0.0.0
OAM Simulator Service	ocn-oam-simulator-service	24.2.0.0.0
Mesa Simulator Service (Data Generator)	mesa-simulator	24.2.0.0.0
cap4c ML model controller	cap4c-model-controller	24.2.0.0.0
cap4c ML model executor	cap4c-model-executor	24.2.0.0.0
cap4c stream analytics	cap4c-stream-analytics	24.2.0.0.0
kafka to mysql serializer	cap4c-kafka-ingestor	24.2.0.0.0
Reporting service	nwdaf-cap4c-reporting-service	24.2.0.0.0
kafka	nwdaf-cap4c-kafka	3.4.0
nwdaf-cap4c-scheduler	nwdaf-cap4c-scheduler-service	24.2.0.0.0
nwdaf-cap4c-spring-cloud-config-server	nwdaf-cap4c-spring-cloud-config-server	24.2.0.0.0
nwdaf-portal	nwdaf-portal	24.2.0.0.0
nwdaf-portal-service	nwdaf-portal-service	24.2.0.0.0
redis	nwdaf-cap4c-redis	7.2.4
ocats-nwdaf	ocats-nwdaf	24.2.0.0.0
ocats-nwdaf-notify	ocats-nwdaf-notify	24.2.0.0.0
Helm Test	nf-test	22.4.0
geo redundancy agent	ocn-nwdaf-geo-redundacy-agent	24.2.0.0.0
nwdaf-egress-gateway	ocingress_gateway	23.4.3
nwdaf-ingress-gateway	ocegress_gateway	23.4.3
configurationinit (ingress and egress)	configurationinit	23.4.3
nrf client configuration server	oc-config-server	23.4.0
nrf client app info	oc-app-info	23.4.0
nrf client perf info	oc-perf-info	23.4.0
nrf client	nrf-client	23.4.2
NWDAF Data Collection Controller	ocn-nwdaf-data-collection-controller	24.2.0.0.0
NWDAF Data Collection Service	ocn-nwdaf-data-collection-service	24.2.0.0.0
cap4c-configuration-manager-service	cap4c-configuration-manager-service	24.2.0.0.0
cap4c-stream-transformer	cap4c-stream-transformer	24.2.0.0.0
nwdaf-cap4c-backuprestore	ocnwdaf-pre-install-hook-image	1.1.5 , Job 24.2.0.0.0
cap4c-api-gateway	cap4c-api-gateway	24.2.0.0.0
Kafka init container image	nwdaf-cap4c-java	17.0
Pre-install hook Image	ocnwdaf-pre-install-hook-image	1.1.5
GRD init container image	nwdaf-cap4c-mysql	8.0.30
enterprise operator	enterprise-operator	8.1.0

Table 2-6 (Cont.) Docker Images for OCNWDAF

Service Name	Docker Image Name	Image Tag
enterprise router	enterprise-router	8.1.0
enterprise server	enterprise-server	8.1.0
capex-optimization service	capex-optimization service	24.2.0.0.0
Executor init container image	nwdaf-cap4c-rsync	3.1

To push the images to customer docker registry, perform the following steps:

1. Verify the package content, checksums of tarballs in the `Readme.txt` file.
2. If the images of the above services are already present in the artifact, then proceed with the Preinstallation Tasks .
3. (Optional) If the images of the above services are not present in the artifact, then the user has to run the following commands to manually load, tag, and push the images:

   ```
   docker load --input <image_file_name.tar>
   ```

   Example:

   ```
   docker load --input images
   ```

4. To push the docker images to the docker repository, run the following command:

   ```
   docker tag <image-name>:<image-tag> <docker-repo>/<image-name>:<image-tag>
   ```

   ```
   docker push <docker_repo>/<image_name>:<image-tag>
   ```

   > **Note**
   >
   > It is recommended to configure the docker certificate before running the push command to access customer registry through HTTPs, otherwise, docker push command may fail.

5. Verify if the image is loaded correctly by running the following command:

   ```
   docker images
   ```

6. (Optional) To push the Helm charts to the Helm repository, run the following command:

   ```
   helm cm-push --force <chart name>.tgz <Helm repo>
   ```

Untar the Preinstaller

(Optional) To extract the *nwdaf-pre-installer.tar.gz* file outside the */helmchart* directory, run the following command:

```
tar xzC <path to extract> -f nwdaf-pre-installer.tar.gz
```

Verify the file structure of the extracted file:

```
- etc/
    - nwdaf-cap4c-spring-cloud-config-prod-properties/
    - kafka-topics.txt
- scripts/
    - util/
        - kubernetes-util.sh
        - helm-util.sh
        - generic-util.sh
    - prepare-dependencies.sh
```

2.2.1.3 Pushing the Images to OCI Docker Registry

The OCNWDAF deployment package includes ready-to-use docker images (inside the images tar file) and Helm charts to help orchestrate containers in Kubernetes. The communication between service pods of OCNWDAF is preconfigured in the Helm charts.

Table 2-7 Docker Images for OCNWDAF

Service Name	Docker Image Name	Image Tag
NWDAF Analytics Info Service	ocn-nwdaf-analytics	24.2.0.0.0
NWDAF MTLF Service	ocn-nwdaf-mtlf-service	24.2.0.0.0
NWDAF Subscription Service	ocn-nwdaf-subscription-service	24.2.0.0.0
AMF NF Simulator Service	ocn-amf-simulator-service	24.2.0.0.0
SMF NF Simulator Service	ocn-smf-simulator-service	24.2.0.0.0
NRF NF Simulator Service	ocn-nrf-simulator-service	24.2.0.0.0
OAM Simulator Service	ocn-oam-simulator-service	24.2.0.0.0
Mesa Simulator Service (Data Generator)	mesa-simulator	24.2.0.0.0
cap4c ML model controller	cap4c-model-controller	24.2.0.0.0
cap4c ML model executor	cap4c-model-executor	24.2.0.0.0
cap4c stream analytics	cap4c-stream-analytics	24.2.0.0.0
kafka to mysql serializer	cap4c-kafka-ingestor	24.2.0.0.0
Reporting service	nwdaf-cap4c-reporting-service	24.2.0.0.0
kafka	nwdaf-cap4c-kafka	3.4.0
nwdaf-cap4c-scheduler	nwdaf-cap4c-scheduler-service	24.2.0.0.0
nwdaf-cap4c-spring-cloud-config-server	nwdaf-cap4c-spring-cloud-config-server	24.2.0.0.0
nwdaf-portal	nwdaf-portal	24.2.0.0.0
nwdaf-portal-service	nwdaf-portal-service	24.2.0.0.0
redis	nwdaf-cap4c-redis	7.2.4
ocats-nwdaf	ocats-nwdaf	24.2.0.0.0
ocats-nwdaf-notify	ocats-nwdaf-notify	24.2.0.0.0
Helm Test	nf-test	22.4.0
geo redundancy agent	ocn-nwdaf-geo-redundacy-agent	24.2.0.0.0
nwdaf-egress-gateway	ocingress_gateway	23.4.3
nwdaf-ingress-gateway	ocegress_gateway	23.4.3

Table 2-7 (Cont.) Docker Images for OCNWDAF

Service Name	Docker Image Name	Image Tag
configurationinit (ingress and egress)	configurationinit	23.4.3
nrf client configuration server	oc-config-server	23.4.0
nrf client app info	oc-app-info	23.4.0
nrf client perf info	oc-perf-info	23.4.0
nrf client	nrf-client	23.4.2
NWDAF Data Collection Controller	ocn-nwdaf-data-collection-controller	24.2.0.0.0
NWDAF Data Collection Service	ocn-nwdaf-data-collection-service	24.2.0.0.0
cap4c-configuration-manager-service	cap4c-configuration-manager-service	24.2.0.0.0
cap4c-stream-transformer	cap4c-stream-transformer	24.2.0.0.0
nwdaf-cap4c-backuprestore	ocnwdaf-pre-install-hook-image	1.1.5 , Job 24.2.0.0.0
cap4c-api-gateway	cap4c-api-gateway	24.2.0.0.0
Kafka init container image	nwdaf-cap4c-java	17.0
Pre-install hook Image	ocnwdaf-pre-install-hook-image	1.1.5
GRD init container image	nwdaf-cap4c-mysql	8.0.30
enterprise operator	enterprise-operator	8.1.0
enterprise router	enterprise-router	8.1.0
enterprise server	enterprise-server	8.1.0
capex-optimization service	capex-optimization service	24.2.0.0.0
Executor init container image	nwdaf-cap4c-rsync	3.1

To push the images to OCI docker registry, perform the following steps:

1. Run the following command to untar or unzip the OCNWDAF package zip file to the specific repository:

   ```
   tar -xvf nwdaf-pkg-<marketing-release-number>.tgz
   ```

   or

   ```
   unzip  nwdaf-pkg-<marketing-release-number>.zip
   ```

   After the package and its content is extracted, the following directory structure is displayed:

   ```
   # Root
   - images
       - tar of images
       - sha 256 of images
   - troubleshooting/
       - nfDataCapture.sh
   - installer/
       - ocn-nwdaf-helmChart/
           - helmChart/
               - templates/
               - charts/
   ```

```
            - values.yaml
            - charts.yaml
            - nwdaf-pre-installer.tar.gz
        - simulator-helmChart/
            - templates/
            - charts/
            - values.yaml
            - charts.yaml
        - custom-templates/
            - ocnwdaf_custom_values.yaml
            - ocnwdaf_simulators_custom_values.yaml
        - scripts/
            - gen_certs.sh
            - readme.txt
    - nwdaf-ats/
        - ocn-ats-nwdaf-tool
            - ngnix
            - templates
        - ocnwdaf_tests
            - data
            - features
    - scripts/
      - gen_certs.sh
      - readme.txt
```

> **Note**
>
> The *readme.txt* file under the scripts folder is for the *gen_certs.sh* script.

2. Verify the package content, checksums of tarballs in the *Readme.txt* file.
3. Run the following commands to manually load, tag, and push the images:

   ```
   docker load --input <image_file_name.tar>
   ```

   Example:

   ```
   docker load --input images
   ```

4. Run one of the following commands to verify that the images are loaded:

   ```
   podman images
   ```

   ```
   docker images
   ```

5. Verify the list of images shown in the output with the list of images shown in the Table 2-7 . If the list does not match, reload the image tar file.

6. Run the following commands to log in to the OCI registry:

   ```
   podman login -u <REGISTRY_USERNAME> -p <REGISTRY_PASSWORD> <REGISTRY_NAME>
   ```

   ```
   docker login -u <REGISTRY_USERNAME> -p <REGISTRY_PASSWORD> <REGISTRY_NAME>
   ```

   Where,

   - <REGISTRY_NAME> is <Region_Key>.ocir.io.
   - <REGISTRY_USERNAME> is <Object Storage Namespace>/<identity_domain>/email_id.
   - <REGISTRY_PASSWORD> is the Auth Token generated by the user.
     For more information about OCIR configuration and creating auth token, see *Oracle Communications Cloud Native Core, OCI Adaptor Deployment Guide*.
   - <Object Storage Namespace> can be obtained from the OCI Console by navigating to **Governance & Administration**, **Account Management**, **Tenancy Details**, **Object Storage Namespace**.
   - <Identity Domain> is the domain of the user.
   - In OCI, each region is associated with a key. For more information, see Regions and Availability Domains.

7. Run one of the following commands to tag the images to the registry:

   ```
   podman tag <image-name>:<image-tag> <podman-repo>/ <image-name>:<image-tag>
   ```

   ```
   docker tag <image-name>:<image-tag> <docker-repo>/ <image-name>:<image-tag>
   ```

   Where,

   - <image-name> is the image name.
   - <image-tag> is the image release number.
   - <docker-repo> is the docker registry address with Port Number if registry has port attached. This is a repository to store the images.
   - <podman-repo> is the podman registry address with Port Number if registry has port attached. This is a repository to store the images.

8. Run one of the following commands to push the image:

   ```
   podman push <oci-repo>/<image-name>:<image-tag>
   ```

   ```
   docker push <oci-repo>/<image-name>:<image-tag>
   ```

   Where, <oci-repo> is the OCI registry path.

9. Make all the image repositories public by performing the following steps:

   > **Note**
   >
   > All the image repositories must be public.

a. Log in to the OCI Console using your login credentials.
b. From the left navigation pane, click **Developer Services**.
c. On the preview pane, click **Container Registry**.
d. From the **Compartment** drop-down list, select **networkfunctions5G (root)**.
e. From the **Repositories and images** drop-down list, select the required image and click **Change to Public**.
   The details of the images are displayed under the Repository information tab and the image changes to public. For example, the `24.2.0db/occne/cndbtier-mysqlndb-client (Private)` changes to `24.2.0db/occne/cndbtier-mysqlndb-client (Public)`.
f. Repeat substep 9e to make all image repositories public.

Before you proceed with the installation procedure, ensure the following:

- The storage class is set to "*oci-bv*".
- The Load Balancer annotations are set as listed below:
  - `oci-network-load-balancer.oraclecloud.com/internal: "true"`
  - `oci-network-load-balancer.oraclecloud.com/security-list-management-mode: All`
  - `oci-network-load-balancer.oraclecloud.com/subnet: <your-lb-subnet-ocid>`
  - `oci.oraclecloud.com/load-balancer-type: nlb`

2.2.1.4 Configuring OCNWDAF Database

The OCNWDAF microservices store the front-end and analytics data in two MySQL databases, the cluster INNODB and Cndb. InnoDB is a self-managed cluster within the OCNWDAF namespace. InnoDB does not require any specific user configuration. The Helm pre-install hook manages the database. However, OCNWDAF requires the database administrator to create an *admin* user for the MySQL database and provide the necessary permissions to access the databases. Before installing OCNWDAF, create a MySQL user to manage the cluster.

> **Note**
>
> - If the *admin* user is already created, update the credentials, such as username and password (base64 encoded) in the *ocn-nwdaf-helmChart/custom-templates/ocnwdaf_custom_values.yaml* file (or the copy of *values.yaml* used for installation or upgrade).
> - If the *admin* user is not created, create an *admin* user following the procedure Creating an Admin User in the Database. Update the user's credentials in the *ocn-nwdaf-helmChart/custom-templates/ocnwdaf_custom_values.yaml* file (or the copy of *values.yaml* used for installation or upgrade).
> - The *admin* user should be a non-root user.
> - Creating this user and updating it under the secrets section is mandatory.

2.2.1.5 Creating an Admin User in the Database

Follow the steps below to create an *admin* user in the database:

1. Run the following command to access the MySQL pod:

   > **Note**
   >
   > Use the namespace in which the Cndb is deployed. For example, if *occne-cndbtier* namespace is used. The default container name is *ndbmysqld-0*.

   ```
   kubectl -n occne-cndbtier exec -it ndbmysqld-0 -- bash
   ```

2. Run the following command to log in to MySQL server using MySQL client:

   ```
   $ mysql -h 127.0.0.1 -uroot -p $ Enter password:
   ```

3. Run the following command to create an *admin* user:

   ```
   CREATE USER IF NOT EXISTS'<nwdaf admin username>'@'%' IDENTIFIED BY
   '<nwdaf admin user password>';
   ```

   For example:

   ```
   CREATE USER IF NOT EXISTS 'nwdaf'@'%' IDENTIFIED BY 'nwdaf';
   ```

   Where, `nwdaf` is the `<nwdaf admin username>` and `nwdaf` is the `<nwdaf admin user password>`.

4. Run the following command to grant the necessary permissions to the *admin* user and run the `FLUSH` command to reload the grant table:

   ```
   GRANT ALL PRIVILEGES ON *.* TO 'nwdaf'@'%' WITH GRANT OPTION;


   FLUSH PRIVILEGES;
   ```

5. Run the following command to generate the base64 encoded username and password:

   ```
   echo -n <string> | base64 -w 0
   ```

   Where, `<string>` is the admin username or password created in Step 3.

   For example:

   ```
   echo -n nwdaf| base64 -w 0 bndkYWY=
   ```

2.2.1.6 Creating Secret for the Private Image Repository

If the user image repository is private and has to be authenticated, follow the steps below:

1. Run the following command to create a secret named *reposecret* with the credentials of the image repository:

   ```
   kubectl create secret docker-registry reposecret --docker-
   server=reposerver --docker-username=repousername --docker-
   password='repopassword' --docker-email=repousermail
   ```

2. Update the `imagePullSecret.enable` parameter to `true` in the ocnwdaf, simulators, and ATS *values.yaml* file.
   For example:

   ```
   imagePullSecret:
       enable: false ## --> update this to 'true'

       name: reposecret
   ```

2.2.1.7 Verifying and Creating OCNWDAF Namespace

This section explains how to verify or create a new namespace in the system.

To verify if the required namespace already exists in the system, run the following command:

```
$ kubectl get namespaces
```

In the output of the above command, check if the required namespace is available. If the namespace is not available, create the namespace using the following command:

```
$ kubectl create namespace <required namespace>
```

Example:

```
$ kubectl create namespace oc-nwdaf
```

Naming Convention for Namespaces

While choosing the name of the namespace where you wish to deploy OCNWDAF, make sure the namespace:

- starts and ends with an alphanumeric character
- contains 63 characters or less
- contains only alphanumeric characters or '-'

> **Note**
>
> It is recommended to avoid using prefix `kube-` when creating namespace as this prefix is reserved for Kubernetes system namespaces.

To export the installation *namespace* name as environment variable, run the following command:

```
export K8_NAMESPACE="<namespace>"
```

2.2.2 Installation Tasks

This section explains how to install OCNWDAF.

> **Note**
>
> Before installing OCNWDAF, you must complete Prerequisites and Preinstallation Tasks .

2.2.2.1 Update OCNWDAF Preinstaller Files

> **Note**
>
> This is an optional procedure.

To update the preinstaller file, perform the following steps:

1. Make the required changes in *config* files present in the extracted *nwdaf-pre-installer* directory and create a fresh tar file by running the following command:

   ```
   tar -zcvf nwdaf-pre-installer.tar.gz nwdaf-pre-installer/
   ```

2. Replace the existing tar file in the */helmChart* directory with the new tar file.

2.2.2.2 Setup Encrypted Credentials

To set up encrypted credentials, perform the following steps:

1. To update the secret values (username and password), replace the existing values with updated values after encoding the values using Base64 encoding method. Listed below are the secrets files:
   - *ocnwdaf-hooks-secret.yaml* under */helmchart/templates/* directory
   - *simulators-hooks-secret.yaml* under */simulator-helmChart/templates/* directory
2. To read the secret values, decode the present values using Base64 decoding method.

2.2.2.3 Configure Database Flag

> **Note**
>
> This is an optional step. Perform this step based on customer requirement.

Update the *dbConfigStatus* flag in *values.yaml* file under */helmchart* with any of the following values (the default value is *alldb*):

- *alldb*: This is the default value of the flag. Set this flag to create a fresh database by removing the existing database. If this flag is present, proceed with the installation of the services.

- *nodb*: This flag disables the *dbCreation* hooks for the installation of the Helm chart. Set this flag to install the services if the database is present without deleting any data.
- *nwdafdb*: This flag is used to create or reinstall the database only for OCNWDAF services. Set this flag to run the *dbCreation* hook only for OCNWDAF services (standard installation is followed for the remaining services).
- *cap4cdb*: This flag is used to create or reinstall the database only for CAP4C services. Set this flag to run the *dbCreation* hook only for CAP4C services (standard installation is followed for the remaining services).

> **Note**
>
> If there is a requirement to install only OCNWDAF or only CAP4C services, set the *dbConfigStatus* flag to create the required DB and the charts that are not needed can be set to 'enabled: false' in the "*values. yaml*" under "`/helm chart`".
>
> For example, if a user wants to install CAP4C services only with its database, then set the *dbConfigStatus* flag to 'cap4cdb', and set the value of all the OCNWDAF FE services that are not required to 'enabled: false' and proceed with the installation procedure.

2.2.2.4 Configure NRF Client Parameter

> **Note**
>
> This is a mandatory procedure.

> **Note**
>
> By default, the NRF Client *primaryNrfApiRoot* is configured as *ocn-nrf-simulator-service:8080*.

When a single OCNRF is used, navigate to the */installer/helmChart/charts/nrf-client* folder and update the *values.yaml* as follows:

```
# Microservice level control if specific microservice need to be disabled
nrf-client:
  profile: |-
         [appcfg]
         primaryNrfApiRoot=ocn-nrf-simulator-service:8080
         secondaryNrfApiRoot=
```

2.2.2.5 Configuring Service Mesh

> **Note**
>
> This configuration step is optional and only applies when a service mesh is available.

OCNWDAF leverages the Platform Service Mesh (for example, Aspen Service Mesh (ASM)) for all the internal and external TLS communication by deploying a special sidecar proxy in each pod to intercept all the network communications. The service mesh integration provides inter-NF communication and allows API gateway to cowork with the service mesh. The service mesh integration supports the services by deploying a special sidecar proxy in each pod to intercept all the network communications between microservices. A service mesh provides the following services:

- Service discovery
- Routing and traffic configuration
- Encryption and authentication/authorization
- Metrics and monitoring

> **Note**
>
> To configure OCNWDAF to support a service mesh, the service mesh must be available in the cluster in which OCNWDAF is installed.

Enable or Disable Service Mesh

To enable or disable service mesh support, update the Istio sidecar section in the *values.yaml* file.

For example:

```
##########################

#ISTIO SIDECAR INJECTION #

##########################

istio:

   ## NOTE:  The label of the namespace will take precedence over the
injection field that is set here. If mesh is to be disabled, make sure the
namespace has no istio-injection label or set to disabled if present

   injection: false
   readinessCheck: &readinessCheck false
```

For more information, see Global Parameters.

Update the following NRF client parameters:

- `istioSidecarQuitUrl`
- `istioSidecarReadyUrl`
- `serviceMeshCheck`

For more information, see NRF Client Parameters.

Update the following Ingress Gateway Parameters in the *values.yaml* file:

- `serviceMeshCheck`

Table 2-8 Ingress Gateway Parameter

Parameter	Description	Detail
serviceMeshCheck	This is a mandatory parameter. This flag must be set to `true` if a Service Mesh is present in the environment where OCNWDAF is deployed. If this parameter is set to `true` load balancing is handled by the Service Mesh.	**Range:** True or False **Default value:** False **Applicable to:** OCNWDAF

Update the following Egress Gateway parameters in the *values.yaml* file:

- `serviceMeshCheck`

Table 2-9 Egress Gateway Parameter

Parameter	Description	Detail
serviceMeshCheck	This is a mandatory parameter. This flag must be set to `true` if a Service Mesh is present in the environment where OCNWDAF is deployed. If this parameter is set to `true` load balancing is handled by the Service Mesh.	**Range:** True or False **Default value:** False **Applicable to:** OCNWDAF

After Service Mesh is enabled and deployed, the proxy containers run along with the OCNWDAF application pods.

> **Note**
>
> The gateways and other services inside the Service Mesh are not accessible from outside the Service Mesh. In order to use OCNWDAF with a Service Mesh, ensure that the dependencies (such as, cnDBTier or analytics consumers) are deployed within the Service Mesh.

2.2.2.6 Configuring Routing Rules in Ingress Gateway

The routing rules are configured in the Ingress Gateway *values.yaml* file. Once the routing rules are configured, the Ingress Gateway reroutes the incoming traffic to the microservices based on the configured routing rules.

Ingress Gateway *values.yaml* file:

```
- id: prodcon
    uri: http://10.123.158.150:31457
    path: /relinquishOwnerShip
    order: 1
    #Below field is used to provide an option to enable/disable route level
xfccHeaderValidation, it will override global configuration for
xfccHeaderValidation.enabled
    metadata:
```

```
      # requestTimeout is used to set timeout at route level. Value should be
in milliseconds.
      requestTimeout: 4000
      requiredTime: 3000
      xfccHeaderValidation:
        validationEnabled: false
      oauthValidator:
        enabled: false
      svcName: "prodcon-1"
      configurableErrorCodes:
        enabled: false
        errorScenarios:
          - exceptionType: "NOT_FOUND_EXCEPTION"
            errorProfileName: "ERR_NOT_FOUND"
          - exceptionType: "UNKNOWN_HOST_EXCEPTION"
            errorProfileName: "ERR_UNKNOWN_HOST"
          - exceptionType: "CONNECT_EXCEPTION"
            errorProfileName: "ERR_400"
          - exceptionType: "XFCC_HEADER_NOT_PRESENT_OR_EMPTY"
            errorProfileName: "ERR_1300"
          - exceptionType: "GLOBAL_RATELIMIT"
            errorProfileName: "ERR_RATE_LIMIT"

      # Server header configuration if defined at Route level(irrespective of
being enabled/disabled) will take precedence over the Global conf. Uncomment
only if needed at Route level.
      #serverHeaderDetails:
      #  enabled: false
      #  errorCodeSeriesId: E2  # If not defined here, value at Global level
will be used as fallback. Value need to be one among "errorCodeSeriesList"
resource defined later.
    filters:
      controlledShutdownFilter:
        applicableShutdownStates:
          - "PARTIAL_SHUTDOWN"
          - "COMPLETE_SHUTDOWN"
        unsupportedOperations:
          - "GET"
          - "PUT"

      #Below are Request Custom Headers
      customReqHeaderEntryFilter:
        headers:
          - methods:
              - ALL
            headersList:
              - headerName: x-entry-headeReq-1
                defaultVal: script:shm-02,x-exit-new-req
                source: incomingReq
                sourceHeader: x-entry-current-user
              - headerName: x-entry-current-user
                defaultVal: 123
                source: incomingReq
                sourceHeader: test
      customReqHeaderExitFilter:
        headers:
```

```
    - methods:
        - ALL
      headersList:
        - headerName: x-exit-headeReq-1
          defaultVal: abc
          source: incomingReq
          sourceHeader: x-exit-current-user
        - headerName: x-exit-current-user
          defaultVal: 123
          source: incomingReq
          sourceHeader: sbi-timer-feature
    - methods:
        - GET
        - POST
      headersList:
        - headerName: x-exit-headeReq-3
          defaultVal: abc
          source: incomingReq
          sourceHeader: x-exit-new-req
          override: false
        - headerName: x-exit-headeReq-4
          defaultVal: 123
          source: incomingReq
          sourceHeader: x-exit-headeReq-1
          override: false
    - methods:
        - DELETE
        - GET
      headersList:
        - headerName: x-exit-headerReq-5
          defaultVal: abc
          source: incomingReq
          sourceHeader: x-exit-headerReq-new
          override: false
        - headerName: x-exit-headerReq-6
          defaultVal: 123
          source: incomingReq
          sourceHeader: x-exit-headerReq-temp
          override: false
# Below are Response Custom Headers
customResHeaderEntryFilter:
  headers:
    - methods:
        - ALL
      headersList:
        - headerName: x-entry-headerRes-1
          defaultVal: abc
          source: incomingReq
          sourceHeader: x-entry-headeReq-1
          override: false
        - headerName: sbi-timer-feature-Res
          defaultVal: 123
          source: incomingReq
          sourceHeader: x-exit-new-req
customResHeaderExitFilter:
  headers:
```

```
            - methods:
                - ALL
              headersList:
                - headerName: x-exit-headerRes-1
                  defaultVal: abc
                  source: incomingReq
                  sourceHeader: x-exit-headerReq-1
                  override: false
                - headerName: sbi-timer-feature
                  defaultVal: 123
                  source: incomingRes
                  sourceHeader: x-exit-headerRes-1
            - methods:
                - GET
                - PUT
              headersList:
                - headerName: x-exit-headeRes-3
                  defaultVal: abc
                  source: incomingRes
                  sourceHeader: x-exit-SourceRes-a
                  override: true
                - headerName: x-exit-headeRes-4
                  defaultVal: 123
                  source: incomingReq
                  sourceHeader: x-exit-SourceRes-b
                  override: false
            - methods:
                - DELETE
              headersList:
                - headerName: x-exit-headeRes-5
                  defaultVal: abc
                  source: incomingRes
                  sourceHeader: ""
                  override: false
                - headerName: x-exit-headeRes-6
                  defaultVal: 123
                  source: incomingRes
                  sourceHeader: ""
                  override: false
    #Below field is used for blacklisting(removing) a request header at route
level.
    removeRequestHeader:
      - name: myheader1
      - name: myheader3
    #Below field is used for blacklisting(removing) a response header at
route level.
    removeResponseHeader:
      - name: myresponseheader1
      - name: myresponseheader3
```

The following Ingress Gateway *routesConfig* parameters are updated:

- `id: prodcon`
- `uri: http://10.123.158.150:31457`
- `path: /relinquishOwnerShip`

For more information on the customizable Ingress Gateway parameters, see Ingress Gateway Parameters.

> **Note**
>
> It is recommended to retain the default values of other *routesConfig* parameters.

2.2.2.7 Enable TLS 1.3 Support

Gateway Services are integrated with OCNWDAF to support TLS 1.3 on the Ingress and Egress interfaces.

This feature enables the support for TLS 1.3 for all functions and interfaces where TLS 1.2 was supported. TLS 1.2 will continue to be supported.

This feature is enabled by default at the time of Gateway Services deployment.

You can configure this feature using Helm parameters. Configure the following parameters in the Ingress Gateway and Egress Gateway, required for TLS1.3:

```
clientDisabledExtension: ec_point_formats #comma-separated-values To disable
extension being sent in ClientHello
serverDisabledExtension: null #comma-separated-values To disable extension
being sent from server originated messages
tlsNamedGroups: null #comma-separated-values to whitelist the
supported_groups extension values
clientSignatureSchemes: null #comma-separated-values to whitelist the
signature_algorithms extension values
service:
  ssl:
    tlsVersion: TLSv1.2,TLSv1.3
allowedCipherSuites:
  - TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
  - TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
  - TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256
  - TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
  - TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
  - TLS_AES_256_GCM_SHA384
  - TLS_AES_128_GCM_SHA256
  - TLS_CHACHA20_POLY1305_SHA256
cipherSuites:
  - TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
  - TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
  - TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256
  - TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
  - TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
  - TLS_AES_256_GCM_SHA384
  - TLS_AES_128_GCM_SHA256
  - TLS_CHACHA20_POLY1305_SHA256
```

For detailed description of TLS 1.3 parameters, see TLS 1.3 Parameters.

Helm Configuration for Ingress Gateway HTTPS

For the Ingress Gateway set the parameters *initssl* and *enableIncomingHttps* in the *values.yaml* file to `true`.

```
global:
  type: NodePort
  staticHttpNodePort: 30788
  staticHttp1NodePort: 31788
enableIncomingHttp1: true
cncc:
  enablehttp1: true
minReplicas: 1
requestTimeout: 10000

fullnameOverride: ingress-gateway-service
initssl: true
enableIncomingHttp: true
enableIncomingHttps: true
```

Where,

- `initssl`: Generates KeyStore and TrustStore for HTTPS support. You must create TLS secret if this parameter is set to true.
- `enableIncomingHttps`: Opens https port on Egress Gateway. You must enable this parameter if `initssl` is set to true.

Helm Configuration for Egress Gateway HTTPS

For the Egress Gateway set the parameters *initssl* and *enableOutgoingHttps* in the *values.yaml* file to `true`.

```
fullnameOverride: egress-gateway-service
initssl: true
enableOutgoingHttps: true
http1:
  enableOutgoingHTTP1: true
minReplicas: 1
requestTimeout: 30000
nettyIdleTimeout: 30000
connectionTimeout: 30000
```

Where,

- `initssl`: Generates KeyStore and TrustStore for HTTPS support. You must create TLS secret if this parameter is set to true.
- `enableOutgoingHttps`: Enables outgoing https connections at Egress Gateway. You must enable this parameter if `initssl` is set to true.
- `enableOutgoingHTTP1`: Enables http1 outgoing connections.

TLS files and Configuration for Ingress and Egress Gateways

Provide the TLS files and configuration for the Ingress and Egress gateways, update the *values.yaml* file:

```
service:
  ssl:
    # TLS verison used
    tlsVersion: TLSv1.2

    # Secret Details for certificates
    privateKey:
      k8SecretName: <secret name>-gateway-secret
      k8NameSpace: ocnwdaf-ns
      rsa:
        fileName: rsa_private_key_pkcs1.pem
      ecdsa:
        fileName: ecdsa_private_key_pkcs8.pem

    certificate:
      k8SecretName: <secret name>-gateway-secret
      k8NameSpace: ocnwdaf-ns
      rsa:
        fileName: apigatewayrsa.cer
      ecdsa:
        fileName: apigatewayecdsa.cer

    caBundle:
      k8SecretName: <secret name>-gateway-secret
      k8NameSpace: ocnwdaf-ns
      fileName: caroot.cer

    keyStorePassword:
      k8SecretName: <secret name>-gateway-secret
      k8NameSpace: ocnwdaf-ns
      fileName: key.txt

    trustStorePassword:
      k8SecretName: <secret name>-gateway-secret
      k8NameSpace: ocnwdaf-ns
      fileName: trust.txt

    initialAlgorithm: RS256
```

Use the same `<secret name>` used during Kubernetes secret creation.

Create Keys and Certificates

1. Generate a root CA (Certificate Authority) and a CA Private Key. Run the following commands:
   To create root certificate authority (CA) key:

   ```
   openssl req -new -keyout cakey.pem -out careq.pem -config ssl.conf -passin
   pass:"keystorepasswd" -passout pass:"keystorepasswd"
   ```

To create root certificate authority (CA) run the following commands:

```
openssl x509 -signkey cakey.pem -req -days 3650 -in careq.pem -out
caroot.cer -extensions v3_ca -passin pass:"keystorepasswd"
echo 1234 > serial.txt
```

2. Generate private keys.
   Run the following commands to generate the RSA private key:

```
openssl req -x509 -nodes -sha256 -days 365 -newkey rsa:2048 -keyout
rsa_private_key -out rsa_certificate.crt -config ssl.conf -passin
pass:"keystorepasswd" -passout pass:"keystorepasswd"
openssl rsa -in rsa_private_key -outform PEM -out
rsa_private_key_pkcs1.pem -passin pass:"keystorepasswd" -passout
pass:"keystorepasswd"
```

   Run the following commands to generate the ECDSA private key:

```
openssl ecparam -genkey -name prime256v1 -noout -out ecdsa_private_key.pem
openssl pkcs8 -topk8 -in ecdsa_private_key.pem -inform pem -out
ecdsa_private_key_pkcs8.pem -outform pem -nocrypt
```

3. Generate the Certificate Signing Request (CSR).
   Generate the RSA Certificate Signing Request using the private key, run the followig command:

```
openssl req -new -key rsa_private_key -out apigatewayrsa.csr -config
ssl.conf -passin pass:"keystorepasswd" -passout pass:"keystorepasswd"
```

   Generate the ECDSA Certificate Signing Request using the private key, run the following commands:

```
openssl req -new -key ecdsa_private_key_pkcs8.pem -x509 -nodes -days 365 -
out ecdsa_certificate.crt -config ssl.conf
openssl req -new -key ecdsa_private_key_pkcs8.pem -out apigatewayecdsa.csr
-config ssl.conf -passin pass:"keystorepasswd" -passout
pass:"keystorepasswd"
```

4. For each key created generate the server certificates.
   Sign the RSA server certificate with root CA private key run the following command:

```
openssl x509 -CA caroot.cer -CAkey cakey.pem -CAserial serial.txt -req -in
apigatewayrsa.csr -out apigatewayrsa.cer -days 365 -extfile ssl.conf -
extensions req_ext -passin pass:"keystorepasswd"
```

   Sign the ECDSA server certificate with root CA private key run the following command:

```
openssl x509 -CA caroot.cer -CAkey cakey.pem -CAserial serial.txt -req -in
apigatewayecdsa.csr -out apigatewayecdsa.cer -days 365 -extfile ssl.conf -
extensions req_ext -passin pass:"keystorepasswd"
```

5. Create *key.txt* by providing a password. This password is used to configure the Gateway's key store. Run the following command:

   ```
   echo "keystorepasswd" > key.txt
   ```

6. Create *trust.txt* by providing a password. This password is used to configure the Gateway's trust store. Run the following command:

   ```
   echo "truststorepasswd" > trust.txt
   ```

Create the Secret

Create the secret, run the following commands:

```
kubectl create ns <NameSpace>
kubectl create secret generic <secret name>-gateway-secret --from-
file=apigatewayrsa.cer --from-file=caroot.cer --from-file=apigatewayecdsa.cer
--from-file=rsa_private_key_pkcs1.pem --from-file=ecdsa_private_key_pkcs8.pem
--from-file=key.txt --from-file=trust.txt -n <Namespace>
```

The *ssl.conf* can be used to configure default entries along with storage area network (SAN) details for your certificate.

Sample *ssl.conf*:

```
#ssl.conf
[ req ]
default_bits = 4096
distinguished_name = req_distinguished_name
req_extensions = req_ext
[ req_distinguished_name ]
countryName = Country Name (2 letter code)
countryName_default = IN
stateOrProvinceName = State or Province Name (full name)
stateOrProvinceName_default = Karnataka
localityName = Locality Name (eg, city)
localityName_default = Bangalore
organizationName = Organization Name (eg, company)
organizationName_default = Oracle
commonName = Common Name (e.g. server FQDN or YOUR name)
commonName_max = 64
commonName_default = localhost
[ req_ext ]
subjectAltName = @alt_names
[alt_names]
IP = 127.0.0.1
DNS.1 = localhost
```

Validate CA Root

Follow the steps below to validate the CA root:

1. Sign all the SSL certificates with the same CA root certificate. And store the CA root in the corresponding truststore.

2. Sign the SSL certificates with different CA root but exchange the certificates and store the corresponding CA roots (from A and B side) in the proper truststores.
3. Disable the CA validation on both sides.

2.2.2.8 Configuring Redundancy Agent

The configuration of the Redundancy Agent microservice is through a Database (DB) query at the start of the service. The installation must enable DB scripts to prevent installation issues. To configure the Redundancy Agent, run the following command:

If the creation of databases and tables is not enabled in the installer, add the configuration of the Redundancy Agent with the following MySQL operation:

```
INSERT INTO georedagent.site_config (site, cap4c_scheduler_uri,
cluster_namespace, core_component, core_component_threshold,
data_collection_uri, dbtier_status_uri, geo_redundancy_enabled, mated_sites,
secondary_site_id, self_address, subscription_uri, tertiary_site_id)
         VALUES('SITE-NAME', 'http://nwdaf-cap4c-scheduler-
service:8080/v1/job/%s/%s', 'K8-NAMESPACE', 'ocn-nwdaf-subscription,ocn-nwdaf-
data-collection', 5, 'http://ocn-nwdaf-data-collection-service:8080/ra/
notify', 'http://dbtier-monitor-svc:9000/status', 1, 2, 'SITE-2', 'http://
ingress-gateway:80', 'http://ocn-nwdaf-subscription-service:8080/nnwdaf-
eventssubscription/v1/subscriptions/updateServingOwner', 'SITE-3');
```

If installation is complete and you want to edit the Redundancy Agent, follow the step below to modify any value by updating the entry of your site:

```
- Database -> georedagent | table -> site_config |
```

For the complete list of Georedundancy Parameters, see Georedundancy Parameters.

2.2.2.9 Configuring Mirror Maker

> **Note**
>
> This is an optional procedure.

Data topics across all georedundant sites are replicated by the Kafka “Mirror Maker 2 (MM2)”. Follow the procedure below to configure the Mirror Maker for data replication:

Prerequisites

Ensure that there are two or more Zookeepers with the corresponding Kafka brokers up and running. To verify, run the following command:

```
kubectl get all -n $K8_NAMESPACE
```

Sample output with two clusters consisting of two Kafka brokers:

```
kafka-sts-0          1/1     Running   0          6d22h
kafka-sts-1          1/1     Running   0          6d22h
kafkab-sts-0         1/1     Running   0          6d22h
kafkab-sts-1         1/1     Running   0          6d22h
```

```
zookeepera-sts-0     1/1     Running   0          6d22h
zookeeperb-sts-0     1/1     Running   0          6d22h
```

Install Mirror Maker

1. Access the registry to download the MM2 image. Run the following search command:

   ```
   podman search ocnwdaf-docker.dockerhub-phx.oci.oraclecorp.com/nwdaf-cap4c
   ```

   Verify if the following output is displayed:

   ```
   ocnwdaf-docker.dockerhub-phx.oci.oraclecorp.com/nwdaf-cap4c/nwdaf-cap4c-
   data-replication
   ```

2. If you do not have access to Oracle's registry, the installer contains the Mirror Maker image as a tar file. Run the following command to load the Mirror Maker image to the cluster:

   ```
   podman load --input ocn-nwdaf-mirror-maker-latest.tar
   ```

   Upload the images to the registry, run the following commands:

   ```
   podman tag localhost/ocn-nwdaf-mirror-maker:<TAG> <REPOSITORY>:<TAG>


   podman push localhost/ocn-nwdaf-mirror-maker:<TAG> <REPOSITORY>:<TAG>
   ```

3. Download the Helm chart. The installer contains the Mirror Maker Helm chart. The Mirror Maker does not run by default, navigate the folder to identify the following files:

   ```
   ├── nwdaf-cap4c-data-replication
   │   ├── Chart.yaml
   │   ├── templates
   │   │   ├── config.yaml
   │   │   ├── sts.yaml
   │   │   └── svc.yaml
   │   └── values.yaml
   ```

4. Edit the fields *imageRegistry*, *imageName*, and *imageVersion* in the *values.yaml* file.

   ```
   nwdafDataReplication:
     projectName: nwdafDataReplication
     imageName: <IMAGE NAME>
     imageVersion: <TAG>
   ```

5. Edit the *config.yaml* file to include the *mm2.properties* file. The *mm2.properties* file configures the Mirror Makers behavior. If multiple Mirror Makers are present in the deployment, create separate *mm2.properties* file for each Mirror Maker.

   ```
   apiVersion: v1
   kind: ConfigMap
   metadata:
     name: {{ .Values.nwdafDataReplication.projectName }}-configmap
   data:
   ```

```
###################################
# MM2 Properties File #
###################################
  mm2.properties: |-
```

6. Install the Helm chart.
   Two-site deployment

   For a two-site deployment, only one Mirror Maker is required, and it can be deployed in any of the sites. Run the following command:

   ```
   helm install nwdaf-data-replication nwdaf-cap4c-mirror-maker
   ```

   Three-site deployment

   In a three-site deployment, three Mirror Makers are deployed in a circular topology in each site. Run the following commands:

   ```
   helm install nwdaf-data-replication-a nwdaf-cap4c-mirror-maker-a
   helm install nwdaf-data-replication-b nwdaf-cap4c-mirror-maker-b
   helm install nwdaf-data-replication-c nwdaf-cap4c-mirror-maker-c
   ```

7. Verify if the Mirror Maker is running, run the following command:

   ```
   kubectl get all -n $K8_NAMESPACE
   ```

   Sample output for a two-site deployment:

   ```
   kafka-a-sts-0                   1/1     Running   0          6d22h
   kafka-a-sts-1                   1/1     Running   0          6d22h
   kafka-b-sts-0                   1/1     Running   0          6d22h
   kafka-b-sts-1                   1/1     Running   0          6d22h
   nwdaf-data-replication-sts-0    1/1     Running   0          6d22h
   zookeeper-a-sts-0               1/1     Running   0          6d22h
   zookeeper-b-sts-0               1/1     Running   0          6d22h
   ```

   Sample output for a three-site deployment:

   ```
   kafka-a-sts-0                   1/1     Running   0          6d22h
   kafka-a-sts-1                   1/1     Running   0          6d22h
   kafka-b-sts-0                   1/1     Running   0          6d22h
   kafka-b-sts-1                   1/1     Running   0          6d22h
   kafka-c-sts-0                   1/1     Running   0          6d22h
   kafka-c-sts-1                   1/1     Running   0          6d22h
   nwdaf-data-replication-a-sts-0  1/1     Running   0          6d22h
   nwdaf-data-replication-b-sts-0  1/1     Running   0          6d22h
   nwdaf-data-replication-c-sts-0  1/1     Running   0          6d22h
   zookeeper-a-sts-0               1/1     Running   0          6d22h
   zookeeper-b-sts-0               1/1     Running   0          6d22h
   zookeeper-c-sts-0               1/1     Running   0          6d22h
   ```

   - The Mirror Maker “nwdaf-data-replication-a” handles the replication for both Sites A and B.

- The Mirror Maker “nwdaf-data-replication-b” handles the replication for both Sites B and C.
- The Mirror Maker “nwdaf-data-replication-c” handles replication for Sites C and A.

8. The replicated topics appear with the cluster name as a prefix.

   ```
   kafka-topics.sh --bootstrap-server kafka-sts-0:9092 --list
   ```

   For example, if there are two clusters named clusterA and clusterB and topic1 is present in clusterB, then the replicated topic is `clusterA.topic1`.

Configuring Mirror Maker

Configure the Mirror Maker's (MM2) configuration file. The file includes information on the topics to be replicated and the cluster in which replication occurs. Configure the *templates/config.yaml* in the Helm chart as follows:

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: {{ .Values.nwdafDataReplication.projectName }}-configmap
data:
###################################
# MM2 Properties File #
###################################
  mm2.properties: |-
    clusters=clusterA, clusterB
    clusterA.bootstrap.servers=kafka-sts-0.
{{ .Values.nwdafDataReplication.config.service1.kafkaService }}.
{{ .Values.nwdafDataReplication.config.service1.namespace }}.svc.
{{ .Values.nwdafDataReplication.config.service1.cluster }}:9092
    clusterB.bootstrap.servers=kafka-sts-0.
{{ .Values.nwdafDataReplication.config.service2.kafkaService }}.
{{ .Values.nwdafDataReplication.config.service2.namespace }}.svc.
{{ .Values.nwdafDataReplication.config.service2.cluster }}:9092

    clusterA.config.storage.replication.factor=1
    clusterB.config.storage.replication.factor=1
    clusterA.offset.storage.replication.factor=1
    clusterB.offset.storage.replication.factor=1
    clusterA.status.storage.replication.factor=1
    clusterB.status.storage.replication.factor=1
    clusterA->clusterB.enabled=true
    clusterB->clusterA.enabled=true
    offset-syncs.topic.replication.factor=1
    heartbeats.topic.replication.factor=1
    checkpoints.topic.replication.factor=1
    topics=nwdaf\.report\.location, nwdaf\.report\.session,
nwdaf\.report\.nfload, nwdaf\.report\.oamperformance,
nwdaf\.report\.oamqosflows, nwdaf\.report\.oamranthroughput,
nwdaf\.report\.oamupf, nwdaf\.report\.uesinarea
    groups=.*
    tasks.max=10
    replication.factor=1
    refresh.topics.enabled=true
    sync.topic.configs.enabled=true
```

```
    refresh.topics.interval.seconds=10
    topics.exclude=.*[\-\.]internal, .*\.replica,
__consumer_offsets, .*\.checkpoints.internal, .*\.heartbeats, ^cluster.*
    topics.blacklist=.*[\-\.]internal, .*\.replica, __consumer_offsets,
^cluster.*
    groups.blacklist=console-consumer-.*, connect-.*, __.*
    clusterA->clusterB.emit.heartbeats.enabled=true
    clusterA->clusterB.emit.checkpoints.enabled=true
    clusterB->clusterA.emit.heartbeats.enabled=true
    clusterB->clusterA.emit.checkpoints.enabled=true
```

Below is the *values.yaml* file:

```
nwdafDataReplication:
  projectName: nwdafDataReplication
  imageName: nwdaf-cap4c/nwdaf-cap4c-mirrormaker
  imageVersion: latest
  deploy:
    replicas: 1
    securityContext:
      user: 1000
      group: 2000
    resources:
      request:
        cpu: 1
        memory: 2Gi
      limits:
        cpu: 1
        memory: 4Gi
    storage:
      mount:
        path: /app-data
        size: 5Gi
        configmap:
          path: /var/mirrormaker
  svc:
    port: 9092
  config:
    env:
    service1:
        kafkaService: kafka-headless-svc
        namespace: nwdaf-alpha-ns
        cluster: blurr7
    service2:
        kafkaService: kafka-headless-svc
        namespace: nwdaf-beta-ns
        cluster: blurr7
```

For more information on the customizable Mirror Maker parameters, see Mirror Maker Parameters.

Topic Configuration

This procedure describes configuring topics in the stream transformer service to accept replicated topics from the Mirror Maker. A new topic is created in the target cluster. The topic name comprises the cluster name as a prefix, followed by a period, and then the topic name.

For example:

```
sourceCluster.topic1
```

Implementing this data replication method is suitable for a "Active/Active" topology, and data generated locally and externally can be distinguished. The stream processor configures topics as a list with the “topics” parameters, as displayed in the example below:

```
bindings:
  # NWDAF - Location
  nwdafLocation-in-0.destination: nwdaf.report.location
  nwdafLocation-out-0.destination: cap4c.report.location
  # NWDAF - Nf Load
  nwdafNfLoad-in-0.destination: nwdaf.report.nfload
  nwdafNfLoad-out-0.destination: cap4c.report.nfload
  # NWDAF - Session
  nwdafSession-in-0.destination: nwdaf.report.session
  nwdafSession-out-0.destination: cap4c.report.session
  # NWDAF - OAM Performance
  nwdafOamPerformance-in-0.destination: nwdaf.report.oamperformance
  nwdafOamPerformance-out-0.destination: cap4c.report.oamperformance
  # NWDAF - UEs in Area
  nwdafUesInArea-in-0.destination: nwdaf.report.uesinarea
  nwdafUesInArea-out-0.destination: cap4c.report.uesinarea
  #NWDAF - OAM Upf
  nwdafOamUpf-in-0.destination: nwdaf.report.oamupf
  nwdafOamUpf-out-0.destination: cap4c.report.oamupf
  #NWDAF - OAM QosFlows
  nwdafOamQosFlows-in-0.destination: nwdaf.report.oamqosflows
  nwdafOamQosFlows-out-0.destination: cap4c.report.oamqosflows
  #NWDAF - OAM Ran Throughput
  nwdafOamRanThroughput-in-0.destination: nwdaf.report.oamranthroughput
  nwdafOamRanThroughput-out-0.destination: cap4c.report.oamranthroughput
```

The configuration is modified to accept replicated messages from Mirror Maker 2 to cluster A.

For example:

```
bindings:
  # NWDAF - Location
  nwdafLocation-in-0.destination:
nwdaf.report.location,clusterB.nwdaf.report.location,clusterC.nwdaf.report.loc
ation
  nwdafLocation-out-0.destination: cap4c.report.location
  # NWDAF - Nf Load
  nwdafNfLoad-in-0.destination:
nwdaf.report.nfload,clusterB.nwdaf.report.nfload,clusterC.nwdaf.report.nfload
  nwdafNfLoad-out-0.destination: cap4c.report.nfload
  # NWDAF - Session
```

```
  nwdafSession-in-0.destination:
nwdaf.report.session,clusterB.nwdaf.report.session,clusterC.nwdaf.report.sessi
on
  nwdafSession-out-0.destination: cap4c.report.session
  # NWDAF - OAM Performance
  nwdafOamPerformance-in-0.destination:
nwdaf.report.oamperformance,clusterB.nwdaf.report.oamperformance,clusterC.nwda
f.report.oamperformance
  nwdafOamPerformance-out-0.destination: cap4c.report.oamperformance
  # NWDAF - UEs in Area
  nwdafUesInArea-in-0.destination:
nwdaf.report.uesinarea,clusterB.nwdaf.report.uesinarea,clusterC.nwdaf.report.u
esinarea
  nwdafUesInArea-out-0.destination: cap4c.report.uesinarea
  #NWDAF - OAM Upf
  nwdafOamUpf-in-0.destination:
nwdaf.report.oamupf,clusterB.nwdaf.report.oamupf,clusterC.nwdaf.report.oamupf
  nwdafOamUpf-out-0.destination: cap4c.report.oamupf
  #NWDAF - OAM QosFlows
  nwdafOamQosFlows-in-0.destination:
nwdaf.report.oamqosflows,clusterB.nwdaf.report.oamqosflows,clusterC.nwdaf.repo
rt.oamqosflows
  nwdafOamQosFlows-out-0.destination: cap4c.report.oamqosflows
  #NWDAF - OAM Ran Throughput
  nwdafOamRanThroughput-in-0.destination:
nwdaf.report.oamranthroughput,clusterB.nwdaf.report.oamranthroughput,clusterC.
nwdaf.report.oamranthroughput
  nwdafOamRanThroughput-out-0.destination: cap4c.report.oamranthroughput
```

Uninstall Mirror Maker

To uninstall the Mirror Maker, run the following command:

```
helm uninstall nwdaf-data-replication
```

2.2.2.10 Enable Model C Communication Support

To enable or disable Model C support, update the *values.yaml* file in the Egress gateway Helm chart. This feature is disabled by default.

Set the value of the parameter `sbiRoutingEnabled` to `true`. By default, it is “false”.

For example:

```
routesConfig:
  - id: scp_via_proxy
    uri: http://request.uri
    path: /nsmf-event-exposure/**
    order: 1
    metadata:
      httpsTargetOnly: false
      httpRuriOnly: false
      sbiRoutingEnabled: true #false for direct routing
```

.

```
.
.
    - id: scp_direct1
    uri: https://dummy.dontchange1
    path: /namf-evts/v1/subscriptions/**
    order: 2
    metadata:
      httpsTargetOnly: false
      httpRuriOnly: false
      sbiRoutingEnabled: true
```

To configure the SCP end point for Model C support, set the `host` and `sbiRoutingEnabled` parameters in the Egress gateway *values.yaml* file as follows:

```
#SBIRouting Configuration
sbiRouting:
  # Default scheme applicable when 3gpp-sbi-target-apiroot header is missing
  sbiRoutingDefaultScheme: http
  sbiRoutingEnabled: true
  peerConfiguration:
    - id: peer1
      host: ocscp-scp-worker
      port: 8080
      apiPrefix: "/"
      healthApiPath: "/health/v3"
```

To enable SCP to route the requests, configure the following:

- Set the host parameter to `ocscp-scp-worker`.
- Set the port number to 8080.
- If the SCP is in a different namespace, add the namespace with the worker service. For example: `ocscp-scp-worker.ocnwdaf-ns`. If the SCP is another tenant, use the IP address.
- HTTPs is used for communication with the SCP. The SCP's configuration must be a FQDN and not an IP address.

2.2.2.11 Configure OCI Metrics

Follow the steps below to configure OCI metrics for OCNWDAF:

1. Configure the `isOciCluster` flag in the *values.yaml* file to `true`.
2. In the *oci* folder, add the *config* and *pem* files.
3. In the *config* file, update the path of the *key_file* container to *ssh/privateKey.pem*.
4. Update the values of `<replace here>` tag with the correct values (configured OCI metrics namespace and OCI compartment id) in *values.yaml* file present in the *ocn-nwdaf-helmChart/helmChart/* folder.

```
...
        isOciCLuster: true
        ociMetricsNamespace: '<replace here>' #Namespace when isOciCLuster
is enabled
```

```
        ociCompartmentId: &ociCompartmentId '<replace here>'
...
```

2.2.2.12 Configure Machine Learning (ML) Model Replication

Follow the procedure below to configure ML model replication across all georedundant sites:

1. On cluster A, locate the load balancer assigned to the container and obtain the external IP address:
   Run the following command:

   ```
   kubectl get svc
   ```

   Sample Output:

   ```
   NAME                       TYPE           CLUSTER-IP     EXTERNAL-IP
   PORT(S)           AGE
   cap4c-model-executor       ClusterIP      None           <none>
   9092/TCP          15d
   cap4c-model-executor-lb    LoadBalancer   10.233.57.59   10.75.245.189
   30000:30910/TCP   15d
   ```

2. On cluster B, access the Synchronization tool (rsync) container, run the `ssh-keycan` and populate *known_hosts* file:
   Run the following command:

   ```
   kubectl get all -n $K8_NAMESPACE
   ```

   Sample output:

   ```
   NAME                          READY   STATUS    RESTARTS   AGE
   cap4c-model-executor-sts-0    2/2     Running   0          15d
   ```

   Run the following commands:

   ```
   $ kubectl exec -it cap4c-model-executor-sts-0 -c nwdaf-cap4c-rsync bash
   ```

   Sample commands:

   ```
   # $ ssh-keyscan -p 30000 {external_ip_lb} >> ~/.ssh/known_hosts
   $ ssh-keyscan -p 30000 10.75.245.189 >> ~/.ssh/known_hosts
   ```

3. On cluster B, copy the public key and paste it under the file *authorized_keys* in cluster A :

   ```
   ## Cluster B.
   $ kubectl exec -it cap4c-model-executor-sts-0 -c nwdaf-cap4c-rsync bash
   ## Copy public key.
   $ cat ~/.ssh/id_rsa.pub


   ## Cluster A.
   $ kubectl exec -it cap4c-model-executor-sts-0 -c nwdaf-cap4c-rsync bash
   ```

```
## Paste key cluster B
$ vi ~/.ssh/authorized_keys
```

4. On cluster B, change the destination IP of rsync:
   For example:

```
$ vi /app/config/config_file
DEST_USER=root
DEST_IP=10.75.245.189
DESTINATION_PATH=/mnt/nfs
DESTINATION_PORT=30000
SOURCE_PATH=/mnt/nfs
```

The logs of rsync jobs are located at:`/var/log/rsync.log`.

The following Helm charts are modified:

ocn-nwdaf-helmChart/helmChart/charts/cap4c-model-executor/templates/sts.yaml

```
containers:
        - name: {{ .Values.rsync.projectName }}
          image:
{{ .Values.global.image.registry  }}/{{ .Values.rsync.imageName }}:
{{ .Values.rsync.imageVersion }}
          imagePullPolicy: {{ .Values.global.image.imagePullPolicy }}
          env:
          {{-
range $key, $val := .Values.modelExecutor.modelExecutor.config.env }}
            - name: {{ $key }}
              value: {{ $val | quote }}
              {{- end }}
          volumeMounts:
            - name: {{ .Values.modelExecutor.modelExecutor.projectName }}-pvc
              mountPath: {{ .Values.rsync.deploy.storage.mountPath }}
        - name: {{ .Values.modelExecutor.modelExecutor.projectName }}
          image: {{ .Values.global.image.registry }}/
cap4c/{{ .Values.modelExecutor.modelExecutor.imageName }}
          imagePullPolicy: {{ .Values.global.image.imagePullPolicy }}
```

ocn-nwdaf-helmChart/helmChart/charts/cap4c-model-executor/templates/svc.yaml

```
---
apiVersion: v1
kind: Service
metadata:
  name: {{ .Values.modelExecutor.modelExecutor.projectName }}-lb
  annotations:
    metallb.universe.tf/address-pool: oam
spec:
  type: LoadBalancer
  allocateLoadBalancerNodePorts: true
  externalTrafficPolicy: Cluster
  internalTrafficPolicy: Cluster
  selector:
    app: {{ .Values.modelExecutor.modelExecutor.projectName }}
  ports:
```

```
  - port: {{ .Values.rsync.svc.port }}
    targetPort: {{ .Values.rsync.svc.targetPort }}
    protocol:  {{ .Values.rsync.svc.protocol }}
```

ocn-nwdaf-helmChart/helmChart/charts/cap4c-model-executor/values.yaml

```
rsync:
  projectName: nwdaf-cap4c-rsync
  imageName: nwdaf-cap4c/nwdaf-cap4c-rsync
  imageVersion: 3.1
  deploy:
    storage:
      size: "10Gi"
      mountPath: "/mnt/nfs"
  svc:
    port: 30000
    targetPort: 22
    protocol: TCP
```

For more information on the customizable parameters, see ML Model Replication Parameters.

2.2.2.13 Configuring Data Director

The OCNWDAF supports the Data Director (OCNADD) as a data source. Follow the procedure below to configure the OCNADD as a data source:

1. Ensure the OCNADD is set up and running.
2. Configure the OCNADD to have a xDR topic:
   - Ensure that the OCNADD has an appropriate ACL feed, filter, and correlation services created (and enabled).
   - During OCNADD deployment, configure the parameter **Include Message with xDR** as **METADATA_HEADERS_DATA**. Select this option to include xDRs with complete messages. For more information, see "*Select xDR Type Related Info*" in the "*Creating Correlation Configurations*" procedure in the "*Correlation Configurations*" section of the *Oracle Communications Network Analytics Data Director User Guide*.
   - The OCNADD setup must have a filter configuration and correlation configuration. For `sessionBasic` and `cellLocation` parameters, appropriate filter and correlation must be created and enabled.
3. Run the *gen_scripts.sh* script to generate the *Truststore* and *Keystore* required for Kafka communication. The *gen_scripts.sh* has to be run with the same *cakey.pem* and *cacert.pem* files used during OCNADD installation.
   The *gen_scripts.sh* requires the namespace for execution. It uses the namespace to ensure where the *Truststore* and *Keystore* are generated.

   For example:

   ```
   bash gen_scripts.sh <namespace>
   ```

   Once the script is run, a password prompt appears, provide the same password used for the CA generation in OCNADD. Additionally, provide the same OCNADD configuration. The common name, state, organization, city, and country must be the same as in the configuration.

4. Update the following properties in the OCNWDAF Helm charts *values.yaml* file.

```
global:
    dataSource: 'data-director'
    kafkaMirrorMaker:
        env:
        OCNADD_BOOTSTRAP_SERVERS: <The OCNADD BOOTSTRAP SERVER>
       TOPIC_NAME: <XDR Topic Name>
        TRUSTSTORE_PASSWORD: <TrustStore Password>
        KEYSTORE_PASSWORD: <Keystore Password>
        KEY_PASSWORD: <Key Password>
        JAAS_CONFIG: <Jaas config used>
```

5. Update the `sessionBasic` parameter the main *values.yaml* file as follows:

```
global:
  datatype:
    sessionBasic: DATA_DIRECTOR
```

6. Update the `cellLocation` parameter the main *values.yaml* file as follows:

```
global:
    datatype:
      cellLocation: DATA_DIRECTOR
```

2.2.2.14 Installing OCNWDAF Package

To install the OCNWDAF package, perform the following steps:

1. Update the values in the `<replace here>` tag in the *values.yaml* file under the *<release directory>/ocn-nwdaf-helmChart/helmChart/* directory according to the setup.

```
...
 image:
        registry: &imageRegistry '<replace here>' #Add image registry here.
        gateway:
            registry: '<replace here>' #Add gateway image registry here.
        imagePullPolicy: &imagePullPolicy IfNotPresent
        initContainer:
            imagePullPolicy: *imagePullPolicy #Set new value if required
by removing *imagePullPolicy and adding desired value
        nrfClient:
            registry: &nrfRegistry '<replace here>' #Add gateway image
registry here.
...
...
    cluster:
        name: &clusterName '<replace here>'
        namespace: &nameSpace '<replace here>'
        storageClass: '<replace here>'
        dbConfig:
            MYSQL_HOST: &mySQLHost '<replace here>'
            MYSQL_PORT: &mySQLPort '<replace here>'
            MYSQL_ENGINE: &mySQLEngine '<replace here>'
```

```
            CNDBTIER_NAMESPACE: &cndbNameSpace '<replace here>'
            CNDBTIER_SQL_POD_NAME: &cndbSQLPodName '<replace here>'
```

2. Update the `<replace here>` tag under the "KAFKA_BROKERS" variable under "NWDAF CONFIGURATION VARIABLES" section with the proper Kafka broker. **Note:** Replace respective OCNWDAF namespaces and cluster names if example values are to be used.

```
...
    ### NWDAF CONFIGURATION VARIABLES ###
            KAFKA_BROKERS: &nwdafkafkabroker '<replace here>' # Example
value "kafka-sts-0.kafka-headless-svc.{nwdafNameSpace}.svc.
{nwdafClusterName}:9092,kafka-sts-1.kafka-headless-svc.
{nwdafNameSpace}.svc.{nwdafClusterName}:9092"
            DRUID_HOST: ""
            DRUID_PORT: ""
...
```

3. Update the secrets with Base64 Encoded values where the `<replace here>` tag present in the *ocnwdaf_custom_values.yaml* file located at *ocn-nwdaf-helmChart/custom-templates/* .

> **Note**
>
> To read the secret values, decode the present values using Base64 decoding method. When Cndb is the database update the newly created *admin* user.

For example:

```
...
    ##########################
    # SECRETS CONFIGURATION #
    ##########################
        secret: #Encode the values in base64 format
            mysqlCndbUsername: cm9vdA== #root for example
            mysqlCndbPassword: cGFzc3dvcmQ= #password for example
            mysqlInnoDbUsername: cm9vdA== #root for example
            mysqlInnoDbPassword: cGFzc3dvcmQ= #password for example
...
```

4. (Optional) Follow this step to set up Data Director as a data source.
   a. Ensure the OCNADD is setup and running.
   b. Configure the OCNADD to have a xDR topic:
      - Ensure the OCNADD has an appropriate ACL feed, filter, and correlation services created (and enabled).
      - The OCNADD setup must have a filter configuration and correlation configuration. For `sessionBasic` and `cellLocation` parameters appropriate filter and correlation must be created and enabled.
   c. Run the *gen_scripts.sh* script to generate the *Truststore* and *Keystore* required for Kafka communication. The *gen_scripts.sh* has to be run with the same *cakey.pem* and *cacert.pem* files used during OCNADD installation.
      The *gen_scripts.sh* requires the namespace for execution. It uses the namespace to ensure where the *Truststore* and *Keystore* are generated.

For example:

```
bash gen_scripts.sh <namespace>
```

When the script is executed, it prompts for the password and the same password used for the CA generation in OCNADD is supposed to be used in the script. Additionally, the same configuration (Common Name,State,Organization, City, Country) must be used which was used for OCNADD.

d. Update the following properties in the OCNWDAF Helm charts *values.yaml* file.

```
global:
    dataSource: 'data-director'
    kafkaMirrorMaker:
        env:
        OCNADD_BOOTSTRAP_SERVERS: <The OCNADD BOOTSTRAP SERVER>
       TOPIC_NAME: <XDR Topic Name>
        TRUSTSTORE_PASSWORD: <TrustStore Password>
        KEYSTORE_PASSWORD: <Keystore Password>
        KEY_PASSWORD: <Key Password>
        JAAS_CONFIG: <Jaas config used>
```

e. Update the `sessionBasic` parameter the main *values.yaml* file as follows:

```
global:
  datatype:
    sessionBasic: DATA_DIRECTOR
```

f. Update the `cellLocation` parameter the main *values.yaml* file as follows:

```
global:
    datatype:
      cellLocation: DATA_DIRECTOR
```

5. Set the *Subcharts* flag in the centralized *values.yaml* file under the *<release directory>/ocn-nwdaf-helmChart/helmChart/* directory. The allowed values are true or false. The services with the flag set to "false" are not deployed.
6. Optionally, update any other parameter in centralized or subchart *values.yaml* files. For example, Prometheus monitoring details or hooks environment variables in the centralized *values.yaml* under the *ocn-nwdaf-helmChart/helmChart* directory. Any microservice specific values like image name or tag, environment variables in microservices subchart *values.yaml* file.

   The following list is the default variables used to configure OCNWDAF, these variables are present in the centralized *values.yaml* files and in the secrets:

   - MYSQL_HOST
   - MYSQL_PORT
   - KAFKA_BROKERS
   - REDIS_HOST
   - REDIS_PORT
   - CAP4C_KAFKA_INGESTOR_DB
   - CAP4C_KAFKA_INGESTOR_DB_USER

- CAP4C_KAFKA_INGESTOR_DB_PASSWORD
- CAP4C_MODEL_CONTROLLER_DB
- CAP4C_MODEL_CONTROLLER_DB_USER
- CAP4C_MODEL_CONTROLLER_DB_PASSWORD
- CAP4C_MODEL_EXECUTOR_DB_USER
- CAP4C_MODEL_EXECUTOR_DB_PASSWORD
- CAP4C_STREAM_ANALYTICS_DB
- NWDAF_CAP4C_REPORTING_SERVICE_USER
- NWDAF_CAP4C_REPORTING_SERVICE_PASSWORD
- NWDAF_CAP4C_SCHEDULER_SERVICE_DB
- NWDAF_CAP4C_SCHEDULER_SERVICE_DB_USER
- NWDAF_CAP4C_SCHEDULER_SERVICE_DB_PASSWORD
- NWDAF_CONFIGURATION_HOST
- NWDAF_USER
- NWDAF_DB_PASSWORD

7. Install OCNWDAF, run the following Helm installation command:

```
helm install <installation name> <path to the chart directory> -
n $K8_NAMESPACE --timeout <timeout>m
```

For example:

```
helm install nwdaf helmChart/ -n ocnwdaf-ns --timeout 30m
```

> **Note**
>
> The parameter `--timeout` is optional. It is recommended to use this parameter to avoid any installation failure due to slow internet or CPU speeds. Use appropriate value for this parameter depending on the speed of image pull from the nodes of the setup. The recommended timeout value is 30 minutes.

Mandatory Installation Instruction

> **Note**
>
> Some services are release name dependent, use "nwdaf" for <installation name> in the Helm install command.

For example:

```
[cloud-user@occne224-cluster-bastion-1 ]$ helm install nwdaf helmChart/ -n
nwdaf-test --timeout 30m
```

Sample output when the installation starts:

```
[cloud-user@occne224-cluster-bastion-1 ]$ helm install nwdaf helmChart/ -n
nwdaf-test --timeout 30m
W0404 04:44:48.456730 3847781 warnings.go:70] autoscaling/v2beta2
HorizontalPodAutoscaler is deprecated in v1.23+, unavain v1.26+; use
autoscaling/v2 HorizontalPodAutoscaler
W0404 04:44:48.459573 3847781 warnings.go:70] autoscaling/v2beta2
HorizontalPodAutoscaler is deprecated in v1.23+, unavain v1.26+; use
autoscaling/v2 HorizontalPodAutoscaler
W0404 04:51:41.957767 3847781 warnings.go:70] autoscaling/v2beta2
HorizontalPodAutoscaler is deprecated in v1.23+, unavain v1.26+; use
autoscaling/v2 HorizontalPodAutoscaler
```

Run the following command to view all the resources present in the namespace:

```
kubectl get all -n $K8_NAMESPACE
```

For example:

```
[cloud-user@occne224-cluster-bastion-1 ~]$ kubectl get all -n $K8_NAMESPACE


[cloud-user@occne224-cluster-bastion-1 ~]$ kubectl get all -n $K8_NAMESPACE
NAME                                    READY   STATUS
RESTARTS   AGE
pod/ocn-nwdaf-db-creation-hook-jj9mx   0/1     ContainerCreating
0          15s

NAME                                    COMPLETIONS   DURATION   AGE
job.batch/ocn-nwdaf-db-creation-hook   0/1           15s        15s
```

Sample output when the installation completes:

```
[cloud-user@occne224-cluster-bastion-1 ]$ helm install nwdaf helmChart/ -
n $K8_NAMESPACE --timeout 30m
W0404 04:44:48.456730 3847781 warnings.go:70] autoscaling/v2beta2
HorizontalPodAutoscaler is deprecated in v1.23+, unavain v1.26+; use
autoscaling/v2 HorizontalPodAutoscaler
W0404 04:44:48.459573 3847781 warnings.go:70] autoscaling/v2beta2
HorizontalPodAutoscaler is deprecated in v1.23+, unavain v1.26+; use
autoscaling/v2 HorizontalPodAutoscaler
W0404 04:51:41.957767 3847781 warnings.go:70] autoscaling/v2beta2
HorizontalPodAutoscaler is deprecated in v1.23+, unavain v1.26+; use
autoscaling/v2 HorizontalPodAutoscaler
W0404 04:51:41.963127 3847781 warnings.go:70] autoscaling/v2beta2
HorizontalPodAutoscaler is deprecated in v1.23+, unavain v1.26+; use
autoscaling/v2 HorizontalPodAutoscaler
NAME: nwdaf
LAST DEPLOYED: Tue Apr  4 04:44:47 2023
NAMESPACE: nwdaf-test
STATUS: deployed
```

```
REVISION: 1
TEST SUITE: None
```

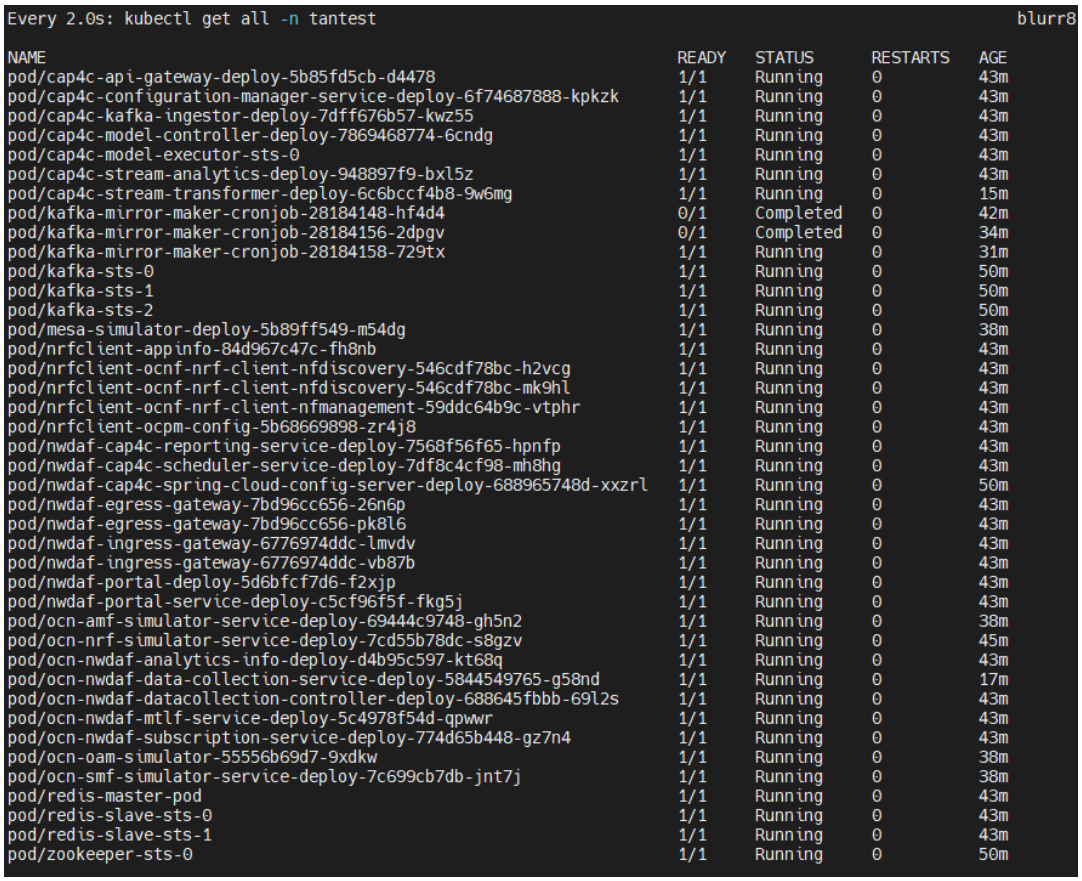
Verify if all the dependencies are in **Running** state (if any pod is not in **Running** state wait for a maximum of five restarts).

Run the following command to view all the resources present in the namespace:

```
kubectl get all -n $K8_NAMESPACE
```

Sample output:

Figure 2-2 Sample Output



```
Every 2.0s: kubectl get all -n tantest                                          blurr8

NAME                                                              READY   STATUS      RESTARTS   AGE
pod/cap4c-api-gateway-deploy-5b85fd5cb-d4478                      1/1     Running     0          43m
pod/cap4c-configuration-manager-service-deploy-6f74687888-kpkzk   1/1     Running     0          43m
pod/cap4c-kafka-ingestor-deploy-7dff676b57-kwz55                  1/1     Running     0          43m
pod/cap4c-model-controller-deploy-7869468774-6cndg                1/1     Running     0          43m
pod/cap4c-model-executor-sts-0                                    1/1     Running     0          43m
pod/cap4c-stream-analytics-deploy-948897f9-bxl5z                  1/1     Running     0          43m
pod/cap4c-stream-transformer-deploy-6c6bccf4b8-9w6mg              1/1     Running     0          15m
pod/kafka-mirror-maker-cronjob-28184148-hf4d4                     0/1     Completed   0          42m
pod/kafka-mirror-maker-cronjob-28184156-2dpgv                     0/1     Completed   0          34m
pod/kafka-mirror-maker-cronjob-28184158-729tx                     1/1     Running     0          31m
pod/kafka-sts-0                                                   1/1     Running     0          50m
pod/kafka-sts-1                                                   1/1     Running     0          50m
pod/kafka-sts-2                                                   1/1     Running     0          50m
pod/mesa-simulator-deploy-5b89ff549-m54dg                         1/1     Running     0          38m
pod/nrfclient-appinfo-84d967c47c-fh8nb                            1/1     Running     0          43m
pod/nrfclient-ocnf-nrf-client-nfdiscovery-546cdf78bc-h2vcg        1/1     Running     0          43m
pod/nrfclient-ocnf-nrf-client-nfdiscovery-546cdf78bc-mk9hl        1/1     Running     0          43m
pod/nrfclient-ocnf-nrf-client-nfmanagement-59ddc64b9c-vtphr       1/1     Running     0          43m
pod/nrfclient-ocpm-config-5b68669898-zr4j8                        1/1     Running     0          43m
pod/nwdaf-cap4c-reporting-service-deploy-7568f56f65-hpnfp         1/1     Running     0          43m
pod/nwdaf-cap4c-scheduler-service-deploy-7df8c4cf98-mh8hg         1/1     Running     0          43m
pod/nwdaf-cap4c-spring-cloud-config-server-deploy-688965748d-xxzrl 1/1    Running     0          50m
pod/nwdaf-egress-gateway-7bd96cc656-26n6p                         1/1     Running     0          43m
pod/nwdaf-egress-gateway-7bd96cc656-pk8l6                         1/1     Running     0          43m
pod/nwdaf-ingress-gateway-6776974ddc-lmvdv                        1/1     Running     0          43m
pod/nwdaf-ingress-gateway-6776974ddc-vb87b                        1/1     Running     0          43m
pod/nwdaf-portal-deploy-5d6bfcf7d6-f2xjp                          1/1     Running     0          43m
pod/nwdaf-portal-service-deploy-c5cf96f5f-fkg5j                   1/1     Running     0          43m
pod/ocn-amf-simulator-service-deploy-69444c9748-gh5n2             1/1     Running     0          38m
pod/ocn-nrf-simulator-service-deploy-7cd55b78dc-s8gzv             1/1     Running     0          45m
pod/ocn-nwdaf-analytics-info-deploy-d4b95c597-kt68q               1/1     Running     0          43m
pod/ocn-nwdaf-data-collection-service-deploy-5844549765-g58nd     1/1     Running     0          17m
pod/ocn-nwdaf-datacollection-controller-deploy-688645fbbb-69l2s   1/1     Running     0          43m
pod/ocn-nwdaf-mtlf-service-deploy-5c4978f54d-qpwwr                1/1     Running     0          43m
pod/ocn-nwdaf-subscription-service-deploy-774d65b448-gz7n4        1/1     Running     0          43m
pod/ocn-oam-simulator-55556b69d7-9xdkw                            1/1     Running     0          38m
pod/ocn-smf-simulator-service-deploy-7c699cb7db-jnt7j             1/1     Running     0          38m
pod/redis-master-pod                                              1/1     Running     0          43m
pod/redis-slave-sts-0                                             1/1     Running     0          43m
pod/redis-slave-sts-1                                             1/1     Running     0          43m
pod/zookeeper-sts-0                                               1/1     Running     0          50m
```

OCNWDAF Microservices Port Mapping

Table 2-10 Port Mapping

Service	Port Type	IP Type	Network Type	Service Port	Container Port
ocn-nwdaf-analytics	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
nwdaf-egress-gateway	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
nwdaf-ingress-gateway	External	NodePort	External/ K8s	80/TCP	8081/TCP

Table 2-10 (Cont.) Port Mapping

Service	Port Type	IP Type	Network Type	Service Port	Container Port
ocn-nwdaf-data-collection-service	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
ocn-nwdaf-datacollection-controller	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
ocn-nwdaf-mtlf	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
ocn-nwdaf-subscription-service	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
ocn-nwdaf-analytics-info	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
ocn-nwdaf-georedagent	Internal	ClusterIP	Internal / K8s	9181/TCP	9181/TCP
cap4c-kafka-ingestor	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
cap4c-model-controller	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
cap4c-model-executor	Internal	ClusterIP	Internal / K8s	9092/TCP	9092/TCP
cap4c-stream-transformer	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
cap4c-stream-analytics	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
cap4c-api-gateway	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
nwdaf-cap4c-reporting-service	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
nwdaf-cap4c-scheduler-service	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
nwdaf-cap4c-spring-cloud-config-server	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
nwdaf-portal	External	NodePort	External / K8s	80/TCP	
nwdaf-portal-service	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
cap4c-configuration-manager-service	Internal	ClusterIP	Internal / K8s	9000/TCP	9000/TCP
cap4c-capex-optimization-service	Internal	ClusterIP	Internal / K8s	9000/TCP	9000/TCP

Note

For NodePort services, Kubernetes allocates the Service Port.

Installation of Simulator Chart

Follow the procedure below to install the simulator chart:

1. Update the values in the `<replace here>` tag present in *values.yaml* under `/simulator-helmchart/` based on the setup:

```
...
    image:
        registry: &imageRegistry '<replace here>' #Add image registry here
Default is ocnwdaf-docker.dockerhub-phx.oci.oraclecorp.com
        imagePullPolicy: &imagePullPolicy IfNotPresent
...

...
    cluster:
        name: &clusterName '<replace here>'
        namespace: &nameSpace '<replace here>'
        dbConfig:
            MYSQL_HOST: &mySQLHost '<replace here>'
            MYSQL_PORT: &mySQLPort '<replace here>'
            MYSQL_ENGINE: &mySQLEngine '<replace here>'
            CNDBTIER_NAMESPACE: &cndbNameSpace '<replace here>'
            CNDBTIER_SQL_POD_NAME: &cndbSQLPodName '<replace here>'
...
```

2. Set the *Subcharts* flag in the centralized *values.yaml* file under the */simulator-helmchart* directory. The allowed values are true or false. The services with the flag set to false are not deployed.
3. Optionally, update any other parameter in centralized or subchart *values.yaml* files. For example, Prometheus monitoring details or hooks environment variables in the centralized *values.yaml* under the */simulator-helmchart* directory. Any microservice specific values like image name or tag, environment variables in microservices subchart *values.yaml* file.
4. Install simulators, run the following Helm installation command:

```
helm install <installation name> <path to the chart directory> -
n $K8_NAMESPACE --timeout <timeout>h
```

   For example:

```
helm install simulators simulator-helmchart/ -n ocnwdaf-ns --timeout 30m
```

> **Note**
>
> The parameter `--timeout` is optional. It is recommended to use this parameter to avoid any installation failure due to slow internet or CPU speeds. Use appropriate value for this parameter depending on the speed of image pull from the nodes of the Bastion host. The recommended timeout value is 30 minutes.

Sample of the terminal screen once the installation starts:

```
[cloud-user@occne224-cluster-bastion-2 ocn-nwdaf-helmChart]$ helm install
simulators simulator-helmChart/ -n ttest --timeout 30m
W0511 10:38:19.670067 2848359 warnings.go:70]
spec.template.spec.containers[0].env[61].name: duplicate name
"SPRING_KAFKA_CONSUMER_PROPERTIES_MAX_POLL_INTERVAL_MS"
NAME: simulators
LAST DEPLOYED: Thu May 11 10:38:12 2023
NAMESPACE: ttest
STATUS: deployed
REVISION: 1
TEST SUITE: None
```

5. Run the following command to verify if all the dependencies are in **Running** state (if any pod is not in **Running** state wait for a maximum of five restarts):

```
kubectl get all -n $K8_NAMESPACE
```

Sample output:

Figure 2-3 Sample Output

```
Every 2.0s: kubectl get all -n tantest                                          blurr8

NAME                                                              READY   STATUS      RESTARTS   AGE
pod/cap4c-api-gateway-deploy-5b85fd5cb-d4478                      1/1     Running     0          43m
pod/cap4c-configuration-manager-service-deploy-6f74687888-kpkzk   1/1     Running     0          43m
pod/cap4c-kafka-ingestor-deploy-7dff676b57-kwz55                  1/1     Running     0          43m
pod/cap4c-model-controller-deploy-7869468774-6cndg                1/1     Running     0          43m
pod/cap4c-model-executor-sts-0                                    1/1     Running     0          43m
pod/cap4c-stream-analytics-deploy-948897f9-bxl5z                  1/1     Running     0          43m
pod/cap4c-stream-transformer-deploy-6c6bccf4b8-9w6mg              1/1     Running     0          15m
pod/kafka-mirror-maker-cronjob-28184148-hf4d4                     0/1     Completed   0          42m
pod/kafka-mirror-maker-cronjob-28184156-2dpgv                     0/1     Completed   0          34m
pod/kafka-mirror-maker-cronjob-28184158-729tx                     1/1     Running     0          31m
pod/kafka-sts-0                                                   1/1     Running     0          50m
pod/kafka-sts-1                                                   1/1     Running     0          50m
pod/kafka-sts-2                                                   1/1     Running     0          50m
pod/mesa-simulator-deploy-5b89ff549-m54dg                         1/1     Running     0          38m
pod/nrfclient-appinfo-84d967c47c-fh8nb                            1/1     Running     0          43m
pod/nrfclient-ocnf-nrf-client-nfdiscovery-546cdf78bc-h2vcg        1/1     Running     0          43m
pod/nrfclient-ocnf-nrf-client-nfdiscovery-546cdf78bc-mk9hl        1/1     Running     0          43m
pod/nrfclient-ocnf-nrf-client-nfmanagement-59ddc64b9c-vtphr       1/1     Running     0          43m
pod/nrfclient-ocpm-config-5b68669898-zr4j8                        1/1     Running     0          43m
pod/nwdaf-cap4c-reporting-service-deploy-7568f56f65-hpnfp         1/1     Running     0          43m
pod/nwdaf-cap4c-scheduler-service-deploy-7df8c4cf98-mh8hg         1/1     Running     0          43m
pod/nwdaf-cap4c-spring-cloud-config-server-deploy-688965748d-xxzrl 1/1    Running     0          50m
pod/nwdaf-egress-gateway-7bd96cc656-26n6p                         1/1     Running     0          43m
pod/nwdaf-egress-gateway-7bd96cc656-pk8l6                         1/1     Running     0          43m
pod/nwdaf-ingress-gateway-6776974ddc-lmvdv                        1/1     Running     0          43m
pod/nwdaf-ingress-gateway-6776974ddc-vb87b                        1/1     Running     0          43m
pod/nwdaf-portal-deploy-5d6bfcf7d6-f2xjp                          1/1     Running     0          43m
pod/nwdaf-portal-service-deploy-c5cf96f5f-fkg5j                   1/1     Running     0          43m
pod/ocn-amf-simulator-service-deploy-69444c9748-gh5n2             1/1     Running     0          38m
pod/ocn-nrf-simulator-service-deploy-7cd55b78dc-s8gzv             1/1     Running     0          45m
pod/ocn-nwdaf-analytics-info-deploy-d4b95c597-kt68q               1/1     Running     0          43m
pod/ocn-nwdaf-data-collection-service-deploy-5844549765-g58nd     1/1     Running     0          17m
pod/ocn-nwdaf-datacollection-controller-deploy-688645fbbb-69l2s   1/1     Running     0          43m
pod/ocn-nwdaf-mtlf-service-deploy-5c4978f54d-qpwwr                1/1     Running     0          43m
pod/ocn-nwdaf-subscription-service-deploy-774d65b448-gz7n4        1/1     Running     0          43m
pod/ocn-oam-simulator-55556b69d7-9xdkw                            1/1     Running     0          38m
pod/ocn-smf-simulator-service-deploy-7c699cb7db-jnt7j             1/1     Running     0          38m
pod/redis-master-pod                                              1/1     Running     0          43m
pod/redis-slave-sts-0                                             1/1     Running     0          43m
pod/redis-slave-sts-1                                             1/1     Running     0          43m
pod/zookeeper-sts-0                                               1/1     Running     0          50m
```

6. The following services with port mapping are deployed:

Table 2-11 Port Mapping

Service	Port Type	IP Type	Network Type	Service Port	Container Port
ocn-nrf-simulator	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
ocn-amf-simulator	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
mesa-simulator	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
ocn-smf-simulator	Internal	ClusterIP	Internal / K8s	8080/TCP	8080/TCP
ocn-oam-simulator	Internal	ClusterIP	Internal / K8s	8085/TCP	8085/TCP

Configure Service Parameters

In the *values.yaml* under `/helmchart/` select the services to deploy, the Helm chart parameters are listed below:

```
nrfclient.enabled: true
ocn-nrf-simulator.enabled: true
nwdaf-cap4c-kafka.enabled: true
nwdaf-cap4c-redis.enabled: true
nwdaf-cap4c-spring-cloud-config-server.enabled: true
nwdaf-cap4c-scheduler-service.enabled: true
nwdaf-cap4c-reporting-service.enabled: &isReportingServiceEnabled true
nwdaf-cap4c-stream-analytics.enabled: true
cap4c-stream-transformer.enabled: true
cap4c-api-gateway.enabled: true
cap4c-configuration-manager-service.enabled:
&isCap4cConfigurationManagerEnabled true
nwdaf-cap4c-model-executor.enabled: &isCap4cModelExecutorEnabled true
nwdaf-cap4c-model-controller.enabled: true
nwdaf-cap4c-kafka-ingestor.enabled: &isKafkaIngestorEnabled true
cap4c-capex-optimization-service.enabled: true
ocn-nwdaf-subscription.enabled: true
ocn-nwdaf-data-collection.enabled: true
ocn-nwdaf-datacollection-controller.enabled: true
ocn-nwdaf-mtlf.enabled: true
ocn-nwdaf-analytics.enabled: true
ocnNwdafGeoredagent.enabled: false
nwdaf-portal-service.enabled: true
nwdaf-portal.enabled: true
common-services-gateways.enabled: true
nwdaf-cap4c-data-replication.enabled: false
cap4cDeployTemp.enabled: false
innodbDeploy.enabled: true
```

In the *values.yaml* under `/simulator-helmChart/` select the simulators to deploy, the simulator Helm chart parameters are listed below:

```
ocn-smf-simulator.enabled: true
ocn-mesa-simulator.enabled: true
```

```
ocn-amf-simulator.enabled: true
ocn-oam-simulator.enabled: true
```

2.2.2.15 Configure Prometheus Metrics

Follow the procedure below to configure Prometheus metrics:

1. Set the `enable` flag to `true` to activate metrics collection through Prometheus.
2. When the `enable` flag is set to `true`, you must provide the `idAddress` or Fully Qualified Domain Name (FQDN) for the Prometheus monitoring service in the following format:

```
...
    ################################
    # PROMETHEUS MONITORING DETAILS #
    ################################
        prometheus:
            enabled: true
            ipAddress: '<replace here>' # Format is
{prometheusServiceName}.{infraNamespace}.svc.{clusterName} or keep empty
...
```

2.2.3 Postinstallation Tasks

This section explains the postinstallation tasks for OCNWDAF.

2.2.3.1 Verifying Installation

To verify the installation:

1. Run the following command to check the installation status:

   ```
   helm status <helm-release> -n <namespace>
   ```

   Where,

   <helm-release> is the Helm release name of OCNWDAF. <namespace>

   <namespace> is the namespace of OCNWDAF deployment.

   For example:

   ```
   helm status ocndaf -n ocndaf
   ```

   If the deployment is successful, then the STATUS is displayed as `deployed`.
2. Run the following command to verify if the pods are up and active:

   ```
   kubectl get pods -n <namespace>
   ```

   Where,

   <namespace> is the namespace of OCNWDAF deployment.

   The STATUS column of all the pods must be 'Running'.

The READY column of all the pods must be n/n, where n is the number of containers in the pod.

3. Run the following command to verify if the services are deployed and active:

   ```
   kubectl -n <namespace> get services
   ```

   Where,

   <namespace> is the namespace of OCNWDAF deployment.

If the installation is unsuccessful or the status of all the pods is not in RUNNING state, , perform the troubleshooting steps provided in *Oracle Communications Networks Data Analytics Function Troubleshooting Guide*.

2.2.3.2 Performing Helm Test

Helm Test is a feature that validates the successful installation of OCNWDAF and determines if the NF is ready to take traffic. The pods are tested based on the namespace and label selector configured for the helm test configurations.

> **Note**
>
> Helm Test can be performed only on helm3.

Prerequisite: To perform the helm test, you must have the helm test configurations completed under the "Global Parameters" section of the `custom_values.yaml` file. For more information on parameters, see Global Parameters.

Run the following command to perform the helm test:

```
helm3 test <helm-release_name> -n <namespace>
```

where:

`helm-release-name` is the release name.

`namespace` is the deployment namespace where OCNWDAF is installed.

Example:

```
helm3 test ocnwdaf -n ocnwdaf
```

Sample output:

```
NAME: ocnwdaf
LAST DEPLOYED: Mon Nov 14 11:01:24 2022
NAMESPACE: ocnwdaf
STATUS: deployed
 REVISION: 1
TEST SUITE: ocnwdaf-test
Last Started: Mon Nov 14 11:01:45 2022
Last Completed: Mon Nov 14 11:01:53 2022
Phase: Succeeded
```

```
NOTES:
# Copyright 2022 (C), Oracle and/or its affiliates. All rights reserved
```

2.2.3.3 Configuring OCNWDAF GUI

This section describes how to configure Oracle Communications Networks Data Analytics Function (OCNWDAF) GUI using the following steps:

Configure OCNWDAF GUI in CNC Console

Prerequisite: To configure OCNWDAF GUI in CNC Console, you must have CNC Console installed. For information on how to install CNC Console, refer to *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide.*

Before installing CNC Console, ensure that the instances parameters are updated in the CNC Console's custom values.yaml file.

Follow the steps listed below:

1. **Set the Image Repository**

   In the CNC Console's custom values.yaml file, set the Image Repository to the repository where the images are located. The parameter *dockerRegistry* is found in line number 10 of the global parameters section:
   For example:

   ```
   dockerRegistry: ocnwdaf-docker.dockerhub-phx.oci.oraclecorp.com
   ```

2. **Update the Cluster Domain**

   Update the cluster's DNS domain based on the deployment. The parameter *clusterDomain* is located in line number 16 of the global parameters section:
   For example:

   ```
   clusterDomain: &clusterDomain "sunstreaker"
   ```

   To identify the cluster name, run the following command:

   ```
   kubectl -n kube-system get configmap kubeadm-config -o yaml | grep -i
       dnsDomain
   ```

3. **Load Balancer Configuration**

   If a Load Balancer is used, use the following configuration:

   ```
   The annotation metallb.universe.tf/address-pool: signaling/oam is required
   in global section if MetalLB in CNE 1.8.x onwards is used

   # Line 25:
   customExtension:
     lbServices:
       labels: {}
       annotations:
        # The annotation metallb.universe.tf/address-pool: signaling/oam is
   required if MetalLB in CNE 1.8.x is used
   ```

```
    metallb.universe.tf/address-pool: oam
    service.beta.kubernetes.io/oci-load-balancer-internal: "true"
```

4. **Set Database Details**

   Use the following configuration:

```
# DB Details by fqdn
  dbHost: &mySqlHostRef "mysql-connectivity-service.<namespace_name>"
  dbPort: &mySqlPortRef "3306"
  secretName: &mySqlSecretNameRef cncc-db-secret

# DB Details by external ip:
  dbHost: &mySqlHostRef 10.233.34.56 <- External ip from mysql-
connectivity-service
  dbPort: &mySqlPortRef 3306
  secretName: &mySqlSecretNameRef cncc-db-secret
```

5. **Activate Cluster IP for Load Balancer**

   Set the parameter *useClusterIpForLbServices* to true.

   Use the following configuration:

```
# Use ClusterIP for LoadBalancer(LB) services.
# The LB services are assigned LoadBalancer service type in k8s service
definition. Set this flag to true to assign ClusterIP service type.
useClusterIpForLbServices: true
```

6. **Update Automatic route generation for CNC Console Manager and Agent Deployment**

   Update the Automatic route generation for CNC Console Manager and Agent Deployment sections either using an external IP or a Load Balancer:

   Using an external IP

```
self:

    cnccId: Cluster1

  mCnccIams:

  - id: Cluster1

    # IP of one of external IP of Cluster nodes

    ip: <external_k8s_node_ip>

    # IAM app port

    port: <service_node_port>

  mCnccCores:

   - id: Cluster1

  aCnccs:
```

```
   - id: Cluster1

     role: Cluster1

     # Path to acore ingress service "service-
name.namespace.svc.clustername"

     fqdn: nwdaf-cncc-acore-ingress-
gateway.<namespace_name>.svc.<cluster_domian>

     # cncc app port

     port: 80

  instances:

   - id: OCCNE-NWDAF-UI-instance1

     # Set type to NWDAF-UI

     type: NWDAF-UI

     owner: Cluster1

     # Path to nwdaf portal UI service "service-
name.namespace.svc.clustername"

     fqdn: nwdaf-portal.<namespace_name>.svc.<cluster_domian>

     # Portal UI port

     port: 80

     # Path to NWDAF on kubernetes cluster "clustername/namespace/ocnwdaf"

     apiPrefix: /<cluster_domain>/<namespace_name>/ocnwdaf

   - id: OCCNE-NWDAF-UI-instance1

     # Set type to NWDAF-API

     type: NWDAF-API

     owner: Cluster1

     # Path to nwdaf API service "service-name.namespace.svc.clustername"

     fqdn: cap4c-api-gateway.<namespace_name>.svc.<cluster_domain>

     # Portal API port

     port: 8080

     # Path to NWDAF on kubernetes cluster "clustername/namespace/
ocnwdafapi"
```

```
    apiPrefix: /<cluster_domain>/<namespace_name>/ocnwdafapi
```

For example:

```
self:
    cnccId: Cluster1
  mCnccIams:
    - id: Cluster1
      ip: 10.123.158.150
      port: 30085
  mCnccCores:
    - id: Cluster1
  aCnccs:
    - id: Cluster1
      role: Cluster1
      fqdn: cncc-acore-ingress-gateway.cncc.svc.blurr7
      port: 30076
  instances:
    - id : Cluster1-nwdaf-instance1
      # Set type to NWDAF-UI
      type: NWDAF-UI
      owner: Cluster1
      fqdn: nwdaf-portal.ocnwdaf-ns.svc.blurr7
      port: 80
      apiPrefix: /blurr7/ocnwdaf-ns/ocnwdaf
    - id : Cluster1-nwdaf-instance1
      type: NWDAF-API
      owner: Cluster1
      fqdn: cap4c-api-gateway.ocnwdaf-ns.svc.blurr7
      port: 8080
      apiPrefix: /blurr7/ocnwdaf-ns/ocnwdafapi
```

Using Load Balancer

```
self:

    cnccId: Cluster1

  mCnccIams:

      - id: Cluster1

        # IP of one of Load Balancer IPs of Cluster nodes

        ip: 10.75.245.212

  mCnccCores:

          - id: Cluster1

  aCnccs:

          - id: Cluster1
```

```
            role: Cluster1

            # Path to acore ingress service "service-
name.namespace.svc.clustername"

            fqdn: cncc-acore-ingress-gateway.cncc.svc.sunstreaker

            # cncc app port

            port: 80

  instances:

          - id: OCCNE-NWDAF-UI-instance1

            # Set type to NWDAF-UI

            type: NWDAF-UI

            owner: Cluster1

            # Path to nwdaf portal UI service "service-
name.namespace.svc.clustername"

            fqdn: nwdaf-portal.ocnwdaf-ns.svc.sunstreaker

            # Portal UI port

            port: 80

            # Path to NWDAF on kubernetes cluster "clustername/namespace/
ocnwdaf"

            apiPrefix: /sunstreaker/ocnwdaf-ns/ocnwdaf

          - id: OCCNE-NWDAF-UI-instance1

            # Set type to NWDAF-API

            type: NWDAF-API

            owner: Cluster1

            # Path to nwdaf API service "service-
name.namespace.svc.clustername"

            fqdn: cap4c-api-gateway.ocnwdaf-ns.svc.sunstreaker

            # Portal API port

            port: 8080

            # Path to NWDAF on kubernetes cluster "clustername/namespace/
ocnwdafapi"

            apiPrefix: /sunstreaker/ocnwdaf-ns/ocnwdafapi
```

For example:

```
self:
    cnccId: Cluster1
  mCnccIams:
      - id: Cluster1
        ip: 10.75.245.212
  mCnccCores:
          - id: Cluster1
  aCnccs:
          - id: Cluster1
            role: Cluster1
            fqdn: cncc-acore-ingress-gateway.cncc.svc.sunstreaker
            port: 80
  instances:
          - id: OCCNE-NWDAF-UI-instance1
            type: NWDAF-UI
            owner: Cluster1
            fqdn: nwdaf-portal.ocnwdaf-ns.svc.sunstreaker
            port: 80
            apiPrefix: /sunstreaker/ocnwdaf-ns/ocnwdaf
          - id: OCCNE-NWDAF-UI-instance1
            type: NWDAF-API
            owner: Cluster1
            fqdn: cap4c-api-gateway.ocnwdaf-ns.svc.sunstreaker
            port: 8080
            apiPrefix: /sunstreaker/ocnwdaf-ns/ocnwdafapi
```

7. **Move to the CNC Console IAM Attributes Section**

   Move to the CNC Console IAM attributes section and update the values as follows:

   ```
   Update port to the same used by IAM

   LOC 244: publicHttpSignalingPort: 30085

   If Static node port needs to be set, then set staticNodePortEnabled flag
   to true and provide value for staticNodePort.

   Else random node port will be assigned by K8

       staticNodePortEnabled: true

       staticHttpNodePort: 30085

       staticHttpsNodePort: 30053
   ```

8. **Move to the CNC Console Core Attributes Section**

   Move to the CNC Console Core attributes section and update the values as follows:

   ```
   Update port to the same used by cncc core

   LOC 244: publicHttpSignalingPort: 30085

   If Static node port needs to be set, then set staticNodePortEnabled flag
   to true and provide value for staticNodePort.
   ```

```
Else random node port will be assigned by K8

    staticNodePortEnabled: true

    staticHttpNodePort: 30085

    staticHttpsNodePort: 30053
```

To identify the external IPs during installation, run the following command:

```
kubectl get pods -n ocnwdaf-ns -owide | grep portal
```

9. **Helm Install**

   Run the Helm install command in the folder where the custom yaml file is located. For example:

   ```
   helm install cncc occncc-xx.x.x.tgz -f occncc_custom_values_xx.x.x.yaml -n cncc
   ```

10. **Monitor the Installation**

    To monitor the installation process, run the following command:

    ```
    watch kubectl get pods -n cncc
    ```

    You can access the IAM and CNC Console once the pods are in up and running state.

11. **Verify IAM**

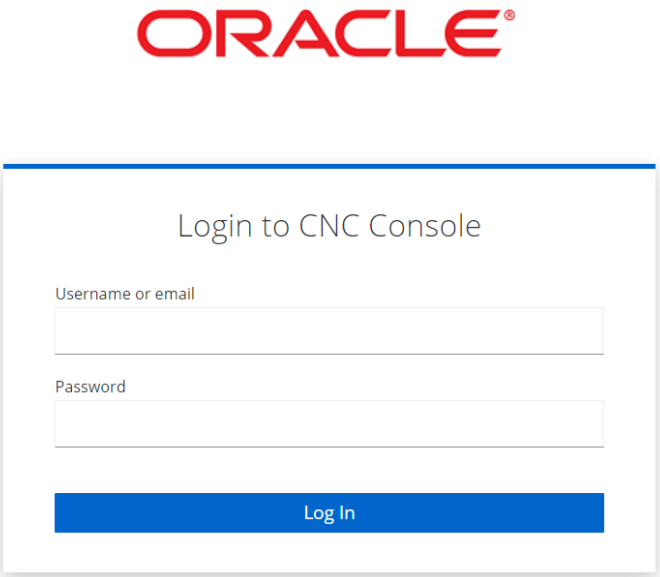
    Verify if IAM is running. For example:

    ```
    IAM: http://10.123.158.150:30085/

    Default user: admin

    Default password: password
    ```

12. **Login to the CNC Console.**

    Provide the **Username** and **Password**.

Figure 2-4 Login



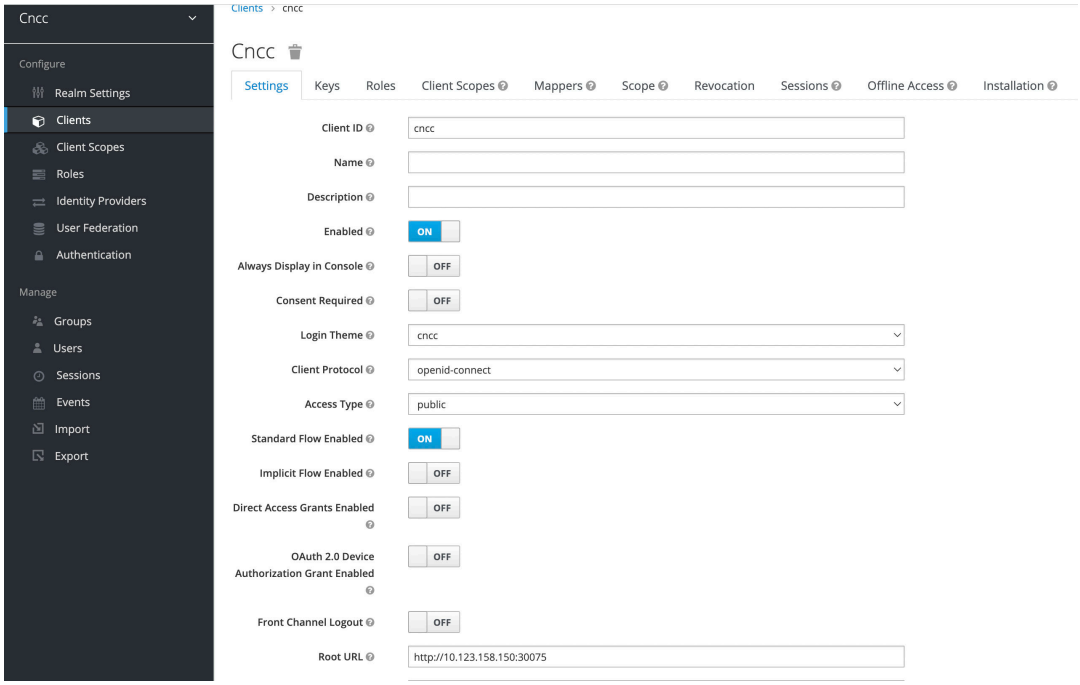
Click **Login**.

Integrate OCNWDAF and CNC Console

If CNC Console is already installed, ensure all the parameters are updated in the *occncc_custom_values.yaml* file. For information refer to *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide.*

1. Login to the CNC Console
2. Click **Clients** option, In the **Settings** tab update the **Root URL** field with the IP on which CNC Console is running and the port defined on *mcore-ingress-gateway* service.

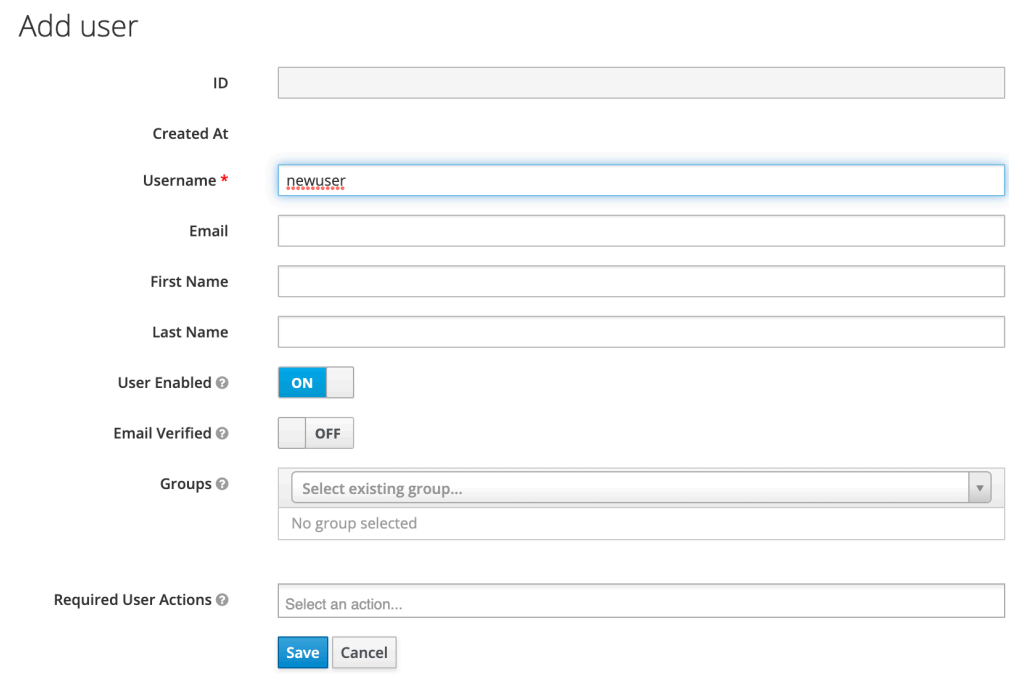
Figure 2-5 Clients



Click **Save**

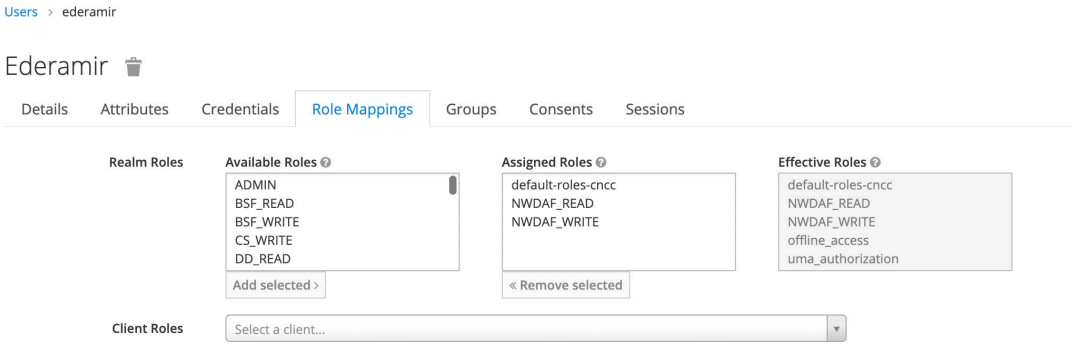
3. To add new user, click **Users** and click **Add User**. Provide a **Username** and fill the form. Click **Save**.

Figure 2-6 Add User



4. Click **Users**, select the newly added user, go to the **Role Mappings** tab. For example:

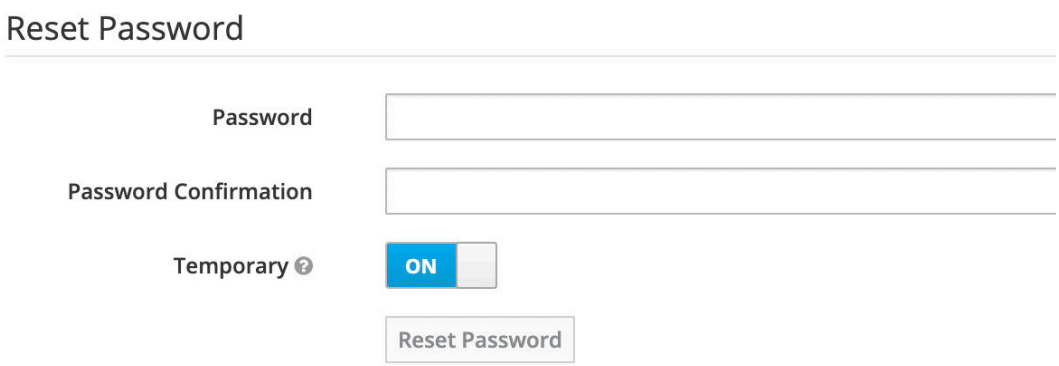
Figure 2-7 Role Mapping



Add **NWDAF_READ** and **NWDAF_WRITE** to the **Assigned Roles**.

5. Use the **Reset Password** screen to create a new password for the user.

Figure 2-8 Reset Password



Access OCNWDAF GUI

To access OCNWDAF GUI, follow the procedure mentioned in the "Accessing CNC Console" section of *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide*.

Uninstall CNC Console

To uninstall CNC Console, run the following commands:

```
helm delete cncc -n cncc
```

Delete all jobs, run the following command:

```
kubectl delete jobs --all -n cncc
```

2.2.3.4 Taking a Backup

Take a backup of the following files, which are required during fault recovery:

- Updated NWDAF-custom-values.yaml file.
- Updated Helm charts.
- Secrets, certificates, and keys that are used during installation.

3 OCNWDAF Customization

Customizing OCNWDAF

This section describes how to customize OCNWDAF.

The OCNWDAF deployment is customized by overriding the default values of various configurable parameters in the `values.yaml` file.

To customize the values yaml file, perform the following steps:

1. Extract the *Custom_Templates* file available in the extracted documentation release package to get the following files that are used to customize the deployment parameters during installation:
   a. `values.yaml`: This file is used to customize the OCNWDAF deployment with ATS.
   b. `nwdafAlertrules.yaml`: This file is used for Prometheus.

   For more information about how to download the package from My Oracle Support, see the Installation Package Download section.
2. Customize the `ocn-nwdaf-helmChart/helmChart/values.yaml` file.
3. Save the updated `ocn-nwdaf-helmChart/helmChart/values.yaml` file in the Helm chart directory.

> **Note**
>
> - All parameters mentioned as mandatory must be present in ocn-nwdaf-helmChart/helmChart/values.yaml file and configured before the deployment.
> - All fixed value parameters listed must be present in the ocn-nwdaf-helmChart/helmChart/values.yaml file with the exact values as specified in this section.
> - The properties in the *values.yaml* of all the sub charts are configurable, but it is not advisable to update the properties. Update the properties of the sub charts only when there is a specific customer requirement.

3.1 Configurable Parameters

This section lists all the OCNWDAF configurable parameters.

3.1.1 Global Parameters

Table 3-1 Global Paramaters

Parameter	Description	Details
`global.test.nfName`	This is a mandatory parameter. The value of *nfName* is specified as *ocnwdaf*. The *nfName* is used as a prefix in the test container name.	**Default value:** ocnwdaf
`global.test.image.name`	This is a mandatory parameter. Name of the test image.	**Default value:** nf_test
`global.test.image.tag`	This is a mandatory parameter. Name of the test image tag.	**Default value:** 23.4.0
`global.test.config.logLevel`	This is an optional parameter. Helm test hook-related configurations. It indicates the logging level of the test container.	**Range:** INFO, DEBUG, FATAL, ERROR, WARN **Default value**: INFO
`global.test.config.timeout`	This is an optional parameter. Helm test hook-related configurations. Beyond this duration, helm test is considered as a failure.	**Default value**: 240
`global.test.complianceEnable`	This is an optional parameter. Helm test hook-related configurations. Sets the test container as compliant.	**Range:** true, false **Default value:** true
`global.test.resources`	This is a mandatory parameter. It specifies the resources to which the test pod needs access.	**Default value:** - deployments/v1 - configmaps/v1 - serviceaccounts/v1 -poddisruptionbudgets/v1 - roles/v1 - statefulsets/v1 - services/v1 - rolebindings/v1

Example of the configurations that should be included under the global section of the *ocnwdaf-custom-values.yaml* file.

```
global:
  test:
    nfName: ocnwdaf
    image:
      name: nf_test
      tag: 23.4.0
    config:
      logLevel: INFO
      timeout: 240
    complianceEnable: true
    resources:
      - deployments/v1
```

```
- configmaps/v1
- serviceaccounts/v1
- poddisruptionbudgets/v1
- roles/v1
- statefulsets/v1
- services/v1
- rolebindings/v1
```

Istio Sidecar Injection Parameters

These parameters are used to enable Service Mesh support:

> **Note**
>
> The label of the namespace takes precedence over the configured `injection` parameter. If Service Mesh has to be disabled, ensure the `injection` parameter is not configured in the namespace or it is disabled.

Table 3-2 Istio Sidecar Paramaters

Parameter	Description	Details
`injection`	This parameter is used to enable Service Mesh support.	**Range:** true, false **Default value:** False
`readinessCheck`	Flag to enable or disable the feature. If disabled then there is no need to configure.	**Range:** true, false **Default value:** False

3.1.2 Microservice Parameters

For each microservice, there is an option to specify the following parameters in its own *values.yaml* file to perform the *readinessProbe*.

Table 3-3 Microservice Parameter

Parameter	Description	Details
`readinessProbe.initialDelaySeconds`	This is an optional parameter. Specifies the configurable wait time before performing the first readiness probe by Kubelet.	**Default value**: *20*
`readinessProbe.timeoutSeconds`	This is an optional parameter. Number of seconds after which the probe times out.	**Default value**: 3
`readinessProbe.periodSeconds`	This is an optional parameter. Specifies the time interval for every readiness probe check performed by Kubelet.	**Default value**: 10
`readinessProbe.successThreshold`	This is an optional parameter. Minimum consecutive successes for the probe to be considered successful after having failed.	**Default value**: 1

Table 3-3 (Cont.) Microservice Parameter

Parameter	Description	Details
`readinessProbe.failureThreshold`	This is an optional parameter. When a Pod starts and the probe fails, Kubernetes will try *failureThreshold* times before giving up.	**Default value**: 3

Following is an example of the configurations that should be included in the *values.yaml* file of each microservice.

```
readinessProbe:
  initialDelaySeconds: 20
  timeoutSeconds: 3
  periodSeconds: 10
  successThreshold: 1
  failureThreshold: 3
```

3.1.3 Georedundancy Parameters

Configure the following parameters to enable and configure georedundancy in the values.yaml file for OCNWDAF:

Table 3-4 REDUNDANCY AGENT CONFIGURATION

Parameter	Description	Default Value
ocnwdaf.cluster.namespace	Name space of the deployment **Note:** Change this to the name space of OCNWDAF deployments.	ocn-nwdaf
global.ocnNwdafGeoredagent	This parameter enables the georedundancy feature, it is turned off by default. Set this parameter to "True" to enable georedundancy.	False
global.siteVariables.OCNWDAF_SITE_ID	This parameter sets the name of the site, it is used by the redundancy agent, the scheduler service, and the subscription service.	OCNWDAF-XX-1
ocnnwdaf.geored.hooks.database	Database information for the hook	nwdaf_subscription
ocnnwdaf.geored.hooks.table	Table information for the hook	nwdaf_subscription
ocnnwdaf.geored.hooks.column1	Column1 information for the hook	record_owner
ocnnwdaf.geored.hooks.column2	Column2 information for the hook	current_owner
ocnnwdaf.geored.hooks.image	Image information for the hook	ocnwdaf-docker.dockerhub-phx.oci.oraclecorp.com/nwdaf-cap4c/nwdaf-cap4c-mysql:8.0.30
ocnnwdaf.geored.agent.name	Name of the deployment	ocn-nwdaf_georedagent

Table 3-4 (Cont.) REDUNDANCY AGENT CONFIGURATION

Parameter	Description	Default Value
ocnnwdaf.geored.agent.replicas	Number of Replicas	1
ocnnwdaf.geored.agent.image.source	Image for Georedundancy (GRD) Agent **Note:** Modify this value if the image is in a different repository.	occne-repo-host:5000/occne/redagent-ms-dev:1.0.31
ocnnwdaf.geored.agent.image.pullPolicy	Image Pull Policy	IfNotPresent
ocnnwdaf.geored.agent.resources.limits.cpu	CPU Limit	1
ocnnwdaf.geored.agent.resources.limits.memory	Memory Limit	1Gi
ocnnwdaf.geored.agent.resources.request.cpu	CPU Request	1
ocnnwdaf.geored.agent.resources.request.memory	Memory Request	1Gi
ocnnwdaf.geored.agent.service.type	Service Type of the Deployment	ClusterIP
ocnnwdaf.geored.agent.service.port.containerPort	Container Port of the Deployment	9181
ocnnwdaf.geored.agent.service.port.targetPort	Target Port of the Deployment	9181
ocnnwdaf.geored.agent.service.port.name	Name of the Service Port	ocnwdafgeoredagentport
ocnnwdaf.geored.agent.service.prometheusport.containerPort	Container Port of the Prometheus	9000
ocnnwdaf.geored.agent.service.prometheusport.targetPort	Target Port of the Prometheus	9000
ocnnwdaf.geored.agent.service.prometheusport.name	Name of the Prometheus **Note:** Modify the port name based on the Prometheus on the deployed setup.	http-cnc-metrics
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_SERVER_HTTP2_ENABLED	Enable/Disable HTTP2	TRUE
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_HEARTBEAT_INTERVAL_MS	Time Interval To check HeartBeat in "ms"	10000
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_HEARTBEAT_THRESHOLD	Number of Time Times to check Heart Beat	5
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_CORE_COMP_THRESHOLD	Number of times to check Heart Beat towards the core components	5
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_SITE_NUMBER	The current site number.	1
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_SITE_ID	Current Site ID	OCNWDAF-XX-1
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_NUMBER_OF_MATED_SITE	Number of mated sites. It is updated based on GRD sites in sync.	1
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_SELF_ADDRESS	Current Agent Address. The resolvable URL of the OCNWDAF Gateway service. This address should be reachable outside the cluster.	
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_MICROSERVICE_LIVELINESS_MS	Check Interval for the OCNWDAF microservice in "ms".	10000

Table 3-4 (Cont.) REDUNDANCY AGENT CONFIGURATION

Parameter	Description	Default Value
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_OCNWDAF_CORE_COMPONENT_LIST	List of OCNWDAF microservices that needs to be verified.	ocn-nwdaf-subscription
ocnnwdaf.geored.agent.env.GEO_RED_SITE_SUBSCRIPTION_OWNERSHIP_TRANSFER_URL	Subscription API for Ownership Transfer	http://ocn-nwdaf-subscription-service-internal:8087/nnwdaf-eventssubscription/v1/subscriptions/updateServingOwner
ocnnwdaf.geored.agent.env.GEO_RED_SITE_DATA_COLLECTION_URL	Data Collection API for Ownership Check	http://ocn-nwdaf-data-collection-service-internal:8081/ra/notify
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_DBTIER_REPLICATION_STATUS_URL	cnDBTier Monitor Service URL for Replication	Use the Reachable Monitor Service from Deployed CNDB namespace. For example: http://mysql-cluster-db-monitor-svc.{cndbnamspace}.svc.{domainname}:8080/db-tier/status/replication
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_DBTIER_STATUS_URL	cnDBTier Monitor Service URL for Local	Use the Reachable Monitor Service from Deployed CNDB namespace. For example: http://mysql-cluster-db-monitor-svc.{cndbnamspace}.svc.{domainname}:8080/db-tier/status/local
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_SITE_SECONDARY_SITEID	Secondary Site ID	OCNWDAF-XX-2
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_SITE_SECONDARY_ADDRESS	Secondary Site Address	The Resolvable URL of the OCNWDAF Gateway of Secondary Site. This address should be reachable outside the cluster
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_SITE_TERTIARY_SITEID	Tertiary Site ID	OCNWDAF-XX-3

Table 3-4 (Cont.) REDUNDANCY AGENT CONFIGURATION

Parameter	Description	Default Value
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_SITE_TERTIARY_ADDRESS	Tertiary Site Address	The Resolvable URL of the OCNWDAF Gateway of Tertiary Site. This address should be reachable outside the cluster
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_DB_URL	IP of the Site cnDBTier	The Cluster IP/ External IP of the CNDB
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_USERNAME	Name of the DB User with privileges to GRD DB and Subscription DB. The user should have access to both GRD and Subscription Databases	occneuser
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_PASSWORD	Password for the DB User	password
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_ENABLE	Enable/disable GRD	false
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_DB_PORT	Port of the database	3306
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_DB_NAME	Name of the GRD database	georedagent
ocnnwdaf.geored.agent.env.GEO_RED_AGENT_CONFIG_SERVER	Config Server URL for the Site's OCNWDAF	http://nwdaf-cap4c-spring-cloud-config-server:8888

3.1.4 Mirror Maker Parameters

Listed below are the customizable Mirror Maker 2 parameters:

Table 3-5 Mirror Maker Parameters

Parameter	Description
clusters	The clusters name.
clusterX.bootstrap.servers	This refers to the brokers that belong to the cluster, host, and port. Multiple brokers can be separated by a comma, and clusterX is replaced by each cluster name.
clusterX.config.storage.replication.factor	The replication factor is used when Kafka Connect creates a topic to store the connector and task configuration data. This value should always be a minimum of “3” for a production system. It cannot exceed the number of Kafka brokers in the cluster. Set the value of this parameter to “1” to use the Kafka broker's default replication factor.

Table 3-5 (Cont.) Mirror Maker Parameters

Parameter	Description
clusterX.offset.storage.replication.factor	The replication factor is used when Kafka Connect creates a topic to store the connector offsets. This value should always be a minimum of “3” for a production system. It cannot exceed the number of Kafka brokers in the cluster. Set the value of this parameter to “1” to use the Kafka broker's default replication factor.
clusterX.status.storage.replication.factor	The replication factor is used when Kafka Connect creates a topic to store the connector and task status updates. This value should always be a minimum of “3” for a production system. It cannot exceed the number of Kafka brokers in the cluster. Set the value of this parameter to “1” to use the Kafka broker's default replication factor.
replication.factor	Indicates the number of brokers available.
nwdafDataReplication.config.serviceN.kafkaService	The Kafka service name to build Kafka service's FQDN.
nwdafDataReplication.config.serviceN.namespace	The namespace to build Kafka service's FQDN.
nwdafDataReplication.config.serviceN.cluster	The cluster to build Kafka service's FQDN.

3.1.5 ML Model Replication Parameters

Listed below are the customizable ML Model Replication parameters:

Table 3-6 ML Model Replication Parameters

Parameter	Description
deploy.storage.size	This parameter indicates the size of the volume mount, the default value is 10Gi.
deploy.storage.mountPath	This parameter indicates the path where the "pvc" is will be mounted in the container. The default value is "*/mnt/nfs*".
svc.port	This parameter indicates the port of the Load Balancer service. The default value is "30000".
svc.targetPort	This parameter indicates the port of the container that it is mapped to the port of the Load Balancer. The value is always set to "22".
svc.port.protocol	This parameter indicates the protocol to be used in the ports. The default protocol is TCP.

3.1.6 IP Family Configuration Parameters

Listed below are the customizable IP Family Configuration parameters:

Table 3-7 IP Family Configuration Parameters

Parameter	Description
INNODB	

Table 3-7 (Cont.) IP Family Configuration Parameters

Parameter	Description
innodbDeploy	This parameter indicates if InnoDB is deployed. Update this parameter to *false* for IPv6 support. For IPv4, update this parameter as *false* only if the value of the parameter *dbInUse* is *cndb*.
CLUSTER-INFO	
dbInUse	This parameter specifies the DB to be used. The allowed values are *cndb* and *innodb*. Update this parameter as *cndb* for IPv6. For IPv4, it is recommended to configure this parameter as *innodb* (either *cndb* or *innodb* can be used).
IP CONFIGURATION	
ipFamilyPolicy	This parameter indicates the supported IPv6 environment. The allowed values are *SingleStack*, *PreferDualStack*, and *RequireDualStack*. If *ipFamilyPolicy* is *SingleStack*, this parameter will be an array with single value *IPv4/IPv6*. If *ipFamilyPolicy* is *DualStack*, this parameter will be an array of both the values. (*RequireDualStack* prioritizes the first entry).
ipFamilies	This parameter indicates the IP Family supported as either *IPv4* or *IPv6*.
ipV6Mode	This parameter indicates if the deployment is in IPv6 mode. If IPv6 is supported, set this parameter as *true*, else set it to *false*.

3.1.7 NRF Client Parameters

To configure NRF client parameters, you should configure the following parameters in the values.yaml file. The following table provides details about the NRF client customization parameters in the `values.yaml` file:

Table 3-8 Configurable Parameters - NRF Client Configuration

Parameter	Description	Details
global.deploymentNrfClientService.envNfNamespace	This is a mandatory parameter. Contains the namespace of the services to be monitored by performance service.	Default value: No services are monitored, leave blank. **Note:** If no services are to be monitored, envNfNamespace can be left blank.
nrf-client.configmapApplicationConfig.profile	This is a mandatory parameter. Contains configuration parameters that goes into nrf-client's config map. **Note:** See config-map table for configurable parameters.	Default Value: Valid profile. Please refer to the ocnwdaf-<*version*>custom-values.yaml example below.

Table 3-8 (Cont.) Configurable Parameters - NRF Client Configuration

Parameter	Description	Details
appinfo.infraServices	This is a conditional parameter. Set this parameter to an empty array if any one of the following conditions are met: • Deploying on occne 1.4 or lesser version • Not deploying on OCCNE • Do not wish to monitor infra services such as db-monitor service	NA
perf-info.configmapPerformance.prometheus	This is a conditional parameter. Specifies Prometheus server URL. **Note:** If no value is specified, OCNWDAF reports "0" load to NRF.	Default Value: http://prometheus-server.prometheus:5802
global.leaderPodDbName	Contains the name for Leader Pod Database in the global parameters. This database is unique per site.	Range: Valid database name.
nrf-client-nfmanagement.dbConfig.leaderPodDbName	Contains the name for Leader Pod Database in the nrf-client-nfmanagement.dbConfig.	Range: Valid database name.
global.networkDbName	Contains the network database name in the global parameters.	Default Value: Valid Release Database name. For Example: nwdafReleaseDB
nrf-client-nfmanagement.dbConfig.networkDbName	Contains the network database name in the nrf-client-nfmanagement.dbConfig parameters.	Default Value: networkDbNameRef
nrf-client-nfmanagement.enablePDBSupport	Set this to true to enable PDB Support. **Note:** If this parameter is set to true, helm test will fail. It is an expected behavior, as the mode is active and on standby, leader pod (nrf-client-management) will be in a ready state and follower will not be in ready state, which will lead to failure in the helm test.	Range: true or false Default Value: true
nrf-client-nfmanagement.replicas	Contains number of NRF-Client replicas.	Default Value: 2

Table 3-9 Configurable parameters of NRF Client Configuration in Config-map

Parameter	Description	Details
primaryNrfApiRoot	Primary NRF hostname and port Hostname/IP:Port.	Range: Valid API root Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x

Table 3-9 (Cont.) Configurable parameters of NRF Client Configuration in Config-map

Parameter	Description	Details
SecondaryNrfApiRoot	secondary NRF hostname and port Hostname/IP:Port For example: nrf2-api-gateway.svc:80	Range: Valid API root Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x
retryAfterTime	When primary NRF is down, this will be the wait Time (in ISO 8601 duration format) after which request to primary NRF will be retried to detect primary NRF's availability. For example: PT120S	Range: Valid ISO 8601 duration format Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x
nrfClientType	The NfType of the NF registering. This should be set to OCNWDAF.	Default Value: OCNWDAF Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x
nrfClientSubscribeTypes	NF Type(s) for which the NF wants to discover and subscribe to the NRF. **Note:** Leave blank if OCNWDAF does not require this option.	Range: AMF, NRF, UDM, SMF, AUSF, NEF, PCF, SMSF, NSSF, UDR, LMF, GMLC, 5G_EIR, SEPP, UPF, N3IWF, AF, UDSF, BSF, CHF, NWDAF Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x
appProfiles	NfProfile of OCNWDAF to be registered with NRF.	Range: Valid NF Profile Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x
enableF3	Support for 29.510 Release 15.3.	Range: true or false Default Value: true Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x
enableF5	Support for 29.510 Release 15.5.	Range: true or false Default Value: true Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x
renewalTimeBeforeExpiry	Time(seconds) before the subscription validity expires. For example: 3600 (1hr)	Range: Time in seconds Default Value: 3600 Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x
validityTime	The default validity time (days) for subscriptions. For example: 30 (30 days)	Range: Time in days Default Value: 30 Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x

Table 3-9 (Cont.) Configurable parameters of NRF Client Configuration in Config-map

Parameter	Description	Details
enableSubscriptionAutoRenewal	Enable renewal of subscriptions automatically.	Range: true or false Default Value: true Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.6.x
acceptAdditionalAttributes	Enable additionalAttributes as part of 29.510 Release 15.5.	Range: true or false Default Value: false Applicable to: OCNWDAF
enableVirtualNrfResolution	Enable virtual NRF session retry by alternate routing service.	Range: true or false Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.9.0
virtualNrfFqdn	Virtual NRF FQDN used to query static list of route.	Default Value: nrf.oracle.com Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.9.0
virtualNrfScheme	Scheme to be used with the virtual FQDN.	Range: http or https Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.9.0
requestTimeoutGracePeriod	An additional grace period where no response is received from the NRF. This additional period shall be added to the requestTimeout value. This will ensure that the egress-gateway shall first timeout, and send an error response to the NRF-client.	Range: Integer value Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.9.0
nrfRetryConfig	Configurations required for the NRF Retry mechanism.	Default Value: Valid configuration. Please refer to the ocnwdaf-<version>custom-values.yaml example below. Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.9.0
healthCheckConfig	Configurations required for the Health check of NRFs.	Default Value: Valid configuration. Please refer to the ocnwdaf-<*version*>custom-values.yaml example below. Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.9.0
supportedDataSetId	The data-set value to be used in queryParams for NFs autonomous or on-demand discovery.	Range: SUBSCRIPTION, POLICY, EXPOSURE, APPLICATION. Applicable to: OCNWDAF Added, Deprecated, or Updated: Added in Release 1.7.1

Table 3-10 NRF Client Parameters

Parameter	Description	Detail
nrfclient.nrf-client.configmapApplicationConfig.profile	This is a mandatory parameter. It contains configuration parameters that goes into nrf-client's config map. **Note:** See configmap table for configurable parameters	Applicable to: OCNWDAF
nrfclient.nrf-client	This is a mandatory parameter. Microservice level control if specific microservice need to be disabled.	Applicable to: OCNWDAF
config-server	This is a mandatory parameter. Details of Config-server microservice.	Applicable to: OCNWDAF
config-server.enabled	This is a mandatory parameter. Engineering-parameter	Applicable to: OCNWDAF
config-server.envMysqlDatabase	This is a mandatory parameter. It specifies MySQL Config Server Database Name.	Default Value: Provisional DB name Applicable to: OCNWDAF
config-server.dbConfig.dbEngine	This is a mandatory parameter. Database hook Configuration	Default Value: Database Engine name Applicable to: OCNWDAF
appinfo.enabled	This is a mandatory parameter. Use to enable or disable appinfo microservices.	Range: true or false Default Value: true Applicable to: OCNWDAF
appinfo.debug	This is a mandatory parameter. Represent appinfo image name. Note: Registry is taken from global section: • image: oc-app-info • appinfo image tag • imageTag: 24.1.0 • Set Log Level to DEBUG. • If false, Log Level shall be INFO	Range: true or false Default Value: false Applicable to: OCNWDAF
serviceMeshCheck	This is a mandatory parameter. This flag needs to be set to `true` if a Service Mesh is present in the environment where OCNWDAF is deployed.	**Range:** True or False. **Default value:** False Applicable to: OCNWDAF
istioSidecarQuitUrl	This is a mandatory parameter. It needs to be set with correct URL format http://127.0.0.1:<istio management port>/quitquitquit" if Service Mesh is present in the environment where OCNWDAF is deployed.	**Default value**: http://127.0.0.1:15000/quitquitquit" Applicable to: OCNWDAF
istioSidecarReadyUrl	This is a mandatory parameter. It needs to be set with correct URL format http://127.0.0.1:<istio management port>/ready" if Service Mesh is present in the environment where OCNWDAF is deployed.	**Default value**: http://127.0.0.1:<istio management port>/ready" Applicable to: OCNWDAF

Table 3-11 NRF Client NF Discovery Parameters

Parameter	Description	Details
nrf-client.nrf-client-nfdiscovery	This is a mandatory parameter. Contains deployment specific configuration for Nrf-Client Discovery Microservice	Applicable to: OCNWDAF
configmapApplicationConfig	This is a mandatory parameter.	Applicable to: OCNWDAF
cpuRequest	This is a mandatory parameter.	Default Value: 2 Applicable to: OCNWDAF
cpuLimit	This is a mandatory parameter.	Default Value: 2 Applicable to: OCNWDAF
memoryRequest	This is a mandatory parameter.	Default Value: 1Gi Applicable to: OCNWDAF
memoryLimit	This is a mandatory parameter.	Default Value: 1Gi Applicable to: OCNWDAF
minReplicas	This is a mandatory parameter.	Default Value: 1 Applicable to: OCNWDAF
maxReplicas	This is a mandatory parameter.	Default Value: 5 Applicable to: OCNWDAF
averageCpuUtil	This is a mandatory parameter.	Default Value: 80 Applicable to: OCNWDAF
commonCfgServer.configServerSvcName	This is a mandatory parameter.	Default Value: nsconfig Applicable to: OCNWDAF
commonCfgServer.port	This is a mandatory parameter.	Default Value: 8080 Applicable to: OCNWDAF
commonCfgClient.enabled	This is a mandatory parameter.	Default Value: *cfgClientEnabled Applicable to: OCNWDAF
nrf-client.nrf-client-nfdiscovery.dbConfig	This is a mandatory parameter. Contains database credentials of Nrf-Client Discovery parameters.	Default Value: Valid database host (Example: ocnwdaf-nsdb.db) Applicable to: OCNWDAF
dbConfig.dbHost	This is a mandatory parameter. DB credential of nrf-client-nfdiscovery parameters.	Applicable to: OCNWDAF
dbConfig.dbPort	This is a mandatory parameter. Databse credential of nrf-client-nfdiscovery parameters.	Default Value: 3306 Applicable to: OCNWDAF
dbConfig.secretName	This is a mandatory parameter.Contains name of the secret.	Default Value: Provisional DB secret Applicable to: OCNWDAF
dbConfig.dbName	This is a mandatory parameter. Contains name of the database.	Default Value: Provisional DB name Applicable to: OCNWDAF
dbConfig.dbUNameLiteral	This is a mandatory parameter. Contains the name of the Key configured for "DB Username" in Secret with following name: "<dbConfig.secretName>".	Applicable to: OCNWDAF

Table 3-11 (Cont.) NRF Client NF Discovery Parameters

Parameter	Description	Details
dbConfig.dbPwdLiteral	This is a mandatory parameter. Contains the name of the Key configured for "DB Password" in Secret with following name: "<dbConfig.secretName>".	Applicable to: OCNWDAF
dbConfig.dbEngine	This is a mandatory parameter. Database engine name.	Default Value: NDBCLUSTER Applicable to: OCNWDAF
serviceMeshCheck	This is a mandatory parameter. This flag needs to be set to `true` if a Service Mesh is present in the environment where OCNWDAF is deployed.	**Range:** True or False. **Default value:** False Applicable to: OCNWDAF
istioSidecarQuitUrl	This is a mandatory parameter. It needs to be set with correct URL format http:// 127.0.0.1:<istio management port>/quitquitquit" if Service Mesh is present in the environment where OCNWDAF is deployed.	**Default value**: http:// 127.0.0.1:15000/ quitquitquit" Applicable to: OCNWDAF
istioSidecarReadyUrl	This is a mandatory parameter. It needs to be set with correct URL format http:// 127.0.0.1:<istio management port>/ready" if Service Mesh is present in the environment where OCNWDAF is deployed.	**Default value**: http:// 127.0.0.1:<istio management port>/ready" Applicable to: OCNWDAF

Table 3-12 NRF Client NF Management Parameters

Parameter	Description	Details
nrf-client-nfmanagement	This is a mandatory parameter. Contains deployment specific configuration for nrf-client-nfmanagement microservice	Applicable to: OCNWDAF
configmapApplicationConfig	This is a mandatory parameter.	Applicable to: OCNWDAF
replicas	This is a mandatory parameter.	Default Value: 1 Applicable to: OCNWDAF
cpuRequest	This is a mandatory parameter.	Default Value: 1 Applicable to: OCNWDAF
cpuLimit	This is a mandatory parameter.	Default Value: 1 Applicable to: OCNWDAF
memoryRequest	This is a mandatory parameter.	Default Value: 1Gi Applicable to: OCNWDAF
memoryLimit	This is a mandatory parameter.	Default Value: 1Gi Applicable to: OCNWDAF
commonCfgServer.configServerSvcName	This is a mandatory parameter.	Default Value: nsconfig Applicable to: OCNWDAF
commonCfgServer.port	This is a mandatory parameter.	Default Value: 8080 Applicable to: OCNWDAF

Table 3-12 (Cont.) NRF Client NF Management Parameters

Parameter	Description	Details
commonCfgClient.enabled	This is a mandatory parameter.	Default Value: *cfgClientEnabled Applicable to: OCNWDAF
dbConfig	This is a mandatory parameter. Contains database credentials of Nrf-Client Discovery parameters,	Default Value: Valid dbConfig set of properties. Please refer to the ocnwdaf-<version>custom-values.yaml example. Applicable to: OCNWDAF
dbConfig.dbHost	This is a mandatory parameter. DB credential of nrf-client-nfdiscovery parameters.	Default Value: Valid database host (Example: ocnwdaf-nsdb.db) Applicable to: OCNWDAF
dbConfig.dbPort	This is a mandatory parameter. Database credential of nrf-client-nfdiscovery parameters.	Default Value: 3306 Applicable to: OCNWDAF
dbConfig.secretName	This is a mandatory parameter. Contains name of the secret.	Default Value: Provisional DB secret Applicable to: OCNWDAF
dbConfig.dbName	This is a mandatory parameter. Contains name of the database.	Default Value: Provisional DB name Applicable to: OCNWDAF
dbConfig.dbUNameLiteral	This is a mandatory parameter. Contains the name of the Key configured for "DB Username" in Secret with following name: "<dbConfig.secretName>".	Applicable to: OCNWDAF
dbConfig.dbPwdLiteral	This is a mandatory parameter. Contains the name of the Key configured for "DB Password" in Secret with following name: "<dbConfig.secretName>".	Applicable to: OCNWDAF
bConfig.dbEngine	This is a mandatory parameter. Database engine name.	Default Value: NDBCLUSTER Applicable to: OCNWDAF
serviceMeshCheck	This is a mandatory parameter. This flag needs to be set to `true` if a Service Mesh is present in the environment where OCNWDAF is deployed.	**Range:** True or False. **Default value:** False Applicable to: OCNWDAF
istioSidecarQuitUrl	This is a mandatory parameter. It needs to be set with correct URL format http:// 127.0.0.1:<istio management port>/quitquitquit" if Service Mesh is present in the environment where OCNWDAF is deployed.	**Default value**: http:// 127.0.0.1:15000/ quitquitquit" Applicable to: OCNWDAF
istioSidecarReadyUrl	This is a mandatory parameter. It needs to be set with correct URL format http:// 127.0.0.1:<istio management port>/ready" if Service Mesh is present in the environment where OCNWDAF is deployed.	**Default value**: http:// 127.0.0.1:<istio management port>/ready" Applicable to: OCNWDAF

Here is a sample configuration for NRF client in ocnwdaf-<*version*>custom-values.yaml file:

```
# Please add below in global section of custom values.yaml of NF deployment.
global:
  # The value of nfName is specified as ocnf which is stands of Oracle NF.
  # nfName is used as a prefix in serivce names of nrf client's service and
other services it connects to for eg appinfo, config server etc.
  nfName: ocnf
  # Global control to enable/disable deployment of NF Discovery service,
enable it if on demand discovery of NF is required.
  nrfClientNfDiscoveryEnable: true
  # Global control to enable/disable deployment of NF Management service.
  nrfClientNfManagementEnable: true
  # Global Parameter to enable/disable DEBUG Container tool
  extraContainers: "DISABLED"
  extraContainersTpl: |
    - command:
        - /bin/sleep
        - infinity
      image: {{ printf "%s/%s:%s" (include "getdockerregistry.name" .)
"ocdebugtool/ocdebug-tools" "22.3.1" }}
      imagePullPolicy: Always
      name: {{ printf "%s-tools-%s" (include "getprefix" .) (include
"getsuffix" .) | trunc 63 | trimPrefix "-" | trimSuffix "-"  }}
      resources:
        requests:
          ephemeral-storage: "2Gi"
          cpu: "0.5"
          memory: "1Gi"
        limits:
          ephemeral-storage: "4Gi"
          cpu: "1"
          memory: "2Gi"
      securityContext:
        allowPrivilegeEscalation: true
        capabilities:
          drop:
          - ALL
          add:
          - NET_RAW
          - NET_ADMIN
        readOnlyRootFilesystem: false
        runAsUser: 7000
  # Global parameter to mention if alternate-route service is
available(deployed) or not.
  alternateRouteServiceEnable: false
  altServiceHTTP2Enabled: true
  altServiceReqTimeout: 3000
  altServiceLookupInterval: 3000
  # Metrics name for OSO
  cncMetricsName: cnc-metrics
  # Jaeger tracing host
  envJaegerAgentHost: ''
  # Jaeger tracing port
  envJaegerAgentPort: 6831
  # Provide value for NodePort
```

```
  nrfClientNodePort: 0
  # Docker registry from which config-server images, nrf-client images will
be pulled
  #dockerRegistry: ocnrf-registry.us.oracle.com:5000
  dockerRegistry: cgbu-cnc-comsvc-release-docker.dockerhub-
phx.oci.oraclecorp.com
  # Readiness-Detector image details with tag
  #Vendor name
  vendor: "Oracle"
  # application name
  applicationName: "nrf-client"
  # prefix for Metrics
  metricPrefix: &metricPrefix ""
  # suffix for Metrics
  metricSuffix: &metricSuffix ""
  # Common service port
  nrfClientCommonServicePort: '9090'
  # Prometheus configuration
  prometheusScrapingConfig:
    enabled: false
    path: "/actuator/prometheus"
  nfInstanceId: 'fe7d992b-0541-4c7d-ab84-c6d70b1b01b1'
  configServerEnable: true
  # Config-Server Service. Shall be used as {{ ReleaseName }}-
configServerFullNameOverride
  configServerFullNameOverride: ocpm-config
  # Mysql Host
  envMysqlHost: &mySqlHostRef 10.233.5.39 # Changed
  envMysqlSecondaryHost: ''
  # Mysql Port
  envMysqlPort: &mySqlPortRef '3306'
  envMysqlSecondaryPort: ''
  # Mysql Secret Name
  dbCredSecretName: &dbCredSecretNameRef 'ocnf-db-pass'
  # Mysql Config Server Databse Name
  # Global Control to disable appinfo service
  appinfoServiceEnable: true
  # Global Control to disable performance info service
  performanceServiceEnable: true
  egressGatewayHost: ocn-nrf-simulator-service.ocnwdaf-ns # Changed
  # Deployment Specific configuration
  deploymentNrfClientService:
    # Services to be monitored by performance service
    # If no services are to be monitored,
envNfNamespace,envNfType,envConsumeSvcName can be left blank
    envNfNamespace: ''
    envNfType: ''
    envConsumeSvcName: ''
    # Egress gateway Host. Shall be used as {{ ReleaseName }}-
envEgressGatewayFullnameOverride
    envEgressGatewayFullnameOverride: egressgateway
    # Egress gateway Port
    envEgressGatewayPort: "8080" # Changed
    # Callback URI to receive Notifications from NRF
    nfApiRoot: http://ocnrf-ingressgateway.ocnrf:80
    nodeSelectorEnabled: false
```

```
    nodeSelectorKey: zone
    nodeSelectorValue: app
  # K8s Secret containing Database/user/password for DB Hooks for creating
tables
  privilegedDbCredSecretName: &privDbCredSecretNameRef 'ocnf-privileged-db-
pass'
  releaseDbName: &dbNameRef 'ocnf_config_server'
  networkDbName: &networkDbNameRef 'nrfNetworkDB'
  # Database Name for LeaderPod
  # Every NF has to configure a different LeaderPod for each site
  # so that when the sites are geo-redundant, the entries in the table do not
crash.
  leaderPodDbName: &leaderPodDbRef 'leaderPodDb'

  # Service Account Name
  serviceAccountName: ""

  # Application name that is added in logs as labels
  app_name: "nrfclient"
  supportedVersions:
    - autoscaling/v2
    - autoscaling/v2beta2
    - autoscaling/v2beta1
    - autoscaling/v1
    - policy/v1
    - policy/v1beta1
  #Resource Values for Hook Jobs
  hookJobResources:
    limits:
      cpu: 2
      memory: 2Gi
    requests:
      cpu: 1
      memory: 1Gi


# Details of perf-info microservices
perf-info:
   image: occnp/oc-perf-info
   imageTag: 22.4.1 # Changed from 22.3.2
   # Service namespace for perf-info
   service_namespace: ocnrf
   # Replicas for perf Info
   replicas: 2
   # Pull Policy - Possible Values are:- Always, IfNotPresent, Never
   imagepullPolicy: IfNotPresent
   service:
     type: ClusterIP
     port: 5905
   resources: {}
     # We usually recommend not to specify default resources and to leave
this as a conscious
     # choice for the user. This also increases chances charts run on
environments with little
     # resources, such as Minikube. If you do want to specify resources,
uncomment the following
```

```
     # lines, adjust them as necessary, and remove the curly braces after
'resources:'.
     # limits:
     #  cpu: 100m
     #  memory: 128Mi
     # requests:
     #  cpu: 100m
     #  memory: 128Mi
   nodeSelector: {}
   tolerations: []
   affinity: {}
   commonCfgClient:
     enabled: false
   commonCfgServer:
   # Do not comment this line in case you want to deploy both config-server
and APIGW in same namespace simultaneously
   # Otherwise comment this line and use 'host'
     configServerSvcName: 'common-config-server'
     host: 'common-config-server'
     port: '80'
     pollingInterval: 5000
   dbConfig:
     dbHost: *mySqlHostRef
     dbPort: *mySqlPortRef
     secretName: *dbCredSecretNameRef
     dbName: *dbNameRef
     # 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
   ingress:
      enabled: false
   configmapPerformance:
     prometheus: http://prometheus-server.prometheus:5802

# Microservice level control if specific microservice need to be disabled
nrf-client:
   # This config map is for providing inputs to NRF-Client
   configmapApplicationConfig:
      &configRef
      # Config-map to provide inputs to Nrf-Client
      # primaryNrfApiRoot - Primary NRF Hostname and Port
      # SecondaryNrfApiRoot - Secondary NRF Hostname and Port
      # nrfRouteList - Can be used to specify routes with priority instead of
primary and secondary NRF API root
      # useNrfRouteList - Can be used to specify whether nrfRouteList should
be used instead of primary and secondary NRF API root
      # nrfScheme - Scheme of primary and secondary NRF http or https
      # retryAfterTime - Default downtime(in Duration) of an NRF detected to
be unavailable.
      # nrfClientType - The NfType of the NF registering
      # nrfClientSubscribeTypes - the NFType for which the NF wants to
subscribe to the NRF.
      # appProfiles - The NfProfile of the NF to be registered with NRF.
```

```
      # enableF3 - Support for 29.510 Release 15.3
      # enableF5 - Support for 29.510 Release 15.5
      # registrationRetryInterval - Retry Interval after a failed autonomous
registration request
      # subscriptionRetryInterval - Retry Interval after a failed autonomous
subscription request
      # discoveryRetryInterval - Retry Interval after a failed autonomous
discovery request
      # discoveryRefreshInterval - The default interval after which
autonomous discovery requests will be resent
      # discoveryDurationBeforeExpiry - This value specifies the rate at
which the NF shall resend discovery requests to NRF. The value shall be
configured in terms of percentage(1-100). if the discovery ValidityPeriod is
60s, then the discovery requests shall be sent at
discoveryDurationBeforeExpiry * 60/100
      # renewalTimeBeforeExpiry - Time Period(seconds) before the
Subscription Validity time expires.
      # validityTime - The default validity time(days) for subscriptions.
      # enableSubscriptionAutoRenewal - Enable Renewal of Subscriptions
automatically.
      # nfHeartbeatRate - This value specifies the rate at which the NF shall
heartbeat with the NRF. The value shall be configured in terms of
percentage(1-100). if the heartbeatTimer is 60s, then the NF shall heartbeat
at nfHeartBeatRate * 60/100
      # acceptAdditionalAttributes - Enable additionalAttributes as part of
29.510 Release 15.5
      # retryForCongestion - The duration(seconds) after which nrf-client
should retry to a NRF server found to be congested.
      # supportedDataSetId - The data-set value to be used in queryParams for
NFs autonomous/on-demand discovery. e.g. data-set=POLICY
      # enableVirtualNrfResolution- enable virtual NRF session retry by
Alternate routing service
      # virtualNrfFqdn - virtual NRF FQDN used to query static list of route
      # virtualNrfScheme - http or https
      # useAlternateScpOnAlternateRouting - enable use SCP on alternate
routing service
      # subscriberNotificationRetry - number of health status notification
retries to a subscriber
      # requestTimeoutGracePeriod - grace period(seconds) for timeout period
until no response is received from NRF
      # nrfRetryConfig - configurations required for the NRF Retry mechanism
      #serviceRequestType - type of service operation for which configuration
is applicable
      #primaryNRFRetryCount - number of retries for primary instance
      #nonPrimaryNRFRetryCount - number of retries for non-primary instance
      #alternateNRFRetriesCount - number of retry attempts
      #errorReasonsForFailure - httpStatusCode or error conditions for which
retry shall be attempted
      #requestTimeout - timeout period(seconds) where no response is received
from NRF
      #gatewayErrorCodes - httpStatusCode sent by gateway for which retry
shall be attempted
      # healthCheckConfig - configurations required for the Health check of
NRFs
      #healthCheckCount - consecutive success/failure operation count
(default -1 means disabled)
```

```
      #healthCheckInterval - interval duration in seconds to perform health
check
      #requestTimeout - timeout period(seconds) where no response is received
from NRF
      #errorReasonsForFailure - httpStatusCode or error conditions for which
the NRF is considered as unhealthy
      #gatewayErrorCodes - httpStatusCode sent by gateway for the NRF shall
be considered unhealthy
      #enableDiscoveryRefresh - Feature flag to enable Automatic Discovery
Refresh
      #enableRediscoveryIfNoProdNFs - Feature flag to enable rediscovery when
No Producer NFs are available
      #offStatesForRediscoveryIfNoProdNFs - Comma separated value for states
to consider Producer NFs as not available

      #appProfiles=[{"nfInstanceId":"fe7d992b-0541-4c7d-ab84-
c6d70b1b01b1","nfType":"NWDAF","nfStatus":"REGISTERED","plmnList":null,"nsiLis
t":null,"fqdn":"pcf.oracle.com","interPlmnFqdn":null,"ipv4Addresses":null,"ipv
6Addresses":null,"priority":null,"capacity":null,"load":null,"locality":null,"
udrInfo":null,"udmInfo":null,"ausfInfo":null,"amfInfo":null,"smfInfo":null,"up
fInfo":null,"pcfInfo":null,"bsfInfo":null,"customInfo":null,"recoveryTime":nul
l,"nfServices":[{"serviceInstanceId":"03063893-
cf9e-4f7a-9827-067f6fa9dd01","serviceName":"nnrf-nfmanagement","versions":
[{"apiVersionInUri":"v1","apiFullVersion":"1.2.2","expiry":"2019-08-03T18:55:0
8.871+0000"}],"scheme":"http","nfServiceStatus":"REGISTERED","fqdn":"nrf.oracl
e.com","interPlmnFqdn":null,"apiPrefix":"bsf-
service","defaultNotificationSubscriptions":null,"allowedPlmns":null,"allowedN
fTypes":["PCF","NEF",
"NWDAF"],"allowedNfDomains":null,"allowedNssais":null,"priority":null,"capacit
y":null,"load":null,"recoveryTime":null,"supportedFeatures":null}],"sNssais":n
ull}]

      profile: |-
         [appcfg]
         primaryNrfApiRoot=ocn-nrf-simulator-service.ocnwdaf-ns:8080
         secondaryNrfApiRoot=
         nrfRouteList=[{"nrfApi":"nrfDeployName-
nrf-1:8080","scheme":"http","weight":100,"priority":1}]
         useNrfRouteList=false
         nrfScheme=http
         retryAfterTime=PT120S
         nrfClientType=NRF
         nrfClientSubscribeTypes=PCF
         appProfiles=[{"nfInstanceId":"fe7d992b-0541-4c7d-ab84-
c6d70b1b01b1","nfType":"NWDAF","nfStatus":"REGISTERED","plmnList":null,"nsiLis
t":null,"fqdn":"ocn-nwdaf-
communication","interPlmnFqdn":null,"ipv4Addresses":null,"ipv6Addresses":null,
"priority":null,"capacity":null,"load":null,"locality":null,"udrInfo":null,"ud
mInfo":null,"ausfInfo":null,"amfInfo":null,"smfInfo":null,"upfInfo":null,"pcfI
nfo":null,"bsfInfo":null,"customInfo":null,"recoveryTime":null,"nfServices":
[{"serviceInstanceId":"03063893-
cf9e-4f7a-9827-067f6fa9dd01","serviceName":"nnrf-nfmanagement","versions":
[{"apiVersionInUri":"v1","apiFullVersion":"1.2.2","expiry":"2019-08-03T18:55:0
8.871+0000"}],"scheme":"http","nfServiceStatus":"REGISTERED","fqdn":"nrf.oracl
e.com","interPlmnFqdn":null,"apiPrefix":"bsf-
service","defaultNotificationSubscriptions":null,"allowedPlmns":null,"allowedN
```

```
fTypes":["PCF","NEF",
"NWDAF"],"allowedNfDomains":null,"allowedNssais":null,"priority":null,"capacit
y":null,"load":null,"recoveryTime":null,"supportedFeatures":null}],"sNssais":n
ull}]
         enableF3=true
         enableF5=true
         registrationRetryInterval=5000
         subscriptionRetryInterval=5000
         enableDiscoveryRefresh=false
         discoveryRetryInterval=5000
         discoveryRefreshInterval=10
         discoveryDurationBeforeExpiry=90
         renewalTimeBeforeExpiry=3600
         enableRediscoveryIfNoProdNFs=false

offStatesForRediscoveryIfNoProdNFs=SUSPENDED,UNDISCOVERABLE,DEREGISTERED
         validityTime=30
         enableSubscriptionAutoRenewal=true
         nfHeartbeatRate=80
         acceptAdditionalAttributes=true
         retryForCongestion=5
         supportedDataSetId=
         enableVirtualNrfResolution=false
         virtualNrfFqdn=nrf.oracle.com
         virtualNrfScheme=http
         useAlternateScpOnAlternateRouting=
         subscriberNotificationRetry=2
         requestTimeoutGracePeriod=2
         enableDiscoveryRefresh=false

nrfRetryConfig=[{"serviceRequestType":"ALL_REQUESTS","primaryNRFRetryCount":1,
"nonPrimaryNRFRetryCount":1,"alternateNRFRetryCount":-1,"errorReasonsForFailur
e":
["503","504","500","SocketTimeoutException","JsonProcessingException","Unknown
HostException","NoRouteToHostException","IOException"],"gatewayErrorCodes":
["503"],"requestTimeout":10},
{"serviceRequestType":"AUTONOMOUS_NFREGISTER","primaryNRFRetryCount":1,"nonPri
maryNRFRetryCount":1,"alternateNRFRetryCount":-1,"errorReasonsForFailure":
["503","504","500","SocketTimeoutException","JsonProcessingException","Unknown
HostException","NoRouteToHostException","IOException"],"gatewayErrorCodes":
["503"],"requestTimeout":10}]

healthCheckConfig={"healthCheckCount":-1,"healthCheckInterval":5,"requestTimeo
ut":10,"errorReasonsForFailure":
["503","504","500","SocketTimeoutException","IOException"],"gatewayErrorCodes"
:["503", "504", "500"]}

   # Deployment specific configuration for Nrf-Client Discovery Microservice
   nrf-client-nfdiscovery:
      global:
          #ephemeralStorage value in MB. Value 0 means ephemeral-storage will
not be set during deployment.
          logStorage: 0 #default calculated value 70
          crictlStorage: 0 #default calculated value 1
          ephemeralStorageLimit: 0 #default calculated value 1024
          maxUnavailable: "25%"
```

```
      configmapApplicationConfig: *configRef
      # NRF Client Microservice image name
      image: nrf-client
      # NRF Client Microservice image tag
      imageTag: '22.3.3'
      envJaegerSamplerParam: '1'
      envJaegerSamplerType: ratelimiting
      envJaegerServiceName: nrf-client-nfdiscovery
      # Resource Details
      cpuRequest: 2
      cpuLimit: 2
      memoryRequest: 1Gi
      memoryLimit: 1Gi
      # Min replicas to scale to maintain an average CPU utilization
      minReplicas: 1
      # Max replicas to scale to maintain an average CPU utilization
      maxReplicas: 2
      averageCpuUtil: 80
      type: ClusterIP
      # Set to true if the discovery results should be cached.
      cacheDiscoveryResults: false
      # Discovery Service Port
      envDiscoveryServicePort: 5910
      # Management Service Port
      envManagementServicePort: 5910
      #Restart Policy for hooks
      hookRestartPolicy: Never
      # prefix for Metrics
      metricPrefix: *metricPrefix
      # suffix for Metrics
      metricSuffix: *metricSuffix
      #The sidecar (istio url) when deployed in serviceMesh
      # Default value: http://127.0.0.1:15000/quitquitquit
      istioSidecarQuitUrl: ""
      # Default value: http://127.0.0.1:15000/ready
      istioSidecarReadyUrl: ""
      # Flag to enable service Mesh
      serviceMeshCheck: false
      # Flag to switch between "HELM" based or "REST" based nfProfile
configuration
      nfProfileConfigMode: "HELM"
      # Flag to enable/ disable the feature
      # Allowed Values: DISABLED, ENABLED, USE_GLOBAL_VALUE
      extraContainers: USE_GLOBAL_VALUE
      commonCfgClient:
         enabled: false
      commonCfgServer:
        # Do not comment this line in case you want to deploy both config-
server and APIGW in same namespace simultaneously
        # Otherwise comment this line and use 'host'
        configServerSvcName: 'common-config-server'
        host: 'common-config-server'
        port: '80'
        pollingInterval: 5000
        nfProfileUri: 'nf/nf-common-component/v1/nrf-client-nfmanagement/
nfProfileList'
```

```
      dbConfig:
        dbHost: *mySqlHostRef
        dbPort: *mySqlPortRef
        secretName: *privDbCredSecretNameRef
        dbName: *dbNameRef
        # 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

   # Deployment specific configuration for Nrf-Client Management Microservice
   nrf-client-nfmanagement:
      global:
         #ephemeralStorage value in MB. Value 0 means ephemeral-storage will
not be set during deployment.
         logStorage: 0 #default calculated value 70
         crictlStorage: 0 #default calculated value 1
         ephemeralStorageLimit: 0 #default calculated value 1024
         minAvailable: 1
      configmapApplicationConfig: *configRef
      # NRF Client Microservice image name
      image: nrf-client
      # NRF Client Microservice image tag
      imageTag: '22.3.3'
      envJaegerSamplerParam: '1'
      envJaegerSamplerType: ratelimiting
      envJaegerServiceName: nrf-client-nfmanagement
      enablePDBSupport: false
      # Resource Details
      replicas: 1
      cpuRequest: 1
      cpuLimit: 1
      memoryRequest: 1Gi
      memoryLimit: 1Gi
      type: ClusterIP
      #Restart Policy for hooks
      hookRestartPolicy: Never
      # prefix for Metrics
      metricPrefix: *metricPrefix
      # suffix for Metrics
      metricSuffix: *metricSuffix
      #The sidecar (istio url) when deployed in serviceMesh
      # Default value: http://127.0.0.1:15000/quitquitquit
      istioSidecarQuitUrl: ""
      # Default value: http://127.0.0.1:15000/ready
      istioSidecarReadyUrl: ""
      # Flag to enable service Mesh
      serviceMeshCheck: false
      # Flag to switch between "HELM" based or "REST" based nfProfile
configuration
      nfProfileConfigMode: "HELM"
      # Flag to switch between "HELM" based or "REST" based nrfRoute
configuration
      nrfRouteConfigMode: "HELM"
```

```
      # Flag to enable/ disable the feature
      # Allowed Values: DISABLED, ENABLED, USE_GLOBAL_VALUE
      extraContainers: USE_GLOBAL_VALUE
      commonCfgClient:
         enabled: false
      commonCfgServer:
        # Do not comment this line in case you want to deploy both config-
server and APIGW in same namespace simultaneously
        # Otherwise comment this line and use 'host'
        configServerSvcName: 'common-config-server'
        host: 'common-config-server'
        port: '80'
        pollingInterval: 5000
      dbConfig:
        dbHost: *mySqlHostRef
        dbPort: *mySqlPortRef
        secretName: *privDbCredSecretNameRef
        dbName: *dbNameRef
        networkDbName: *networkDbNameRef
        # Database for leaderPod selection
        leaderPodDbName: *leaderPodDbRef
        # 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

# Details of Config-server microservice
config-server:
   enabled: true
   image: occnp/oc-config-server
   imageTag: 22.3.2
   fullNameOverride: "config-server"
   envJaegerServiceName: pcf-config
   # This is the NfInstanceId of NF that will get deployed. This shall be
used in the profile being registered.
   nfInstanceId: 'fe7d992b-0541-4c7d-ab84-c6d70b1b01b1'
   # Mysql Config Server Databse Name
   envMysqlDatabase: ocnf_config_server
   # Replicas for Config server - This is exact value without scaling
   replicas: 1
   nodeSelectorEnabled: false
   nodeSelectorKey: zone
   nodeSelectorValue: app
   # Resource details
   resources:
    limits:
      cpu: 1
      memory: 1Gi
    requests:
      cpu: 0.5
      memory: 1Gi
   servicePcfConfig:
       type: NodePort
```

```
# Details of appinfo microservices
appinfo:
   enabled: true
   image: occnp/oc-app-info
   imageTag: 22.3.2
   pullPolicy: IfNotPresent
    # Replicas for Appinfo - This is exact value without scaling
   replicas: 1
   # Set Log Level to DEBUG. If false, Log Level shall be INFO
   debug: true
   serviceAccountName: ''

   commonCfgClient:
     enabled: false
   commonCfgServer:
   # Do not comment this line in case you want to deploy both config-server
and APIGW in same namespace simultaneously
   # Otherwise comment this line and use 'host'
     configServerSvcName: 'common-config-server'
     host: 'common-config-server'
     port: '80'
     pollingInterval: 5000
   dbConfig:
     dbHost: *mySqlHostRef
     dbPort: *mySqlPortRef
     secretName: *dbCredSecretNameRef
     dbName: *dbNameRef
     # 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
   # Service to be monitored by appinfo
   # nFType in core_services must consist of nfType used in nrfclient profile.
   #Examples-1 NRF with all services listed
   #core_services:
   #  nrf:
   #  - "ocnrf-nfRegistration"
   #  - "ocnrf-nfSubscription"
   #Example-2 NRF without listing any services
   core_services: {}
   # Infrastructure services
   # If using occne 1.4 or if you don't want to monitor infra services such
as db-monitor service then the below mentioned
   # attribute 'infraServices' should be uncommented and empty array should
be passed as already mentioned.
   # If infraServices is not set, by default appinfo shall monitor status of
db-monitor-svc and db-replication-svc.
   #infraServices: []
```

3.1.8 Ingress Gateway Parameters

Listed below are the customizable Ingress Gateway parameters:

Table 3-13 Routes Config Customizable Parameters

Parameter	Description	Details
`globalRemoveRequestHeader[0].name`	This field is used for blacklisting (removing) a request header at global level. Hence, it will be applied to all routes configured. Additional header can be configured by adding a new element in the next line and so on.	**Default Value:** Value to be updated accordingly
`globalRemoveResponseHeader[0].name`	This field is used for blacklisting(removing) a response header at global level. Hence, it will be applied to all routes configured. Additional header can be configured by adding a new element in the next line and so on.	**Default Value:** Value to be updated accordingly
`routesConfig[0].id`	This is a mandatory parameter. Id of the route.	**Default Value:** Value to be updated accordingly
`routesConfig[0].uri`	This is a mandatory parameter. Service name of the internal microservice of this NF.	**Default Value:** Value to be updated accordingly
`routesConfig[0].path`	This is a mandatory parameter. Provide the path to be matched.	**Default Value:** Value to be updated accordingly
`routesConfig[0].order`	This is a mandatory parameter. Provide the order of the execution of this route.	**Default Value:** Value to be updated accordingly
`routesConfig[0].metadata.requestTimeout`	requestTimeout is used to set timeout at route level. Value should be in milliseconds. If present then it will override global request timeout	**Default Value:**0
`routesConfig[0].metadata.xfccHeaderValidation.validationEnabled`	This is used to provide an option to enable or disable route level xfccHeaderValidation, it will override global configuration for xfccHeaderValidation.enabled	**Default Value:**False
`routesConfig[0].metadata.oauthValidator.enabled`		**Default Value:** Value to be updated accordingly
`routesConfig[0].metadata.ccaHeaderValidation.enabled`	This is used to provide an option to enable or disable route level ccaHeaderValidation, it will override global configuration for ccaHeaderValidation.enabled	**Default Value:**False
`routesConfig[0].filters.invalidRouteFilter.errorCodeOnInvalidRoute`	This is a mandatory parameter. If invalidRouteFilter filter is configured, then keep the 'order' value highest compared to other routesComment the parameters related to invalidRouteFilter if configurable error code is not required for invalid route. Configurable error code for invalid route.	**Default Value:** Value to be updated accordingly

Table 3-13 (Cont.) Routes Config Customizable Parameters

Parameter	Description	Details
routesConfig[0].filters.invalidRouteFilter.errorCauseOnInvalidRoute	This is a mandatory parameter. Error cause for invalid route.	**Default Value:** Value to be updated accordingly
routesConfig[0].filters.invalidRouteFilter.errorTitleOnInvalidRoute	This is a mandatory parameter. Error title for invalid route.	**Default Value:** Value to be updated accordingly
routesConfig[0].filters.invalidRouteFilter.errorDescriptionOnInvalidRoute	This is a mandatory parameter. Error description for invalid route.	**Default Value:** Value to be updated accordingly
routesConfig[0].filters.removeRequestHeader[0].name	This field is used for blacklisting(removing) a request header at route level. Additional header can be configured by adding a new element in the next line and so on.	The value of "name" attribute denotes the name of the request header which is to be blacklisted/removed at route level. Add a new entry in next line for every header to be removed.
routesConfig[0].filters.removeResponseHeader[0].name	Below field is used for blacklisting(removing) a response header at route level. Additional header can be configured by adding a new element in the next line and so on.	The value of "name" attribute denotes the name of the response header which is to be blacklisted/removed at route level. Add a new entry in next line for every header to be removed.
routesConfig[0].metadata.svcName	The following parameter configurable per route in route-metadata is used to track Overload Control data. If this parameter is not configured in route metadata then svc name from routesConfig[0].uri field is used as the required key to track Overload Control data.	The value of "svcName" attribute denotes the back-end service tag to be used as the required key (configurable per route) to track Overload Control data instead of using back-end service name from routesConfig[0].uri as the required key
routesConfig[0].metadata.serverHeaderDetails.enabled	Server header configuration if defined at Route level (irrespective of being enabled/disabled) will take precedence over the Global conf.	**Default Value:** Value to be updated accordingly
routesConfig[0].metadata.serverHeaderDetails.errorCodeSeriesId	If not defined here, value at Global level will be used as fallback. Value need to be one among "errorCodeSeriesList" resource defined.	**Default Value:** Value to be updated accordingly
routesConfig[0].metadata.requiredTime	If isSbiTimerEnabled is true then this is the minimum time required to process an incoming request. If the timeout falls below this then request will be rejected.	**Default Value:** Value to be updated accordingly

3.1.9 TLS 1.3 Parameters

The following table describes the parameters for TLS 1.3 feature:

Table 3-14 Parameters

Parameter Name	Description	Details
`clientDisabledExtension`	This is an optional parameter. Disables the extension sent by messages originated by clients (ClientHello).	**Data Type**: String **Range**: NA **Default Value**: ec_point_formats
`serverDisabledExtension`	This is an optional parameter. Disables the extension sent by messages originated by servers (ServerHello).	**Data Type**: String **Range**: NA **Default Value**: null
`tlsNamedGroups`	This is an optional parameter. Provides a list of values sent in the supported_groups extension. These are comma-separated values.	**Data Type**: String **Range**: NA **Default Value**: null
`clientSignatureSchemes`	This is an optional Parameter. Provides a list of values sent in the signature_algorithms extension. These are comma-separated values.	**Data Type**: String **Range**: NA **Default Value**: null
`service.ssl.tlsVersion`	This is a mandatory parameter. Indicates the TLS version.	**Data Type**: String **Range**: • TLSv1.2 , TLSv1.3 • TLSv1.2 • TLSv1.3 **Default Value**: TLSv1.2, TLSv1.3

`allowedCipherSuites`	This is an optional parameter.
	Indicates allowed Ciphers.
		Data Type: String
		Range: NA
		Default Values:
		`- TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384`
		`- TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384`
		`- TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256`
		`- TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256`
		`- TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256`
		`- TLS_AES_256_GCM_SHA384`
		`- TLS_AES_128_GCM_SHA256`
		`- TLS_CHACHA20_POLY1305_SHA256`

Table 3-14 (Cont.) Parameters

Parameter Name	Description	Details
`cipherSuites`	This is an optional parameter. Indicates supported cipher suites.	**Data Type**: String **Range**: NA **Default Values**: - `TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384` - `TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384` - `TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256` - `TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256` - `TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256` - `TLS_AES_256_GCM_SHA384` - `TLS_AES_128_GCM_SHA256` - `TLS_CHACHA20_POLY1305_SHA256`
`messageCopy.security.tlsVersion`	This is a conditional parameter. Indicates the TLS version for establishing communication between Kafka and NF when security is enabled.	**Data Type**: String **Range**: • TLSv1.3 • TLSv1.2 **Default Value**: TLSv1.3

4
Upgrading OCNWDAF

This section provides information on how to upgrade an existing OCNWDAF deployment. The section describes the preupgrade tasks, supported upgrade paths, and the upgrade procedure.

> **Note**
>
> If the environment has cnDBTier 23.2.0 installation, follow the instruction below:
>
> - If cnDBTier 23.2.0 release is installed, set the *ndb_allow_copying_alter_table* parameter to 'ON' in the cnDBTier custom values *dbtier_23.2.0_custom_values_23.2.0.yaml* file and perform cnDBTier upgrade before install, upgrade, or any fault recovery procedure is performed for OCNWDAF. Set the parameter to its default value, 'OFF' once the activity is completed and perform the cnDBTier upgrade to apply the parameter changes.
> - To perform cnDBTier upgrade, see *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*.

4.1 Supported Upgrade Paths

The following table lists the supported upgrade paths for OCNWDAF:

Table 4-1 Supported Upgrade Paths

Source Release	Target Release
24.1.0.0.0, 24.2.0	24.2.2

4.2 Preupgrade Tasks

Before starting the procedure to upgrade OCNWDAF, perform the following tasks:

> **Note**
>
> While performing an upgrade, you must align the *values.yaml* file of the target release as per the *helm-chart/values.yaml* file of the source release or the older release. Do not enable any new feature during the upgrade. The parent or sub-charts values.yaml must not be changed while performing the upgrade, unless it is explicitly specified in this document.

1. If previous installation was done with CNDB root user configuration, create a new user with root privileges.
2. Follow the procedure Creating an Admin User in the Database and replace the Cndb values in the secrets section of the *values.yaml* file, see Installing OCNWDAF Package.

Run the commands as displayed in the example below to create the version schema for the previous release:

```
DROP DATABASE IF EXISTS version_schema;
CREATE DATABASE IF NOT EXISTS version_schema CHARACTER SET utf8;
CREATE TABLE IF NOT EXISTS version_schema.VERSION_INFO(version_id int,
service_name varchar(255), version varchar(255), updated_on datetime(6) ,
PRIMARY KEY (version_id));
INSERT INTO VERSION_INFO(version_id, service_name, version, updated_on)
VALUES(1, 'NWDAF', '24.1.0', current_timestamp());

CREATE DATABASE IF NOT EXISTS `af`;
USE `af`;
    drop table if exists `af_event_subscription`;
    CREATE TABLE af_event_subscription (
      subscription_id varchar(36) NOT NULL,
      subscription json DEFAULT NULL,
      PRIMARY KEY (subscription_id)
    );
```

Run the above command with the new user created in Cndb and with the root user in InnoDB.

For example:

```
kubectl -n nwdaf-deploy exec -it service/nwdaf-mysql-innodb-cluster --
mysql --user=root --host=nwdaf-mysql-innodb-cluster --password=password
```

3. During the upgrade process, ensure that the IP Family configuration in the target release matches with the IP configuration in the source release. Changing the IP Family while performing upgrade is not supported.
4. To support future upgrade or rollback, enable the *nwdaf-cap4c-backuprestore* chart in the *values.yaml* file. This ensures a backup is available in case future upgrade or rollback fails.

> **Note**
>
> In the current release only upgrade is supported.

4.3 Upgrade Tasks

Perform this procedure to upgrade OCNWDAF.

Upgrade Order

Ensure you follow the upgrade order listed below:

1. Uninstall NWDAF simulator for the completion of the retention period.
2. Upgrade source NFs (DD, SCP, and so on).

> **Note**
>
> Upgrade to a new release succeeds if compatibility is maintained. See "Compatibility Matrix" in the Oracle Communications Network Analytics Suite Release Notes.

3. Ensure that no OCNWDAF pod is in the failed state.
4. Perform all the Preupgrade Tasks.
5. Upgrade the OCNWDAF.

> **Note**
>
> No configuration should be performed during upgrade.

6. Install the simulators (When the deployment does not have the OCNADD as a data source).

Helm Upgrade

Upgrading an existing deployment replaces the running containers and pods with target release containers and pods. If there is no change in the pod configuration, then it is not replaced. Unless there is a change in the service configuration of a microservice, the service endpoints remain unchanged.

Run the following command to perform a Helm Upgrade within the current release (24.2.0 to 24.2.x):

```
helm upgrade <installation name> <path to the chart directory> -
n $K8_NAMESPACE --timeout <timeout>m --values <path to custom values file> --
no-hooks
```

For example:

```
helm upgrade nwdaf helmChart/ -n ocnwdaf-ns --timeout 30m --values custom-
templates/ocnwdaf_custom_values.yaml --no-hooks
```

Run the following command to perform an upgrade from the previous release (24.1.0 to 24.2.0):

```
helm upgrade <installation name> <path to the chart directory> -
n $K8_NAMESPACE --timeout <timeout>m --values <path to custom values file>
```

For example:

```
helm upgrade nwdaf helmChart/ -n ocnwdaf-ns --timeout 30m --values custom-
templates/ocnwdaf_custom_values.yaml
```

5
Uninstalling OCNWDAF

To perform an automated uninstall, run the following command:

```
helm uninstall <installation name> -n $K8_NAMESPACE
```

This command removes all the resources including the PVCs.

Sample Output:

```
[cloud-user@occne224-cluster-bastion-1 ]$ helm uninstall nwdaf -
n $K8_NAMESPACE
W0404 05:04:57.056877 3860334 warnings.go:70] autoscaling/v2beta2
HorizontalPodAutoscaler is deprecated in v1.23+, unavailable     in v1.26+;
use autoscaling/v2 HorizontalPodAutoscaler
W0404 05:04:57.065008 3860334 warnings.go:70] autoscaling/v2beta2
HorizontalPodAutoscaler is deprecated in v1.23+, unavailable     in v1.26+;
use autoscaling/v2 HorizontalPodAutoscaler
release "nwdaf" uninstalled
```

To verify if the uninstallation procedure is successful, see Verify Uninstallation.

To perform a manual uninstall, run the following commands:

```
helm uninstall <installation name> -n <namespace> --no-hooks
```

```
kubectl delete statefulset.apps/nwdaf-mysql-innodb-cluster deployment.apps/
nwdaf-mysql-innodb-cluster-router service/nwdaf-mysql-innodb-cluster
innodbcluster/nwdaf-mysql-innodb-cluster  --ignore-not-found -n <namespace>
```

```
kubectl delete all --all -n $K8_NAMESPACE && kubectl delete secret --all -
n $K8_NAMESPACE
```

> ⚠ **Caution**
>
> The `kubectl delete` command deletes all the Kubernetes objects of the specified namespace.

For troubleshooting procedures, see, *Oracle Communications Networks Data Analytics Function Troubleshooting Guide*.

5.1 Verify Uninstallation

To verify the OCNWDAF uninstallation, run the following command:

```
$ kubectl get all -n <release-namespace>
```

In case of successful uninstallation, no OCNWDAF resources are displayed in the command output.

Sample Output:

```
[cloud-user@occne224-cluster-bastion-1 ~]$ kubectl get all -n $K8_NAMESPACE
No resources found in nwdaf-test namespace.
```

6
Fault Recovery

This chapter explains how to perform fault recovery for OCNWDAF deployment.

6.1 Introduction

This section describes the procedures to perform fault recovery for Oracle Communications Networks Data Analytics Function (OCNWDAF) deployment. The OCNWDAF operators can take database backup and restore it either on the same or a different cluster. The OCNWDAF stores data in the following storage's:

- MySQL NDB Cluster
- Apache Kafka

> **Note**
>
> This section describes the recovery procedures to restore OCNWDAF databases only. To restore all the databases that are part of cnDBTier, see *Oracle Communications Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*.

> **Note**
>
> You must take database backup and restore it either on the same or a different cluster. It uses the OCNWDAF database to run any command or follow instructions.

6.2 Fault Recovery Impact

This section provides an overview of Fault recovery scenarios and the impacted areas.

The following table provides information about the impacted areas during Oracle Communications Network data Analytics Function Fault recovery:

Table 6-1 Fault Recovery Impacted Area

Scenario	Requires Fault Recovery or re-install of Kafka?	Requires Fault Recovery or re-install of MySQL?	Other
Deployment Failure	No	No	Uninstall and re-install Helm.
cnDBTier Corruption	Yes	Yes	Restore MySQL from backup and ensure it is not re-installed.
When cnDBTier failed in a Single Site	No	Yes	Restore MySQL from backup and ensure it is not re-installed.

Table 6-1 (Cont.) Fault Recovery Impacted Area

Scenario	Requires Fault Recovery or re-install of Kafka?	Requires Fault Recovery or re-install of MySQL?	Other
Configuration Database Corruption	No	Yes	Backup and restore of configuration database is required.
Site Failure	No	No	Uninstall and re-install Helm.

6.3 Prerequisites

Ensure that the following prerequisites are met before performing the fault recovery procedures:

- Ensure that cnDBTier is in a healthy state and available. Run the following command to check the status of cnDBTier service:

  ```
  kubectl -n <namespace> exec <management node pod> -- ndb_mgm -e show
  ```

- Enable the automatic backup on cnDBTier by scheduling regular backups. The regular backups help in fault recovery with the following tasks:
  - Restore stable version of the network function databases
  - Minimize significant loss of data due to upgrades or roll back failures
  - Minimize loss of data due to system failure
  - Minimize loss of data due to data corruption or deletion due to external input
  - Migrate network function database information from one site to another
  - Docker images used during the previous installation or upgrade must be retained in the external data source

6.4 Fault Recovery Scenarios

This chapter describes the fault recovery procedures for various scenarios.

6.4.1 Deployment Failure

This scenario describes how to recover OCNWDAF when the deployment corrupts.

To recover OCNWDAF:

1. Run the following command to uninstall OCNWDAF:

   ```
   helm uninstall <release_name> --namespace <namespace>

   Example:
   helm uninstall oc-nwdaf --namespace oc-nwdaf
   ```

For more information about uninstalling OCNWDAF, see the **Uninstalling OCNWDAF** chapter in *Oracle Communication Networks Data Analytics Function Installation and Fault Recovery Guide.*

2. Install OCNWDAF as described in the **Installing OCNWDAF** chapter in *Oracle Communication Networks Data Analytics Function Installation and Fault Recovery Guide.* Use the back up of custom values file to reinstall the OCNWDAF.

Restore OCNWDAF, cnDBTier, and OCNWDAF database (DB) as described in Restoring OCNWDAF and cnDBTier.

6.4.2 cnDBTier Corruption

This section describes how to recover database when the data replication is broken due to database corruption and cnDBTier has failed in single site.

When the database corrupts, the database on all the other sites may also corrupt due to data replication. It depends on the replication status after the corruption has occurred. If the data replication is broken due to database corruption, then cnDBTier fails in either single or multiple sites (not all sites). And if the data replication is successful, then database corruption replicates to all the cnDBTier sites and cnDBTier fails in all sites.

If corrupted database replicated to mated sites, refer to the procedure When cnDBTier failed in a Single Site.

6.4.3 When cnDBTier failed in a Single Site

This section describes how to recover database when the data replication is broken due to database corruption and cnDBTier has failed in a single site.

To recover database:

1. Uninstall OCNWDAF helm chart. For information about uninstalling OCNWDAF, see the section **Uninstalling OCNWDAF** .
2. For cnDBTier fault recovery:
   a. Create on-demand backup from mated site that has health replication with failed site. For more information about cnDBTier backup, see the **Create On-demand Database Backup** chapter in the *Oracle Communications Cloud Native Core cnDBTier, Installation, Upgrade, and Fault Recovery Guide.*
   b. Use the backup data from mate site for restore. For more information about cnDBTier restore, see the **Restore Georeplication Failure** chapter in *Oracle Communications Cloud Native Core cnDBTier, Installation, Upgrade, and Fault Recovery Guide.*
3. Install OCNWDAF Helm chart. For more information about installing OCNWDAF, see the section **Installing OCNWDAF**.

6.4.4 Configuration Database Corruption

This scenario describes how to recover OCNWDAF when its configuration database corrupts.

The configuration database is stored in a site exclusive database along with its tables. Thus, corruption of configuration database impacts only a particular site.

To recover OCNWDAF configuration database, user has to restore the DB backup.

1. Transfer the *<backup_ filename >.sql.gz* file to the SQL node where user want to restore it.

2. Log into MySQL NDB Cluster's SQL node on the new DB cluster and create a new database where the database needs to be restored.
3. For details on creating database, user and adding permissions, see **Configuring Database, Creating Users, and Granting Permissions** section in the **Preinstallation** Chapter in *Oracle Communications Networks Data Analytics Function Installation Guide*.

> **Note**
>
> The database name created in the above step should be same as the database name created in the following step.

4. To restore the database to the new database created use the following command:

```
gunzip < <backup_filename>.sql.gz | mysql -h127.0.0.1 –u <username> -p
<backup-database-name>
```

Enter the password when prompted.

Example:

```
gunzip < OCNWDAFdbBackup.sql.gz | mysql -h127.0.0.1 -u dbuser -p OCNWDAFdb
```

6.4.5 Site Failure

This section describes how to perform fault recovery when the site has a software failure.

It is assumed that the user has cnDBTier and OCNWDAFinstalled on multiple sites with automatic data replication and backup enabled.

To recover the failed sites:

1. Run the Cloud Native Environment (CNE) installation procedure to install a new cluster. For more information, see *Oracle Communications Cloud Native Core, Cloud Native Environment (CNE) Installation Guide, Upgrade, and Fault Recovery Guide*.
2. For cnDBTier fault recovery:
   a. Take on-demand backup from the mate site that has health replication with the failed site or sites. For more information about on-demand backup, see the **Create On-demand Database** Backup chapter in the *Oracle Communications Cloud Native Core, cnDBTier Installation Guide, Upgrade, and Fault Recovery Guide.*
   b. Use the backup data from the mate site to restore the database. For more information about database restore, see the **Restore Georeplication Failure chapter** in the *Oracle Communications Cloud Native Core, cnDBTier Installation Guide, Upgrade, and Fault Recovery Guide.*
3. Install OCNWDAF Helm chart. For more information about installing OCNWDAF, see the **Installing OCNWDAF** section.

6.4.6 Kafka Issues

Kafka related issues (and solution) are described in the following sections.

Scenario 1

OCNWDAFmicroservices need to consume Kafka messages again from the beginning. This scenario can occur if any of the OCNWDAF microservices stopped consuming messages or failed to process them correctly. For example, when a DB downtime occurs, none of the messages consumed by the microservices will be processed correctly and we need to "retry" them.

Current Kafka configuration in OCNWDAFis based on transactions. Restart the microservice that needs to consume such messages and the messages from the last offset in Kafka are consumed. After restarting the service, the messages backlog is not consumed, change the microservice configuration stored in the Spring Cloud Configuration.

Solution

1. Ensure the microservice consumer configuration is `auto-offset-reset: earliest`. This will process the topic partition at the earliest offset (current setup value).
2. Redeploy the microservice.

Scenario 2

OCNWDAF microservices must ignore all messages in Kafka. This scenario can occur when the data sources like AMF, SMF, UDM, and so on are generating wrong data and overloading OCNWDAF.

Solution 1

Delete all messages in the topic, follow the steps below:

- Delete and recreate the topic.

OR

- Update the retention Kafka retention policy
  1. Stop the consumer microservice.
  2. Check the current retention policy, run the command:

     ```
     kafka-configs --zookeeper <zkhost>:2181 --describe --entity-type topics
     --entity-name <topic name>
     ```

  3. Update the retention policy in Kafka to a very low value (for example,1 min per instance):

     ```
     kafka-configs.sh --zookeeper <zkhost>:2181 --entity-type topics --alter
     --entity-name <topic name> --add-config retention.ms=60000
     ```

  4. Wait for Kafka service to delete the messages.
  5. Set the retention policy value.
  6. Redeploy the microservice.

Solution 2

Follow the procedure below, to retain the wrong messages and allow the Kafka service to delete the messages according to the retention policy.

1. Change Kafka consumer configuration to `auto-offset-reset: latest`. This will process the messages from the latest partition offset.

2. Redeploy the microservice.

6.4.7 Microservice Deployment Issue

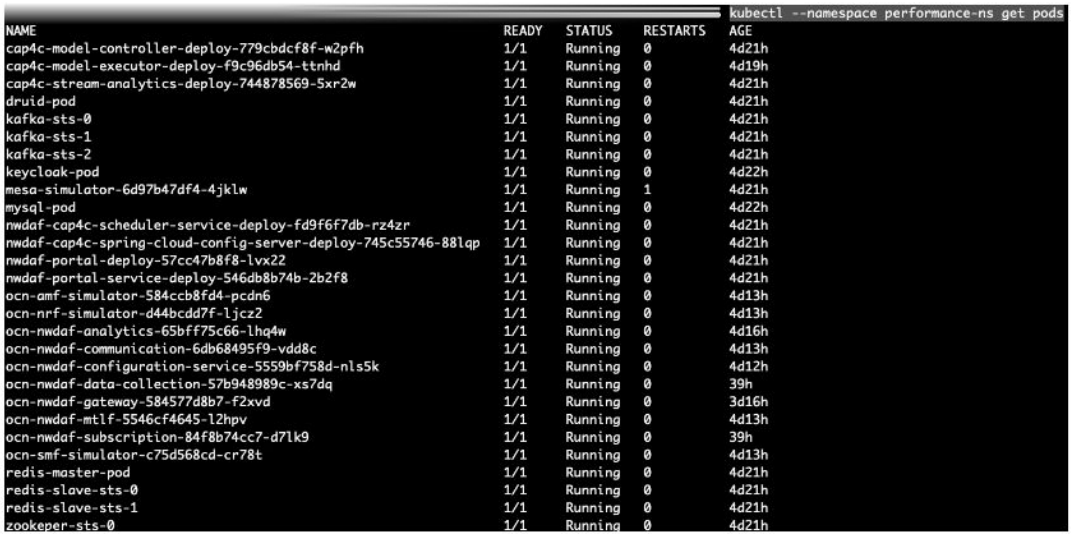
Follow the procedure below to resolve microservice deployment issue:

1. Run the following command to obtain information on the pods deployed and their status:

   ```
   kubectl --namespace [namespace name] get pods --sort-
   by='.status.containerStatuses[0].restartCount'
   ```

   Sample Output:

   Figure 6-1 Sample Output



```
kubectl --namespace performance-ns get pods
NAME                                                  READY   STATUS    RESTARTS   AGE
cap4c-model-controller-deploy-779cbdcf8f-w2pfh        1/1     Running   0          4d21h
cap4c-model-executor-deploy-f9c96db54-ttnhd           1/1     Running   0          4d19h
cap4c-stream-analytics-deploy-744878569-5xr2w         1/1     Running   0          4d21h
druid-pod                                             1/1     Running   0          4d21h
kafka-sts-0                                           1/1     Running   0          4d21h
kafka-sts-1                                           1/1     Running   0          4d21h
kafka-sts-2                                           1/1     Running   0          4d21h
keycloak-pod                                          1/1     Running   0          4d22h
mesa-simulator-6d97b47df4-4jklw                       1/1     Running   1          4d21h
mysql-pod                                             1/1     Running   0          4d22h
nwdaf-cap4c-scheduler-service-deploy-fd9f6f7db-rz4zr  1/1     Running   0          4d21h
nwdaf-cap4c-spring-cloud-config-server-deploy-745c55746-88lqp  1/1     Running   0          4d21h
nwdaf-portal-deploy-57cc47b8f8-lvx22                  1/1     Running   0          4d21h
nwdaf-portal-service-deploy-546db8b74b-2b2f8          1/1     Running   0          4d21h
ocn-amf-simulator-584ccb8fd4-pcdn6                    1/1     Running   0          4d13h
ocn-nrf-simulator-d44bcdd7f-ljcz2                     1/1     Running   0          4d13h
ocn-nwdaf-analytics-65bff75c66-lhq4w                  1/1     Running   0          4d16h
ocn-nwdaf-communication-6db68495f9-vdd8c              1/1     Running   0          4d13h
ocn-nwdaf-configuration-service-5559bf758d-nls5k      1/1     Running   0          4d12h
ocn-nwdaf-data-collection-57b948989c-xs7dq            1/1     Running   0          39h
ocn-nwdaf-gateway-584577d8b7-f2xvd                    1/1     Running   0          3d16h
ocn-nwdaf-mtlf-5546cf4645-l2hpv                       1/1     Running   0          4d13h
ocn-nwdaf-subscription-84f8b74cc7-d7lk9               1/1     Running   0          39h
ocn-smf-simulator-c75d568cd-cr78t                     1/1     Running   0          4d13h
redis-master-pod                                      1/1     Running   0          4d21h
redis-slave-sts-0                                     1/1     Running   0          4d21h
redis-slave-sts-1                                     1/1     Running   0          4d21h
zookeper-sts-0                                        1/1     Running   0          4d21h
```

2. Observe the **Restarts** column, the ideal value is "0", indicating the pods have not re-started. If the column **Status** is not **Running** and the value of the **Restarts** is constantly increasing implies an underlying problem with the microservice or any dependency.
3. Refer to the *Oracle Communications Networks Data Analytics Function Troubleshooting Guide* to resolve the issue.
4. If required, re-deploy the microservice.

In a Kubernetes setup, at least one pod of each microservice must be deployed so, if the problem root cause is due to a dependency, re-deploying the microservice is not required. It is sufficient to fix the dependency and wait for Kubernetes to retry the deployment.

If there are any changes in the Spring Cloud Config properties of the microservice, refreshing the property through its actuator with a POST request to `http://{host}:{port}/actuator/refresh`. If the issue is not resolved (not all properties support online refresh), redeploy the microservice.

6.5 Backup and Restore

This chapter describes the Backup and Restore procedures.

6.5.1 OCNWDAF Database Backup and Restore

Introduction

Perform this procedure to take a backup of the OCNWDAF database (DB) and restore the database on a different cluster. This procedure is for on-demand backup and restore of OCNWDAF DB. The commands used for these procedures are provided by the MYSQL Network Database(NDB) cluster.

Prerequisite

Ensure that the MYSQL NDB cluster is in a healthy state, and each of its database node is in running state. Run the following command to check the status of cnDBTier service:

```
kubectl -n <namespace> exec <management node pod> -- ndb_mgm -e show
```

Where,

- `<namespace>` is the namespace where cnDBTier is deployed
- `<management node pod>` is the management node pod of cnDBTier

Example:

```
[cloud-user@vcne2-bastion-1 ~]$ kubectl -n nwdafsvc exec ndbmgmd-0 -- ndb_mgm
-e show
Connected to Management Server at: localhost:1186
Cluster Configuration
---------------------
[ndbd(NDB)]     2 node(s)
id=1    @10.233.86.202  (mysql-8.0.22 ndb-8.0.22, Nodegroup: 0, *)
id=2    @10.233.81.144  (mysql-8.0.22 ndb-8.0.22, Nodegroup: 0)

[ndb_mgmd(MGM)] 2 node(s)
id=49   @10.233.81.154  (mysql-8.0.22 ndb-8.0.22)
id=50   @10.233.86.2  (mysql-8.0.22 ndb-8.0.22)

[mysqld(API)]   2 node(s)
id=56   @10.233.81.164  (mysql-8.0.22 ndb-8.0.22)
id=57   @10.233.96.39  (mysql-8.0.22 ndb-8.0.22)

[cloud-user@vcne2-bastion-1 ~]$
```

OCNWDAF DB Backup

If the OCNWDAF database backup is required, do the following:

1. Log in to any of the SQL node or API node, and then run the following command to take dump of the database:

   ```
   kubectl exec -it <sql node> -n <namespace> bash
   mysqldump --quick -h127.0.0.1 –u <username> -p  <databasename>| gzip >
   <backup_filename>.sql.gz
   ```

   Where,

- <sql node> is the SQL node of cnDBTier
- <namespace> is the namespace where cnDBTier is deployed
- <username> is the database username
- <databasename> is the name of the database that has to be backed up
- <backup_filename> is the name of the backup dump file

2. Enter the OCNWDAF database name and password in the command when prompted. Example:

```
kubectl exec -it ndbmysqld-0 -n nwdaf bash
mysqldump --quick -h127.0.0.1 -u dbuser -p nwdafdb | gzip >
NWDAFdbBackup.sql.gz
```

> **Note**
>
> Ensure that there is enough space on the directory to save the backup file.

OCNWDAF RESTORE

If OCNWDAF database restore is required, do the following:

1. Transfer the <backup_ filename>.sql.gz file to the SQL node where you want to restore it.
2. Log in to the SQL node of the MYSQL NDB cluster on the new DB cluster and create a new database where the database needs to be restored
3. To restore the database to the new database created, run the following command:

```
gunzip < <backup_filename>.sql.gz | mysql -h127.0.0.1 –u <username> -p
<databaseName >
```

Example:

```
gunzip < nwdafdbBackup.sql.gz | mysql -h127.0.0.1 -u dbuser -p newnwdafdb
```

4. Enter the password when prompted.

6.5.2 Restoring OCNWDAF and cnDBTier

Perform this procedure to restore OCNWDAF, cnDBTier, and OCNWDAF database (DB).

Prerequisites:

- Take a backup of the custom_values.yaml file that was used for installing OCNWDAF.
- Take a backup of the OCNWDAFdatabase and restore the database as described in Restoring OCNWDAF and cnDBTier Perform this task once every evening.

If OCNWDAF deployment is corrupted, do the following:

1. Run the following command to uninstall the corrupted OCNWDAF deployment:

```
helm uninstall <release_name> --namespace <namespace>
```

Where,

- <release_name> is a name used to track this installation instance.
- <namespace> is the release number.

Example:

```
helm uninstall ocnwdaf --namespace nwdafsvc
```

2. Install OCNWDAFusing the backed up copy of the custom_values.yaml file. For information about installing OCNWDAF using Helm, see Installation Tasks.

If cnDBTier and NF deployment is corrupted, do the following:

1. Install cnDBTier as described in *Oracle Communication Cloud Native Core, cnDBTier Installation, Upgrade, and Fault Recovery Guide*.
2. Restore OCNWDAFDB as described in Restoring OCNWDAF and cnDBTier
3. Install OCNWDAFusing the backed up copy of the custom_values.yaml file. For information about installing OCNWDAF, see Installation Tasks

If DB Secret or cnDBTier mysql FQDN or IP or PORT is changed, do the following:

1. In the backed up copy of the custom_values.yaml file, update these values: dbHost/dbPort/dbAppUserSecretName/dbPrivilegedUserSecretName.

```
# DB Connection Service IP Or Hostname with secret name.
  database:
    dbHost: "mysql-connectivity-service.nwdafsvc"
    dbPort: "3306"
    # K8s Secret containing Database/user/password for all services of
OCNWDAF interacting with DB.
    dbAppUserSecretName: "seppuser-secret"
    # K8s Secret containing Database/user/password for DB Hooks for
creating tables
    dbPrivilegedUserSecretName: "nwdafprivilegeduser-secret"
```

2. Run the following Helm upgrade command to update the secrets for OCNWDAF control plane microservices, such as configuration, subscription, audit, and notification, to connect to the DB with changed DB Secret or DB FQDN, IP, or Port:

```
helm upgrade <release name> -f <custom_values.yaml> --namespace
<namespace> <helm-repo>/chart_name --version <helm_version>
```

Example:

```
helm upgrade ocnwdaf -f /home/cloud-user/1.12/values.yaml /home/cloud-user/
1.11.0/ocnwdaf --namespace nwdafsvc
```

6.5.3 Kafka Backup and Restore

Follow the backup procedures described below:

- Backup Zookeeper State Data
- Backup Kafka Topics and Messages

Once the backup procedures are completed, follow the restore procedures:

- Restore Zookeeper State Data
- Restore Kafka Data and Messages

Finally, follow the procedure to Verify the Restoration.

Backup Zookeeper State Data

The Zookeeper stores its data in the directory specified by the `dataDir` field in the `~/kafka/config/zookeeper.properties` configuration file. Read the value of this field to determine the directory to backup. By default, `dataDir` points to the `/tmp/zookeeper` directory.

> **Note**
>
> If the `dataDir` points to some other directory in your installation, use that value instead of `/tmp/zookeeper` in the following commands.

1. Run the command `~/kafka/config/zookeeper.properties`.

   Sample output:

   ```
   # the directory where the snapshot is stored.
   dataDir=/tmp/zookeeper
   # the port at which the clients will connect
   clientPort=2181
   # disable the per-ip limit on the number of connections since this is a
   non-production config
   maxClientCnxns=0
   ```

2. Create a compressed archive file of the contents in the directory. Run the command:

   ```
   tar -czf /home/kafka/zookeeper-backup.tar.gz /tmp/zookeeper/*
   ```

3. Run the command `ls`, to verify if the `tar` file is created. The output will display the compressed file `zookeeper-backup.tar.gz`.
4. A backup of the Zookeeper State Data is successfully created.

Backup Kafka Topics and Messages

Kafka stores topics, messages, and internal files in the directory that the `log.dirs` field specifies in the `~/kafka/config/server.properties` configuration file. Read the value of this field to determine the directory to backup. By default, `log.dirs` points to the `/tmp/kafka-logs` directory.

> **Note**
>
> If the `log.dirs` points to some other directory in your installation, use that value instead of `/tmp/kafka-logs` in the following commands.

1. Run the command `~/kafka/config/server.properties`.

Sample output:

```
############################# Log Basics #############################

# A comma separated list of directories under which to store log files
log.dirs=/tmp/kafka-logs

# The default number of log partitions per topic. More partitions allow
greater
# parallelism for consumption, but this will also result in more files
across
# the brokers.
num.partitions=1

# The number of threads per data directory to be used for log recovery at
startup and flushing at shutdown.
# This value is recommended to be increased for installations with data
dirs located in RAID array.
num.recovery.threads.per.data.dir=1
```

2. Stop the Kafka service so that the data in the `log.dirs` is in a consistent state. Run `exit` to become a non-root user, then run the command:

   ```
   sudo systemctl stop kafka
   ```

3. Once the Kafka service is stopped, login as Kafka root user. Run the command:

   ```
   sudo -iu kafka
   ```

   > **Note**
   >
   > Always stop or start the Kafka and Zoo Keeper services as non-root sudo user, as in the Apache Kafka installation prerequisite the **kafka** user is restricted as a security precaution. This prerequisite disables sudo access for the **kafka** user, hence commands fail to execute.

4. Create a compressed archive file of the contents in the directory. Run the command:

   ```
   tar -czf /home/kafka/kafka-backup.tar.gz /tmp/kafka-logs/*
   ```

5. Run the command `ls`, to verify if the `tar` file is created. The output will display the compressed file `kafka-backup.tar.gz`.
6. Start the Kafka service, run `exit` to become a non-root user, then run the command:

   ```
   sudo systemctl start kafka
   ```

7. Once the Kafka service is started, login as Kafka root user. Run the command:

   ```
   sudo -iu kafka
   ```

8. A backup of the Kafka Data is successfully created.

Restore Zookeeper State Data

1. To prevent data directories from receiving invalid data during the restoration period, stop both Zookeeper and Kafka. Run the following commands:
   - Run `exit` to become a non-root user, then run the command:

     ```
     sudo systemctl stop kafka
     ```

   - Stop the Zookeeper service:

     ```
     sudo systemctl stop zookeeper
     ```

2. Login as Kafka root user. Run the command:

   ```
   sudo -iu kafka
   ```

3. Delete the existing cluster data directory, run the command:

   ```
   rm -r /tmp/zookeeper/*
   ```

4. Restore the backedup data, run the command:

   ```
   tar -C /tmp/zookeeper -xzf /home/kafka/zookeeper-backup.tar.gz --strip-components 2
   ```

   > **Note**
   >
   > The `-C` flag specifies the `tar` to change to the directory `/tmp/zookeeper` before extracting the data. Specifying `--strip 2` flag in the command ensures `tar` extracts the archive's contents in the directory `/tmp/zookeeper/` and not in any another directory (such as `/tmp/zookeeper/tmp/zookeeper/`) inside it.

5. Cluster state data is successfully restored.

Restore Kafka Data and Messages

1. Delete the existing Kafka directory, run the command:

   ```
   rm -r /tmp/kafka-logs/*
   ```

2. After directory deletion, the Kafka installation is similar to a fresh installation with no topics or messages present in it. Restore the backed up data, extract the files:

   ```
   tar -C /tmp/kafka-logs -xzf /home/kafka/kafka-backup.tar.gz --strip-components 2
   ```

   The `-C` flag specifies `tar` to change to the directory `/tmp/kafka-logs` before extracting the data. Specifying `--strip 2` flag ensures that the archive's contents are extracted in `/tmp/kafka-logs/` and not in another directory (such as `/tmp/kafka-logs/kafka-logs/`) inside it.

3. Run `exit` to become a non-root user, then run the command:

   ```
   sudo systemctl start kafka
   ```

   Start the Zookeeper service

   ```
   sudo systemctl start zookeeper
   ```

4. Login as Kafka root user. Run the command:

   ```
   sudo -iu kafka
   ```

5. Kafka data is successfully restored.

Verify the Restoration

1. Once Kafka is successfully running, run the following command to read the messages:

   ```
   ~/kafka/bin/kafka-console-consumer.sh --bootstrap-server localhost:9092 --
   topic <TopicName> --from-beginning
   ```

   > **Note**
   >
   > If Kafka has not started up properly, you might encounter the following warning:
   >
   > ```
   > Output
   > [2018-09-13 15:52:45,234] WARN [Consumer clientId=consumer-1,
   > groupId=console-consumer-87747] Connection to node -1 could not be
   > established. Broker may not be available.
   > (org.apache.kafka.clients.NetworkClient)
   > ```

   Always wait for Kafka to start fully before performing this step.

2. Retry the previous step if you encountered a warning, or run the following command (as non-root sudo user) to restart Kafka:

   ```
   sudo systemctl restart kafka
   ```

3. The following message is displayed if restoration is successful:

   ```
   Output
   <Topic Message>
   ```

   > **Note**
   >
   > If you do not see this message, check if you missed out procedure steps in the previous section and run them.

A successful verification implies, data has been backed up and restored correctly in a single Kafka installation.