Oracle® Communications

Network Analytics Suite Security Guide

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Oracle Communications Network Analytics Suite Security Guide, Release 24.3.0.0.1

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Contents

A Network Port Flows

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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
AF	Application Function
API	Application Programming Interface
AMF	Access and Mobility Management Function
CLI	Command Line Interface
CNC	Cloud Native Core
CNE	Oracle Communications Cloud Native Core, Cloud Native Environment
FQDN	Fully Qualified Domain Name
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
MPS	Messages Per Second
Network Slice	A logical network that provides specific network capabilities and network characteristics.
NEF	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
OHC	Oracle Help Center
OSDC	Oracle Service Delivery Cloud
PLMN	Public Land Mobile Network
REST	Representational State Transfer
SBA	Service Based Architecture
SBI	Service Based Interface

Table (Cont.) Acronyms

Acronym	Description
SCP	Service Communication Proxy
SEPP	Security Edge Protection Proxy
SMF	Session Management Function
SNMP	Simple Network Management Protocol
SVC	Services
SUPI	Subscription Permanent Identifier
UDM	Unified Data Management
UE	User Equipment
URI	Uniform Resource Identifier

What's New in This Guide

This section lists the documentation updates for Network Analytics Suite release 24.3.x.

Release 24.3.0.0.1 - G12508-03, March 2025

- There are no updates to this document in this release.

Release 24.3.0 - G12508-02, February 2025

- Removed all the references of PCF as it is not supported in this release.

Release 24.3.0 - G12508-01, November 2024

OCNADD

- Updated OCNADD Overview with the details of "Storage Adapter" in "OCNADD Services" table.
- Updated the Context Diagram(s) for non-centralized deployment, centralized deployment, and two site redundancy.
- Updated the External Data Flows for "DF6: Direct Kafka Consumer Feed", "DF7: REST ", and "DF8: Data Export".
- Updated procedure for TLS Configuration.

1 Introduction

The Security Guide provides an overview of the security information applicable to the Oracle Communications Network Analytics Suite of products.

This document contains recommendations and step-by-step instructions to assist the customer in hardening the Network Analytics Suite system, it also provides a simplified trust model for the system.

1.1 References

The following references provide additional background on product operations and support:

- *Oracle Communications Networks Data Analytics Function User Guide*
- *Oracle Communications Networks Data Analytics Function Solutions Guide*
- *Oracle Communications Networks Data Analytics Function Troubleshooting Guide*
- *Oracle Communications Networks Data Analytics Function Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Network Analytics Data Director Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Network Analytics Data Director Troubleshooting Guide*
- *Oracle Communications Network Analytics Data Director User Guide*

2
Overview

2.1 OCNWDAF Overview

Deployment Environment

The OCNWDAF can be deployed in a variety of possible configurations and environments:

Table 2-1 Deployment Environment

Type	Host	CNE	Description
Cloud	Customer Cloud	CNE	The CNE is deployed on the cloud provided by the customer. The OCNWDAF is deployed on the Kubernetes cluster managed by CNE.

OCNWDAF 3GPP Standards

Table 2-2 OCNWDAF 3GPP Standards

Network Function	Abbreviation	Description	3GPP Standard
Networks Data Analytics Function	OCNWDAF	Assists in collecting and analyzing data in a 5G network.	• 3GPP TS 23.288 v17.9.0 • 3GPP TS 29.520 v17.8.0 • 3GPP TS 29.508 v17.5.0 • 3GPP TS 29.518 v17.5.0 • 3GPP TS 23.501 v17.5.0 • 3GPP TS 23.502 v17.4.0 • 3GPP TS 33.521 v17.1.0

2.2 OCNADD Overview

Deployment Environment

The OCNADD can be deployed in a variety of possible configurations and environments:

Table 2-3 Deployment Environment

Type	Host	CNE	Description
Cloud	Customer Cloud	OCCNE	The OCCNE is deployed on the cloud provided by the customer. The OCNADD is deployed on the Kubernetes cluster managed by OCCNE.

OCNADD Services

Table 2-4 OCNADD Services

Services	Descriptio
Admin Service	The Admin Service administers the Kafka Cluster and it provides an interface to create and delete a Consumer Adapter deployment.
Aggregation Service	The Aggregation Service collects and aggregates network traffic from multiple NFs (For example: SCP 1 and 2 and/or SEPP, NRF, 3rd party NF, and so on).
Alarm Service	The OCNADD Alarm service is used to store the alarms generated by other OCNADD services.
UI Router Service	The OCNADD UI Router service acts as an interface between the CNC Console and the OCNADD services.
Configuration Service	The Configuration Service is used by the OCNADD UI service to configure 3rd party message feed.
Consumer Adapter Service	The Consumer Adapter Service manages the third-party specific connection parameters and provide secure message transport towards the third-party consumer application.
Health Monitoring Service	The Health Monitoring Service monitors the health of each OCNADD service and provides alerts related to the overall health of the OCNADD.
Kafka Broker Service	The Kafka Broker Service stores the incoming network traffic from different NFs. It also stores the intermediate processed data from different microservices.
GUI service	The GUI service is used as an interface between the CNC Console and OCNADD that provides the user interface to configure the Data Feeds.
Filter service	The filter service filters the feed data as per configuration. The filtered feed is then used for preparing xDR reports or consumed by External Kafka Feeds.
Correlation service	The correlation service creates xDR reports for the feed data as per configuration. The xDR reports are then consumed by External Kafka Feeds.

Table 2-4 (Cont.) OCNADD Services

Services	Descriptio
Redundancy Agent	The Redundancy agent is responsible for syncing configurations and maintaining two-site redudancy between mated worker group pair.
Export Service	The export service is responsible for exporting the XDRs to the third party server using the secure file transfer service (SFTP) based on the export configuration.
Ingress Adapter	The ingress adapter service is responsible for providing an interface to ingest data into the OCNADD using REST from the non Oracle 5G NFs.
Storage Adapter	The service is responsible for storing the generated xDRs by the correlation service in the extended storage database.

3
Secure Development Practices

Given below are the practices followed for a secure development environment:

3.1 Vulnerability Handling

For details about the vulnerability handling, refer Oracle Critical Patch Update Program. The primary mechanism to backport fixes for security vulnerabilities in Oracle products is quarterly Critical Patch Update (CPU) program.

In general, the OCNWDAF and OCNADD Software is on a quarterly release cycle, with each release providing feature updates and fixes and updates to relevant third party software. These quarterly releases provide cumulative patch updates.

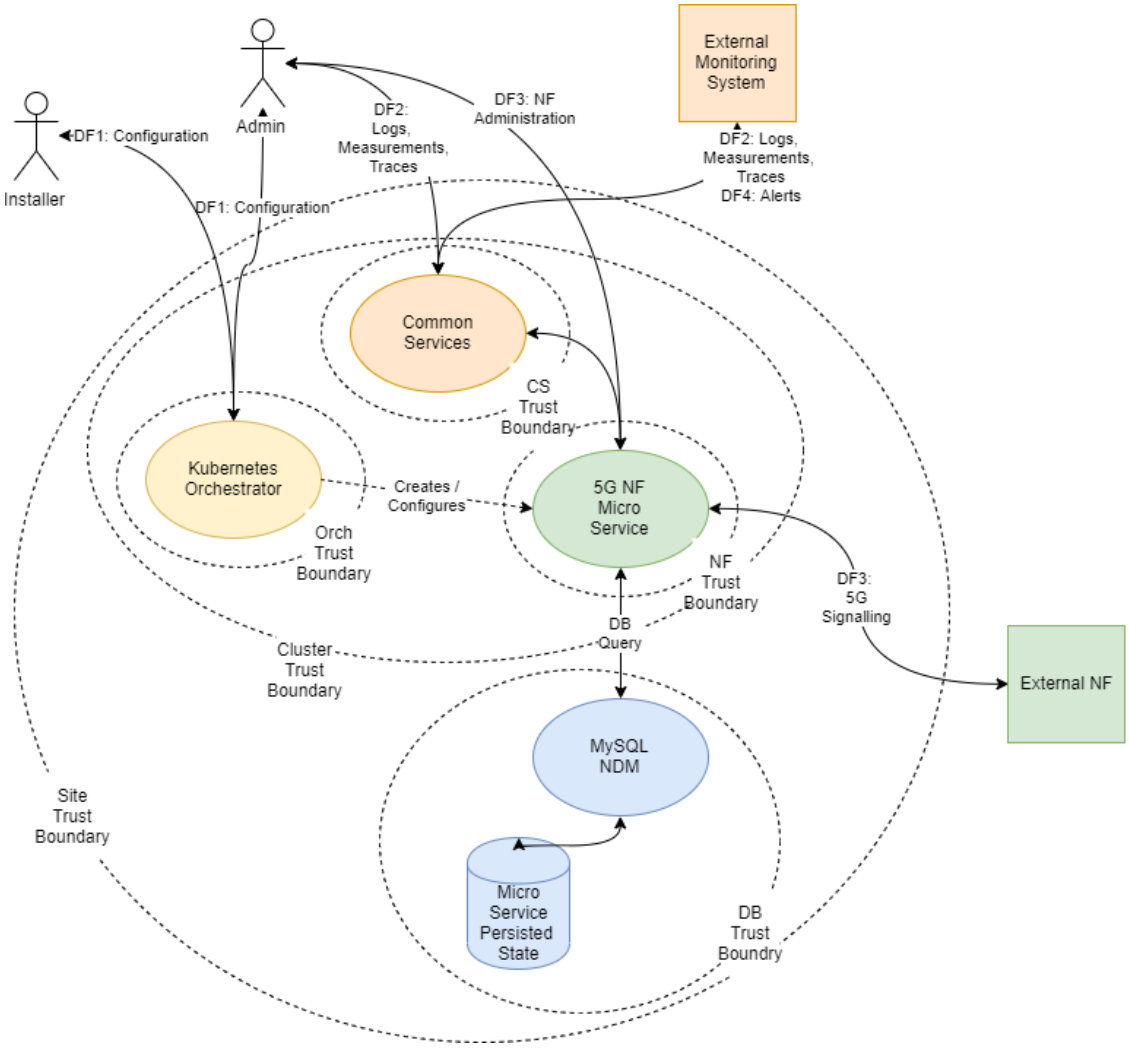
3.2 Trust Model for OCNWDAF

The following Trust Model depicts the reference trust model (regardless of the target environment). The model describes the critical access points and controls site deployment.

While the model shows a single 5G NF microservice deployed, several NFs are also deployed in individual clusters.

3.2.1 Context diagram

Figure 3-1 Context Diagram



3.2.2 Key Trust Boundaries

Following are the key trust boundaries:

Table 3-1 Key Trust Boundaries

Trust Boundary	Includes	Access Control
Site Trust Boundary	All the NFs and other supporting elements for a given site.	Cluster Access Policies are implemented using some kind of Access Control Group (or Security Group) mechanism.

Table 3-1 (Cont.) Key Trust Boundaries

Trust Boundary	Includes	Access Control
Cluster Trust Boundary	All the compute elements for a given cluster	Network Policies control Ingress and Egress traffic. Pod Security Policies manage the workloads allowed in the cluster (For example, no pods requiring privilege escalation).
DB Trust Boundary	All the cnDBTier elements for a given cluster	Firewall Policies control Ingress and Egress traffic. Database grants access and other permission mechanisms that provide authorization for users.
Orchestrator Trust Boundary (Orch Trust Boundary)	The orchestration interface and keys	Firewall Policies control the access to a Bastion server which provides orchestration services. Access to the Bastion host uses Secure Socket Shell (SSH) protocol. The cluster orchestration keys are stored on the Bastion host.
CS Trust Boundary	The common services implementing logging, tracing, and measurements.	Each of the common services provides independent Graphical User Interfaces (GUIs) that are currently open. The customer may want to introduce an api-gateway, implement authentication and authorization mechanisms to protect the OAM (Operations, Administrations, and Maintenance) data. The common services can be configured to use Transport Layer Security (TLS). When TLS is used, certificates must be generated and deployed through the orchestrator.
NF Trust Boundaries	A collection of 5G Network Functions deployed as a service.	Some 5G NF microservices provide OAM access through a GUI. 5G NF microservices provide Signaling access through a TLS protected HTTP2 interface. The certificates for these interfaces are managed via the certificate manager.

3.2.3 External Data Flows

The following are external data flows:

Table 3-2 External Data Flows

Data Flow	Protocol	Description
DF1: Configuration	SSH	The installer or administrator accesses the orchestration system hosted on the Bastion Server. The installer or administrator must use ssh keys to access the bastion to a special orchestration account (not root). Password access is not allowed.
DF2: Logs, Measurements, Traces	HTTP/HTTPS	The administrator or operator interacts with the common services using web interfaces.
DF3: 5G Signaling	HTTP2 (w/TLS)	All signaling interaction between NFs at a site and NFs at an external site is sent through TLS protected HTTP2.
DF4: Alerts	SNMP (Trap)	Alerting is performed using SNMP traps.

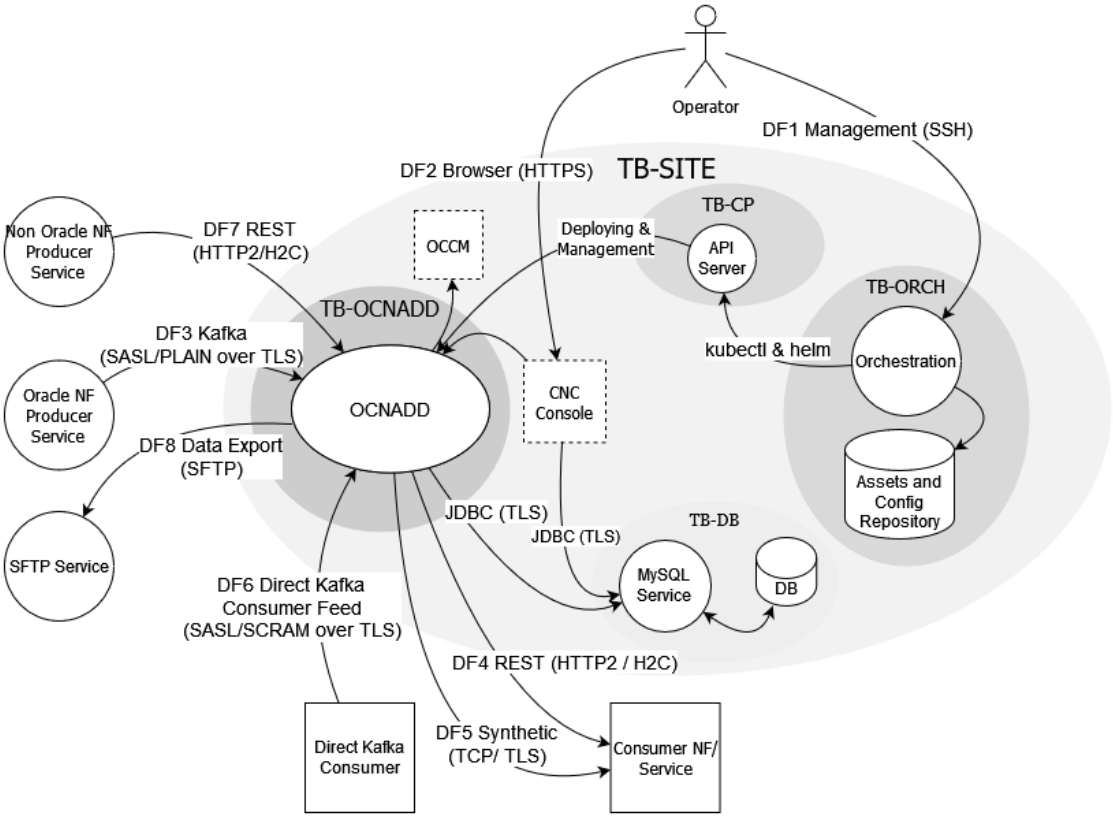
The complete list of network flows including service types and ports are available in Network Port Flows.

3.3 Trust Model for OCNADD

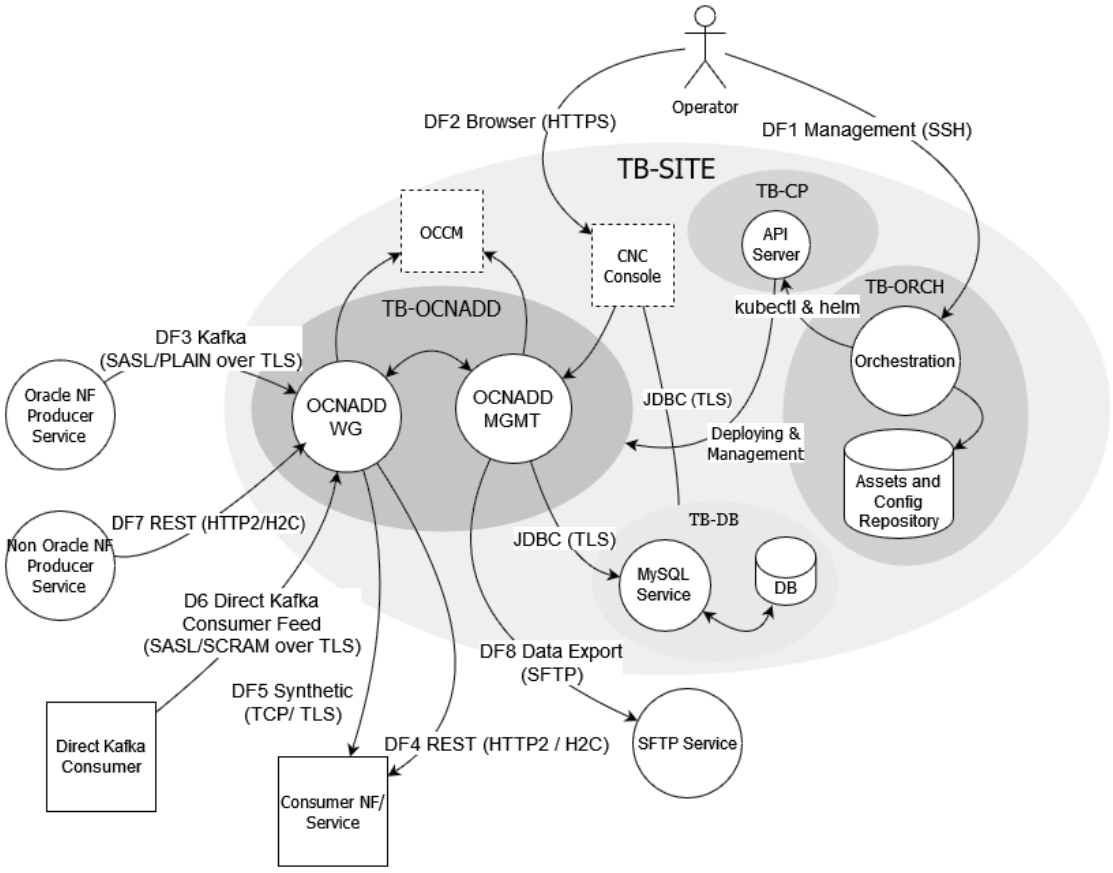
The following Trust Model depicts the reference trust model (regardless of the target environment). The model describes the critical access points and controls site deployment.

3.3.1 Context Diagram

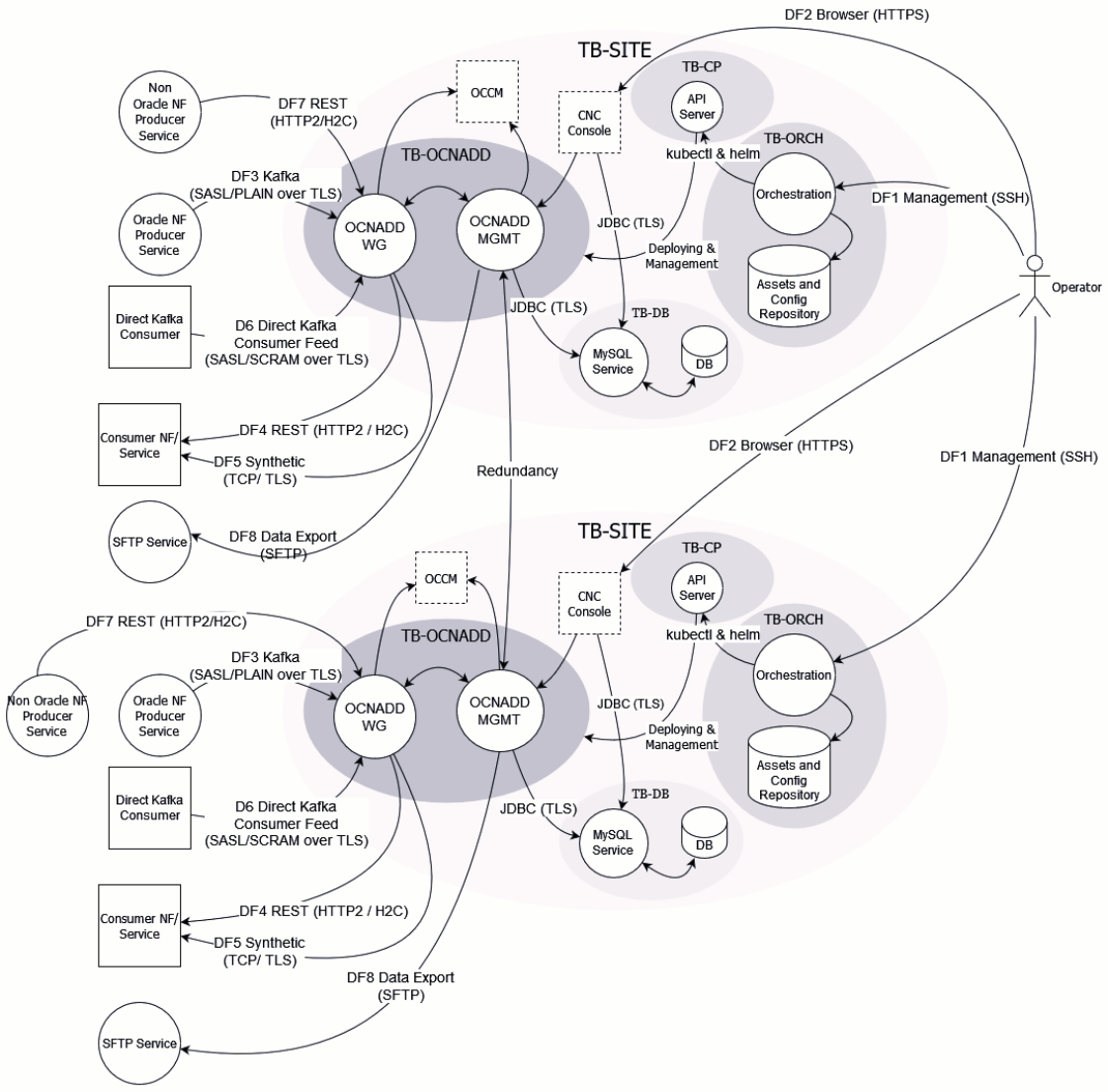
Non-Centralized Deployment



Centralized Deployment



Two-Site Redundancy



3.3.2 Key Trust Boundaries

Following are the key trust boundaries:

Table 3-3 Key Trust Boundaries

Trust Boundary	Access Control
OCNADD	Kubernetes Namespace for OCNADD where its internal micro-services are deployed.
Site	Where the Kubernetes cluster is deployed.
Control Plane	This trust boundary delineates the control plane elements of the clusters, that is, API Server, kubelet, containerd and etcd. The configuration database (ETCD service) is isolated so that only control plane services can access it.
Database	MySQL service deployed in a separate Kubernetes namespace.

Table 3-3 (Cont.) Key Trust Boundaries

Trust Boundary	Access Control
CNE Infra	Namespace containing all the infrastructure related services (like Prometheus). Provided by CNE.
Orchestration	Includes the orchestration server and the Code and Image Repository.

3.3.3 External Data Flows

The following table describes external data flows of OCNADD:

Table 3-4 External Data Flows

Data Flow	Protocol	Description
DF1: Management	SSH	Operator will login to the orchestration server through SSH for deploying OCNADD and/or managing the OCNADD Kubernetes deployment using helm.
DF2: Browser	HTTPS	Operator uses CNC Console to create, manage feed configuration and monitor OCNADD. CNC Console is accessed through the browser and the Operator is authenticated with username and password before access is granted.
DF3: Kafka	SASL_SSL	Oracle NFs write the 5G SBI data or messages into the Kafka exposed by OCNADD in the respective topics. OCNADD will then process according to the feed configurations. The communications are encrypted using TLS and Oracle NF will authenticate themselves to Kafka through SASL/PLAIN (username and password).
DF4: Consumer NF	HTTP2(w/TLS)	OCNADD forwards the message feed to respective consumer NF/s as HTTP2 (over TLS) or H2C (HTTP2 clear text) messages according to the feed configurations. The traffic segregation is provided using CNLB egress NAD support. The CNLB support has to be enabled in the helm charts for the egress traffic separation in the consumer adapter and corresponding feed configuration should be done. The CNLB route the packets using the layer3/layer4 information from the defined network attachment definition(NAD).

Table 3-4 (Cont.) External Data Flows

Data Flow	Protocol	Description
DF5: Consumer NF (Synthetic Packet)	TCP	OCNADD forwards the Synthetic Packet to respective consumer NF/s as TCP or TCP_SECURED messages based on the feed configuration.
DF6: Direct Kafka Consumer Feed	Kafka (SASL/SCRAM over TLS)	External Kafka consumer can read data directly from authorized Kafka topic. Consumers are authenticated using SASL/SCRAM (SCRAM-256 and/or SCRAM-512). All communications will be encrypted with TLS.
DF7: REST	HTTP2	Non Oracle NF forwards the messages to OCNAD ingress adapter service using HTTP2 (over TLS) or H2C (HTTP2 clear text) according to the ingress feed configuration. The traffic segregation is provided using CNLB ingress NAD support. The CNLB support has to be enabled in the helm charts for the ingress traffic separation in the ingress adapter and corresponding feed configuration should be done. The CNLB route the packets using the layer3/layer4 information from the defined network attachment definition (NAD).
DF8: Data Export	SFTP	OCNADD send the exported records to the external third party server using secure file transport service based on the data export configuration.

4

Implementing Security Recommendations and Guidelines

4.1 Implementing Security Recommendations and Guidelines for OCNWDAF

This section provides specific recommendations and guidelines for Oracle Communications Network Data Analytics Function (OCNWDAF) security.

4.1.1 Common Security Recommendations and Procedures

This section provides details of the common security recommendations and guidelines.

4.1.1.1 4G and 5G Application Authentication and Authorization

Cloud Native Core NFs support integration with platform service meshes and mTLS may be provided by the platform service mesh, thereby securing communication flows between all applications that participate in the platform service mesh. mTLS also encrypts the data flows so that only the endpoints of the mTLS session can access the contents of the communication data.

4G and 5G NFs use Mutual Transport Layer Security (mTLS) authentication to secure communication. All NFs require establishing a trust relationship with all peers by exchanging and trusting peer root or intermediate certificates. The peer certificates must be available in the truststore (K8s Secrets) to establish secure communication.

4G and 5G NFs also support manual importation and a semiautomatic import using the cert-manager external provider.

4.1.1.2 Configure TLS Version

You can configure the TLS version by updating the custom *values.yaml* file as follows:

```
ssl:
    # TLS verison used
    tlsVersion: TLSv1.2,TLSv1.3
```

You can provide both the TLS versions as comma separated values.

For more information, see *Oracle Communications Networks Data Analytics Function Installation, Upgrade, and Fault Recovery Guide*.

4.1.1.3 cnDBTier Authentication and Authorization

The cnDBTier provides a highly available multisite database used to store NF state and configuration. When installed, the MySQL DB is configured with a root account whose password is randomly generated. Each NF must have additional accounts for that particular NF. The procedures in this section explains how to change these account passwords. Additionally, communication between the NFs and the MySQL query nodes are protected using TLS.

Procedure: Modify MySQL NDB Root Password

This procedure is executed by the DB Administrator

For each of the MySQL Query nodes, perform the following steps :

Table 4-1 Modify MySQL NDB Root Password

Step	Description	Est Time
1.	Log into the next query node using ssh: `$ ssh admusr@<mysql query node>`	1m
2.	Execute the following command to make the node as root: `$ sudo su`	1m
3.	Invoke mysql using existing DB Root credentials: `# mysql -h 127.0.0.1 -uroot -p` Enter password: `<enter existing root password>`	1m
4.	Change the DB Root credentials: `mysql> ALTER USER'root'@'localhost'IDENTIFIED BY'<NEW_PASSWORD>';` `mysql> FLUSH PRIVILEGES;`	1m
5	Repeat steps 1 through 4 for each MySQL Query node.	

> **Note**
>
> If you are accessing a DB instance for the first time, the DB Root password is stored in the `/var/occnedb/mysqld_expired.log` file. (The system generates a random password at installation time).

> **Note**
>
> **Recommendation 1: Separation of Roles**
>
> The roles of DB Administrator and Cluster Administration must be kept separate. The DB Administrator must be responsible for securing and maintaining the cnDBTier MySQL NDM cluster. The Cluster Administrator must be responsible for securing and operating the Bastion Host and K8s Cluster. When 5G NFs are installed, the DB Administrator is required to create new NF database and NF DB accounts (using the DB Root credentials). Once this is completed, the Cluster Administrator installs the NF (using helm).
>
> **Recommendation 2: Use Strong Passwords**
>
> The DB Administrator must choose a complex DB Root password as per their organization's security. guidelines.

Procedure: Configure TLS for MySQL NDB Query Nodes

The MySQL NDB comes preconfigured to use a self-signed certificate that expires after 365 days. User can replace this certificate using the following procedure:

Table 4-2 Configure TLS for MySQL NDB Query Nodes

Step	Description	Est Time
1.	Create private CA and a set of Keys/Certificate pairs for use in securing MySQL : `$ my_ssl_rsa_setup`	1m
2.	The available set of PEM files containing CA, server, and client certificates and keys must be installed on all the MySQL Query Nodes.	
3.	Using SCP, copy the PEM files to the MySQL Query Node: `$ scp *.pem admusr@<mysql query node>`	1m
4.	Login to the MySQL Query Node using ssh: `$ ssh admusr@<mysql query node>`	1m

5	Create a directory to hold the TLS keys and certs, and move them into root:
	`$ sudo mkdir /var/occnedb/opensslcerts`
	`$ sudo chmod 700 /var/occnedb/opensslcerts`
	`$ sudo mv ~admusr/*pem /var/occnedb/opensslcerts`
		1m

6	Configure MySQL to use the new TLS certs and keys by executing the following command: `$ sudo vi /etc/my.cnf`
	Update the [mysqld] section as follows:
	`[mysqld]`
	`ssl-ca=/var/occnedb/opensslcerts/ca.pem`
	`ssl-cert=/var/occnedb/opensslcerts/server-cert.pem`
	`ssl-key=/var/occnedb/opensslcerts/server-key.pem`
	`tls_version=TLSv1.2`
	`ssl-cipher=DHE-RSA-AES128-GCM-SHA256`
		5m

7	Restart the mysql daemon: `$ sudo /etc/init.d/mysql.server restart`	1m
	Repeat steps 3 through 7 for each MySQL Query node.	

> **Note**
>
> It is possible to integrate into an existing Public Key Infrastructure (PKI) by creating signing requests and having the PKI to generate the needed key/certificate pairs.

4.1.1.4 Cloud Native Core Ingress and Egress Gateways Specific Security Recommendations and Guidelines

This section provides Ingress and Egress Gateways specific security recommendations and guidelines.

> **Note**
>
> The following procedures can be performed by any authenticated user who has privileged access to the system. This user can create different roles for specific operations. For creation of role and role binding, see the NF or component-specific Installation and Upgrade Guide.

The procedures are:

- **Enabling TLS and Ciphers in Ingress and Egress Gateway**
- **Certificate Management and Dynamic Reload of Certificates in Gateways**

Enabling TLS and Ciphers in Ingress and Egress Gateway

Use the following procedure to enable TLS and Ciphers:

1. Helm Configuration to enable TLS:
   To open HTTPS port in Ingress Gateway, set the `enableIncomingHttps` parameter to true.

   To configure the HTTPS client in Ingress Gateway, set the `enableOutgoingHttps` parameter to true.
2. Create the following files:
   a. RSA or ECDSA Private key (Example: `rsa_private_key_pkcs1.pem`)
   b. Truststore password (Example: `trust.txt`)
   c. Key store password (Example: `key.txt`)
   d. Certificate chain for truststore (Example: `caroot.cer`)
   e. Signed server certificate (Example: `ocingress.cer`) or Signed client certificate (Example: `ocegress.cer`)

   Note: Creation of private keys, certificates, and passwords is at the discretion of user.
3. Run the following command to create secret:

   ```
   $ kubectl create secret generic ocingress-secret --from-
   file=rsa_private_key_pkcs1.pem
   --from-file=trust.txt --from-file=key.txt --from-file=ocingress.cer --from-
   file=caroot.cer -n ocingress
   ```

4. Enable the cipher suites:
   - Cipher Suites to be enabled on Server side (Ingress Gateway).
   - Cipher Suites to be enabled on Client side (Egress Gateway).

Cipher Suites:

```
TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256
TLS_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
```

Certificate Management and Dynamic Reload of Certificates in Gateways

Whenever certificates get compromised or a new certificate chain is required to be added to the truststore, you can update the key and truststore used by the application.

To update the key and the truststore, update or replace the secret:

```
$ kubectl create secret generic ocingress-secret --from-
file=rsa_private_key_pkcs1.pem
 --from-file=trust.txt --from-file=key.txt --from-file=tmp.cer --from-
file=caroot.cer --dry-run -o yaml
 -n ocingress| kubectl replace -f - -n ocingress
```

Whenever there is an update in the certificate chain or signed certificate placed in secret, Kubernetes watcher implemented in update container checks for a change in file state and replaces the key and truststore accordingly in the mounted shared volume.

Dynamic reload of certificates is not supported in Ingress Gateway as of now, so a manual restart of pod is required when any update in the configuration is made with respect to https.

In case of Egress Gateway, update container will trigger the rest endpoint to reload key and truststore dynamically. Then Egress Gateway will pickup new store files from shared volume and reload trust and key managers. Egress Gateway will use the replaced store to establish new connections and gracefully terminate existing connections by sending a GOAWAY frame.

4.1.2 Oracle Communications Networks Data Analytics Function (OCNWDAF) Specific Security Recommendations and Guidelines

This section provides specific recommendations and guidelines for Oracle Communications Networks Data Analytics Function (OCNWDAF) security.

> **Note**
>
> The following procedures can be performed by any authenticated user who has privileged access to the system. This user can create different roles for specific operations. For creation of role and role binding, see the *Oracle Communications Networks Data Analytics Function Installation and Fault Recovery Guide*.

> **Note**
>
> kubectl commands might vary based on the platform deployment. Replace kubectl with Kubernetes environment-specific command line tool to configure Kubernetes resources through kube-api server. The instructions provided in this document are as per the Oracle Communications Cloud Native Environment (CNE) version of kube-api server.

> **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 the hyphens or any special characters are part of the copied content.

The procedures are:

- Oauth Token Validation Configuration
  - Rest Configuration
  - Public key Update for Changed Access Token
  - Disabling the Signature Validation for Oauth
- Create HTTPS Certificates
- Obtain List of Certificate Providers Allowed
- Configuring Kafka Security
- MySQL Configuration
- OCNWDAF Secret Configuration to Enable HTTPS

Oauth Token Validation Configuration

Use the following procedure for Oauth Token validation configuration:

1. NRF creates access tokens using following private keys:
   - **ECDSA private key**
     Example:

     ```
     ecdsa_private_key_pkcs8.pem
     ```

   - **RSA private key**
     Example:

     ```
     rsa_private_key_pkcs1.pem
     ```

     In order to validate access token secret needs to be created and configured in ocnwdaf ingress gateway with certificates fetched from nrf.

     Example:

     ```
     6faf1bbc-6e4a-4454-a507-a14ef8e1bc5c_ES256.crt
     ```

2. Log in to Bastion Host or server from where kubectl can be executed.
3. Create namespace for the secret.

```
$ kubectl create namespace ocnwdaf
```

4. Create Kubernetes secret for NF Access token validation

> **Note**
>
> The file names in below command are same as in Step 1.

```
$ kubectl create secret generic oauthsecret --from-file=6faf1bbc-6e4a-4454-
a507-a14ef8e1bc5c_ES256.crt-n ocnwdaf
```

5. Run the following command to verify if the secret is created successfully:

```
$ kubectl describe secret oauthsecret -n ocnwdaf
```

Rest Configuration

We need REST based configurations to distinguish certificates configured from different NRF and use them properly to validate token received from specific NRF. These configurations can be added from CNCC GUI which internally uses config API and payload as below:

```
“/nwdaf/nf-common-component/v1/igw/oauthvalidatorconfiguration”

Payload:

{
              "keyIdList": [{

                            "keyId": "664b344e74294c8fa5d2e7dfaaaba407",
                            "kSecretName": "samplesecret1",
                            "certName": "samplecert1.crt",
                            "certAlgorithm": "ES256"
                          }],
              "instanceIdList": [{

                            "instanceId": "664b344e74294c8fa5d2e7dfaaaba407",
                            "kSecretName": "samplesecret2",
                            "certName": "samplecert2.crt",
                            "certAlgorithm": "ES256"

                             }],
              "oAuthValidationMode": "INSTANCEID_ONLY"

}
```

The multiple **keyId** and **instanceId** object of different NRFs can be configured.

Using **oAuthValidationMode** mode of validation can be selected.

Example: INSTANCEID_ONLY, KID_ONLY or KID_PREFERRED

KID_PREFERRED is a fall back mode where it checks for keyId in token, if token contains keyId then validation mode is KID_ONLY or else it falls back to INSTANCEID_ONLY.

Public key Update for Changed Access Token

Use the following procedure for public key update for changed access token:

1. Log in to Bastion Host or server from where kubectl can be executed.
2. Update the secret with new or updated details:

```
# Delete the secret and recreate it
$ kubectl delete secret oauthsecret -n ocnwdaf

# Fetch updated certificates from nrf

# Recreate the secret with updated details
$ kubectl create secret generic oauthsecret --from-file=0263663c-
f5c2-4d1b-9170-f7b1a9116337_ES256.crt

-n ocudr
```

3. Certificate configuration update request needs to be sent using CNCC GUI with the updated **keyIdList** and **instanceIdList** with new certificates.

Disabling the Signature Validation for Oauth

If **serviceMeshCheck** flag is enabled under ingress gateway in custom-values file, signature validation is disabled by default.

In this case, only header and payload are validated, and request is successful even if token has wrong signature.

Create HTTPS Certificates

Access to the OCNWDAF subscription endpoint is enabled through the gateway service. To access the endpoint, use a HTTPS version 2 **POST** request.

Endpoint address: `<path>nnwdaf-eventssubscription/v1/subscriptions`

1. To configure HTTPS version 2, enable the property in the configuration file and generate a SSL certificate. Configure the property in the project using the `.properties` file. See below example:
   Example:

```
server.http2.enabled=true
server.ssl.enabled=true
server.ssl.key-store-type=PKCS12
server.ssl.key-store=classpath:localhost.p12
server.ssl.key-store-password=<password>
```

2. To create the certificate, run the following commands:

```
openssl req -x509 -out localhost.crt -keyout localhost.key \
-newkey rsa:2048 -nodes -sha256 \
-subj '/CN=localhost' -extensions EXT -config <( \
printf "[dn]\nCN=localhost\n[req]\ndistinguished_name = dn\n[EXT]
```

```
\nsubjectAltName=DNS:localhost\nkeyUsage=digitalSignature\nextendedKeyUsage
=serverAuth")
```

Two files are generated - a `.crt` file and a `.key` file.

3. Use openssl to create a PKCS truststore file that contains both the certificate and key, see below example:
   Example:

```
openssl pkcs12 -export -in localhost.crt -inkey localhost.key -name
localhost -out localhost.p12
```

4. Configure the properties, see below example:
   Example:

```
server.ssl.enabled=true
server.ssl.key-store-type=PKCS12
server.ssl.key-store=classpath:localhost.p12
server.ssl.key-store-password=<password>
```

Obtain List of Certificate Providers Allowed

The following command lists the SSL certificate providers allowed:

```
cd JAVA_HOME/jre/lib/security
keytool -list -keystore cacerts
```

SSL Providers allow `jdk version 17.0.2`.

- actalisauthenticationrootca
- affirmtrustcommercialca
- affirmtrustnetworkingca
- affirmtrustpremiumca
- affirmtrustpremiumeccca
- amazonrootca1
- amazonrootca2
- amazonrootca3
- amazonrootca4
- baltimorecybertrustca
- buypassclass2ca
- buypassclass3ca
- camerfirmachambersca
- camerfirmachamberscommerceca
- camerfirmachambersignca
- cert_100_emsign_root_ca___g1100
- cert_101_emsign_ecc_root_ca___g3101
- cert_102_emsign_root_ca___c1102

- cert_103_emsign_ecc_root_ca___c3103
- cert_104_hongkong_post_root_ca_3104
- cert_106_microsoft_ecc_root_certificate_authority_2017106
- cert_107_microsoft_rsa_root_certificate_authority_2017107
- cert_108_e_szigno_root_ca_2017108
- cert_109_certsign_root_ca_g2109
- cert_110_trustwave_global_certification_authority110
- cert_111_trustwave_global_ecc_p256_certification_authority111
- cert_112_trustwave_global_ecc_p384_certification_authority112
- cert_113_naver_global_root_certification_authority113
- cert_114_ac_raiz_fnmt_rcm_servidores_seguros114
- cert_115_globalsign_root_r46115
- cert_116_globalsign_root_e46116
- cert_117_globaltrust_2020117
- cert_118_anf_secure_server_root_ca118
- cert_119_certum_ec_384_ca119
- cert_120_certum_trusted_root_ca120
- cert_121_tuntrust_root_ca121
- cert_122_harica_tls_rsa_root_ca_2021122
- cert_123_harica_tls_ecc_root_ca_2021123
- cert_124_autoridad_de_certificacion_firmaprofesional_cif_a62634068124
- cert_125_vtrus_ecc_root_ca125
- cert_126_vtrus_root_ca126
- cert_127_isrg_root_x2127
- cert_128_hipki_root_ca___g1128
- cert_129_globalsign_ecc_root_ca___r4129
- cert_130_gts_root_r1130
- cert_131_gts_root_r2131
- cert_132_gts_root_r3132
- cert_18_secure_global_ca18
- cert_19_comodo_certification_authority19
- cert_20_network_solutions_certificate_authority20
- cert_22_certigna22
- cert_24_certsign_root_ca24
- cert_25_netlock_arany__class_gold__f__tan__s__tv__ny25
- cert_26_hongkong_post_root_ca_126
- cert_27_securesign_rootca1127
- cert_28_microsec_e_szigno_root_ca_200928

- cert_30_autoridad_de_certificacion_firmaprofesional_cif_a6263406830
- cert_31_izenpe_com31
- cert_40_twca_root_certification_authority40
- cert_42_ec_acc42
- cert_43_hellenic_academic_and_research_institutions_rootca_201143
- cert_50_ca_disig_root_r250
- cert_51_accvraiz151
- cert_52_twca_global_root_ca52
- cert_54_e_tugra_certification_authority54
- cert_56_atos_trustedroot_201156
- cert_69_staat_der_nederlanden_ev_root_ca69
- cert_74_cfca_ev_root74, Feb 22, 2022, trustedCertEntry
- cert_75_oiste_wisekey_global_root_gb_ca75
- cert_76_szafir_root_ca276
- cert_77_certum_trusted_network_ca_277
- cert_81_ac_raiz_fnmt_rcm81
- cert_86_tubitak_kamu_sm_ssl_kok_sertifikasi___surum_186
- cert_87_gdca_trustauth_r5_root87
- cert_88_trustcor_rootcert_ca_188
- cert_89_trustcor_rootcert_ca_289
- cert_90_trustcor_eca_190
- cert_94_ssl_com_ev_root_certification_authority_ecc94
- cert_96_oiste_wisekey_global_root_gc_ca96
- cert_97_uca_global_g2_root97
- cert_98_uca_extended_validation_root98
- cert_99_certigna_root_ca99
- certumca
- certumtrustednetworkca
- chunghwaepkirootca
- comodoaaaca
- comodoeccca
- comodorsaca
- digicertassuredidg2
- digicertassuredidg3
- digicertassuredidrootca
- digicertglobalrootca
- digicertglobalrootg2
- digicertglobalrootg3

- digicerthighassuranceevrootca
- digicerttrustedrootg4
- dtrustclass3ca2
- dtrustclass3ca2ev
- entrust2048ca
- entrustevca
- entrustrootcaec1
- entrustrootcag2
- entrustrootcag4
- geotrustglobalca
- geotrustprimaryca
- geotrustprimarycag2
- geotrustprimarycag3
- geotrustuniversalca
- globalsignca
- globalsigneccrootcar4
- globalsigneccrootcar5
- globalsignr3ca
- globalsignrootcar6
- godaddyclass2ca
- godaddyrootg2ca
- haricaeccrootca2015
- haricarootca2015
- identrustcommercial
- identrustpublicca
- letsencryptisrgx1
- luxtrustglobalroot2ca
- quovadisrootca1g3
- quovadisrootca2
- quovadisrootca2g3
- quovadisrootca3
- quovadisrootca3g3
- secomscrootca1
- secomscrootca2
- securetrustca
- sslrooteccca
- sslrootevrsaca
- sslrootrsaca

- starfieldclass2ca
- starfieldrootg2ca
- starfieldservicesrootg2ca
- swisssigngoldg2ca
- swisssignplatinumg2ca
- swisssignsilverg2ca
- teliasonerarootcav1
- thawteprimaryrootca
- thawteprimaryrootcag2
- thawteprimaryrootcag3
- ttelesecglobalrootclass2ca
- ttelesecglobalrootclass3ca
- usertrusteccca
- usertrustrsaca
- verisignclass3g3ca
- verisignclass3g4ca
- verisignclass3g5ca
- verisignuniversalrootca
- xrampglobalca Kafka security configuration

Configuring Kafka Security

Use the following procedure to configure basic Kafka security:

Prerequisite: SSL certificates and keys.

Configuring Kafka Brokers

1. Configure Kafka to use TLS or SSL encryption, edit the configuration file `server.properties`. This file is usually stored in the Kafka config directory.

   > **Note**
   >
   > Login as *su* to ensure the ownership of the file is not changed.

   ```
   kafka config cmd

   /opt/kafka/config# su -s /bin/bash kafka
   ```

2. Add the following properties for each broker configuration, see below example:
   Example:

   ```
   listeners=PLAINTEXT://kafka-broker-host-name:9092,SSL://kafka-broker-host-
   name:9093
   advertised.listeners=PLAINTEXT://kafka-broker-host-name:9092,SSL://kafka-
   broker-host-name:9093
   ```

```
ssl.truststore.location=/var/private/ssl/kafka.server.truststore.jks

ssl.keystore.location=/var/private/ssl/kafka.server.keystore.jks

ssl.truststore.password=<secret_value>

ssl.keystore.password=<secret_value>

ssl.key.password=<secret_value>

security.inter.broker.protocol=SSL
```

In the above sample configurations, PLAINTEXT and SSL protocols are used for the SSL enabled brokers.

3. Complete the above process for each broker, then restart the Kafka Cluster. Run the following scripts to reset the Kafka Cluster:

```
kafka-server-stop.sh
kafka-server-start.sh
```

4. Enable Client Authentication (two way authentication), run the following command:

```
ssl.client.auth=required
```

Configuring Kafka Client

1. On the client side both certificates and keys are required. Configure all the clients communicating with SSL enabled Kafka Cluster. See below example:
Example:

```
bootstrap.servers=kafka-broker-host-name:9093

security.protocol=SSL

ssl.truststore.location=/var/private/ssl/kafka.client.truststore.jks

ssl.truststore.password=<secret_value>

ssl.keystore.location=/var/private/ssl/kafka.client.keystore.jks

ssl.keystore.password=<secret_value>

ssl.key.password=<secret_value>
```

Where `kafka-broker-host-name` is the FQDN of the broker.

ACL authorization

1. To enable and use the `AclAuthorizer`, set its full class name for your broker configuration in file `server.properties`.

2. Run the following command:

   ```
   authorizer.class.name=kafka.security.authorizer.AclAuthorizer
   ```

3. Kafka ACLs control the principals that perform operations on Kafka resources. Kafka brokers can use ZooKeeper ACLs by enabling broker configuration in the properties file.

   ```
   zookeeper.set.acl=true
   ```

4. Create ACLs for every topic, see below example:
   Example:

   ```
   kafka-acls --bootstrap-server localhost:9092 --command-config adminclient-
   configs.conf --add \
   --allow-principal User:* --operation All --topic mesa.report.location
   ```

MySQL Configuration

cnDBTier is used for database connections. This ensures security issues are avoided and the data is encrypted.

You can configure the secret values for the database username and password for both cnDBTier and innodb from within the `ocnwdaf_custom_values.yaml` file located in the `ocn-nwdaf-helmChart/custom-templates/` directory. By default, the username is "root" and the password is "password" in base 64encoded format. You can replace it with relevant username and password.

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

OCNWDAF Secret Configuration to Enable HTTPS

Use the following procedure to create Kubernetes secret for HTTPS:

Prerequisites:

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

> **Note**
>
> Private Keys, certificates, passwords are created at the discretion of users.

1. Log in to Bastion Host or server from where you can run `kubectl` commands.
2. Create a namespace for the secret by following:
   a. Verify if the required namespace already exists in the system:

      ```
      $ kubectl get namespaces
      ```

   b. In the output of the above command, check if required namespace is available. If unavailable, create the namespace using following command:

      > **Note**
      >
      > This is an optional step. In case required namespace already exists, proceed with next procedures.
      >
      > ```
      > $ kubectl create namespace <required namespace>
      > ```
      >
      > Example:
      >
      > ```
      > $ kubectl create namespace ocnwdaf
      > ```

3. Create `nwdaf-tls secret` based on TLS certificates:

   ```
   K8_NAMESPACE=<insert-your-namespace>
   CERT_PATH=<certificate-path>
   kubectl create secret generic nwdaf-tls \
   --save-config \
   --dry-run=client \
   --from-file=${CERT_PATH}/nwdaf.crt --from-file=${CERT_PATH}/nwdaf.key -o
   yaml | \
   kubectl -n ${K8_NAMESPACE} apply -f -
   ```

   > **Note**
   >
   > `.crt` and `.key` files should be named `nwdaf.crt` and `nwdaf.key`

4. After successful secret creation, the following message is displayed:

   ```
   secret/nwdaf-tls created
   ```

4.2 Implementing Security Recommendations and Guidelines for OCNADD

This section provides specific recommendations and guidelines for OCNADD security.

4.2.1 TLS Configuration

External TLS Communication

DF2: Browser and **DF3: Kafka communication** is over TLS only. No additional steps apart from certificate creation need to be performed.

DF4: Consumer NF communication can be configured to use clear text or TLS through the OCNADD GUI. For more information, see "Configuring OCNADD Using CNC Console" section in the *Oracle Communications Network Analytics Data Director User Guide*.

DF5: Consumer NF (Synthetic Feed) communication can be configured to use TCP or TCP_SECURED through the OCNADD GUI. For more information, see "Configuring OCNADD Using CNC Console" section in the *Oracle Communications Network Analytics Data Director User Guide*.

DF6: Direct Kafka Consumer Feed communication is over TLS only. No additional steps apart from certificate creation need to be performed. Refer to Internal TLS Communication section for more info about certificate creation.

See Certificate Creation for NFs and Third Party Consumers before creating certificates for NFs, OCNADD, third party consumers, and Kafka Consumers.

Internal TLS Communication

The created certificates will already have the required configuration for TLS/mTLS communications if OCCM is used for certificate creation.

In addition to the above communications, TLS is also used for internal OCNADD communication by default.

> **Note**
>
> Data Director 24.3.x and prior releases require TLS certificates for all services. In future releases, certificate management and segregation for internal and external-facing services will be streamlined.
>
> Before proceeding further, ensure that the required certificates for all services have been created using the section "Configuring SSL or TLS Certificates" in the *Oracle Communications Network Analytics Data Director Installation, Upgrade, and Fault Recovery Guide*.
>
> For details on adding entries for service certificates, see the "**Certificate and Secret Generation**" section.

Enable intraTLS in OCNADD

To enable or disable internal TLS, the following steps need to be undertaken:

- Enable internal TLS in Helm Charts.

- Change the value of `global.ssl.intraTlsEnabled` to `true/false` in the `ocnadd-custom-values.yaml`. It is set to `true` by default.

```
ssl:
    intraTlsEnabled:true
```

- Upgrade OCNADD deployment/s to enable TLS for internal communications
  - **If centralized deployment model is used:**
    * First, upgrade management group deployment:

      ```
      helm upgrade -n <management-namespace> -f <managment-custom-values>
      <management-release-name> <release-chart>
      ```

      For example:

      ```
      helm upgrade -n ocnadd-deploy-mgmt -f ocnadd-custom-values-
      mgmt.yaml ocnadd-mgmt ocnadd
      ```

    * Then, upgrade each worker group deployment after management group upgrade is complete:

      ```
      helm upgrade -n <worker-group-namespace> -f <worker-group-custom-
      values> <worker-group-release-name> <release-chart>
      ```

      > **Note**
      >
      > Use the mgmt group namespace for the default worker group.

      For example:

      ```
      helm upgrade -n ocnadd-deploy-wg1 -f ocnadd-custom-values-wg.yaml
      ocnadd-wg ocnadd
      ```

    * Update the `global.env.admin.OCNADD_UPGRADE_WG_NS` in management custom values YAML file with comma separated worker group namespaces:

      ```
      global.env.admin.OCNADD_UPGRADE_WG_NS=ocnadd-deploy-wg1,ocnadd-
      deploy-wg2          # Update in ocnadd-custom-values-mgmt.yaml
      ```

      > **Note**
      >
      > Use the mgmt group namespace for the default worker group.

    * Upgrade management group charts again with Consumer Adapter, Correlation, Storage Adapter, Ingress Adapter upgrade flags set to `true` if enabled in the configuration.

      ```
      helm upgrade -n <management-namespace> -f <managment-custom-values>
      <management-release-name> <release-chart> --set
      ```

```
global.env.admin.OCNADD_ADAPTER_UPGRADE_ENABLE=true,global.env.admin
.OCNADD_CORR_UPGRADE_ENABLE=true,global.env.admin.OCNADD_INGRESS_ADA
PTER_UPGRADE_ENABLE=true,global.env.admin.OCNADD_STORAGE_ADAPTER_UPG
RADE_ENABLE=true
```

For example:

```
helm upgrade -n ocnadd-deploy-mgmt -f ocnadd-custom-values-
mgmt.yaml ocnadd-mgmt ocnadd --set
global.env.admin.OCNADD_ADAPTER_UPGRADE_ENABLE=true,global.env.admin
.OCNADD_CORR_UPGRADE_ENABLE=true,global.env.admin.OCNADD_INGRESS_ADA
PTER_UPGRADE_ENABLE=true,global.env.admin.OCNADD_STORAGE_ADAPTER_UPG
RADE_ENABLE=true
```

- **If Non-Centralized deployment model is used:**
  * Run helm upgrade for release chart with Consumer Adapter, Correlation, Storage Adapter, Ingress Adapter upgrade flags set to `true` if enabled in the configuration

```
helm upgrade -n <release-namespace> -f <custom-values> <release-
name> <release-chart> --set
global.env.admin.OCNADD_ADAPTER_UPGRADE_ENABLE=true,global.env.admin
.OCNADD_CORR_UPGRADE_ENABLE=true,global.env.admin.OCNADD_INGRESS_ADA
PTER_UPGRADE_ENABLE=true,global.env.admin.OCNADD_STORAGE_ADAPTER_UPG
RADE_ENABLE=true
```

For example:

```
helm upgrade -n ocnadd-deploy -f ocnadd-custom-values.yaml ocnadd
ocnadd --set
global.env.admin.OCNADD_ADAPTER_UPGRADE_ENABLE=true,global.env.admin
.OCNADD_CORR_UPGRADE_ENABLE=true,global.env.admin.OCNADD_INGRESS_ADA
PTER_UPGRADE_ENABLE=true,global.env.admin.OCNADD_STORAGE_ADAPTER_UPG
RADE_ENABLE=true
```

Disable intraTLS in OCNADD

1. **Disable Internal TLS in Helm Charts:**
   a. Change the value of `global.ssl.intraTlsEnabled` to `false` in the `ocnadd-custom-values-24.3.0.yaml` file. It is set to `true` by default.
   b. Example setting:

```
ssl: intraTlsEnabled:false
```

2. **Upgrade OCNADD Deployments to Disable TLS for Internal Communications**:
   a. **If a Centralized Deployment Model is Used**:
      i. First, upgrade the management group deployment:

```
helm upgrade -n <management-namespace> -f <management-custom-
values> <management-release-name> <release-chart>
```

For example:

```
helm upgrade -n ocnadd-deploy-mgmt -f ocnadd-custom-values-
mgmt.yaml ocnadd-mgmt ocnadd
```

b. Then, upgrade each worker group deployment after the management group upgrade is complete:

```
helm upgrade -n <worker-group-namespace> -f <worker-group-custom-
values> <worker-group-release-name> <release-chart>
```

> **Note**
>
> Use the management group namespace for the default worker group.

For example:

```
helm upgrade -n ocnadd-deploy-wg1 -f ocnadd-custom-values-wg.yaml
ocnadd-wg ocnadd
```

c. Update the `global.env.admin.OCNADD_UPGRADE_WG_NS` in the management custom values YAML file with comma-separated worker group namespaces:

```
global.env.admin.OCNADD_UPGRADE_WG_NS=ocnadd-deploy-wg1,ocnadd-deploy-
wg2  # Update in ocnadd-custom-values-mgmt.yaml
```

> **Note**
>
> Use the management group namespace for the default worker group.

d. Upgrade the management group charts again with the Consumer Adapter, Correlation, Storage Adapter, and Ingress Adapter upgrade flags set to `true` if enabled in the configuration:

```
helm upgrade -n <management-namespace> -f <management-custom-values>
<management-release-name> <release-chart> --set
global.env.admin.OCNADD_ADAPTER_UPGRADE_ENABLE=true,global.env.admin.OCN
ADD_CORR_UPGRADE_ENABLE=true,global.env.admin.OCNADD_INGRESS_ADAPTER_UPG
RADE_ENABLE=true,global.env.admin.OCNADD_STORAGE_ADAPTER_UPGRADE_ENABLE=
true
```

For example:

```
helm upgrade -n ocnadd-deploy-mgmt -f ocnadd-custom-values-mgmt.yaml
ocnadd-mgmt ocnadd --set
global.env.admin.OCNADD_ADAPTER_UPGRADE_ENABLE=true,global.env.admin.OCN
ADD_CORR_UPGRADE_ENABLE=true,global.env.admin.OCNADD_INGRESS_ADAPTER_UPG
RADE_ENABLE=true,global.env.admin.OCNADD_STORAGE_ADAPTER_UPGRADE_ENABLE=
true
```

3. **If a Non-Centralized Deployment Model is Used:**

a. Run `helm upgrade` for the release chart with the Consumer Adapter, Correlation, Storage Adapter, and Ingress Adapter upgrade flags set to `true` if enabled in the configuration:

```
helm upgrade -n <release-namespace> -f <custom-values> <release-name>
<release-chart> --set
global.env.admin.OCNADD_ADAPTER_UPGRADE_ENABLE=true,global.env.admin.OCN
ADD_CORR_UPGRADE_ENABLE=true,global.env.admin.OCNADD_INGRESS_ADAPTER_UPG
RADE_ENABLE=true,global.env.admin.OCNADD_STORAGE_ADAPTER_UPGRADE_ENABLE=
true
```

For example:

```
helm upgrade -n ocnadd-deploy -f ocnadd-custom-values.yaml ocnadd
ocnadd --set
global.env.admin.OCNADD_ADAPTER_UPGRADE_ENABLE=true,global.env.admin.OCN
ADD_CORR_UPGRADE_ENABLE=true,global.env.admin.OCNADD_INGRESS_ADAPTER_UPG
RADE_ENABLE=true,global.env.admin.OCNADD_STORAGE_ADAPTER_UPGRADE_ENABLE=
true
```

Note

- External Kafka feeds with filter and correlation features cannot be used without enabling internal TLS.
- The Export feature will not work as it is dependent on the Correlation feeds, which require intraTLS to be enabled.

Certificate and Secret Generation

- Certificates produced Manually
- Certificates Produced by OCCM

Certificates produced Manually

The OCNADD services can communicate with each other as well as with external interfaces in both secure encrypted mode as well as in insecure mode. For establishing encrypted communication between the services, there is a necessity to generate TLS certificates and private keys for each microservice. The service certificate is generated using the provided CA certificate see the *Oracle Communications Network Analytics Data Director Installation and Upgrade Guide* section "Configuring SSL or TLS Certificates"

The generated service certificates are stored as the Kubernetes secret.

> **Note**
>
> The default certification creation assumes that internal TLS is enabled and creates the certificates for all the OCNADD services. The customers can choose to delete surplus entries from `ssl_certs/default_values/values_template` file or from `ssl_certs/default_values/management_service_values_template` and `ssl_certs/default_values/worker_group_service_values_template` file in case of centralized deployment, when not using internal TLS. This will reduce the number of certificates to be signed by the CA.
>
> It is recommended to create the certificates for all the OCNADD services in release 24.3.x or prior, however if the customer choose not to create the certificates for all the services, then deployment may fail because of known limitation. See 24.3.x Release Note for all the known issues list and corresponding workaround.

Below are sample **values** files with/without internal TLS enabled:

where:

- ocnadd-deploy: is the namespace where OCNADD is deployed
- occne-ocnadd: is the Kubernetes domain name

For Non-Centralized Deployment or Centralized mode with default worker group

```
# Do not modify any keys in global section. Please edit only values present
in global section.
# Edit only commonName value for Root CA. Do not modify key
# You can add multiple services in same manner as the sample services are
added. The format should be as follows
#service name, common name for service and list of subject alternate name
#e.g.,
#[<service_name>]
#commonName=your.svc.common.name
#IP.1 = 127.0.0.1
#IP.2 = 10.72.31.4
#DNS.1 = localhost
#DNS.2 = svc.cluster.local
# Make sure to provide a single empty line (without space) after end of every
section
# Do not add comments anywhere in this script to avoid parsing error

[global]
countryName=IN
stateOrProvinceName=KA
localityName=BLR
organizationName=ORACLE
organizationalUnitName=CGBU
defaultDays=365

##root_ca
commonName=*.svc.occne-ocdd

[kafka-broker]
client.commonName=kafka-broker-zk
```

```
server.commonName=kafka-broker
DNS.1=*.kafka-broker.ocnadd-deploy.svc.occne-ocdd
DNS.2=kafka-broker
DNS.3=*.kafka-broker
DNS.4=kafka-broker-0.kafka-broker
DNS.5=kafka-broker-1.kafka-broker
DNS.6=kafka-broker-2.kafka-broker
DNS.7=kafka-broker-3.kafka-broker
DNS.8=kafka-broker.ocnadd-deploy
DNS.9=kafka-broker-0.kafka-broker.ocnadd-deploy
DNS.10=kafka-broker-1.kafka-broker.ocnadd-deploy
DNS.11=kafka-broker-2.kafka-broker.ocnadd-deploy
DNS.12=kafka-broker-3.kafka-broker.ocnadd-deploy
DNS.13=*.kafka-broker-headless.ocnadd-deploy.svc.occne-ocdd
DNS.14=kafka-broker-headless
DNS.15=*.kafka-broker-headless
DNS.16=kafka-broker-0.kafka-broker-headless
DNS.17=kafka-broker-1.kafka-broker-headless
DNS.18=kafka-broker-2.kafka-broker-headless
DNS.19=kafka-broker-3.kafka-broker-headless
DNS.20=kafka-broker-headless.ocnadd-deploy
DNS.21=kafka-broker-0.kafka-broker-headless.ocnadd-deploy
DNS.22=kafka-broker-1.kafka-broker-headless.ocnadd-deploy
DNS.23=kafka-broker-2.kafka-broker-headless.ocnadd-deploy
DNS.24=kafka-broker-3.kafka-broker-headless.ocnadd-deploy

[zookeeper]
client.commonName=zookeeper-zk
server.commonName=zookeeper
DNS.1=*.zookeeper.ocnadd-deploy.svc.occne-ocdd
DNS.2=zookeeper
DNS.3=zookeeper.ocnadd-deploy

[ocnaddthirdpartyconsumer]
client.commonName=ocnaddthirdpartyconsumer-client
server.commonName=ocnaddthirdpartyconsumer
DNS.1=*.ocnaddthirdpartyconsumer.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddthirdpartyconsumer
DNS.3=ocnaddthirdpartyconsumer.ocnadd-deploy
DNS.4=ocnaddthirdpartyconsumer.ocnadd-deploy.svc.occne-ocdd

[oraclenfproducer]
client.commonName=oraclenfproducer
server.commonName=oraclenfproducer-server
DNS.1=*.oraclenfproducer.ocnadd-deploy.svc.occne-ocdd
DNS.2=oraclenfproducer
DNS.3=oraclenfproducer.ocnadd-deploy

[ocnadduirouter]
client.commonName=ocnadduirouter-client
server.commonName=ocnadduirouter
DNS.1=*.ocnadduirouter.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnadduirouter
DNS.3=ocnadduirouter.ocnadd-deploy

[ocnaddadminservice]
```

```
client.commonName=ocnaddadminservice-client
server.commonName=ocnaddadminservice
DNS.1=*.ocnaddadminservice.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddadminservice
DNS.3=ocnaddadminservice.ocnadd-deploy

[ocnaddalarm]
client.commonName=ocnaddalarm-client
server.commonName=ocnaddalarm
DNS.1=*.ocnaddalarm.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddalarm
DNS.3=ocnaddalarm.ocnadd-deploy

[ocnaddconfiguration]
client.commonName=ocnaddconfiguration-client
server.commonName=ocnaddconfiguration
DNS.1=*.ocnaddconfiguration.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddconfiguration
DNS.3=ocnaddconfiguration.ocnadd-deploy

[ocnaddhealthmonitoring]
client.commonName=ocnaddhealthmonitoring-client
server.commonName=ocnaddhealthmonitoring
DNS.1=*.ocnaddhealthmonitoring.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddhealthmonitoring
DNS.3=ocnaddhealthmonitoring.ocnadd-deploy

[ocnaddscpaggregation]
client.commonName=ocnaddscpaggregation-client
server.commonName=ocnaddscpaggregation
DNS.1=*.ocnaddscpaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddscpaggregation
DNS.3=ocnaddscpaggregation.ocnadd-deploy

[ocnaddnrfaggregation]
client.commonName=ocnaddnrfaggregation-client
server.commonName=ocnaddnrfaggregation
DNS.1=*.ocnaddnrfaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddnrfaggregation
DNS.3=ocnaddnrfaggregation.ocnadd-deploy

[ocnaddbsfaggregation]
client.commonName=ocnaddbsfaggregation-client
server.commonName=ocnaddbsfaggregation
DNS.1=*.ocnaddbsfaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddbsfaggregation
DNS.3=ocnaddbsfaggregation.ocnadd-deploy

[ocnaddseppaggregation]
client.commonName=ocnaddseppaggregation-client
server.commonName=ocnaddseppaggregation
DNS.1=*.ocnaddseppaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddseppaggregation
DNS.3=ocnaddseppaggregation.ocnadd-deploy

[ocnaddnonoracleaggregation]
```

```
client.commonName=ocnaddnonoracleaggregation-client
server.commonName=ocnaddnonoracleaggregation
DNS.1=*.ocnaddnonoracleaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddnonoracleaggregation
DNS.3=ocnaddnonoracleaggregation.ocnadd-deploy

[ocnaddingressadapter]
client.commonName=ocnaddingress-client
server.commonName=ocnaddingress
DNS.1=*.ocnaddingressadapter.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddingressadapter
DNS.3=ocnaddingressadapter.ocnadd-deploy

[adapter]
client.commonName=adapter
server.commonName=adapter-server
DNS.1=*adapter.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddconsumeradapter
DNS.3=ocnaddconsumeradapter.ocnadd-deploy

[ocnaddcorrelation]
client.commonName=ocnaddcorrelation-client
server.commonName=ocnaddcorrelation
DNS.1=*.ocnaddcorrelation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddcorrelation
DNS.3=ocnaddcorrelation.ocnadd-deploy

[ocnaddfilter]
client.commonName=ocnaddfilter-client
server.commonName=ocnaddfilter
DNS.1=*.ocnaddfilter.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddfilter
DNS.3=ocnaddfilter.ocnadd-deploy

[ocnaddbackuprestore]
client.commonName=ocnaddbackuprestore
server.commonName=ocnaddbackuprestore-server
DNS.1=ocnaddbackuprestore

[ocnaddpreupgradeaclhelmhook]
client.commonName=ocnaddpreupgradeaclhelmhook-client
server.commonName=ocnaddpreupgradeaclhelmhook
DNS.1=*.ocnaddpreupgradeaclhelmhook.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddpreupgradeaclhelmhook
DNS.3=ocnaddpreupgradeaclhelmhook.ocnadd-deploy

[ocnaddredundancyagent]
client.commonName=ocnaddredundancyagent-client
server.commonName=ocnaddredundancyagent
DNS.1=*.ocnaddredundancyagent.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddredundancyagent
DNS.3=ocnaddredundancyagent.ocnadd-deploy

[ocnaddstorageadapterservice]
client.commonName=ocnaddstorageadapterservice-client
server.commonName=ocnaddstorageadapterservice
```

```
DNS.1=*.ocnaddstorageadapterservice.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddstorageadapterservice
DNS.3=ocnaddstorageadapterservice.ocnadd-deploy

[ocnaddexportservice]
client.commonName=ocnaddexportservice-client
server.commonName=ocnaddexportservice
DNS.1=*.ocnaddexportservice.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddexportservice
DNS.3=ocnaddexportservice.ocnadd-deploy

[kraft-controller]
client.commonName=kraft-controller-zk
server.commonName=kraft-controller
DNS.1=*.kraft-controller.ocnadd-deploy.svc.occne-ocdd
DNS.2=kraft-controller
DNS.3=*.kraft-controller
DNS.4=kraft-controller-0.kraft-controller
DNS.5=kraft-controller-1.kraft-controller
DNS.6=kraft-controller-2.kraft-controller
DNS.7=kraft-controller.ocnadd-deploy
DNS.8=kraft-controller-0.kraft-controller.ocnadd-deploy
DNS.9=kraft-controller-1.kraft-controller.ocnadd-deploy
DNS.10=kraft-controller-2.kraft-controller.ocnadd-deploy
DNS.11=kraft-controller-0.kraft-controller.ocnadd-deploy.svc.occne-ocdd
DNS.12=kraft-controller-1.kraft-controller.ocnadd-deploy.svc.occne-ocdd
DNS.13=kraft-controller-2.kraft-controller.ocnadd-deploy.svc.occne-ocdd

##end
```

Note

- External Kafka feed with filter and correlation features can not be used without enabling internal TLS, example CORRELATED FEED, FILTER CORRELATED FEED, AGGREGATED KAFKA FEED etc.
- The Export feature will not work as it is dependent on the Correlation feeds, which requires intraTLS to be enabled.

For Centralized Deployment

- **ssl_certs/default_values/management_service_values_template** or its copies should be as follows:

```
# Do not modify any keys in global section. Please edit only values
present in global section.
# Edit only commonName value for Root CA. Do not modify key
# You can add multiple services in same manner as the sample services are
added. The format should be as follows
#service name, common name for service and list of subject alternate name
#e.g.,
#[<service_name>]
#commonName=your.svc.common.name
#IP.1 = 127.0.0.1
```

```
#IP.2 = 10.72.31.4
#DNS.1 = localhost
#DNS.2 = svc.cluster.local
# Make sure to provide a single empty line (without space) after end of
every section
# Do not add comments anywhere in this script to avoid parsing error

[global]
countryName=IN
stateOrProvinceName=KA
localityName=BLR
organizationName=ORACLE
organizationalUnitName=CGBU
defaultDays=365

##root_ca
commonName=*.svc.occne-ocdd

[ocnadduirouter]
client.commonName=ocnadduirouter-client
server.commonName=ocnadduirouter
DNS.1=*.ocnadduirouter.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnadduirouter
DNS.3=ocnadduirouter.ocnadd-deploy

[ocnaddadminservice]
client.commonName=ocnaddadminservice-client
server.commonName=ocnaddadminservice
DNS.1=*.ocnaddadminservice.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddadminservice
DNS.3=ocnaddadminservice.ocnadd-deploy

[ocnaddalarm]
client.commonName=ocnaddalarm-client
server.commonName=ocnaddalarm
DNS.1=*.ocnaddalarm.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddalarm
DNS.3=ocnaddalarm.ocnadd-deploy

[ocnaddconfiguration]
client.commonName=ocnaddconfiguration-client
server.commonName=ocnaddconfiguration
DNS.1=*.ocnaddconfiguration.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddconfiguration
DNS.3=ocnaddconfiguration.ocnadd-deploy

[ocnaddhealthmonitoring]
client.commonName=ocnaddhealthmonitoring-client
server.commonName=ocnaddhealthmonitoring
DNS.1=*.ocnaddhealthmonitoring.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddhealthmonitoring
DNS.3=ocnaddhealthmonitoring.ocnadd-deploy

[ocnaddbackuprestore]
client.commonName=ocnaddbackuprestore
server.commonName=ocnaddbackuprestore-server
```

```
DNS.1=ocnaddbackuprestore

[ocnaddredundancyagent]
client.commonName=ocnaddredundancyagent-client
server.commonName=ocnaddredundancyagent
DNS.1=*.ocnaddredundancyagent.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddredundancyagent
DNS.3=ocnaddredundancyagent.ocnadd-deploy

[ocnaddexportservice]
client.commonName=ocnaddexportservice-client
server.commonName=ocnaddexportservice
DNS.1=*.ocnaddexportservice.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddexportservice
DNS.3=ocnaddexportservice.ocnadd-deploy

##end
```

- **ssl_certs/default_values/worker_group_service_values_template** or its copies should be as follows:

```
# Do not modify any keys in global section. Please edit only values
present in global section.
# Edit only commonName value for Root CA. Do not modify key
# You can add multiple services in same manner as the sample services are
added. The format should be as follows
#service name, common name for service and list of subject alternate name
#e.g.,
#[<service_name>]
#commonName=your.svc.common.name
#IP.1 = 127.0.0.1
#IP.2 = 10.72.31.4
#DNS.1 = localhost
#DNS.2 = svc.cluster.local
# Make sure to provide a single empty line (without space) after end of
every section
# Do not add comments anywhere in this script to avoid parsing error

[global]
countryName=IN
stateOrProvinceName=KA
localityName=BLR
organizationName=ORACLE
organizationalUnitName=CGBU
defaultDays=365

##root_ca
commonName=*.svc.occne-ocdd

[kafka-broker]
client.commonName=kafka-broker-zk
server.commonName=kafka-broker
DNS.1=*.kafka-broker.ocnadd-deploy.svc.occne-ocdd
DNS.2=kafka-broker
DNS.3=*.kafka-broker
DNS.4=kafka-broker-0.kafka-broker
```

```
DNS.5=kafka-broker-1.kafka-broker
DNS.6=kafka-broker-2.kafka-broker
DNS.7=kafka-broker-3.kafka-broker
DNS.8=kafka-broker.ocnadd-deploy
DNS.9=kafka-broker-0.kafka-broker.ocnadd-deploy
DNS.10=kafka-broker-1.kafka-broker.ocnadd-deploy
DNS.11=kafka-broker-2.kafka-broker.ocnadd-deploy
DNS.12=kafka-broker-3.kafka-broker.ocnadd-deploy
DNS.13=*.kafka-broker-headless.ocnadd-deploy.svc.occne-ocdd
DNS.14=kafka-broker-headless
DNS.15=*.kafka-broker-headless
DNS.16=kafka-broker-0.kafka-broker-headless
DNS.17=kafka-broker-1.kafka-broker-headless
DNS.18=kafka-broker-2.kafka-broker-headless
DNS.19=kafka-broker-3.kafka-broker-headless
DNS.20=kafka-broker-headless.ocnadd-deploy
DNS.21=kafka-broker-0.kafka-broker-headless.ocnadd-deploy
DNS.22=kafka-broker-1.kafka-broker-headless.ocnadd-deploy
DNS.23=kafka-broker-2.kafka-broker-headless.ocnadd-deploy
DNS.24=kafka-broker-3.kafka-broker-headless.ocnadd-deploy

[zookeeper]
client.commonName=zookeeper-zk
server.commonName=zookeeper
DNS.1=*.zookeeper.ocnadd-deploy.svc.occne-ocdd
DNS.2=zookeeper
DNS.3=zookeeper.ocnadd-deploy

[ocnaddscpaggregation]
client.commonName=ocnaddscpaggregation-client
server.commonName=ocnaddscpaggregation
DNS.1=*.ocnaddscpaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddscpaggregation
DNS.3=ocnaddscpaggregation.ocnadd-deploy

[ocnaddnrfaggregation]
client.commonName=ocnaddnrfaggregation-client
server.commonName=ocnaddnrfaggregation
DNS.1=*.ocnaddnrfaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddnrfaggregation
DNS.3=ocnaddnrfaggregation.ocnadd-deploy


[ocnaddbsfaggregation]
client.commonName=ocnaddbsfaggregation-client
server.commonName=ocnaddbsfaggregation
DNS.1=*.ocnaddbsfaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddbsfaggregation
DNS.3=ocnaddbsfaggregation.ocnadd-deploy

[ocnaddseppaggregation]
client.commonName=ocnaddseppaggregation-client
server.commonName=ocnaddseppaggregation
DNS.1=*.ocnaddseppaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddseppaggregation
DNS.3=ocnaddseppaggregation.ocnadd-deploy
```

```
[ocnaddnonoracleaggregation]
client.commonName=ocnaddnonoracleaggregation-client
server.commonName=ocnaddnonoracleaggregation
DNS.1=*.ocnaddnonoracleaggregation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddnonoracleaggregation
DNS.3=ocnaddnonoracleaggregation.ocnadd-deploy

[ocnaddfilter]
client.commonName=ocnaddfilter-client
server.commonName=ocnaddfilter
DNS.1=*.ocnaddfilter.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddfilter
DNS.3=ocnaddfilter.ocnadd-deploy

[ocnaddingressadapter]
client.commonName=ocnaddingress-client
server.commonName=ocnaddingress
DNS.1=*.ocnaddingressadapter.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddingressadapter
DNS.3=ocnaddingressadapter.ocnadd-deploy

[adapter]
client.commonName=adapter
server.commonName=adapter-server
DNS.1=*adapter.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddconsumeradapter
DNS.3=ocnaddconsumeradapter.ocnadd-deploy

[ocnaddcorrelation]
client.commonName=ocnaddcorrelation-client
server.commonName=ocnaddcorrelation
DNS.1=*.ocnaddcorrelation.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddcorrelation
DNS.3=ocnaddcorrelation.ocnadd-deploy

[ocnaddstorageadapterservice]
client.commonName=ocnaddstorageadapterservice-client
server.commonName=ocnaddstorageadapterservice
DNS.1=*.ocnaddstorageadapterservice.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddstorageadapterservice
DNS.3=ocnaddstorageadapterservice.ocnadd-deploy

[ocnaddpreupgradeaclhelmhook]
client.commonName=ocnaddpreupgradeaclhelmhook-client
server.commonName=ocnaddpreupgradeaclhelmhook
DNS.1=*.ocnaddpreupgradeaclhelmhook.ocnadd-deploy.svc.occne-ocdd
DNS.2=ocnaddpreupgradeaclhelmhook
DNS.3=ocnaddpreupgradeaclhelmhook.ocnadd-deploy

[kraft-controller]
client.commonName=kraft-controller-zk
server.commonName=kraft-controller
DNS.1=*.kraft-controller.ocnadd-deploy.svc.occne-ocdd
DNS.2=kraft-controller
DNS.3=*.kraft-controller
```

```
DNS.4=kraft-controller-0.kraft-controller
DNS.5=kraft-controller-1.kraft-controller
DNS.6=kraft-controller-2.kraft-controller
DNS.7=kraft-controller.ocnadd-deploy
DNS.8=kraft-controller-0.kraft-controller.ocnadd-deploy
DNS.9=kraft-controller-1.kraft-controller.ocnadd-deploy
DNS.10=kraft-controller-2.kraft-controller.ocnadd-deploy
DNS.11=kraft-controller-0.kraft-controller.ocnadd-deploy.svc.occne-ocdd
DNS.12=kraft-controller-1.kraft-controller.ocnadd-deploy.svc.occne-ocdd
DNS.13=kraft-controller-2.kraft-controller.ocnadd-deploy.svc.occne-ocdd

##end
```

Note

- External Kafka feed with filter and correlation features can not be used without enabling internal TLS, example CORRELATED FEED, FILTER CORRELATED FEED, AGGREGATED KAFKA FEED etc.
- The Export feature will not work as it is dependent on the Correlation feeds, which requires intraTLS to be enabled.

MTLS Configuration

The customers can opt to use MTLS for internal OCNADD communication. To enable the internal MTLS, run the following steps:

- Enable internal MTLS in Helm Charts.
  Change the value of global.ssl.mTLS to "true" in the `ocnadd-custom-values.yaml`. By default it is set to false.

  ```
  ssl:
      intraTlsEnabled: true
      mTLS: true
  ```

  Change the value of `global.acl.kafkaClientAuth` to required in `ocnadd-custom-values.yaml`

  ```
  global
      acl
          kafkaClientAuth: required
  ```

- The certificate creation step remains the same as mentioned in the "**TLS Configuration**" section.

Note

It is mandatory to enable internal TLS and to create certificates and secrets for MTLS to work.

Certificates Produced by OCCM

Oracle Communications Certificate Management (OCCM) is an automated solution for managing the certificates needed for Oracle Communications Network Analytics Data Director services. OCCM constantly monitors and renews the certificates based on their validity or expiry period.

The created certificates will already have the required TLS/mTLS configuration, eliminating the need for additional steps to configure mTLS and TLS requirements.

To generate certificates using OCCM, follow these steps:

1. Create secrets as outlined in the "OCCM Secrets" section of the *Oracle Communications Network Analytics Data Director Installation and Upgrade Guide*.
2. Modify the `custom_values.yaml` file according to the "Helm Parameter Configuration for OCCM" section of the *Oracle Communications Network Analytics Data Director Installation and Upgrade Guide*.
3. Run `helm install` command. See "Installing OCNADD Package" section in the *Oracle Communications Network Analytics Data Director Installation and Upgrade Guide*.

Customizing CSR and Certificate Extensions

OpenSSL creates the Certificate Signing Requests (CSRs) and certificates in the `generate_certs.sh` script of OCNADD. OpenSSL configuration file templates `ssl_certs/templates/services_client_openssl.cnf` and `ssl_certs/templates/services_server_openssl.cnf` are used during CSR or certificate creation.

Modify the files based on customer requirements. For more information, see OpenSSL x509 v3 Certificate and CSR Configuration.

Key Usage Requirement for Client and Server CSR

- Certificates Produced Manually
- Certificates Produced by OCCM

Certificates Produced Manually

External CA may require specific key usage and external key usage to be mentioned in the CSR. Add or modify the `[ req_ext ]` section in both `ssl_certs/templates/services_client_openssl.cnf` and `ssl_certs/templates/services_server_openssl.cnf` files as follows:

```
[ req_ext ]

# Extensions to add to a certificate request

basicConstraints = CA:FALSE
keyUsage=critical,digitalSignature,keyEncipherment # Modify Key Usage
extendedKeyUsage=serverAuth,clientAuth # Add Extended Key Usage
```

Also add reference to `req_ext` in `[ req ]` section as follows:

```
[ req ]
default_bits        = 2048
default_keyfile     = privkey.pem
```

```
distinguished_name  = req_distinguished_name
attributes      = req_attributes
x509_extensions = usr_cert  # The extensions to add to the self signed cert
req_extensions = req_ext # Add extensions required for CSR
```

The above code snippets add the standard key and extended key usage required by the CA to sign the certificate. The user can similarly add other specific usage requirements.

Certificates Produced by OCCM

In the certificate signing request (CSR) utilized for certificate creation through OCCM, the X509v3 Extended Key Usage is set to "TLS Web Client Authentication" and "TLS Web Server Authentication," specifying the certificate's purpose for client and server authentication. Additionally, the X509v3 Key Usage is set to "DIGITAL_SIGNATURE" and "KEY_ENCIPHERMENT," indicating the permitted functions for the key's usage.

Adding or Updating SAN Entries

- Certificates Produced Manually
- Certificates Produced by OCCM

Certificates Produced Manually

These steps should be followed when Subject Alternative Name (SAN) entries need to be updated or added to certificates, and certificates are generated using CACert and CAKey, or only Certificate Signing Requests (CSR) are generated using the `generate_certs.sh` script.

- If external access is enabled, then while running script, select "y" when prompted to add SAN entries.

  ```
  Do you want to add any IP for adding SAN entries to existing dd services
  (y/n): y
  ```

  If user selects "yes," a list of services is shown and user can add the SAN entries for any of the listed services by selecting the corresponding service number.

  In the following example, the list of management services is shown for user to add SAN entries. Enter the number corresponding to the service for which user wants to enter IP. After choosing the service, give IP addresses as input, else enter "n" to exit.

  ```
  For the following services:
  1. ocnadduirouter
  2. ocnaddadminservice
  3. ocnaddalarm
  4. ocnaddconfiguration
  5. ocnaddhealthmonitoring
  6. ocnaddbackuprestore
  7. ocnaddredundancyagent

  Enter the number corresponding to the service for which you want to add
  IP: 3
  Please enter IP for the service ocnaddalarm or enter "n" to exit :
  10.20.30.40
  Please enter IP for the service ocnaddalarm or enter "n" to exit :
  10.20.30.41
  ```

```
Please enter IP for the service ocnaddalarm or enter "n" to exit : n
Do you want to add IP to any other service (y/n) : n
```

- Follow the steps mentioned in section Renewing OCNADD Certificates to renew or recreate the certificates with the modified SAN entries.

Certificates Produced by OCCM

To update or add Subject Alternative Name (SAN) entries for Kafka, the redundancy agent, or the ingress adapter, modify the "`global.certificates.occm.san`" section in the `custom_values.yaml` file with the necessary SAN entries. See "Adding/Updating Loadbalancer IPs in SAN through OCCM" section of the Oracle Communications Network Analytics Data Director Installation and Upgrade Guide. The certificates generated by OCCM will then incorporate the updated SAN configuration.

Updating SAN Entries

```
san:
    kafka:
        update_required: false
        # Provide Kafka Load balancer IPs here
        ips: ["10.10.10.10"]
        uuid:
            client:
            server:
    redundancy_agent:
        update_required: false
        # Provide Redundancy Agent Load balancer IP here
        ips: ["10.10.10.11"]
        uuid:
            client:
            server:
    ingress_adapter:
        update_required: false
        # Provide every Ingress Adapter's Load Balancer IP here
        ips: ["10.10.10.12"]
        uuid:
            client:
            server:
```

4.2.2 Network Policies

OCNADD is also shipped with Network Policies for ingress connections which are disabled by default. Customers can configure the intended sources of connections by modifying the `ocnadd-custom-values.yaml` file as mentioned below.

Network policies can be enabled to provide an additional security layer restricting both internal and external connections. The Network Policies are categorized into two categories:

- Internal Service Connections: The connections between services that are internal to the OCNADD namespace or internal to the OCNADD management and worker group namespaces.
- External Service Connections: The services from sources that are external to the OCNADD namespace or external to both the OCNADD management and worker group namespaces. The external connections can further be categorized into 4 categories:

- Connections From CNCC: For rendering OCNADD Dashboard
- Connections From NF: For connections to Kafka from NF acting as Kafka producer or consumer
- Connections From CNE Infrastructure Services: For fetching metrics and generating alerts
- Connections From IP blocks/CIDRS: For connections to Kafka from NF acting as Kafka producer or consumer

To enable network policies, change the value of `global.network.policy.enable` to `true` in `ocnadd-custom-values.yaml` file, by default it is `false`. By enabling this field, network policies for **Internal Service Connections** are enabled by default, no modifications are required.

```
network:
    # enable network policies
    policy:
      enable: true
```

If using the centralized mode of deployment, include the following in the `ocnadd-custom-values.yaml` file for the management group chart to allow connections from Worker Group:

```
global:
    network:
        ingress:
          namespaces:
            # allow ingress network connfections from below worker group
namespaces/s
            workergroups:          # Considering two worker groups namepaces
            - ocnadd-deploy-wg1
            - ocnadd-deploy-wg2
```

To specify the CNCC namespace, update the values in `global.network.ingress.namespaces.cncc` to the CNCC namespace in the `ocnadd-custom-values.yaml` file.

```
global:
    network:
        ingress:
          namespaces:
            # allow ingress network connections to gui from below cncc
namespace/s
            cncc:                 # Allowing connections from CNCC namespace:
occncc
            - occncc
```

To specify the NF namespaces, update the values in `global.network.ingress.namespaces.kafka` to the NF namespaces in the `ocnadd-custom-values.yaml` file.

```
global:
    network:
        ingress:
          namespaces:
            # allow ingress network connections to kafka from below
namespace/s
            kafka:                # Allowing connections from NRF, SCP, SEPP
namespaces
            - ocnrf
            - ocsepp
            - ocscp
```

To specify the namespace containing CNE infrastructure services like Prometheus, update the values in `global.network.ingress.namespaces.infra` to the CNE infra namespace in the `ocnadd-custom-values.yaml` file.

```
global:
     network:
         ingress:
            namespaces:
               # allow ingress network connections from below infra
namespace/s
               infra:             # Allowing connection from occne-infra
               - occne-infra
```

If connections to Kafka from sources external to the Kubernetes cluster are required, or if connections from specific IP/network are required, update the value in `global.network.ingress.external.enable` to `true`. Then, add the required IP/Network address in CIDR format in `global.network.ingress.external.cidrs.kafka` in the `ocnadd-custom-values.yaml`.

```
global:
      network:
          # Allow external network connections to kafka from below IPs/CIDRs/
Network
          # needed for external kafka consumer
          external:
              enable: true                    # Changed to true
              cidrs:
                 kafka:
                     - 10.10.10.10/32         # Allows connections from
10.10.10.10 IP address
                     - 192.168.10.0/24        # Allows connections from
192.168.10.0 - 192.168.10.255 IP addresses
```

If redundancy agent is enabled, communication from peer redundancy agent in primary or secondary site needs to be allowed. Update the value in `global.network.ingress.external.enable` to `true` and update the peer agent's

Loadbalancer IP address in `global.network.ingress.external.cidrs.agent` in the `ocnadd-custom-values.yaml`.

```
global:
      network:
          # Allow external network connections to kafka from below IPs/CIDRs/
Network
          # needed for external kafka consumer
          external:
              enable: true                      # Changed to true
              cidrs:
                 agent:
                     - 100.10.123.1/32          # Loadbalancer IP address of
peer redundancy agent
```

Steps to enable Network Policy

- Install OCNADD.
- Modify `ocnadd-custom-values.yaml` as needed:
  - For a centralized deployment model, modify connections for NF namespaces or external IP/CIDRs independently for each worker group in their respective `ocnadd-custom-values.yaml` files.
- Perform Helm upgrade of OCNADD deployment:
  - The specific steps for the helm upgrade will vary based on the selected OCNADD deployment model. See *Oracle Communications Network Analytics Data Director Installation, Upgrade Guide, and Fault Recovery Guide* for detailed instructions.
  - In a centralized deployment model, start by performing the helm upgrade for management group services. Subsequently, perform the helm upgrade for each worker group namespace.

4.2.3 Kafka Security Configuration

The basic configuration for Kafka security in order to be compliant with product delivery is described below.

Prerequisites

- SSL certificates & keys (generated using SSL scripts which are provided as part of OCNADD release)

Configuring SASL for Kafka

Kafka uses the Java Authentication and Authorization Service (JAAS) for SASL configuration. In OCNADD, by default, all Kafka communication (inter-broker, Kafka-client, and Kafka-broker and between Kafka and Zookeeper) happens with a common user (ocnadd) configured in `<chart-path>/charts/ocnaddkafka/config/kafka_server_jaas.conf`

Customers can add more users in `<chart-path>/charts/ocnaddkafka/config/kafka_server_jaas.conf` file. In case of Centralized Deployment, <chart-path> should be the path to the worker group services chart, and each worker group can have different users added to them independently of each other.

The "ocnadd" user is the default user for all internal Kafka communication and should not be modified.

Below are the sample changes to add NRF, SCP, and SEPP users in Kafka:

```
KafkaServer {
org.apache.kafka.common.security.plain.PlainLoginModule required
username="ocnadd"
password="<change this>"
user_ocnadd="<change this>";
user_NRF="NRF-secret";
user_SCP="SCP-secret";
user_SEPP="SEPP-secret";
};
Client {
org.apache.zookeeper.server.auth.DigestLoginModule required
username="ocnadd"
password="<change this>";
};
```

In the above code snippet `user_NRF="NRF-secret"` is added for NRF user, `user_SEPP="SEPP-secret"` is added for SEPP user, and `user_SCP="SCP-secret"`is added for SCP user. Where "NRF-secret", "SEPP-secret" and "SCP-secret" are the passwords.

After making the above changes, continue with the installation steps as mentioned in the *Oracle Communications Network Analytics Data Director Installation, Upgrade, and Fault Recovery Guide*.

> **Note**
>
> - Field marked as `<change this>` needs to be updated by the user to set the Kafka admin password.
> - User addition is one time operation and can be done only during installation.
> - It is recommended to use a strong password in **kafka_server_jass.conf**.

External Kafka Feed

To enable Kafka Feed support, see the steps mentioned in "Enable Kafka Feed Configuration Support" section of *Oracle Communications Network Analytics Data Director User Guide*.

4.2.4 MySQL Configuration

The OCNADD uses cnDBtier service for the database, which provides secure database connectivity. For configuration details, see *Oracle Communications Network Analytics Data Director Installation Guide, Upgrade, and Fault Recovery Guide*.

4.2.5 Certificate Creation for NFs and Third Party Consumers

The following sections provide information about certificate creation rules to be considered by the NFs and Third Party Consumers.

Certification Creation for NFs

NFs must ensure the following conditions are met prior to sending data to OCNADD over TLS:

- NFs must trust the Certificate Authority(CA) that issues the certificate to the OCNADD. The CA certificate for OCNADD's Certificate Authority must be included in the trust store, *cacert* file, or the *ca-bundle* of the NF.
- When **mTLS** is enabled in OCNADD and an NF in the same Kubernetes cluster wishes to send data to the SSL endpoint instead of SASL_SSL endpoint, the TLS certificate of the NF should be issued by the same CA issuing certificate to the OCNADD or any one of the trusted CAs.

Certification Creation for Third Party Consumers

When TLS encrypted feeds (HTTP2 or TCP_SECURED) are configured, it is essential that the third party endpoint given in the feed configuration supports TLS. In addition to supporting TLS, consider the following while creating certificates for the consumer:

- The certificate should be signed by any of the trusted CAs or by the CA issuing certificate for the OCNADD.
- The certificates Common Name (CN) or Subject Alternative Name (SAN) contains the host name or IP address provided as part of the feed configuration.
  For example, if Feed A is configured to send data to Consumer A (*https://thirdpartyconsumer/*) and Feed B is configured to send data to Consumer B (*https://10.10.10.10*), the certificate for Consumer A must contain the *thirdpartyconsumer* in CN or SAN of its certificate and similarly Consumer B's certificate must contain 10.10.10.10 in the SAN field of its certificate.
- If **mTLS** is enabled by the Third Party Consumer, it must trust the CA issuing certificate for OCNADD. The CA certificate for OCNADD's CA must be included in the trust store, *cacert* file or *ca-bundle* of the Third Party Consumer.

CA Certificate Expiry

Suppose the CA certificate expires before the OCNADD certificate expiry. In that case, the customer can renew the CA (if self-managed) and reuse the certificate provided the CA certificate's hash, private key, public key, and so on remain the same.

Renewing the OCNADD certificate and performing a rollout restart after renewing the CA certificate will ensure that OCNADD services are using a valid, non-expired CA certificate. For more information, see, Renewing OCNADD Certificates.

4.2.6 Renewing OCNADD Certificates

Follow the steps in the sections below to renew the OCNADD certificates.

> **Note**
>
> Steps to renew the certificate vary based on the method used to create the certificates.

Certificate Generated Using CACert and CAKey

If the certificate is generated using CACert and CAKey:

1. Add the services whose certificates must be renewed in the `ssl_certs/default_values/renew_cert_files` file.

The following code snippet displays the services to be added if Internal TLS is enabled:

```
# This files contain the list of services for which certificate needs to
be renewed
# The service name should be exactly same for which the certificates has
been initially generated
# defaultDays is number of days upto which certificate should be renewed.
Certificate for all listed
# service will be updated with this value.

defaultDays=90

kafka-broker
zookeeper
ocnadduirouter
ocnaddadminservice
ocnaddalarm
ocnaddconfiguration
ocnaddhealthmonitoring
ocnaddscpaggregation
ocnaddnrfaggregation
ocnaddsepaggreagation
adapter
ocnaddcorrelation
ocnaddfilter
ocnaddbackuprestore
ocnaddpreupgradeaclhelmhook
```

2. Run the following command:

```
./generate_certs.sh -cacert <path to>/cacert.pem -cakey <path to>/
cakey.pem --renew
```

3. Choose the mode of deployment when prompted *Select the mode of deployment*.
4. Choose the namespace where OCNADD, OCNADD management group services or OCNADD worker group services is/are deployed when prompted *Enter kubernetes namespace*:
5. Provide password to your CA key when prompted *Enter passphrase for CA Key file*:
6. Older certificates will be revoked and newer certificates will be created and the rollout restart of services will be performed.

Only CSR is Generated

If only the CSR is generated:

1. Navigate to `ssl_certs/demoCA/dd_mgmt_worker_services/<namespace>/services/<service-name>/client` or `ssl_certs/demoCA/dd_mgmt_worker_services/<namespace>/services/<service-name>/server ssl_certs/` for each <service-name> given in default_values/values file.
   For example, navigating to client folder for adapter service in worker group namespace `ocnadd-deploy-wg1`

```
[ssl_certs]$ ls
default_values demoCA generate_certs.sh generate_secrets.sh logs template
[ssl_certs]$ cd demoCA/dd_mgmt_worker_services/ocnadd-deploy-wg1/services/
```

```
adapter/client/
[client]$ ls
adapter-clientcert.pem adapter-client.csr adapter-clientprivatekey.pem
adapter_client_ssl.cnf client_rsa_certificate.crt
```

2. Delete the old CSR request.
   The following example displays how to delete the old CSR request for the adapter service:

   ```
   [client]$ ls
   adapter-clientcert.pem  adapter-client.csr  adapter-clientprivatekey.pem
   adapter_client_ssl.cnf  client_rsa_certificate.crt
   [client]$ rm adapter-client.csr
   [client]$ ls
   adapter-clientcert.pem  adapter-clientprivatekey.pem
   adapter_client_ssl.cnf  client_rsa_certificate.crt
   ```

3. To create a new CSR (client.csr) from the old certificate (clientcert.pem) and private key (clientprivatekey.pem), run the following command:

   ```
   openssl x509 -x509toreq -in clientcert.pem -signkey clientprivatekey.pem -
   out client.csr
   ```

   The following example displays how to create a new client CSR for the adapter service:

   ```
   [client]$ ls
   adapter-clientcert.pem  adapter-clientprivatekey.pem
   adapter_client_ssl.cnf  client_rsa_certificate.crt
   [client]$ openssl x509 -x509toreq -in adapter-clientcert.pem -signkey
   adapter-clientprivatekey.pem -out adapter-client.csr
   Getting request Private Key
   Generating certificate request
   [client]$ ls
   adapter-clientcert.pem  adapter-client.csr  adapter-clientprivatekey.pem
   adapter_client_ssl.cnf  client_rsa_certificate.crt
   [client]$
   ```

4. Repeat the steps 1 up to 3 for all other services.
5. Create new certificates from the newly created CSR and follow the "Generate Certificate Signing Request (CSR)" procedure from step 5 in the *Oracle Communications Network Analytics Data Director Installation, Upgrade, and Fault Recovery Guide.*
6. Run the following commands to perform rollout restart of all OCNADD services:

   ```
   kubectl rollout restart -n <ocnadd-deploy> deployment
   ```

   Where `<ocnadd-deploy>` is the namespace where OCNADD, OCNADD management group services or OCNADD worker group services is/are deployed.

Certificate is Generated Using OCCM

OCCM monitors the certificate validity and initiates automatic certificate renewal based on the renew before period configuration.

Update the `renewBefore` (Days) parameter in the `custom_values.yaml` file to specify the desired number of days before the certificate expiration when renewal should occur. Refer to

the Oracle Communications Certificate Management guide to determine the certificate expiration period. After updating the parameter and renewing the certificates, restart the deployments and statefulsets for both the management group and worker group using the following commands:

```
kubectl rollout restart -n <ocnadd-deploy> deployment
kubectl rollout restart -n <ocnadd-deploy> statefulset
```

4.2.7 Signing OCI Container Registry Images for Security

To meet security requirements, images can be signed and stored in Oracle Cloud Infrastructure Registry (also known as Container Registry).

Signed images provide a way to verify both the source of an image and its integrity.

Signing an image requires an Encryption Key.

The Encryption Key can be created as follows:

1. Log in to the OCI Console.
2. Click the **Hamburger** menu and select **Identity and Security**.
3. Under **Identity and Security**, select **Vault**.
4. Click the **Create Vault** button.
5. Enter the name of the vault to be kept.
6. Click the **Create Vault** button.
7. After some time, the vault is created.
8. Click the newly created vault.
9. Click **Master Key Encryption**.
10. Click **Create Key**:
    a. Select **Protection Mode** as **Software**.
    b. Enter the name of the key to be kept.
    c. Select **Key Shape Algorithm** as **RSA** and **KeyShape Length** as 2048.
    d. Click **Create Key**.

To sign the image pushed into Container Registry using the master key and key version in the Vault service:

1. Open the Developer Tool and click **Cloud Shell**.
2. Run the following command to sign the image:

   ```
   oci artifacts container image-signature sign-upload --compartment-id
   <compartment-ocid> --kms-key-id <key-ocid> --kms-key-version-id <key-
   version-ocid> --signing-algorithm <signing-algorithm> --image-id <image-
   ocid> --description <signature-description> --metadata <image-metadata-
   json>
   ```

   Where,

- `--compartment-id <compartment-ocid>`: Copy from compartment OCID from Identity >> Compartments >> <YOUR COMPARTMENT> >> OCID Copy.
- `--kms-key-id <key-ocid>`: Copy the Version of key from Key Management & Secret Management >> Vaults >> <VAULT_NAME> >> KeyDetails >> OCID Copy.
- `--kms-key-version-id <key-version-ocid>`: Copy the Version of key from Key Management & Secret Management >> Vaults >> <VAULT_NAME> >> KeyDetails >> Key Version Copy.
- `--signing-algorithm <signing-algorithm>`: Any one of the following: SHA_224_RSA_PKCS_PSS, SHA_256_RSA_PKCS_PSS, SHA_384_RSA_PKCS_PSS, SHA_512_RSA_PKCS_PSS.
- `--image-id <image-ocid>`: Copy image OCID from Container Registry >> <IMAGE_NAME> >> <VERSION> >> OCID Copy.
- <Optional>`--description <signature-description>`: Description of the signature.
- <Optional>`--metadata <image-metadata-json>`: JSON file that contains metadata of the image.

To verify if the image is signed:

1. Open the navigation menu and click **Developer Services**.
2. Under **Containers & Artifacts**, click **Container Registry**.
3. Select the region that contains the repository.
4. Select the compartment that contains the repository.
   The **Repositories and images** field lists the repositories in the selected region and compartment to which you have access.
5. Click the plus (**+**) button beside the name of a repository containing signed images. Below the name of the repository, the images in the repository are listed that can be identified by the version identifier of each image.

   The text **"(Signed)"** appears beside images that have been signed.

4.2.8 Cleaning Up Sensitive Information After Installation

The Helm chart contains critical information, which is required only during installation. Hence, take backup of Helm chart and remove it from bastion server after deployment.

A
Network Port Flows

This section describes network port flows for CNE and OCNWDAF.

Network Port Flows

- Cluster IP addresses are reachable outside of the cluster and are typically assigned by using a Network Load Balancer.
- Node IP addresses are reachable from the bastion host (and may be exposed outside of the cluster).

CNE Port Flows

Table A-1 CNE Port Flows

Name	Server/ Container	Ingress Port ext[:int]/ Proto	TLS	Cluster IP (Service IP)	Node IP	Notes
SSH	ALL	22/TCP	Y		SSH Access	Administrative SSH Access. Only root or key is not allowed.
Repository	Bastion Host	80/TCP,443/ TCP, 5000/TCP			Repository Access	Access repositories (YUM, Docker, Helm, and so on.)
MySQL Query	MySQL SQL Node	3306/TCP	N		Microservice SQL Access	The SQL Query interfaces are used for NWDAF to access the database.
ETCD Client	Kubernetes Master Nodes	2379/TCP	Y		Client Access	Keystore DB used by Kubernetes
Kubelet API	Kubernetes Nodes	10250/TCP	Y		Control Plane Node Access	API which allows full node access.
Kubelet State	Kubernetes Nodes	10255/TCP	Y		Node State Access	Unauthenticated read-only port, allowing access to node state.
Kube-proxy	Kubernetes Nodes	10256/TCP	N		Health Check	Health check server for Kube Proxy.
Kube-controller	Kubernetes Nodes	10257/TCP	Y		Controller Access	HTTPS Access
Kube-Scheduler	Kubernetes Node	10259/TCP	Y		Scheduler Access	HTTPS Access

Table A-1 (Cont.) CNE Port Flows

Name	Server/ Container	Ingress Port ext[:int]/ Proto	TLS	Cluster IP (Service IP)	Node IP	Notes
Jaeger Agent	Kubernetes Nodes	5775/UDP	N		Agent	Accepts zipkin.thrift in compact Thrift protocol (deprecated; only used by very old Jaeger clients, circa 2016).
Jaeger Agent	Kubernetes Nodes	5778/TCP	N		Agent	Serves SDK configs, namely sampling strategies at /sampling.
Jaeger Agent	Kubernetes Nodes	6831/UDP	N		Agent	UDP Accepts jaeger.thrift in compact Thrift protocol used by most current Jaeger clients.
Jaeger Agent	Kubernetes Nodes	6831/UDP	N		Agent	UDP Accepts jaeger.thrift in binary Thrift protocol used by Node.js Jaeger client (because thriftrw npm package does not support compact protocol).
Jaeger Agent	Kubernetes Nodes	14271/TCP	N		Agent	Admin port: health check at / and metrics at /metrics.
Jaeger Collector	Kubernetes Nodes	9411/TCP	N		Collector	Accepts Zipkin spans in Thrift, JSON and Proto (disabled by default).
Jaeger Collector	Kubernetes Nodes	14250/TCP	N		Collector	Used by jaeger-agent to send spans in model.proto format.
Jaeger Collector	Kubernetes Nodes	14268/TCP	N		Collector	Accepts spans directly from clients in jaeger.thrift format with binary thrift protocol (POST to /api/traces). Also serves sampling policies at /api/sampling, similar to Agent's port 5778.
Jaeger Collector	Kubernetes Nodes	14269/TCP	N		Collector	Admin port: health check at / and metrics at /metrics.
Jaeger-Query	Kubernetes Nodes	80/TCP	N	GUI		Service frontend
Prometheus Server	Kubernetes Nodes	80/TCP	N	GUI		Prometheus Server

Table A-1 (Cont.) CNE Port Flows

Name	Server/ Container	Ingress Port ext[:int]/ Proto	TLS	Cluster IP (Service IP)	Node IP	Notes
Prometheus-Exporter	Kubernetes Nodes	9100/TCP	N		Prometheus Exporter	Prometheus Exporter
Alertmanager	Kubernetes Nodes	80/TCP	N	GUI		The Alertmanager handles alerts sent by client applications such as the Prometheus server.

OCNWDAF Port Flows

Table A-2 OCNWDAF Port Flows

Name	Server / Container	Ingress Port [external]:internal	TLS	Cluster IP (Service IP)	Node IP	Notes
NWDAF	Kubernetes Nodes/ NWDAF Service	8080/TCP	Y	Ingress Gateway	ocn-nwdaf-gateway-service	NWDAF
NWDAF Portal	Kubernetes Nodes/ NWDAF Service	80/TCP	Y	GUI	nwdaf-portal	NWDAF GUI web.