# Oracle® Communications

# Cloud Native Core, Certificate Management User Guide

Release 23.4.4
F87126-05
October 2024

Oracle Communications Cloud Native Core, Certificate Management User Guide, Release 23.4.4

F87126-05

# Contents

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# Acronyms

The following table lists the acronyms and the terminologies used in the document:

**Table Acronyms and Terminologies**

| Acronym | Definition |
|---|---|
| 3GPP | 3rd Generation Partnership Project |
| API | Application Programming Interface |
| CCA | Client Credentials Assertions |
| CMP | Certificate Management Protocol |
| CNC | Cloud Native Core |
| CNC Console | Cloud Native Configuration Console |
| OCCM | Oracle Communications Certificate Management |
| CA | Certification Authority is a trusted entity that issues Secure Sockets Layer (SSL) certificates. CAs are also called issuer in this document. |
| DNS | Domain Name Server |
| EE | End Entity |
| ECC | Elliptic Curve Cryptography |
| HSM | Hardware Security Module |
| IDP | Identity Provider |
| LCM | Life Cycle Management |
| PKI | Public Key Infrastructure |
| RA | Registration Authority |
| RSA | Rivest-Shamir-Adleman |
| SAN | Subject Alternative Name |
| URI | Uniform Resource Indicator |
| URN | Uniform Resource Name |
| CMP Identity Key | Private Key used by Certificate Management to sign the CMPv2 requests and establish trust between Certificate Management and CA. |
| CMP Identuty Certificate | Certificate that corresponds to and certifies the CMP Identity Key. It is included in the CMPv2 requests for authentication by CA. |

# What's New in This Guide

This section lists the documentation updates for Release 23.4.x.

**Release 23.4.4 - F87126-05, October 2024**

- Updated the OccmFailureMinor description.

**Release 23.4.3 - F87126-04, July 2024**

There are no updates in this release.

**Release 23.4.2 - F87126-03, April 2024**

There are no updates in this release.

**Release 23.4.1 - F87126-02, March 2024**

- Updated the descriptions for the Issuer Distinguished Name and Recipient Distinguished Name in the Creating Issuer section.

**Release 23.4.0 - F87126-01, December 2023**

This is the initial release of this document.

# 1 Introduction

Oracle Communications Cloud Native core, Certificate Management (OCCM) is an automated solution for managing the certificates needed for Oracle 5G Network Functions (NFs). OCCM constantly monitors and renews the certificates based on their validity or expiry period.

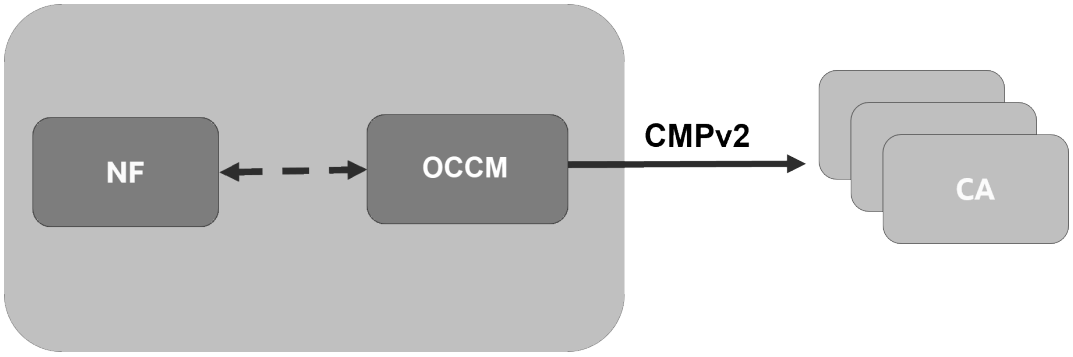
As 3GPP recommends using separate certificates based on the client or server mode and the type of workflow, it leads to many certificates in the network. Automated certificate management eliminates any possibilities of network disruption due to expired certificates. In SBA network deployments, the Network Functions (NFs) are required to support multiple operator certificates for different purposes and interfaces. This amounts to hundreds of certificates in the network with varying validity periods and unwieldy to monitor and renew the certificates manually. Hence, automation of certificate management becomes important to avoid network disruptions due to expired certificates.

## 1.1 Overview

OCCM integrates with the Certificate Authority(s) using Certificate Management Protocol Version 2 (CMPv2) and RFC4210 to facilitate these certificate management operations:

- Operator-initiated certificate creation
- Operator-initiated certificate recreation
- Automatic certificate monitoring and renewal

**Figure 1-1 OCCM Integration with CA**




OCCM supports transport of CMPv2 messages using HTTP-based protocol.

OCCM provides the following mechanisms to establish initial trust between OCCM and CA(s):

1. Certificate-based message signing
2. Pre-shared key or MAC based authentication

All the subsequent CMPv2 procedures are authenticated using the certificate-based mechanism in compliance with 3GPP TS 33.310.

The keys and X.509 certificates are managed using Kubernetes secrets.

# 1.2 Reference

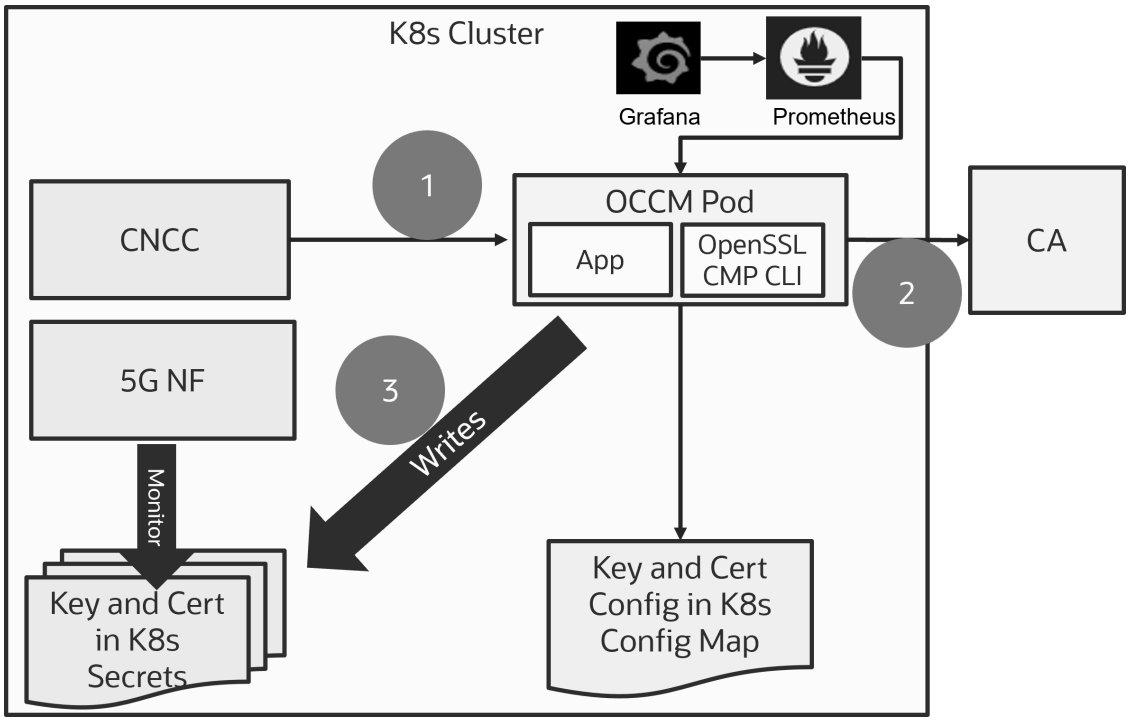
Refer to the following documents for more information:

- *Oracle Communications Cloud Native Configuration Console User Guide*
- *Oracle Communications Cloud Native Configuration Console Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core Security Guide*
- *Oracle Communications Cloud Native Core Solution Upgrade Guide*

# 2
# OCCM Architecture

OCCM is a Cloud Native application consisting of a single microservice. OCCM is packaged and delivered as a CSAR or Helm chart.

**Figure 2-1 OCCM Architecture**




### Architecture Description

OCCM is deployed as a single Kubernetes POD and has a small resource footprint. The OCCM application uses a set of OpenSSL Certificate Management Protocol (CMP) CLI commands based on the provided configuration and the certificate management procedure that needs to be carried out at a point in time. The Output – Key and Certificate – is stored in configuration defined Kubernetes secret.

Operator provides the desired key and certificate configuration through Console. OCCM contacts the CA for certificate signing. After successful Certificate creation, OCCM writes the key and cert in Kubernetes secrets.

OCCM provides the following deployment models to support certificate management for the integrated NF(s) instantiated within the same cluster:

- Dedicated deployment model - OCCM resides in the same Kubernetes namespace as the NF or Components.
- Shared deployment model - OCCM is deployed in a separate Kubernetes namespace and can manage certificates of multiple NFs or components deployed in other Kubernetes namespaces.

Appropriate permissions must be assigned to OCCM using Kubernetes Service Account, Role and Role Binding, based on the selected deployment model.

# 3
# OCCM Supported Features

This section describes the features supported by Oracle Communications Cloud Native core, Certificate Management (OCCM).

## 3.1 Integration with Certificate Authority

OCCM integrates with one or more Certificate Authorities (CAs) using the Certificate Management Protocol version 2 (CMPv2), as proposed by the 3GPP TS33.310. Operators have the flexibility to configure OCCM to integrate with a single CA or multiple CAs, depending on the layout of CA hierarchy deployed in the network. However, it is recommended that each intermediate CA manage multiple certificates of the same type.

The two CMPv2 procedures used by OCCM are:

- Initialization procedure: This is used to create certificates.
- Key update procedure: This is used for certificate renewal scenarios.

OCCM employs two modes to establish initial trust between OCCM and CAs for initial trust establishment:

- Using a pre-shared key
- Using a key and certificate

These options are available when the first request is made towards the CA. For all subsequent requests, OCCM uses the certificate based mechanism to sign the CMPv2 requests in compliance with 3GPP standards.

> **Note**
>
> OCCM supports HTTP 1.0 and HTTP 1.1 versions. OCCM initiates the request using HTTP 1.0. If the CA supports HTTP 1.1 only, then OCCM shifts to using HTTP 1.1 version. HTTPs is not supported in this release.

### 3.1.1 Establishing Initial Trust Between OCCM and CA

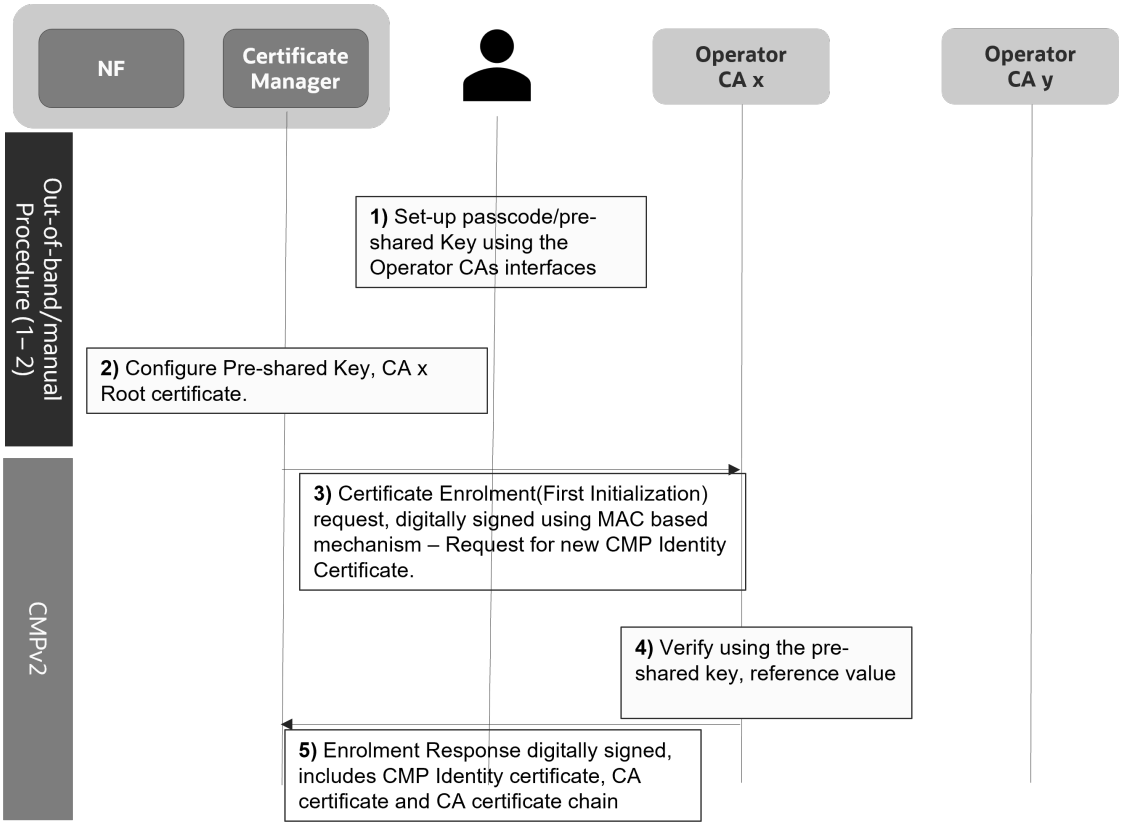
OCCM can be configured to establish trust between Oracle Communication Certificate (OCCM) and Certificate Authorities (CAs) by enabling PKI message protection in the following ways:

- MAC based trust establishment
- Certificate based trust establishment

#### 3.1.1.1 MAC Based Trust Establishment

OCCM supports initial trust establishment with each of the configured CAs using the preconfigured pre-shared (MAC) key.

**Figure 3-1 MAC Based Trust Establishment**

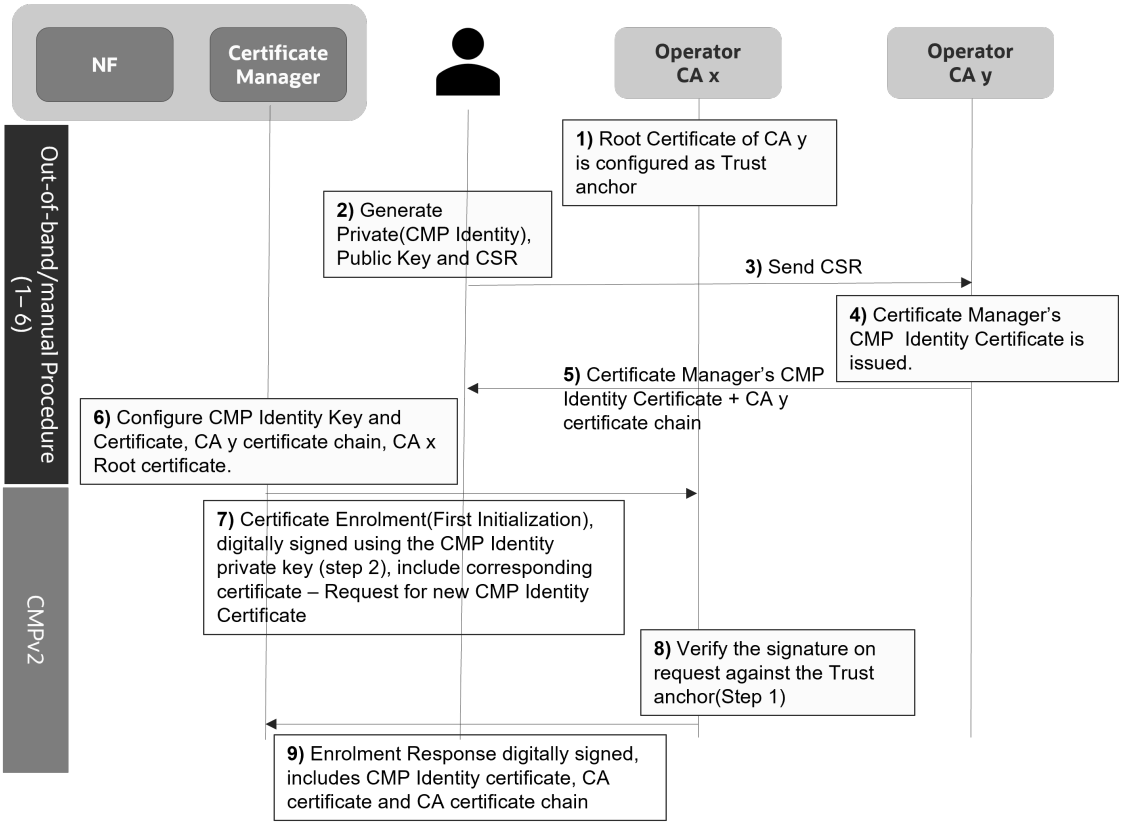



OCCM generates the key pair and requests for the OCCM certificate for each of the configured CAs using the first Initialization Request. The first Initialization Request towards each of the CAs is signed using the preshared key. The CA authenticates the initialization request and signs the OCCM Certificate. OCCM can be configured to authenticate the responses of the first initializing procedure using the preshared (MAC) key. All subsequent requests are always signed using the OCCM key and certificate.

## 3.1.1.2 Certificate Based Trust Establishment

OCCM supports initial trust establishment with CA using the preconfigured private key and x.509 certificate.

**Figure 3-2 Certificate Based Trust Establishment**




OCCM signs the first initialization request towards a CA using preconfigured key or certificate.

OCCM can be configured to:

- Continue using the same key and certificate to sign the subsequent CMPv2 requests OR
- Generate a new certificate using the first Initialization Request

In case OCCM uses the same key and certificate to sign the subsequent CMPv2 requests, OCCM requests for generation of the NF certificate in the first Initialization Request.

In case OCCM generates a new certificate using the first Initialization Request, OCCM requests for generation of OCCM certificate in the first Initialization Request. NF Certificate generation is requested from next Initialization Request onwards.

# 3.2 Managing Issuers

Issuers, also called Certificate Authorities (CAs), are a trusted entity that issues Secure Sockets Layer (SSL) certificates. OCCM supports the following aspects of issuer management:

- Pre-configuration for OCCM Bootstrapping
- Creating Issuers
- Updating Issuers
- Deleting Issuers

## 3.2.1 Pre-configuration for OCCM Bootstrapping

The following secrets can be pre-configured for OCCM bootstrapping:

- **MAC Secret:** The MAC secret is a manually configured pre-shared key or password based MAC secret and reference. This is used by OCCM to sign the first initialization request. CA then validates the request and issues a signed OCCM certificate. For more information see the 'Using the pre-shared key' section in OCCM Certificate Configuration Modes.
  To create the MAC Secret, run the following command:

  ```
  kubectl create secret generic <k8s secret name> --from-literal=<mac secret key>=<mac secret value> --from-literal=<reference key>=<reference value> -n <namespace>
  ```

  For example:

  ```
  kubectl create secret generic ca1-mac-secret --from-literal=pwd='pass:****' --from-literal=ref='abcd' -n ns1
  ```

- **CMP Identity Secret:** The CMP Identity secret is a manually configured private key and certificate, using which OCCM certificate is requested from CA. This is used by OCCM to sign the first initialization request. CA then validates the request and issues a signed OCCM certificate. You can also use the same private key and certificate as OCCM certificate. For more information, see the 'Using the pre-configured private key and certificate' section in OCCM Certificate Configuration Modes
  To create the CMP Identity Key, run the following command:

  ```
  kubectl create secret generic <k8s secret name> --from-file=<cmp key file location> --from-file=<cmp cert file location> -n <namespace>
  ```

  For example:

  ```
  kubectl create secret generic ca1-cmp-identity-secret --from-file=cmpkey.pem --from-file=cmpcert.pem -n ns1
  ```

- **OCCM Trust Store Secret:** The OCCM Trust Store secret holds OCCM trust store information (CA certificates), and is used as a trust anchor when validating the digital signature included in the CMP responses.
  To create the OCCM Trust Store secret, run the following command:

  ```
  kubectl create secret generic <k8s secret name> --from-file=<CA root cert file location> --from-file=<Intermediate CA cert file location> --from-file=<CMP server cert file location> -n <namespace>
  ```

  For example:

  ```
  kubectl create secret generic ca1-occm-trust-store-secret --from-file=caroot.pem --from-file=intcacert.pem --from-file=servercert.pem -n ns1
  ```

# 3.2.2 Creating Issuer

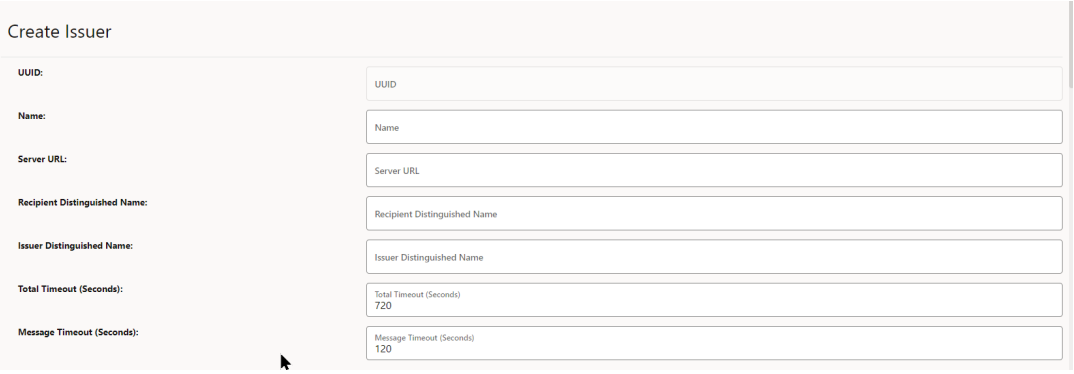
Issuers are resources that represent CAs and are able to generate signed certificates. You can configure issuers through REST API or using the CNC Console GUI. The maximum number of issuers that can be supported at a time is 30.

### Configuring Issuer Using CNC Console GUI

To manually configure issuer using CNC Console GUI:

1. Log in to CNC Console using your log in credentials and select the OCCM Instance.
2. Click **OCCM** from the left pane and then click **Issuer**.
3. Click **Add**. The **Create Issuer** page appears.

**Figure 3-3 Create Issuer**




4. Enter the following information on the Create Issuer page :

**Table 3-1 Create Issuer**

| Field Name | Description |
|---|---|
| Name | Name of the Issuer |
| Recipient Distinguished Name | Distinguished name(DN) of the CMP server(usually the addressed CA). Used in the recipient field of CMP request message headers.<br>The argument must be formatted as /type0=value0/type1=value1/type2=....<br>Special characters may be escaped by \ (backslash); whitespace is retained. Empty values are permitted, but the corresponding type will not be included. Giving a single / will lead to an empty sequence of RDNs (a NULL-DN). Multi-valued RDNs can be formed by placing a + character instead of a / between the AttributeValueAssertions (AVAs) that specify the members of the set. Example:<br>`/DC=org/DC=OpenSSL/DC=users/UID=123456+CN=John Doe` |

**Table 3-1 (Cont.) Create Issuer**

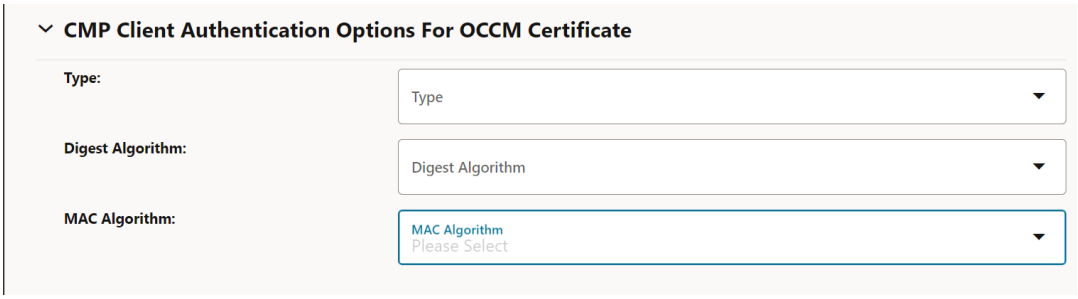
| Field Name | Description |
|---|---|
| Issuer Distinguished Name | X509 issuer Distinguished Name of the CA server to place in the requested certificate template in IR/KUR.<br>The argument must be formatted as / type0=value0/type1=value1/type2=....<br>Special characters may be escaped by \ (backslash); whitespace is retained. Empty values are permitted, but the corresponding type will not be included. Giving a single / will lead to an empty sequence of RDNs (a NULL-DN). Multi-valued RDNs can be formed by placing a + character instead of a / between the AttributeValueAssertions (AVAs) that specify the members of the set. Example:<br>`/DC=org/DC=OpenSSL/DC=users/ UID=123456+CN=John Doe` |
| Total Timeout (Seconds) | The total time in seconds allowed for the CMP transaction to complete |
| Message Timeout (Seconds) | The total time (in seconds) a CMP request-response message round trip is allowed to take. |

5. Under **CMP Client Authentication Options For OCCM certificate**, enter the following information:

**Table 3-2 Initial Authentication Options**

| Field Name | Possible Values |
|---|---|
| Type | MAC, SIGNATURE<br>For more information, see OCCM Certificate Configuration Modes. |
| Digest Algorithm | SHA256, SHA384, SHA512 |
| MAC Algorithm | HMACSHA256, HMACSHA384, HMACSHA512 |

**Figure 3-4 CMP Client Authentication Options For OCCM Certificate**

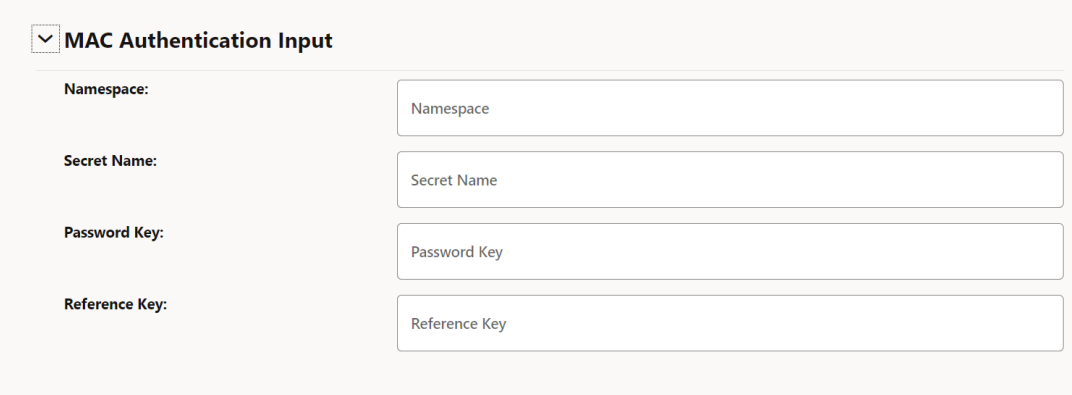



6. If you are using the password based MAC authentication mechanism, then under **MAC Authentication Input**, enter the following information:

**Table 3-3 MAC Authentication Input**

| Field Name | Description |
|---|---|
| Namespace | Name of the Kubernetes namespace |
| Secret Name | Kubernetes secret name |
| Password Key | Kubernetes secret data key against which MAC secret is provided. |
| Reference Key | Kubernetes secret data key against which reference string is provided. |

**Figure 3-5 MAC Authentication Input**

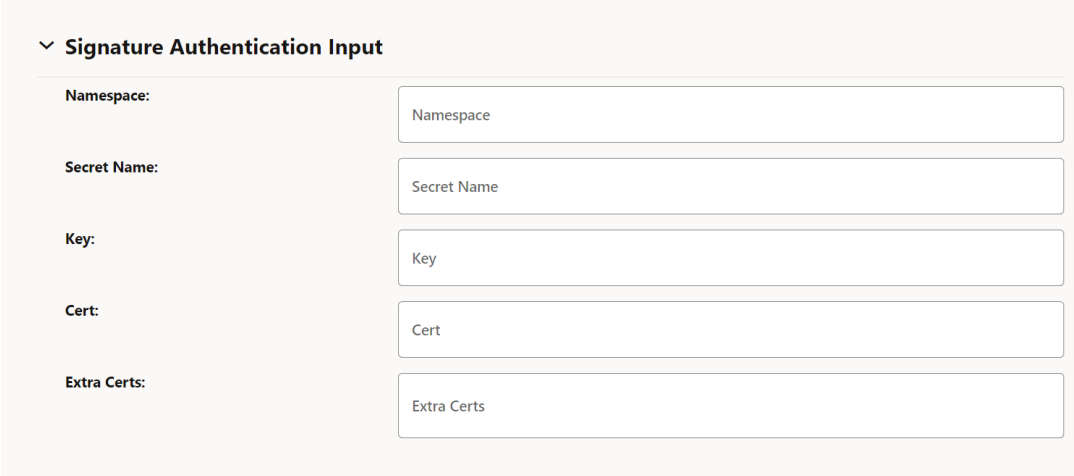



7. Under **Signature Authentication Input,** enter the following information:

**Table 3-4 Signature Authentication Input**

| Field Name | Description |
|---|---|
| Namespace | Name of the Kubernetes namespace |
| Secret Name | A unique secret name |
| Key | Kubernetes secret data key against which the pre-configured private key file (private key file for the client's current CMP signer certificate) is provided. |
| Cert | Kubernetes secret data key against which the pre-configured certificate (client's current CMP signer certificate) is provided. |
| Extra Certs | Extra Certificates, if any, for client authentication. |

**Figure 3-6 Signature Authentication Input**

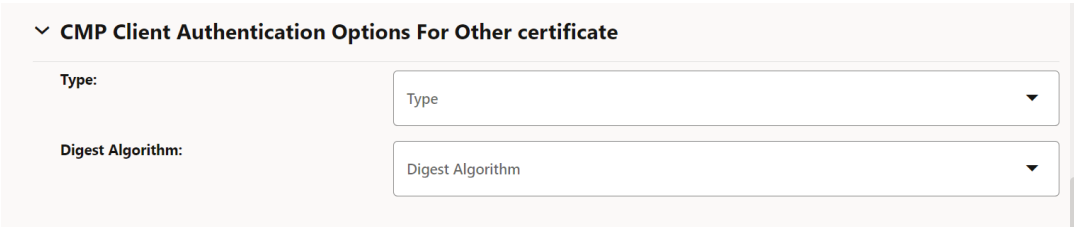



8. Under **CMP Client Authentication Options For Other certificate**, enter the following information:

**Table 3-5 CMP Client Authentication Options For Other certificate**

| Field Name | Possible Values |
|---|---|
| Type | SIGNATURE |
| Digest Algorithm | SHA256, SHA384, SHA512 |

**Figure 3-7 CMP Client Authentication Options For Other certificate**




9. Under **Signature Authentication Input,** enter the following information:

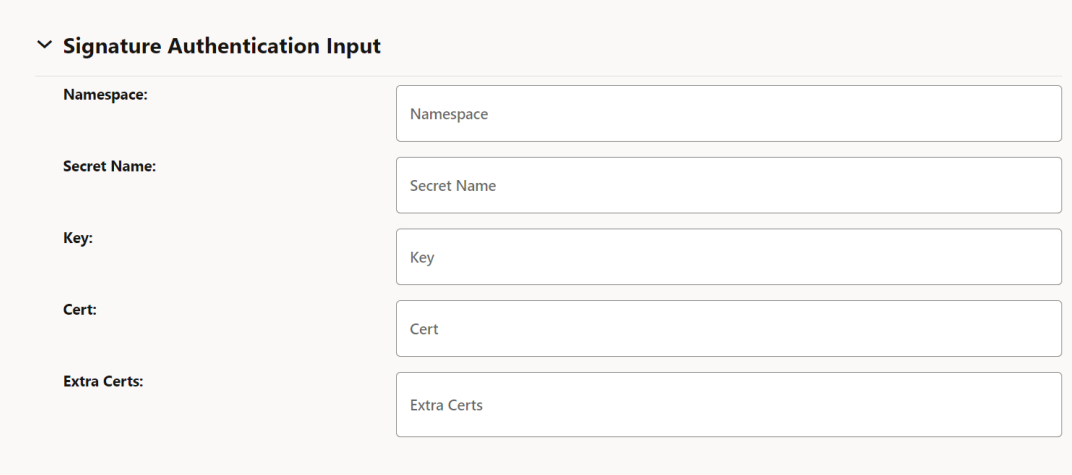
**Table 3-6 Signature Authentication Input**

| Field Name | Description |
|---|---|
| Namespace | Name of the Kubernetes namespace |
| Secret Name | A unique secret name |
| Key | Kubernetes secret data key against which OCCM key is provided or created based on whether OCCM certificate is created in manual or automatic mode. |
| Cert | Kubernetes secret data key against which OCCM certificate is provided or created based on whether OCCM cert is created in manual or automatic mode. |

**Table 3-6 (Cont.) Signature Authentication Input**

| Field Name | Description |
|---|---|
| Extra Certs | List of Kubernetes secret data keys against which the certificates to append in the extraCerts field can be provided or will be created (if received from CA) along with the OCCM certificate, based on whether OCCM cert is created in manual or automatic mode. |

**Figure 3-8 Signature Authentication Input**

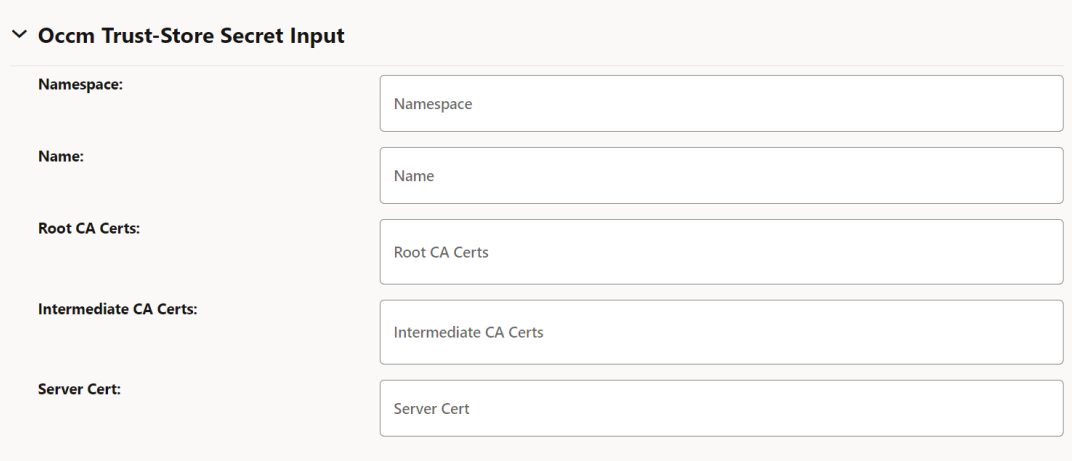



10. Under **Occm Trust-Store Secret Input**, enter the following information:

**Table 3-7 Occm Trust-Store Secret Input**

| Field | Description |
|---|---|
| Namespace | Name of the Kubernetes namepace |
| Name | Kubernetes secret which holds OCCM trust store information (CA certificates). |
| Root CA Certs | The certificate(s), typically of root CAs, the client shall use as trust anchors when validating the certificate issued by CA.<br>**Note**: If server cert is present this is ignored. |
| Intermediate CA Certs | Any untrusted intermediate CA certificate(s) to use when validating newly enrolled certificates. |
| Server Cert | CMP server or CA server's certificate to expect and directly trust when validating the certificate issued by CA.<br>**Note**: If this is present root CA certificates will be ignored. |

**Figure 3-9 Occm Trust-Store Secret Input**



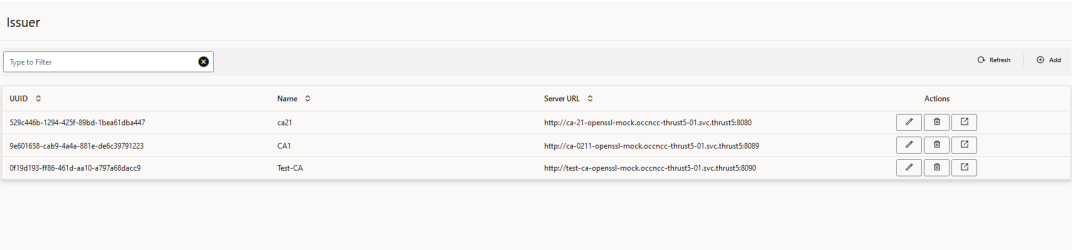

11. Enter either the root CA certificates and intermediate CA certificate, or the server certificate in the respective fields.
12. Click **Save**.

## 3.2.3 Updating Issuer

You can update the issuer as long as it is not in use by any certificate. To update the issuer:

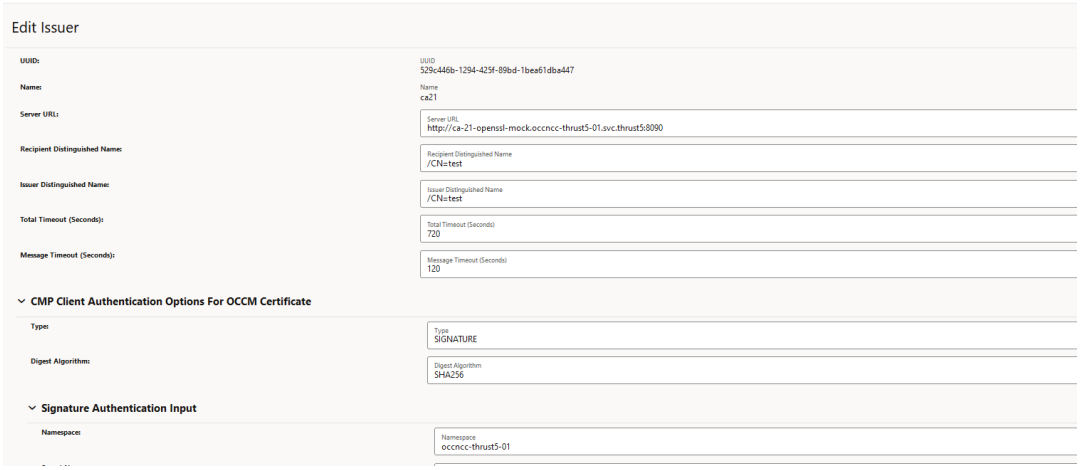
1. Log in to CNC Console using your log in credentials and select the OCCM Instance.
2. Click **OCCM** from the left pane and then click **Issuer**.

**Figure 3-10 Issuer Page**




3. Click the pencil icon next to the issuer that you want to update. The Edit Issuer page appears.

**Figure 3-11 Edit Issuer**




4. Edit the fields that you need to update and then click **Save**

> **Note**
>
> Issuer can't be edited if it is in use by any certificate.

## 3.2.4 Deleting Issuers

To delete issuers:

1. Log in to CNC Console using the log in credentials, and select the OCCM Instance.
2. Click **OCCM** from the left pane and then click **Issuer**.
3. Click **Delete** and click **OK** on the confirmation prompt to delete the issuer.

> **Note**
>
> An issuer can only be deleted if there are no certificates referring to this issuer entry.

# 3.3 Managing Certificates

OCCM creates a new key-pair (private and public key) for each of the certificates to be created. This is applicable to both NF and OCCM certificates.

OCCM supports the following key aspects of certificate management:

- Creating OCCM Certificates
- Creating NF Certificates
- Monitoring and Renewing OCCM and NF Certificates

> **Note**
>
> - Grafana dashboards can be used to visualize certificate status such as expiry time, etc.
> - The maximum number of certificates supported (OCCM certificates and NF certificates combined) is 100.

## 3.3.1 Creating OCCM Certificates

Each certificate configuration in OCCM is a certificate request. It specifies input fields that are used to generate a private key pair and certificate signing request to obtain a signed certificate from the referenced issuer.

To create an OCCM certificate:

- A CMPv2 Initialization Request is sent to the CA. Each request supports one certificate request. A separate initialization request for each certificate request is used.
- The Initialization Requests and Certificate Confirms are digitally signed by the CMP Identity Key.
- OCCM supports Proof of Possession (PoP) in the initialization request. PoP of the signing key contains the algorithm identifier and signature. This signature is based on the certificates template structure.
- The recommended signing algorithms for the CMPv2 messages and Proof of Possession are RSA Encryption and ECDSA.
- The recommended hash algorithms for the CMPv2 messages and Proof of Possession are SHA-256 and SHA-384.

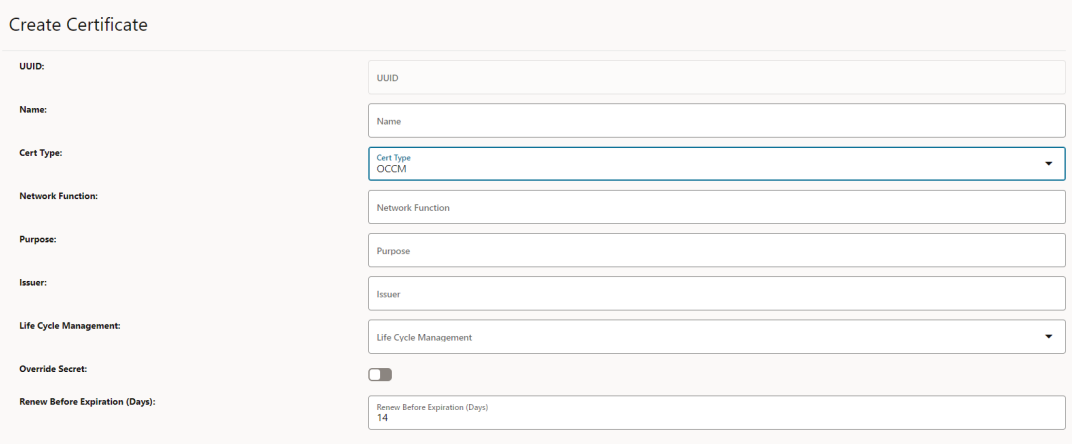
When the preshared key mechanism is used to establish the initial trust between OCCM and CA, the first OCCM certificate, also known as CMP Identity Key Certificate, corresponding to a particular CA is created in the first initialization procedure.

When certificate based initial trust is established, then the operator can choose to continue with the preconfigured OCCM certificate or can choose to create a new OCCM certificate via the first initialization procedure, which is configurable.

To create OCCM Certificates:

1. Log in to CNC Console using your log in credentials and select the OCCM Instance.
2. Click **OCCM** from the left pane and then click **Certificate**.
3. Click **Add**. The **Create Certificate** page appears.

**Figure 3-12 Create OCCM Certificate**




4. Enter the following information:

**Table 3-8 Create OCCM Certificate**

| Field Name | Description and Possible Values |
|---|---|
| Name | Name of the certificate |
| Cert Type | Select OCCM for OCCM certificates |
| Network Function | OCCM |
| Purpose | Purpose of the OCCM Certificate |
| Issuer | Name of the issuer for the certificate |
| Life Cycle Management | Possible values are MANUAL and AUTOMATIC. For more information, see OCCM Certificate Configuration Modes. |

5. Under **Private Key Options**, enter the following information:

**Table 3-9 Private Key Options**

| Field Name | Possible Values |
|---|---|
| Key Algorithm | RSA, EC |
| Key Encoding | DER, PEM |
| Key Size | KEYSIZE_2048, KEYSIZE_4096 |
| Elliptic Curve | SECP256k1, SECP384r1 |

**Figure 3-13 Private Key Options**


6. The **Private Key Output** section is auto populated from corresponding issuer after the certificate is saved. You can skip this section.

**Table 3-10 Private Key Output**

| Field Name | Description |
|---|---|
| Namespace | Name of the namespace |
| Secret Name | Kubernetes Secret Name |
| Key | Kubernetes secret key against which the key-pair will be stored. |

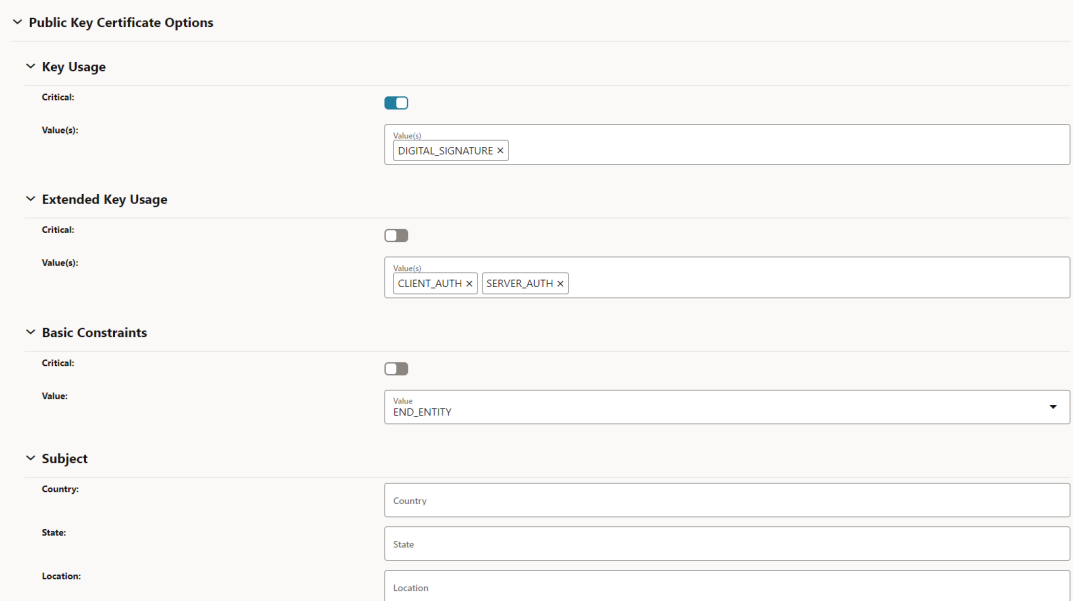
**Figure 3-14 Private Key Output**


7. Under **Public Key Certificate Options**, enter the following:

**Table 3-11 Public Key Certificate Options**

| Field Name | Description |
|---|---|
| Key Usage | Value(s): DIGITAL_SIGNATURE |
| Extended Key Usage | Value(s): CLIENT_AUTH and SERVER_AUTH |
| Basic Constraints | Value(s): END_ENTITY |
| Subject | Country: Enter country code:<br>State: Enter state code<br>Location: City or town where company is legally located.<br>Organization: Name of your organization<br>Organisation Unit: Name of business unit<br>Common Name: The Common Name (CN) represents the server name to be protected by the certificate.<br>Requested Validity (Days): Number of days requested for which the certificate will be valid. |

**Figure 3-15 Public Key Certificate Options**

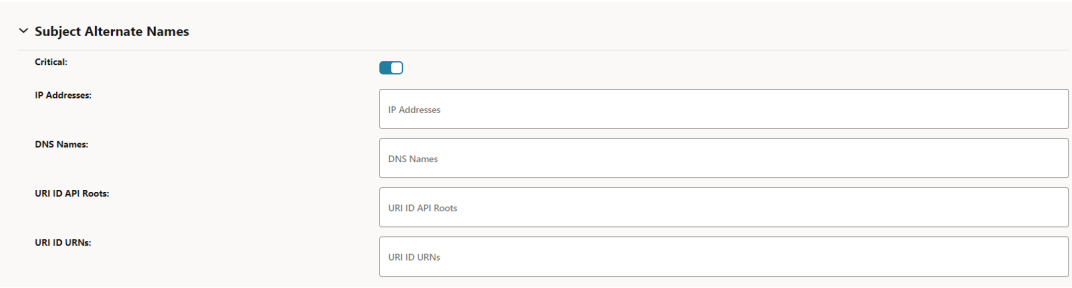



8. Under **Subject Alternate Names**, enter the following:

**Table 3-12 Subject Alternate Names**

| Field Name | Description |
|---|---|
| IP Address | The IPs you want to protect under this certificate |
| DNS Names | List of DNS domain names |
| URI ID API Roots | List of URI ID |
| URI ID URNs | List of URI ID |

**Figure 3-16 Subject Alternate Names**




9. The **Certificate Output** section is auto populated from corresponding issuer after the certificate is saved. You can skip this section.

**Table 3-13 Certificate Output**

| Field Name | Description |
|---|---|
| Namespace | Name of the namespace |
| Secret Name | Name of the secret |

**Table 3-13 (Cont.) Certificate Output**

| Field Name | Description |
|---|---|
| Key | The key against which the certificate will be populated |

**Figure 3-17 Certificate Output**


10. (Optional) Under **Certificate Chain Output**, enter the following:

**Table 3-14 Certificate Chain Output**

| Field Name | Description |
|---|---|
| Namespace | Name of the namespace |
| Secret Name | Name of the secret |
| Key | Kubernetes secret key against which the certificate chain will be stored. |

**Figure 3-18 Certificate Chain Output**


If the **Certificate Chain Output** section is filled, then the certificate chain can either be obtained from the CA or can be configured manually. This is based on the `extractCertChainFromCmpResponse` helm parameter. For more information, see *Oracle Communications Cloud Native Core, Certificate Management Installation, Upgrade, and Fault Recovery Guide*

> **Note**
>
> `extractCertChainFromCmpResponse:` This field when set true specifies that certificate chain will be extracted from CA's CMP response message. When false, the operator can configure the chain manually. This certificate chain is used in the TLS handshake along with the certificate.

11. Click **Save**.

# 3.3.1.1 OCCM Certificate Configuration Modes

The following section highlights the configuration applicable to these modes and control how the OCCM certificates are generated. The purpose of the following issuer configuration and certificate configuration sections is to highlight the difference in the fields for different modes.

OCCM can be configured with one of the following modes available to establish the initial Trust with the CA(s):

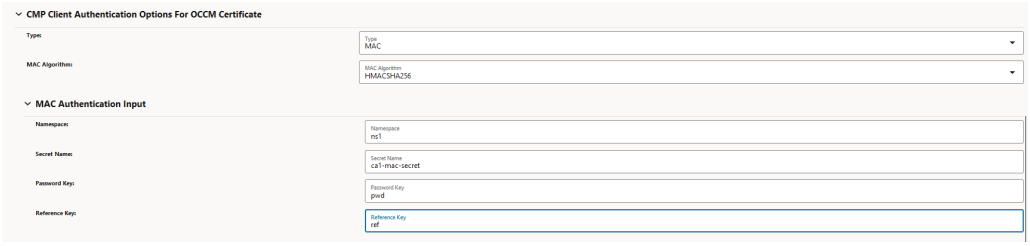
- Using the pre-shared key
- Using the pre-configured private key and certificate

### Using the Pre-shared Key

With this mode of configuration, OCCM signs the first initialization request using the pre-shared key. CA validates the request and issues a signed OCCM certificate.

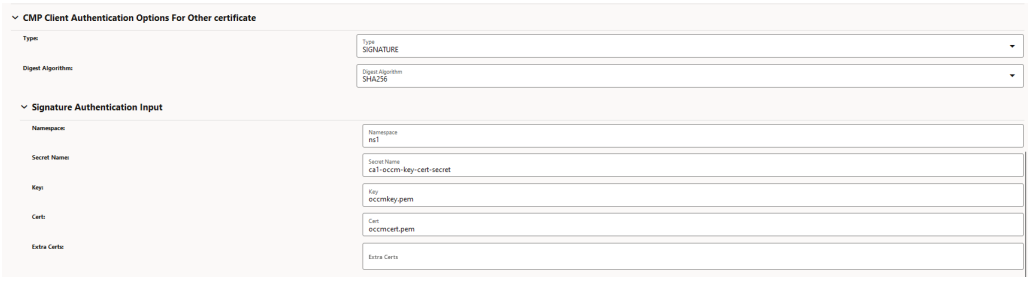
1. **Issuer configuration**
   To configure the issuer using the pre-shared key,
   a. The MAC authentication input must be provided under **CMP Client Authentication Options for OCCM Certificate**.

**Figure 3-19 CMP Client Authentication Options for OCCM Certificate**



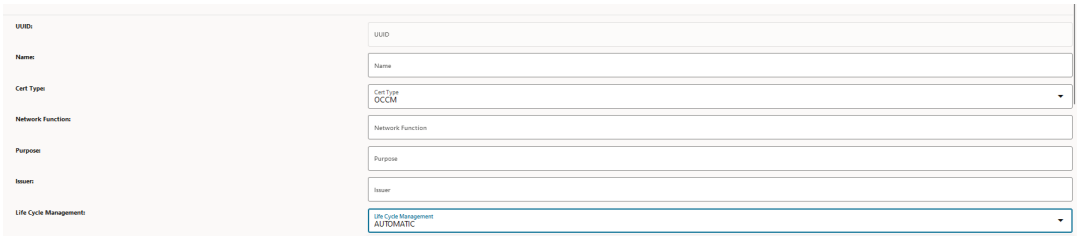

   b. OCCM key and certificate output location must be specified under **CMP Client Authentication Options for Other Certificate**. OCCM certificate received from CA will be written here.

**Figure 3-20 CMP Client Authentication Options for Other Certificate**




2. **Certificate configuration**
   To configure the OCCM Certificate using the pre-shared key, select OCCM from the **Cert Type** drop down, and select AUTOMATIC from the **Life Cycle Management** on the **Create Certificate** page.

**Figure 3-21 OCCM Certificate Configuration using Pre-shared Key**




### Using the pre-configured private key and certificate

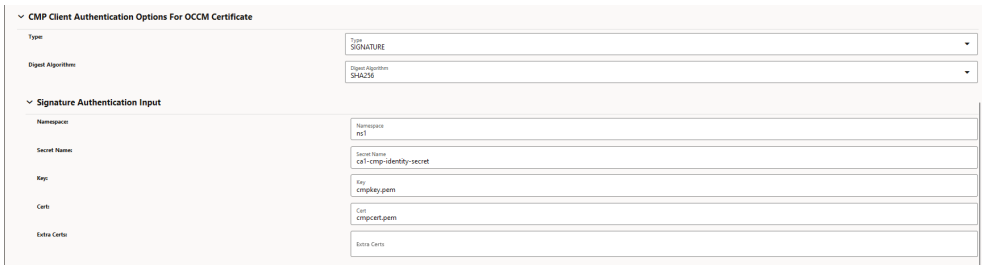
The pre-configured private key and certificate mode can be used in the following two ways:

1. OCCM signs the first initialization request using the pre-configured private key and certificate. CA validates the request and issues a signed OCCM certificate.

   a. **Issuer Configuration**
   Here, to configure the issuer,

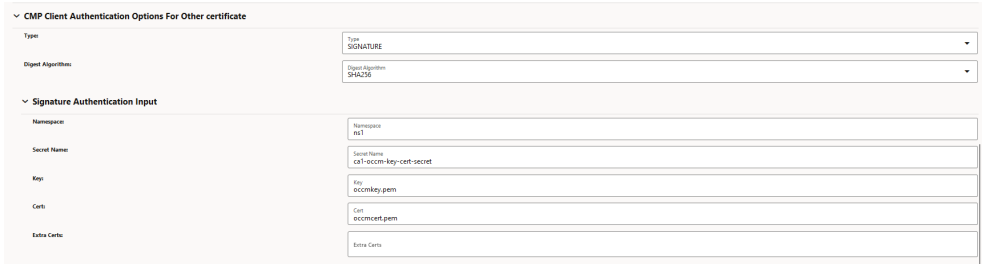
      i. Provide the Signature authentication input under **CMP Client Authentication Options for OCCM Certificate.**

**Figure 3-22 CMP Client Authentication Options for OCCM Certificate**




      ii. OCCM key and certificate output location needs to be specified under **CMP Client Authentication Options for Other Certificate.** OCCM certificate received from CA will be written here.

**Figure 3-23 CMP Client Authentication Options for Other Certificate**



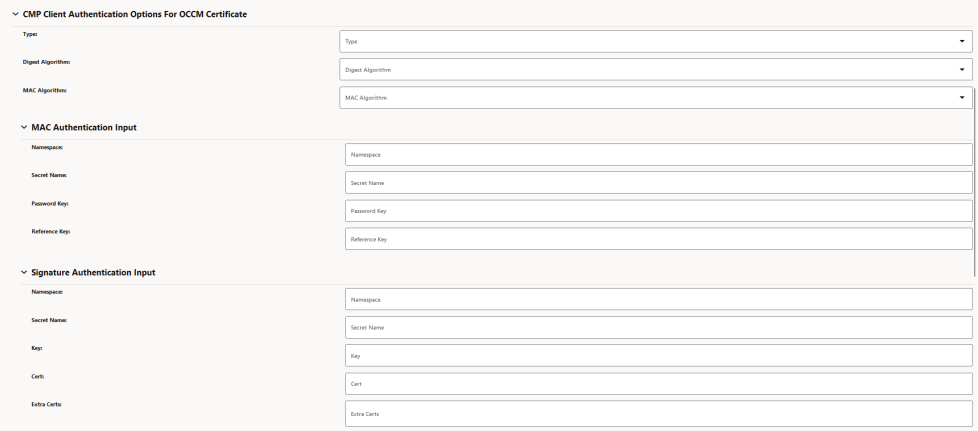

   b. **OCCM Certificate Configuration**
   To configure the OCCM Certificate, select OCCM from the **Cert Type** drop down, and select AUTOMATIC from the **Life Cycle Management** on the **Create Certificate** page.

2. The pre-configured private key and certificate (generated out of band) can itself be used as the OCCM certificate.

a. **Issuer Configuration**

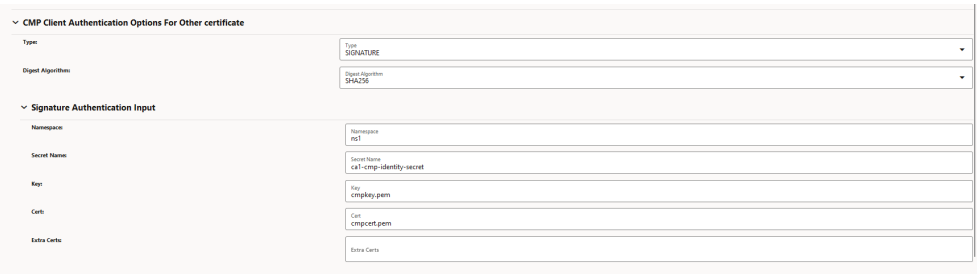
i. Here, you must skip the **CMP Client Authentication Options for OCCM Certificate.**

**Figure 3-24 Issuer Configuration**




ii. OCCM key and certificate output location needs to be specified under **CMP Client Authentication Options for Other Certificate.** Manually created OCCM key and certificate location should be specified here.

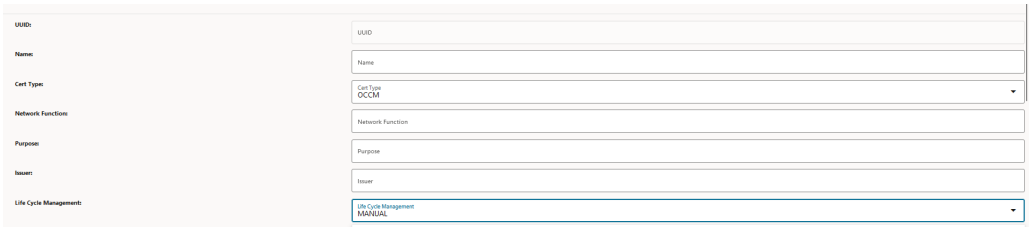
**Figure 3-25 CMP Client Authentication Options for Other Certificate**




b. **OCCM Certificate Configuration**

To configure the OCCM Certificate, select OCCM from the **Cert Type** drop down, and select MANUAL from the **Life Cycle Management** on the **Create Certificate** page.

**Figure 3-26 OCCM Certificate Configuration**



> **Note**
>
> This configuration is available for each of the issuers, therefore the modes for the CAs can be controlled individually.

## 3.3.2 Create NF Certificates

To create an NF certificate:

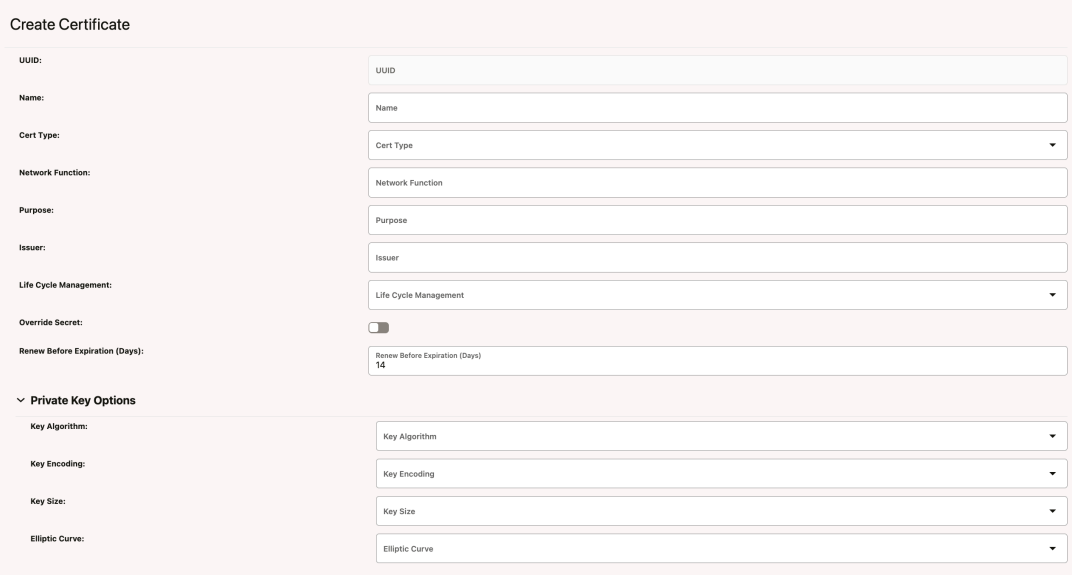
- A CMPv2 Initialization Request is sent to the CA. Each request supports one certificate request. A separate initialization request for each certificate request is used.
- The Initialization Requests and Certificate Confirms are digitally signed by the CMP Identity Key.
- OCCM supports Proof of Possession (PoP) in the initialization request. PoP of the signing key contains the algorithm identifier and signature. This signature is based on the certificates template structure.
- The recommended signing algorithms for the CMPv2 messages and Proof of Possession are RSA Encryption and ECDSA.
- The recommended hash algorithms for the CMPv2 messages and Proof of Possession are SHA-256 and SHA-384.

You can configure NF certificates through REST API or using the CNC Console GUI.

To create NF Certificates using CNC Console GUI:

1. Log in to CNC Console using your log in credentials and select the OCCM Instance.
2. Click **OCCM** from the left pane and then click **Certificate**.
3. Click **Add**. The **Create Certificate** page appears.

**Figure 3-27 Create NF Certificate**




4. Enter the following information:

**Table 3-15 Create NF Certificate**

| Field Name | Description and Possible Values |
|---|---|
| Name | Name of the certificate |
| Cert Type | Select OTHER for NF certificates |
| Network Function | Name of the NF |
| Purpose | Purpose of the NF Certificate |
| Issuer | Name of the issuer for the certificate |
| Life Cycle Management | Possible values are MANUAL and AUTOMATIC. |

5. Under **Private Key Options**, enter the following information:

**Table 3-16 Private Key Options**

| Field Name | Possible Values |
|---|---|
| Key Algorithm | RSA, EC |
| Key Encoding | DER, PEM |
| Key Size | KEYSIZE_2048, KEYSIZE_4096 |
| Elliptic Curve | SECP256k1, SECP384r1 |

**Figure 3-28 Private Key Options**


6. **Under Private Key Output,** enter the following information:

**Table 3-17 Private Key Output**

| Field Name | Description |
|---|---|
| Namespace | Name of the namespace |
| Secret Name | Kubernetes Secret Name |
| Key | Kubernetes secret key against which the key-pair will be stored. |

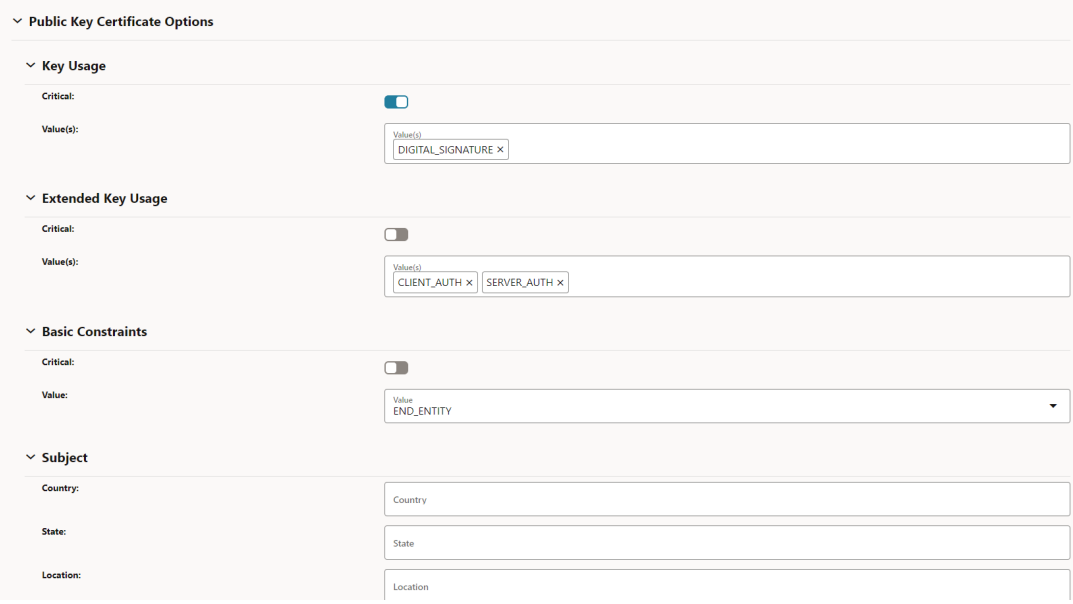
**Figure 3-29 Private Key Output**


7. Under **Public Key Certificate Options**, enter the following:

**Table 3-18 Public Key Certificate Options**

| Field Name | Description |
|---|---|
| Key Usage | Value(s): DIGITAL_SIGNATURE |
| Extended Key Usage | Value(s): CLIENT_AUTH and SERVER_AUTH |
| Basic Constraints | Value(s): END_ENTITY |
| Subject | Country: Enter country code:<br>State: Enter state code<br>Location: City or town where company is legally located.<br>Organization: Name of your organization<br>Organisation Unit: Name of business unit<br>Common Name: The Common Name (CN) represents the server name to be protected by the certificate.<br>Requested Validity (Days): Number of days requested for which the certificate will be valid. |

**Figure 3-30 Public Key Certificate Options**




8. Under **Subject Alternate Names**, enter the following:

**Table 3-19 Subject Alternate Names**

| Field Name | Description |
|---|---|
| IP Address | The IPs you want to protect under this certificate |
| DNS Names | List of DNS domain names |
| URI ID API Roots | List of URI ID (API root of the NF Instance) |
| URI ID URNs | List of URI ID (URN of the NFInstanceId) |

**Figure 3-31 Subject Alternate Names**


9. Under Certificate Output, enter the following for the NF certificate:

**Table 3-20 Certificate Output**

| Field Name | Description |
|---|---|
| Namespace | Name of the namespace |
| Secret Name | Name of the secret |
| Key | The key against which the certificate will be populated |

**Figure 3-32 Certificate Output**


10. (Optional) Under **Certificate Chain Output**, enter the following:

**Table 3-21 Certificate Chain Output**

| Field Name | Description |
|---|---|
| Namespace | Name of the namespace |
| Secret Name | Name of the secret |
| Key | Kubernetes secret key against which the certificate chain will be stored. |

**Figure 3-33 Certificate Chain Output**


If the **Certificate Chain Output** section is filled, then the certificate chain can either be obtained from the CA or can be configured manually. This is based on the

`extractCertChainFromCmpResponse` helm parameter. For more information, see *Oracle Communications Cloud Native Core, Certificate Management Installation, Upgrade, and Fault Recovery Guide*

> **Note**
>
> `extractCertChainFromCmpResponse:` This field when set true specifies that certificate chain will be extracted from CA's CMP response message. When false, the operator can configure the chain manually. This certificate chain is used in the TLS handshake along with the certificate.

11. (Optional) under **CA Bundle Input**, enter the following information:

**Table 3-22 CA Bundle Input**

| Field Name | Description |
|---|---|
| Namespace | Name of the namespace |
| Secret Name | Name of the secret |
| Key | Kubernetes secret key against which CA bundle certificate(s) will be stored. |

**Figure 3-34 CA Bundle Input**


12. Click **Save**.

For sample NF configuration, see Creating NF Certificate Using OCCM - Sample Configuration.

## 3.3.3 Renew NF Certificates

To renew NF certificates:

- OCCM sends CMPv2 Key Update Request (KUR) to the CA.
- Key Update Request is used to renew OCCM certificate (CMP Identity Key) and NF Certificates.
- The Key Update Request can be signed either by the OCCM key and certificate or by the certificate that is being renewed and its corresponding key. The corresponding certificate is included in extraCerts.

To renew certificates:

1. **Set the Key Update Request mode:**
   Certificate renewal is a CMP Key Update Request (KUR) procedure. You can configure OCCM to sign the KUR in two ways:
   - Using OCCM key and certificate

- Using the certificate that is being renewed and its corresponding key.

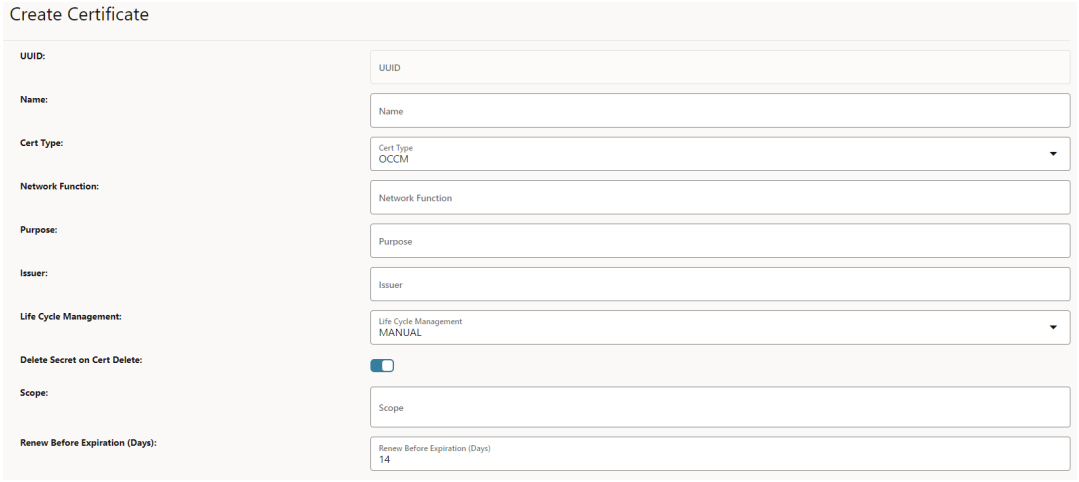
You can use the `occmConfig.cmp.config.useKurOldCertMode` parameter to determine how OCCM will sign the KUR at the time of deployment.

- If `occmConfig.cmp.config.useKurOldCertMode` is set to true, OCCM key and certificate will be used to sign the CMP KUR message.
- If `occmConfig.cmp.config.useKurOldCertMode` is set to false, the certificate that is being renewed will be used.

By default, this parameter is set to false.

2. **Configure Renew Before Expiration (days)**:
OCCM monitors the certificate validity and initiates automatic certificate renewal based on the renew before period configuration. You can update the **Renew Before Expiration (Days)** field on the **Create Certificate** page at the time of certificate creation. This field specifies the number of days before the certificate expiry date when the certificate must be renewed.

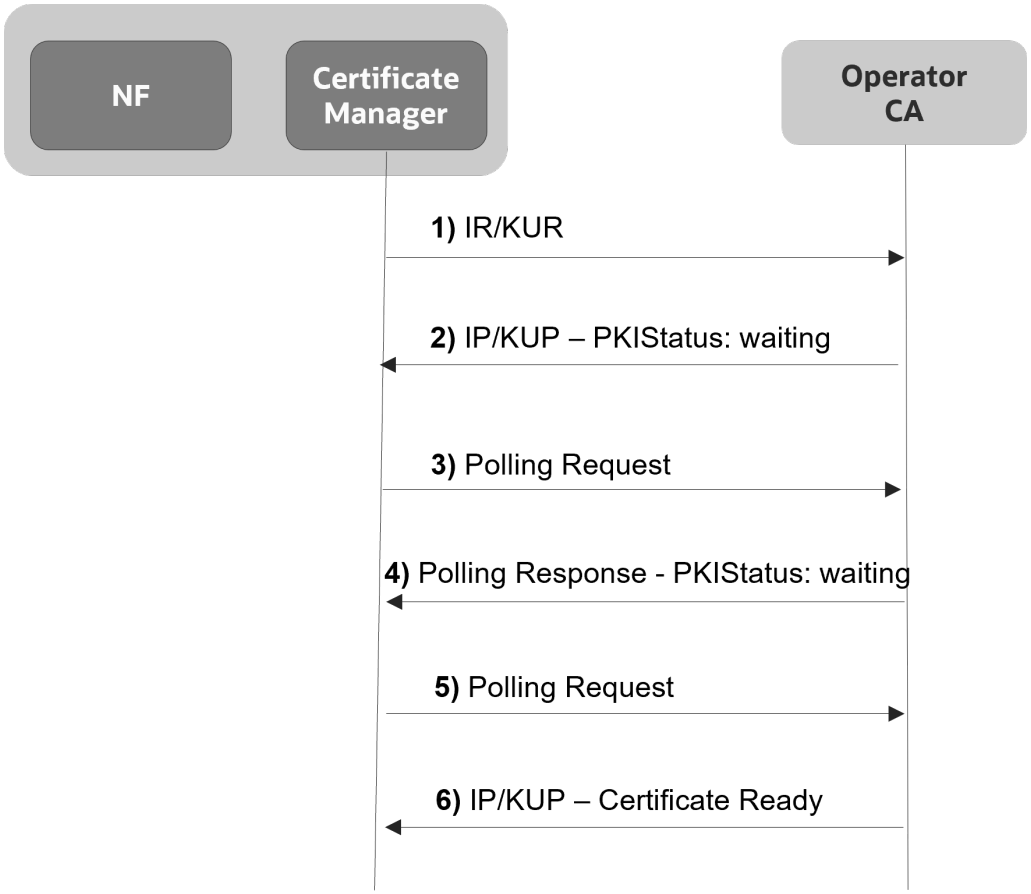
**Figure 3-35 Renew Before Expiration (Days)**




## 3.3.4 Polling for Certificates

After the Initialization Response or Key Update Response, if the certificate is not available yet, the CA responds with PKI status 'Waiting'. The application keeps polling until the CA is ready with the certificate. Openssl implicitly handles polling. No additional configuration is required at the application level in this regard. However, the Total Timeout field can be set in the issuer configuration, which can restrict this polling time. It is the maximum total number of seconds a transaction may take, including polling etc. If the time specified by total timeout has elapsed, the polling will stop.

**Figure 3-36 Polling for Certificates**




## 3.3.5 Deleting the Certificate Configuration

To delete the certificate configuration:

1. Log in to CNC Console using your log in credentials and select the **OCCM** Instance.
2. Click **OCCM** from the left pane and then click **Certificate**.
3. Click **Delete** and click **OK** on the confirmation prompt to delete the certificate.

> **Note**
>
> This procedure only deletes the certificate configuration from OCCM.
> Run the following command to delete the Kubernetes secret holding the certificates:
>
> ```
> kubectl delete secrets <secret name> -n <namespace>
> ```
>
> For example:
>
> ```
> kubectl delete secrets nrf-tls-secret -n ns1
> ```

# 3.4 OCCM Retry on Failure

OCCM supports retry on encountering failures during the certificate creation, certificate renewal and manipulation of Kubernetes secrets.

- The procedure is retried until successful or interrupted by an action executed by the operator.
- Retry is not controlled through any maximum limit.
- The retry interval is an pre-defined value and set to 30s.

Some of the failure scenarios for which retries will be attempted:

- CA is unavailable, not reachable, or busy
- Any errors returned by CA

OCCM also provides a retry mechanism for errors encountered during Kubernetes secret update with the generated key and certificate. Based on the error encountered (insufficient permissions, Kubernetes internal errors etc), once the User fixes the issue, the Kubernetes secrets are automatically updated due to the ongoing retries.

> **Note**
>
> In this case, there is no attempt to recreate the Key and Certificate. The retry is restricted to updating the Kubernetes secrets with the key and certificate that are already generated.

# 3.5 Network Policies

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

Previously, the pods under deployment could be contacted by any other pods in the Kubernetes cluster without any restrictions. Now, Network Policy provides namespace-level isolation, which allows secured communications to and from OCCM with rules defined in the respective Network Policies. The network policies enforce access restrictions for all the applicable data flows except communication from Kubernetes node to pod for invoking container probe. For example, OCCM internal microservices can't be contacted directly by any other pods.

**Managing Support for Network Policies**

**Enable**

To use this feature, network policies need to be applied to the namespace wherein OCCM is applied.

**Configure**

You can configure this feature using Helm. For information about Configuring Network Policy for OCCM deployment, see *Oracle Communications Certificate Management Installation, Upgrade, and Fault Recovery Guide.*

### Observe

There are no specific metrics and alerts required for the Support of Network Policy functionality.

# 4 Introducing OCCM in an Existing NF Deployment

This section describes the procedure to introduce OCCM in an existing NF deployment where certificates are managed manually. OCCM helps in automating certificate management.

You can move from manual management to automated manages in one of 2 ways:

- Using existing key and certificate
- Using a new key and certificate

**Moving NFs from Manual Certificate Management to Automated Certificate Management with Existing Key and Certificate**

1. Configure a key and certificate on OCCM. You must reuse the same Kubernetes secret and the content as used by NF with manually generated key and certificate. The NF configuration must not be updated.
2. OCCM monitors the existing key and certificate in the configured Kubernetes secret and renews it. The metrics attached to the key and certificate are generated.

> **Note**
>
> The existing key and certificate are not validated against the configuration. However, the renewed certificate will be aligned with the configuration.

**Moving NFs from Manual Certificate Management to Automated Certificate Management With new Key and Certificate**

1. Configure a key and certificate on OCCM making sure to reuse the same Kubernetes secret as used by NF with manually generated key and certificate. Reusing the Kubernetes secret make sure that the NF configuration is not updated.
2. OCCM creates a new key and certificate in the configured Kubernetes secret and deletes the old key and certificate. The old key and certificate is deleted to generate OCCM metrics attached to the certificate creation.

**Procedure**

The operator can select the following values for the LCM Type field:

- Manual (With existing key and certificate)
- Automatic (With new key and certificate)

**Manual**

- In Manual mode, existing certificates are configured at OCCM so that OCCM can manage the lifecycle of certificates. For example, the certificates that are already being used by NFs can be monitored by OCCM and further renewed by OCCM. In this case, the same Kubernetes secret and the content as used by NF with manually generated key and Certificate is reused by OCCM.

> **Note**
>
> The existing Key and Cert are not validated against the configuration. Renewed certificate will be aligned with the configuration though.

**Automatic**

- In Automatic mode, OCCM can create fresh certificates or override the existing certificate with a new one. For example, if NFs want to create a new key and certificate to override old one through OCCM, and monitor them, then a key and certificate can be created on OCCM using the same Kubernetes secret as used by NF with manually generated key and certificate
- OCCM creates a new key and certificate in the configured Kubernetes secret and deletes the old key and certificate

> **Note**
>
> While reusing the Kubernetes secret and content. you must ensure that the NF configuration is not updated.

**Table 4-1 Dependency of LCM type on Kubernetes Secret**

| LCM Type | Description |
|---|---|
| Manual | Operator doesn't need to create a new secret. OCCM uses the existing Kubernetes secret. |
| Automatic | Operator can either create a new secret or use the existing Kubernetes secret with the `Override Secret` flag |

**Table 4-2 Behaviour of different LCM Types**

| LCM Type | Preexisting Kubernetes Secret | Override Secret Flag | Behaviour |
|---|---|---|---|
| Automatic | No | No Impact | Certificate is created irrespective of the override flag |
| Automatic | Yes | True or False | True: The Kubernetes secret is overridden<br>False: An error is thrown because you must either use a new secret or set the override flag to true. This error is thrown upfront on the user interface or in the response if APIs are used. |

**Table 4-2 (Cont.) Behaviour of different LCM Types**

| LCM Type | Preexisting Kubernetes Secret | Override Secret Flag | Behaviour |
|---|---|---|---|
| Manual | No | NA | An error is thrown because OCCM expects a preconfigured Kubernetes secret. This error is thrown upfront on the user interface or in the response if APIs are used. |
| Manual | Yes | NA | Certificate configuration is created at OCCM for further certificate renewal and monitoring. |

### Moving Back to Manual Certificate Management

- If the operator wants to move back to manual certificate monitoring, then they can delete the entry from the OCCM configuration. OCCM doesn't delete the secret when the entry is deleted and the certificate can be monitored manually (if operator used same secret location).
- If user creates a separate secret during certificate management from OCCM and operator doesn't want to use the secret further, then operator can delete the entry from OCCM and must also delete the Kubernetes secret.

# 5 Accessing OCCM Resources Through Curl and Postman

CNC Console provides a secure option for accessing OCCM resources through curl and postman using the CNC Console IAM access token. This section describes how to generate access tokens and access OCCM APIs.

## 5.1 Generate Access Tokens

CNC Console IAM provides a REST API for generating and refreshing access tokens.

To generate access tokens:

1. Send a POST request to the following URL to get an access token from CNC Console IAM:
   `http://${cncc-iam-ingress-extrenal-ip}:${cncc-iam-ingress-service-port}/cncc/auth/realms/${realm}/protocol/openid-connect/token`

   For example: `https://{host}:{port}/cncc/auth/realms/cncc/protocol/openid-connect/token`

2. The body of the request must be *x-www-form-urlencoded* encoded as follows:

   ```
   'client_id': 'your_client_id',
   'username': 'your_username',
   'password': 'your_password',
   'grant_type': 'password'
   ```

   For example:

   ```
   'client_id': 'cncc-api-access',
   'username': 'user1',
   'password': '********',
   'grant_type': 'password'
   ```

3. Run the following curl command to generate access tokens:

   ```
   curl --location --request POST 'http://{host}:{port}/cncc/auth/realms/cncc/protocol/openid-connect/token' \
   --header 'Content-Type: application/x-www-form-urlencoded' \
   --data-urlencode 'grant_type=password' \
   --data-urlencode 'username=user1' \
   --data-urlencode 'password=********' \
   --data-urlencode 'client_id=cncc-api-access'
   ```

4. In response, you will get an **access_token** and a **refresh_token**:

   ```
   {
       "access_token": "eyJhbGc...O9l2Q",
   ```

```
    "expires_in": 300,
    "refresh_expires_in": 1800,
    "refresh_token": "eyJhbG...5vKPF-ZIg",
    "token_type": "bearer",
    "not-before-policy": 0,
    "session_state": "6c42d978-14ac-4793-a1e3-789cfbdb2b74",
    "scope": "email profile"
}
```

# 5.2 Refresh Access Tokens

If the access token has expired, you can refresh it by sending a POST request to the same URL, but containing the refresh token instead of username and password:

Perform the following procedure to refresh the access tokens:

If the access_token has expired, it can be refreshed by sending a POST request to the same URL as above; but the POST method must have the refresh token instead of username and password. The format is as follows:

```
'client_id': 'your_client_id',
'refresh_token': refresh_token_from_previous_request,
'grant_type': 'refresh_token'
```

For Example:

```
'client_id': 'cncc-api-access',
'refresh_token': 'eyJhbGciOiJIU...dKnmFb5vKPF-ZIg',
'grant_type': 'refresh_token'
```

In response, you will receive a new **access_token** and **refresh_token**.

# 5.3 Issuer Configuration API Access

You need the CNC Console IAM access tokens to access the OCCM Issuer APIs through CNC Console.

You must include the following headers when you send an API request:

- Authorization: The access token must be used in every request to a NF resource by placing it in the *Authorization* header.
- oc-cncc-id: M-CNCC uses the oc-cncc-id header to find the agent or master owning the instance.
- oc-cncc-instance-id: A-CNCC Core (or M-CNCC Core ) uses the oc-cncc-instance-id header to find the NF instance for routing.

Following headers must be passed in the curl or postman request while accessing the OCCM Issuers resource:

```
curl --request POST 'http://${occm-external-ip}:${occm-service-port}/occm-
config/v1/issuers/'
--header 'Content-Type: application/json'
```

```
--header 'oc-cncc-id: Cluster1'
--header 'oc-cncc-instance-id: Cluster1-occm-instance1'
--header 'Authorization: Bearer <Token>'
--data-raw '{
    "name": "CA1",
    "server": "http://ca1-openssl-mock.ns1.svc.thrust5:8090",
    "recipientDN": "/CN=x.company.com",
    "issuerDN": "/CN=x.company.com",
    "totalTimeout": "720",
    "messageTimeout": "120",
    "cmpProtectionOccmCert": {
        "type": null,
        "digestAlgorithm": null,
        "macAlgorithm": null,
        "macK8sSecretIn": {
            "namespace": "",
            "name": "",
            "passKey": "",
            "refKey": ""
        },
        "signK8sSecretIn": {
            "namespace": "",
            "name": "",
            "key": "",
            "cert": "",
            "extraCerts": []
        }
    },
    "cmpProtectionOtherCert": {
        "type": "SIGNATURE",
        "digestAlgorithm": "SHA256",
        "signK8sSecretIn": {
            "namespace": "ns1",
            "name": "ca1-cmp-identity-secret",
            "key": "cmpkey.pem",
            "cert": "cmpcert.pem",
            "extraCerts": []
        }
    },
    "occmTrustStoreK8sSecretIn": {
        "namespace": "ns1",
        "name": "ca1-occm-trust-store-secret",
        "rootCACerts": [
            "caroot.pem"
        ],
        "intCACerts": [
            "intcacert.pem"
        ],
        "serverCert": "servercert.pem"

  }
}'
```

# 5.4 Certificate Configuration API Access

You need the CNC Console IAM access token that you generated to access OCCM Certificates Configuration API:

```
curl --request POST 'http://${occm-external-ip}:${occm-service-port}/occm-
config/v1/certs/'
--header 'Content-Type: application/json'
--header 'oc-cncc-id: Cluster1'
--header 'oc-cncc-instance-id: Cluster1-occm-instance1'
--header 'Authorization: Bearer <Token>'
--data-raw ' {

    "name": "NRF TLS Cert",
    "lcmType": "AUTOMATIC",
    "certType": "OTHER",
    "renewBefore": "14",
    "certPurpose": "NRF SBI",
    "issuer": "CA1",
    "privateKey": {
        "keyAlgo": "RSA",
        "keySize": "KEYSIZE_2048",
        "keyEncoding": "PEM",
        "ecCurve": null,
        "privateKeyK8sSecretOut": {
            "namespace": "ns1",
            "name": "nrf-tls-secret",
            "key": "nrfkey.pem"
        }
    },
    "csr": {
        "extendedKeyUsage": {
            "critical": false,
            "extendedKeyUsageValues": [
                "CLIENT_AUTH",
                "SERVER_AUTH"
            ]
        },
        "keyUsage": {
            "critical": true,
            "keyUsageValues": [
                "DIGITAL_SIGNATURE"
            ]
        },
        "basicConstraints": {
            "critical": false,
            "basicConstraintsValue": "END_ENTITY"
        },
        "subject": {
            "country": "IN",
            "state": "KA",
            "location": "BLR",
            "organization": "Oracle",
            "organizationUnit": "CGBU",
```

```
                "commonName": "a.company.com"
            },
            "days": "365",
            "subjectAltName": {
                "critical": false,
                "ipAddress": [
                    "10.10.10.20",
                    "10.10.10.21"
                ],
                "dns": [
                    "y.company.com",
                    "z.company.com"
                ],
                "uriIdApiRoot": null,
                "uriIdUrn": [
                    "urn:uuid:f81d4fae-7dec-11d0-a765-00a0c91e6bf6"
                ]
            },
            "certK8sSecretOut": {
                "namespace": "ns1",
                "name": "nrf-tls-secret",
                "key": "nrfcert.pem"
            },
            "certChainK8sSecretOut": {
                "namespace": "ns1",
                "name": "nrf-tls-secret",
                "key": "nrfcertchain.pem"
            }
        },
        "caBundleK8sSecretIn": {
            "namespace": "ns1",
            "name": "ca-bundle-secret",
            "key": "ca-bundle.pem"
        },
        "nf": "NRF",
        "overrideSecret": false
}'
```

# 5.5 Logging API Access

You need the CNC Console IAM access token that you generated to access OCCM Logging APIs.

```
curl --location --request PUT 'http://host:port/occm-config/v1/occm/logging' \
--header 'oc-cncc-id: Cluster1' \
--header 'oc-cncc-instance-id: Cluster1-occm-instance1' \
--header 'Authorization: Bearer eyJhbGciOiJSUzI1NiIs...' \
--header 'Content-Type: application/json' \
--data-raw '{
    "appLogLevel": "DEBUG",
    "packageLogLevel": [
        {
            "packageName": "root",
            "logLevelForPackage": "ERROR"
        },
```

```
                {
                    "packageName": "org.springframework",
                    "logLevelForPackage": "WARN"
                }
            ]
        }'
```

# 6
# OCCM Metrics

This chapter provides information about metrics for OCCM.

**Dimension Description**

The following table describes different types of metric dimensions:

**Table 6-1 OCCM Dimension Description**

| Dimension | Description | Possible Values |
|---|---|---|
| method | Http method | GET, PUT, POST, DELETE |
| httpVersion | Http protocol version | HTTP/1.1 |
| scheme | Http protocol scheme | HTTP, UNKNOWN |
| uri | URL of requested API | /occm-config/v1/certs |
| nfType | API called by NF | eg: SCP, NRF, OCCM |
| statusCode | Http status code | 200, 202 |
| certUuid | Unique ID for the purpose of logging and tracking | eg: 7523a545-089b-49e9-a05c-ae5141db544b |
| requestType | Type of request | IR, KUR |
| certName | Name of the certificate | NRFTLS-1, SCPTLS-1 |
| certPurpose | Purpose of the certificate creation | NRF SBI |
| issuerName | Name of the Issuer | CA |
| errorReason | Reason of the error | eg:ERR_K8S_SECRET_CREATION_ERROR |
| operationType | Type of operation | CREATE, RENEW, DELETE |
| host | Application hosted on cluster | eg: occm.occncc-thrust5-01.svc.thrust5 |
| application | Name of the application | OCCM |
| caServer | URL of the Certificate Authority (Issuer) | eg:http://ca1-openssl-mock.occncc-thrust5-01.svc.thrust5:8089 |
| status | To know the status of openssl CMP cmd | SUCCESS, FAILED |

## 6.1 occm_config_http_requests_total

**Table 6-2 occm_config_http_requests_total**

| Field | Details |
|---|---|
| Description | OCCM Configuration total HTTP request counter metric |
| Type | Counter |

**Table 6-2 (Cont.) occm_config_http_requests_total**

| Field | Details |
|---|---|
| Dimensions | • host<br>• application<br>• httpVersion<br>• scheme<br>• method<br>• nfType<br>• uri |
| Example | ccm_config_http_requests_total{app_kubernetes_io_application="occm", app_kubernetes_io_component="occm", app_kubernetes_io_engVersion="23.4.3", app_kubernetes_io_instance="occm", app_kubernetes_io_managed_by="Helm", app_kubernetes_io_microservice="occm", app_kubernetes_io_mktgVersion="23.4.3.0.0", app_kubernetes_io_name="occm", app_kubernetes_io_part_of="occm", app_kubernetes_io_vendor="Oracle", app_kubernetes_io_version="23.4.3.0.0", application="occm", container="occm", endpoint="cnc-metrics", helm_sh_chart="occm-23.4.3", host="occm.occncc-thrust5-01.svc.thrust5", httpVersion="HTTP/1.1", instance="10.233.121.228:9000", job="occne-infra/occne-nf-cnc-podmonitor", method="POST", namespace="occncc-thrust5-01", nfType="NRF", pod="occm-occm-67764765f8-7rpm8", pod_template_hash="67764765f8", scheme="http", uri="/occm-config/v1/certs"} |

# 6.2 occm_config_http_response_total

**Table 6-3 occm_config_http_response_total**

| Field | Details |
|---|---|
| Description | OCCM Configuration total HTTP response counter metric |
| Type | Counter |
| Dimensions | • host<br>• httpVersion<br>• scheme<br>• method<br>• nfType<br>• statusCode<br>• uri |
| Example | occm_config_http_responses_total{app_kubernetes_io_application="occm", app_kubernetes_io_component="occm", app_kubernetes_io_engVersion="23.4.3", app_kubernetes_io_instance="occm", app_kubernetes_io_managed_by="Helm", app_kubernetes_io_microservice="occm", app_kubernetes_io_mktgVersion="23.4.3.0.0", app_kubernetes_io_name="occm", app_kubernetes_io_part_of="occm", app_kubernetes_io_vendor="Oracle", app_kubernetes_io_version="23.4.3.0.0", application="occm", container="occm", endpoint="cnc-metrics", helm_sh_chart="occm-23.4.3", host="occm.occncc-thrust5-01.svc.thrust5", httpVersion="HTTP/1.1", instance="10.233.121.228:9000", job="occne-infra/occne-nf-cnc-podmonitor", method="POST", namespace="occncc-thrust5-01", nfType="NRF", pod="occm-occm-67764765f8-7rpm8", pod_template_hash="67764765f8", scheme="http", statusCode="202", uri="/occm-config/v1/certs"} |

# 6.3 occm_cmp_requests_total

**Table 6-4 occm_cmp_requests_total**

| Field | Details |
|---|---|
| Description | OCCM total CMP request counter metric |
| Type | Counter |
| Dimensions | • certUuid<br>• certName<br>• nfType<br>• requestType<br>• issuerName<br>• caServer |
| Example | occm_cmp_requests_total{app_kubernetes_io_application="occm", app_kubernetes_io_component="occm", app_kubernetes_io_engVersion="23.4.3", app_kubernetes_io_instance="occm", app_kubernetes_io_managed_by="Helm", app_kubernetes_io_microservice="occm", app_kubernetes_io_mktgVersion="23.4.3.0.0", app_kubernetes_io_name="occm", app_kubernetes_io_part_of="occm", app_kubernetes_io_vendor="Oracle", app_kubernetes_io_version="23.4.3.0.0", application="occm", caServer="http://ca90-openssl-mock.occncc-thrust5-01.svc.thrust5:8083", certName="NRFTLS-47", certUuid="c0578b02-caab-454a-bd97-422b0e1c575b", container="occm", endpoint="cnc-metrics", helm_sh_chart="occm-23.4.3", instance="10.233.121.228:9000", issuerName="CA90", job="occne-infra/occne-nf-cnc-podmonitor", namespace="occncc-thrust5-01", nfType="NRF", pod="occm-occm-67764765f8-7rpm8", pod_template_hash="67764765f8", requestType="ir"}<br>occm_cmp_requests_total{app_kubernetes_io_application="occm", app_kubernetes_io_component="occm", app_kubernetes_io_engVersion="23.4.3", app_kubernetes_io_instance="occm", app_kubernetes_io_managed_by="Helm", app_kubernetes_io_microservice="occm", app_kubernetes_io_mktgVersion="23.4.3.0.0", app_kubernetes_io_name="occm", app_kubernetes_io_part_of="occm", app_kubernetes_io_vendor="Oracle", app_kubernetes_io_version="23.4.3.0.0", application="occm", caServer="http://ca90-openssl-mock.occncc-thrust5-01.svc.thrust5:8083", certName="NRFTLS-47", certUuid="c0578b02-caab-454a-bd97-422b0e1c575b", container="occm", endpoint="cnc-metrics", helm_sh_chart="occm-23.4.3", instance="10.233.121.228:9000", issuerName="CA90", job="occne-infra/occne-nf-cnc-podmonitor", namespace="occncc-thrust5-01", nfType="NRF", pod="occm-occm-67764765f8-7rpm8", pod_template_hash="67764765f8", requestType="kur"} |

# 6.4 occm_cmp_responses_total

**Table 6-5 occm_cmp_responses_total**

| Field | Details |
|---|---|
| Description | OCCM total CMP response counter metric |
| Type | Counter |
| Service Operation | |

**Table 6-5 (Cont.) occm_cmp_responses_total**

| Field | Details |
|---|---|
| Dimensions | • certUuid<br>• certName<br>• nfType<br>• requestType<br>• status<br>• statusCode<br>• issuerName<br>• caServer |
| Example | occm_config_http_responses_total{app_kubernetes_io_application="occm", app_kubernetes_io_component="occm", app_kubernetes_io_engVersion="23.4.3", app_kubernetes_io_instance="occm", app_kubernetes_io_managed_by="Helm", app_kubernetes_io_microservice="occm", app_kubernetes_io_mktgVersion="23.4.3.0.0", app_kubernetes_io_name="occm", app_kubernetes_io_part_of="occm", app_kubernetes_io_vendor="Oracle", app_kubernetes_io_version="23.4.3.0.0", application="occm", container="occm", endpoint="cnc-metrics", helm_sh_chart="occm-23.4.3", host="occm.occncc-thrust5-01.svc.thrust5", httpVersion="HTTP/1.1", instance="10.233.121.228:9000", job="occne-infra/occne-nf-cnc-podmonitor", method="POST", namespace="occncc-thrust5-01", nfType="NRF", pod="occm-occm-67764765f8-7rpm8", pod_template_hash="67764765f8", scheme="http", statusCode="202", uri="/occm-config/v1/certs"} |

# 6.5 occm_cert_expiry

**Table 6-6 occm_cert_expiry**

| Field | Details |
|---|---|
| Description | OCCM Cert expiry gauge metrics. It will indicate Certificate expiry timestamp. |
| Type | Gauge |
| Dimensions | • certUuid<br>• certName<br>• nfType<br>• issuerName<br>• certPurpose |
| Example | occm_cert_expiry{app_kubernetes_io_application="occm", app_kubernetes_io_component="occm", app_kubernetes_io_engVersion="23.4.3", app_kubernetes_io_instance="occm", app_kubernetes_io_managed_by="Helm", app_kubernetes_io_microservice="occm", app_kubernetes_io_mktgVersion="23.4.3.0.0", app_kubernetes_io_name="occm", app_kubernetes_io_part_of="occm", app_kubernetes_io_vendor="Oracle", app_kubernetes_io_version="23.4.3.0.0", application="occm", certName="NRFTLS-47", certPurpose="NRF SBI", certUuid="c0578b02-caab-454a-bd97-422b0e1c575b", container="occm", endpoint="cnc-metrics", helm_sh_chart="occm-23.4.3", instance="10.233.121.228:9000", issuerName="CA90", job="occne-infra/occne-nf-cnc-podmonitor", namespace="occncc-thrust5-01", nfType="NRF", pod="occm-occm-67764765f8-7rpm8", pod_template_hash="67764765f8"} |

# 6.6 occm_cert_status

**Table 6-7 occm_cert_status**

| Field | Details |
|---|---|
| Description | OCCM Cert status gauge metric. It will indicate Certificate status CREATING(1), READY(2), FAILED(3), DELETED(6), EXPIRED(7), WAITING(8) |
| Type | Gauge |
| Dimensions | • certUuid<br>• nfType<br>• certName<br>• certPurpose<br>• issuerName |
| Example | occm_cert_status{app_kubernetes_io_application="occm", app_kubernetes_io_component="occm", app_kubernetes_io_engVersion="23.4.3", app_kubernetes_io_instance="occm", app_kubernetes_io_managed_by="Helm", app_kubernetes_io_microservice="occm", app_kubernetes_io_mktgVersion="23.4.3.0.0", app_kubernetes_io_name="occm", app_kubernetes_io_part_of="occm", app_kubernetes_io_vendor="Oracle", app_kubernetes_io_version="23.4.3.0.0", application="occm", certName="NRFTLS-47", certPurpose="NRF SBI", certUuid="c0578b02-caab-454a-bd97-422b0e1c575b", container="occm", endpoint="cnc-metrics", helm_sh_chart="occm-23.4.3", instance="10.233.121.228:9000", issuerName="CA90", job="occne-infra/occne-nf-cnc-podmonitor", namespace="occncc-thrust5-01", nfType="NRF", pod="occm-occm-67764765f8-7rpm8", pod_template_hash="67764765f8"} |

# 6.7 occm_cmp_cli_durations

**Table 6-8 occm_cmp_cli_durations**

| Field | Details |
|---|---|
| Description | OCCM cmp cli duration histogram metrics . CMP cli time taken in between request and response from CA |
| Type | Histogram |
| Dimensions | • certUuid<br>• nfType<br>• certName<br>• requestType<br>• caServer |
| Example | occm_cmp_cli_durations_bucket{app_kubernetes_io_application="occm", app_kubernetes_io_component="occm", app_kubernetes_io_engVersion="23.4.3", app_kubernetes_io_instance="occm", app_kubernetes_io_managed_by="Helm", app_kubernetes_io_microservice="occm", app_kubernetes_io_mktgVersion="23.4.3.0.0", app_kubernetes_io_name="occm", app_kubernetes_io_part_of="occm", app_kubernetes_io_vendor="Oracle", app_kubernetes_io_version="23.4.3.0.0", application="occm", caServer="http://ca90-openssl-mock.occncc-thrust5-01.svc.thrust5:8083", certName="NRFTLS-47", certUuid="c0578b02-caab-454a-bd97-422b0e1c575b", container="occm", endpoint="cnc-metrics", helm_sh_chart="occm-23.4.3", instance="10.233.121.228:9000", job="occne-infra/occne-nf-cnc-podmonitor", le="5.0", namespace="occncc-thrust5-01", nfType="NRF", pod="occm-occm-67764765f8-7rpm8", pod_template_hash="67764765f8", requestType="kur"} |

# 6.8 occm_cert_request_status_total

**Table 6-9 occm_cert_request_status**

| Field | Details |
|---|---|
| Description | OCCM Certificate request status counter metric.<br>It will indicate certificate status, error reason, operation type whether CREATE or Renew etc. |
| Type | Counter |
| Dimensions | • certName<br>• certUuid<br>• errorReason<br>• issuerName<br>• nfType<br>• operationType |
| Example | occm_cert_request_status_total{app_kubernetes_io_application="occm", app_kubernetes_io_component="occm", app_kubernetes_io_engVersion="23.4.3", app_kubernetes_io_instance="occm", app_kubernetes_io_managed_by="Helm", app_kubernetes_io_microservice="occm", app_kubernetes_io_mktgVersion="23.4.3.0.0", app_kubernetes_io_name="occm", app_kubernetes_io_part_of="occm", app_kubernetes_io_vendor="Oracle", app_kubernetes_io_version="23.4.3.0.0", application="occm", certName="NRFTLS-47", certUuid="c0578b02-caab-454a-bd97-422b0e1c575b", container="occm", endpoint="cnc-metrics", errorReason="OK", helm_sh_chart="occm-23.4.3", instance="10.233.121.228:9000", issuerName="CA90", job="occne-infra/occne-nf-cnc-podmonitor", namespace="occncc-thrust5-01", nfType="NRF", operationType="RENEW", pod="occm-occm-67764765f8-7rpm8", pod_template_hash="67764765f8"} |

# 7 OCCM Alerts

This section describes the alerts available for OCCM.

> **Note**
>
> Alert file is packaged with OCCM CSAR package.
>
> - Review the occm_alerting_rules_promha_<version>.yaml file and edit the value of the parameters in the occm_alerting_rules_promha_<version>.yaml file (if needed to be changed from default values) before configuring the alerts. See above table for details.
> - kubernetes_namespace is configured as kubernetes namespace in which OCCM is deployed. Default value is occm. Please update the occm_alerting_rules_promha_<version>.yaml file to reflect the correct OCCM kubernetes namespace.

## 7.1 OccmCertExpiryWithinMinorThreshold

**Table 7-1 OccmCertExpiryWithinMinorThreshold**

| Field | Details |
|---|---|
| **Description** | OCCM Certificate Expiry Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} for {{$labels.certPurpose}} will expire soon within 90 days |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} for {{$labels.certPurpose}} will expire soon within 90 days |
| **Severity** | Minor |
| **Condition** | Certificate will expire soon within 90 days |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7001 |
| **Metric Used** | occm_cert_expiry |
| **Recommended Actions** | Information that Certificate is going to expire within 90 days. The alert is cleared when the certificate is renewed so that the Certificate expiry days falls below the Minor threshold or when the Certificate expiry days crosses the Major threshold, in which case theOccmCertExpiryWithinMajorThreshold alert is raised.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Check certificate configuration for renew before days.<br>2. If this is unexpected, contact My Oracle Support. |

# 7.2 OccmCertExpiryWithinMajorThreshold

**Table 7-2 OccmCertExpiryWithinMajorThreshold**

| Field | Details |
|---|---|
| **Description** | OCCM Certificate Expiry Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} for {{$labels.certPurpose}} will expire soon within 30 days |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} for {{$labels.certPurpose}} will expire soon within 30 days |
| **Severity** | Major |
| **Condition** | Certificate will expire soon within 30 days |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7001 |
| **Metric Used** | occm_cert_expiry |
| **Recommended Actions** | Information that Certificate is going to expire within 30 days. The alert is cleared when the certificate is renewed or when the Certificate expiry days crosses the Critical threshold, in which case OccmCertExpiryWithinCriticalThreshold alert is raised.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Check certificate configuration for renew before days.<br>2. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>3. Depending on the failure reason, take the resolution steps.<br>4. If this is unexpected, contact My Oracle Support. |

# 7.3 OccmCertExpiryWithinCriticalThreshold

**Table 7-3 OccmCertExpiryWithinCriticalThreshold**

| Field | Details |
|---|---|
| **Description** | OCCM Certificate Expiry Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} for {{$labels.certPurpose}} will expire soon within 1 week |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} for {{$labels.certPurpose}} will expire soon within 1 week |
| **Severity** | Critical |
| **Condition** | Certificate will expire soon within 1 week |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7001 |

**Table 7-3 (Cont.) OccmCertExpiryWithinCriticalThreshold**

| Field | Details |
|---|---|
| **Metric Used** | occm_cert_expiry |
| **Recommended Actions** | Information that Certificate is going to expire within 1 week. The alert is cleared when the certificate is renewed.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Check certificate configuration for renew before days.<br>2. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>3. Depending on the failure reason, take the resolution steps.<br>4. If this is unexpected, contact My Oracle Support. |

# 7.4 OccmCertExpired

**Table 7-4 OccmCertExpired**

| Field | Details |
|---|---|
| **Description** | OCCM Certificate has Expired Critical Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} for {{$labels.certPurpose}} is expired |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} for {{$labels.certPurpose}} is expired |
| **Severity** | Critical |
| **Condition** | Certificate has expired |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7002 |
| **Metric Used** | occm_cert_expiry |
| **Recommended Actions** | Information that Certificate has expired. The alert is cleared when the certificate is renewed.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. Refer user guide for procedure to renew expired certificate.<br>4. If this is unexpected, contact My Oracle Support. |

# 7.5 OccmServiceDown

**Table 7-5 OccmServiceDown**

| Field | Details |
|---|---|
| **Description** | OCCM Service Down Alert<br>New certificates will not be created, and existing ones can not be renewed until OCCM is back |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: OCCM service is down |
| **Severity** | Critical |
| **Condition** | The pods of the occm service is unavailable. |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7004 |
| **Metric Used** | up<br>**Note:**This is a prometheus metric used for instance availability monitoring. If this metric is not available, use the similar metric as exposed by the monitoring system. |
| **Recommended Actions** | The alert is cleared when the occm service is available.<br>Steps:<br>1. Check the orchestration logs of occm service and check for liveness or readiness probe failures.<br>2. Refer to the application logs on Kibana and filter based on occm service names. Check for ERROR WARNING logs related to thread exceptions.<br>3. Depending on the failure reason, take the resolution steps.<br>4. In case the issue persists, contact My Oracle Support. |

# 7.6 OccmMemoryUsageMinorThreshold

**Table 7-6 OccmMemoryUsageMinorThreshold**

| Field | Details |
|---|---|
| **Description** | OCCM Memory Usage Alert<br>OCCM Memory Usage for pod {{ $labels.pod }} has crossed the configured minor threshold (70%) (value={{ $value }}) of its limit. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: Memory Usage of pod exceeded 70% of its limit. |
| **Severity** | Minor |
| **Condition** | A pod has reached the configured minor threshold( 70%) of its memory resource limits. |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7005 |

**Table 7-6 (Cont.) OccmMemoryUsageMinorThreshold**

| Field | Details |
|---|---|
| **Metric Used** | container_memory_usage_bytes,<br>**Note** : This is a kubernetes metric used for instance availability monitoring. If the metric is not available, use the similar metric as exposed by the monitoring system. |
| **Recommended Actions** | The alert gets cleared when the memory utilization falls below the Minor Threshold or crosses the major threshold, in which case OccmMemoryUsageMajorThreshold alert shall be raised.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.7 OccmMemoryUsageMajorThreshold

**Table 7-7 OccmMemoryUsageMajorThreshold**

| Field | Details |
|---|---|
| **Description** | OCCM Memory Usage Alert<br>OCCM Memory Usage for pod {{ $labels.pod }} has crossed the configured major threshold (80%) (value={{ $value }}) of its limit. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: Memory Usage of pod exceeded 80% of its limit. |
| **Severity** | Major |
| **Condition** | A pod has reached the configured major threshold( 80%) of its memory resource limits. |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7005 |
| **Metric Used** | container_memory_usage_bytes,<br>**Note** : This is a kubernetes metric used for instance availability monitoring.If the metric is not available, use the similar metric as exposed by the monitoring system. |

**Table 7-7 (Cont.) OccmMemoryUsageMajorThreshold**

| Field | Details |
|---|---|
| **Recommended Actions** | The alert gets cleared when the memory utilization falls below the Major Threshold or crosses the critical threshold, in which case OccmMemoryUsageMajorThreshold alert shall be raised<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.8 OccmMemoryUsageCriticalThreshold

**Table 7-8 OccmMemoryUsageCriticalThreshold**

| Field | Details |
|---|---|
| **Description** | OCCM Memory Usage Alert<br>OCCM Memory Usage for pod {{ $labels.pod }} has crossed the configured critical threshold (90%) (value={{ $value }}) of its limit.. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: Memory Usage of pod exceeded 90% of its limit. |
| **Severity** | Critical |
| **Condition** | A pod has reached the configured critical threshold ( 90% ) of its memory resource limits |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7005 |
| **Metric Used** | container_memory_usage_bytes,<br>Note : This is a kubernetes metric used for instance availability monitoring.If the metric is not available, use the similar metric as exposed by the monitoring system. |
| **Recommended Actions** | The alert gets cleared when the memory utilization falls below the Critical Threshold.Note : The threshold is configurable in the alerts.yaml<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.9 OccmCPUUsageMinorThreshold

**Table 7-9 OccmCPUUsageMinorThreshold**

| Field | Details |
|---|---|
| **Description** | OCCM CPU Usage Alert<br>OCCM Pod {{$labels.pod}} has high CPU usage detected. |
| **Summary** | namespace: {{ $labels.namespace}}, podname: {{ $labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: CPU usage is {{ $value \| printf "%.2f" }} which is usage is above 70% (current value is: {{ $value }}) |
| **Severity** | Minor |
| **Condition** | CPU usage is above 70% |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7006 |
| **Metric Used** | container_cpu_usage_seconds_total |
| **Recommended Actions** | Information regarding CPU usage If it is above 70%<br>The alert gets cleared when the CPU usage falls below the Minor Threshold.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.10 OccmCMPFailureMinor

**Table 7-10 OccmCMPFailureMinor**

| Field | Details |
|---|---|
| **Description** | OCCM CMP Command Execution Failure Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while executing CMP cmd with {{$labels.statusCode}}. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while executing CMP cmd with {{$labels.statusCode}}. |
| **Severity** | Minor |
| **Condition** | Certificate has failed while executing CMP cmds. |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7007 |
| **Metric Used** | occm_cmp_responses_total |

**Table 7-10 (Cont.) OccmCMPFailureMinor**

| Field | Details |
|---|---|
| **Recommended Actions** | Information that the rate of certificate failure due to CMP command execution error has crossed the threshold. The alert is cleared when the rate of certificate failure due to CMP command execution error falls below the Minor threshold or when the error rate crosses the Major threshold, in which case the OccmCMPFailureMajor alert is raised.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.11 OccmCMPFailureMajor

**Table 7-11 OccmCMPFailureMajor**

| Field | Details |
|---|---|
| **Description** | OCCM CMP Command Execution Failure Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while executing CMP cmd with {{$labels.statusCode}}. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while executing CMP cmd with {{$labels.statusCode}}. |
| **Severity** | Major |
| **Condition** | Certificate has failed while executing CMP cmds |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7007 |
| **Metric Used** | occm_cmp_responses_total |
| **Recommended Actions** | Information that the rate of certificate failure due to CMP command execution error has crossed the threshold. The alert is cleared when the rate of certificate failure due to CMP command execution error falls below the Major threshold or when the error rate crosses the Critical threshold, in which case the OccmCMPFailureCritical alert is raised.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.12 OccmCMPFailureCritical

**Table 7-12 OccmCMPFailureCritical**

| Field | Details |
|---|---|
| **Description** | OCCM CMP Command Execution Failure Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while executing CMP cmd with {{$labels.statusCode}}. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while executing CMP cmd with {{$labels.statusCode}}. |
| **Severity** | Critical |
| **Condition** | Certificate has failed while executing CMP cmds |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7007 |
| **Metric Used** | occm_cmp_responses_total |
| **Recommended Actions** | Information that the rate of certificate failure due to CMP command execution error has crossed the threshold. The alert is cleared when the rate of certificate failure due to CMP command execution error falls below the Critical threshold.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.13 OccmFailureMinor

**Table 7-13 OccmFailureMinor**

| Field | Details |
|---|---|
| **Description** | OCCM Internal Failure Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while creating cert with {{$labels.errorReason}}. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while creating cert with {{$labels.errorReason}}. |
| **Severity** | Minor |
| **Condition** | Certificate has failed while creating |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7008 |
| **Metric Used** | occm_cert_request_status_total |

**Table 7-13 (Cont.) OccmFailureMinor**

| Field | Details |
|---|---|
| **Recommended Actions** | Information that the rate of OCCM errors has crossed the threshold. The alert is cleared when the rate OCCM error falls below the Minor threshold or when the error rate crosses the Major threshold, in which case the OccmFailureMajor alert is raised.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.14 OccmFailureMajor

**Table 7-14 OccmFailureMajor**

| Field | Details |
|---|---|
| **Description** | OCCM Internal Failure Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while creating cert with {{$labels.errorReason}}. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while creating cert with {{$labels.errorReason}}. |
| **Severity** | Major |
| **Condition** | Certificate has failed while creating |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7008 |
| **Metric Used** | occm_cmp_responses_total |
| **Recommended Actions** | Information that the rate of OCCM errors has crossed the threshold. The alert is cleared when the rate OCCM error falls below the Major threshold or when the error rate crosses the Critical threshold, in which case the OccmFailureCritical alert is raised.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.15 OccmFailureCritical

**Table 7-15 OccmFailureCritical**

| Field | Details |
|---|---|
| **Description** | OCCM CMP Command Execution Failure Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while creating cert with {{$labels.errorReason}}. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed while creating cert with {{$labels.errorReason}}. |
| **Severity** | critical |
| **Condition** | Certificate has failed while creating |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7008 |
| **Metric Used** | occm_cmp_responses_total |
| **Recommended Actions** | Information that the rate of certificate failure due to CMP command execution error has crossed the threshold. The alert is cleared when the rate of certificate failure due to CMP command execution error falls below the Critical threshold.<br>Note: The threshold is configurable in the occm_alertingrules_<version>.yaml file.<br>Steps:<br>1. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>2. Depending on the failure reason, take the resolution steps.<br>3. If this is unexpected, contact My Oracle Support. |

# 7.16 OccmRenewBeforValidityCritical

**Table 7-16 OccmRenewBeforValidityCritical**

| Field | Details |
|---|---|
| **Description** | OCCM Renew Before is greater than Cert Validity Alert<br>The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed because renew before validity is greater than cert validity {{$labels.errorReason}}. |
| **Summary** | namespace: {{$labels.namespace}}, podname: {{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . \| first \| value \| humanizeTimestamp }}{{ end }}: The certificate {{$labels.certName}} used by {{$labels.nfType}} has failed because renew before validity is greater than cert validity {{$labels.errorReason}}. |
| **Severity** | critical |
| **Condition** | Certificate has failed because renew before validity is greater than cert validity |
| **OID** | 1.3.6.1.4.1.323.5.3.54.1.2.7009 |

**Table 7-16 (Cont.) OccmRenewBeforValidityCritical**

| Field | Details |
|---|---|
| **Metric Used** | occm_cert_request_status_total |
| **Recommended Actions** | Information that the Certificate has failed because renew before validity is greater than cert validity.<br>Steps:<br>1. Check certificate configuration for renew before days.<br>2. Also Check the validity requested for the Certificate and validity assigned by the CA.<br>3. Refer to the application logs on Kibana and filter based on occm service name. Check for ERROR WARNING logs related to thread exceptions.<br>4. Depending on the failure reason, take the resolution steps.<br>5. If this is unexpected, contact My Oracle Support. |

# 7.17 OCCM Alert and MIB Configuration in Prometheus

### CNE supporting Prometheus HA

This section describes the measurement based Alert rules configuration for OCCM in Prometheus. You must use the updated `occm_alerting_rules_promha_<version>.yaml file`.

Run the following command to create ot update the PrometheusRule resource specified in the alert YAML file:

```
$ kubectl apply -f occm_alerting_rules_promha_<version>.yaml
```

### Disabling Alerts

This section describes the procedure to disable the alerts in OCCM. To disable alerts:

1. Edit `occm_alerting_rules_promha_<version>.yaml` file to remove specific alert.
2. Remove complete content of the specific alert from the `occm_alerting_rules_promha_<version>.yaml` file.
   For example, ff you want to remove OccmServiceDown alert, remove the complete content:

```
## ALERT SAMPLE START##
- alert: OccmServiceDown
      annotations:
        description: 'New certificates will not be created, and existing
ones can not be renewed until OCCM is back'
        summary: 'namespace: {{$labels.namespace}}, podname:
{{$labels.pod}}, timestamp: {{ with query "time()" }}{{ . | first | value
| humanizeTimestamp }}{{ end }}: OCCM service is down'
      expr: absent(up{pod=~".*occm.*", namespace="occm-ns"}) or
(up{pod=~".*occm.*", namespace="occm-ns"}) == 0
      labels:
```

```
        severity: critical
        oid: "1.3.6.1.4.1.323.5.3.54.1.2.7004"
        namespace: ' {{ $labels.namespace }} '
        podname: ' {{$labels.pod}} '
## ALERT SAMPLE END##
```

3. Perform Alert configuration.

### Validating Alerts

Configure and Validate Alerts in Prometheus Server. Refer to OCCM Alert Configuration for procedure to configure the alerts.

After configuring the alerts in Prometheus server, a user can verify that by following steps:

1. Open the Prometheus server from your browser using the <IP>:<Port>
2. Navigate to Status and then Rules
3. Search OCCM. OCCMAlerts list is displayed.

> **Note**
>
> If you are unable to see the alerts, it means that the alert file has not loaded in a format which the Prometheus server accepts. Modify the file and try again.

### Configuring SNMP-Notifier

Configure the IP and port of the SNMP trap receiver in the SNMP Notifier using following procedure:

1. Execute the following command to edit the deployment:

   ```
   kubectl edit deploy <snmp_notifier_deployment_name> -n <namespace>
   ```

   Example:

   ```
   $ kubectl edit deploy occne-snmp-notifier -n occne-infra
   ```

2. Edit the destination as follows:

   ```
   --snmp.destination=<destination_ip>:<destination_port>
   ```

   Example:

   ```
   --snmp.destination=10.75.203.94:162
   ```

### MIB Files for OCCM

here are two MIB files which are used to generate the traps. The user need to update these files along with the Alert file in order to fetch the traps in their environment.

- `occm_mib_tc_<version>.mib`: This is considered as OCCM top level mib file, where the Objects and their data types are defined

- `occm_mib_<version>.mib`: This file fetches the Objects from the top level mib file and based on the Alert notification, these objects can be selected for display.

> **Note**
>
> MIB files are packaged along with OCCM CSAR package. Download the file from MOS. For more information, see *Oracle Communications Cloud Native Core, Certificate Management Installation, Upgrade, and Fault Recovery Guide.*

# 8
# OCCM KPIs

This section describes the KPIs available for OCCM.

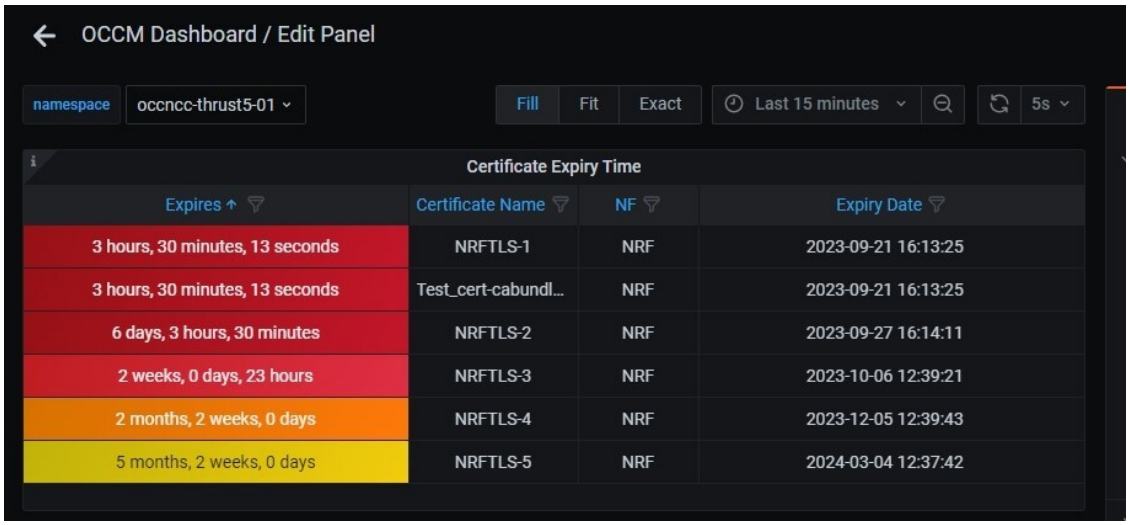
## 8.1 Certificate Expiry Time

**Table 8-1 Certificate Expiry Time**

| Field | Details |
|---|---|
| **Description** | Certificate Expiry Time to list NF, Certificate Name, Expiry Date |
| **Expression** | OCCM dashboard in grafana will show Certificate Expiry Time panel with columns. Table visualization listing Expires, NF, Certificate Name, Expiry Date. Expires column uses color coding to indicate near expiry status.<br>all:occm_cert_expiry{namespace="$namespace"} * 1000 != 0<br>Expires column:((occm_cert_expiry{namespace="$namespace"} != 0)-time())*1000 |

**OCCM KPI Dashboard**

**Figure 8-1 Certificate Expiry Time**




**Color coding description**:-

Red (Critical):- Certificate expiring within 0 <= 7 days Or Certificate expired <= 0 days

Light Red(Major):- Certificate expiring within > 7 <= 30 days

Orange (Minor):- Certificate expiring within > 30 <= 90

Yellow :- Certificate expiring within > 90 <= 180

Green :- Certificates not Expiring sooner

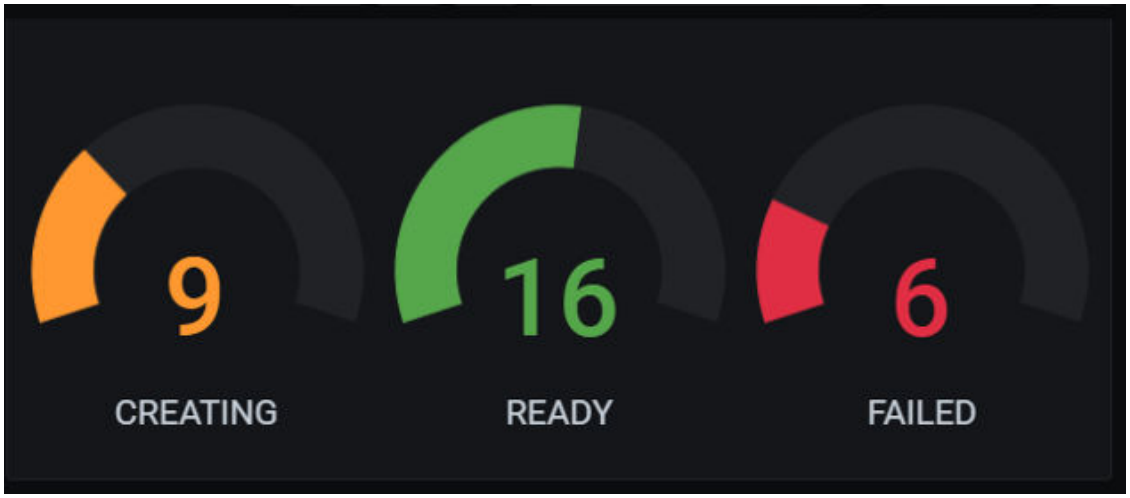
# 8.2 Certificate Readiness Status

**Table 8-2 Certificate Readiness Status**

| Field | Details |
|---|---|
| **Description** | Certificate Readiness Status to indicate if number of Ready and Failed Certificates |
| **Expression** | OCCM dashboard in grafana will show Certificate Readiness Status panel gauge visualization to indicate if number of Ready and Failed Certificates<br>Creating:count(occm_cert_status{namespace="$namespace"} == 1)<br>Ready:count(occm_cert_status{namespace="$namespace"} == 2)<br>Failed:count(occm_cert_status{namespace="$namespace"} == 3)<br>Waiting:count(occm_cert_status{namespace="$namespace"} == 8) |

**OCCM KPI Dashboard**

**Figure 8-2 Certificate Readiness Status**




Creating: Orange

Ready: Green

Failed: Red

Waiting: Light Orange

# 8.3 CMP Request

**Table 8-3 CMP Request**

| Field | Details |
|---|---|
| **Description** | Total CMP requests initiated from OCCM towards CA per NF |

**Table 8-3 (Cont.) CMP Request**

| Field | Details |
|---|---|
| **Expression** | OCCM dashboard in grafana will show CMP Request panel which is total CMP requests per NF.<br>all:sum(rate(occm_cmp_requests_total{namespace="$namespace"}[2m]))<br>SCP:sum(rate(occm_cmp_requests_total{namespace="$namespace", nfType=~"SCP\|scp"}[2m]))<br>NRF:sum(rate(occm_cmp_requests_total{namespace="$namespace", nfType=~"NRF\|nrf"}[2m])) |

# 8.4 CMP Responses

**Table 8-4 CMP Responses**

| Field | Details |
|---|---|
| **Description** | Total CMP responses received from CA per NF by OCCM |
| **Expression** | OCCM dashboard in grafana will show CMP Response panel which is total CMP responses per NF.<br>all:sum(rate(occm_cmp_responses_total{namespace="$namespace"}[2m]))<br>SCP:sum(rate(occm_cmp_responses_total{namespace="$namespace", nfType=~"SCP\|scp"}[2m]))<br>NRF:sum(rate(occm_cmp_responses_total{namespace="$namespace", nfType=~"NRF\|nrf"}[2m])) |

# 8.5 Configuration Requests

**Table 8-5 Configuration Requests**

| Field | Details |
|---|---|
| **Description** | Total Issuer and Certificate configuration requests |
| **Expression** | OCCM dashboard in grafana will show Config Requests panel. Total Issuer and Certificate configuration requests.<br>all:sum(rate(occm_config_http_requests_total{namespace="$namespace"}[2m]))<br>SCP certs:sum(rate(occm_config_http_requests_total{namespace="$namespace", uri=~".*/certs.*", nfType=~"SCP\|scp"}[2m]))<br>NRF certs:sum(rate(occm_config_http_requests_total{namespace="$namespace", uri=~".*/certs.*", nfType=~"NRF\|nrf"}[2m]))<br>issuers:sum(rate(occm_config_http_requests_total{namespace="$namespace", uri=~".*/issuers.*"}[2m])) |

# 8.6 Configuration Responses

**Table 8-6 Configuration Responses**

| Field | Details |
|---|---|
| **Description** | Total Issuer and Certificate configuration responses |
| **Expression** | OCCM dashboard in grafana will show Config Responses panel. Total Issuer and Certificate configuration responses.<br>all:sum(rate(occm_config_http_responses_total{namespace="$namespace"}[2m]))<br>SCP certs:sum(rate(occm_config_http_responses_total{namespace="$namespace", uri=~".*/certs.*", nfType=~"SCP\|scp"}[2m]))<br>NRF certs:sum(rate(occm_config_http_responses_total{namespace="$namespace", uri=~".*/certs.*", nfType=~"NRF\|nrf"}[2m]))<br>issuers:sum(rate(occm_config_http_responses_total{namespace="$namespace", uri=~".*/issuers.*"}[2m])) |

# 8.7 CPU Usage

**Table 8-7 CPU Usage**

| Field | Details |
|---|---|
| **Description** | CPU usage of OCCM pod |
| **Expression** | Time series indicates CPU usage of OCCM pod.<br>sum(rate(container_cpu_usage_seconds_total{image!="",namespace="$namespace", pod=~"occm-.*."}[2m])) by(pod) |

# 8.8 Memory Usage

**Table 8-8 Memory Usage**

| Field | Details |
|---|---|
| **Description** | Memory usage of OCCM pod |
| **Expression** | Time series indicates Memory usage of OCCM pod.<br>(avg_over_time(container_memory_usage_bytes{container=~"occm", namespace="$namespace"}[2m])) |

# 8.9 OpenSSL CLI Duration (occm_cmp_cli_durations)

**Table 8-9 OpenSSL CLI Duration (occm_cmp_cli_durations)**

| Field | Details |
|---|---|
| **Description** | CMP cli time taken in between request and response from CA |
| **Expression** | Used to show the duration of openssl cmp calls<br>occm_cmp_cli_durations_bucket{namespace="occm-ns", uuid="fdsfds-9880-fsd99"} |

# 8.10 Number of requests sent to the CA

**Table 8-10 Number of requests sent to the CA**

| Field | Details |
|---|---|
| **Description** | Metric will peg when request cmd prepared and send to CA for generate certificate. |
| **Expression** | count(occm_cmp_requests_total{namespace="$namespace"} |

# 8.11 Number of responses received from CA

**Table 8-11 Number of responses received from CA**

| Field | Details |
|---|---|
| **Description** | Metric will peg when response received from CA for generate certificate. |
| **Expression** | count(occm_cmp_responses_total{namespace="occm-ns"}) |

# 8.12 Number of responses based on response code from CA

**Table 8-12 Number of responses based on response code from CA**

| Field | Details |
|---|---|
| **Description** | Metric will peg when response received from CA for generate certificate. |
| **Expression** | count(occm_cmp_responses_total{namespace="occm-ns", statusCode="OK", status = "SUCCESS"}) or<br>count(occm_cmp_responses_total{namespace="occm-ns", statusCode="ERR_CMP_COMMAND_FAILED", status = "FAILED"}) |

# 8.13 Type of request sent to CA

**Table 8-13 Type of request sent to CA**

| Field | Details |
|---|---|
| **Description** | Metric will peg when request cmd prepared and send to CA for generate certificate. |
| **Expression** | count(occm_cmp_requests_total{namespace="occm-ns", requestType="ir"}) or<br>count(occm_cmp_requests_total{namespace="occm-ns", requestType="kur"}) |

# 8.14 Number of certificates issued by CA

**Table 8-14 Number of certificates issued by CA**

| Field | Details |
|---|---|
| **Description** | Metric will peg when response received from CA for generate certificate. |

**Table 8-14 (Cont.) Number of certificates issued by CA**

| Field | Details |
|---|---|
| **Expression** | count(occm_cmp_responses_total{namespace="occm-ns", status = "SUCCESS", statusCode = "OK"}) |

# 8.15 Number of CSRs denied by CA

**Table 8-15 Number of CSRs denied by CA**

| Field | Details |
|---|---|
| **Description** | Metric will peg when response received from CA for generate certificate. |
| **Expression** | count(occm_cmp_responses_total{namespace="occm-ns", status = "FAILED"}) |

# 8.16 Error while writing the key, certificate, or chain in the Kubernetes secrets

**Table 8-16 Error while writing the key, certificate, or chain in the Kubernetes secrets**

| Field | Details |
|---|---|
| **Description** | Metric will peg when cert renew or create worker complete its process |
| **Expression** | occm_cert_request_status{namespace="occm-ns", errorReason= "ERR_SECRET_FAILED"} |

# 8.17 Unable to access or read from Kubernetes secrets

**Table 8-17 Unable to access or read from Kubernetes secrets**

| Field | Details |
|---|---|
| **Description** | Metric will peg when cert renew or create worker complete its process |
| **Expression** | occm_cert_request_status{namespace="occm-ns", errorReason= "ERR_SECRET_EXIST"} |

# 8.18 Check Renewed Certificate

**Table 8-18 Check Renewed Certificate**

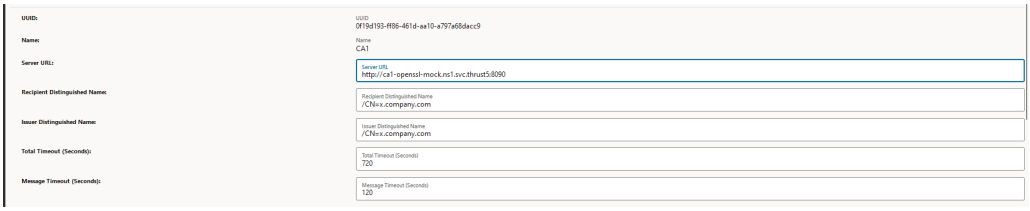
| Field | Details |
|---|---|
| **Description** | Metric will peg when cert renew or create worker complete its process |
| **Expression** | occm_cert_request_status_total{namespace="occncc-thrust5-02", operationType="RENEW"} |

# A.1 Creating NF Certificate Using OCCM - Sample Configuration

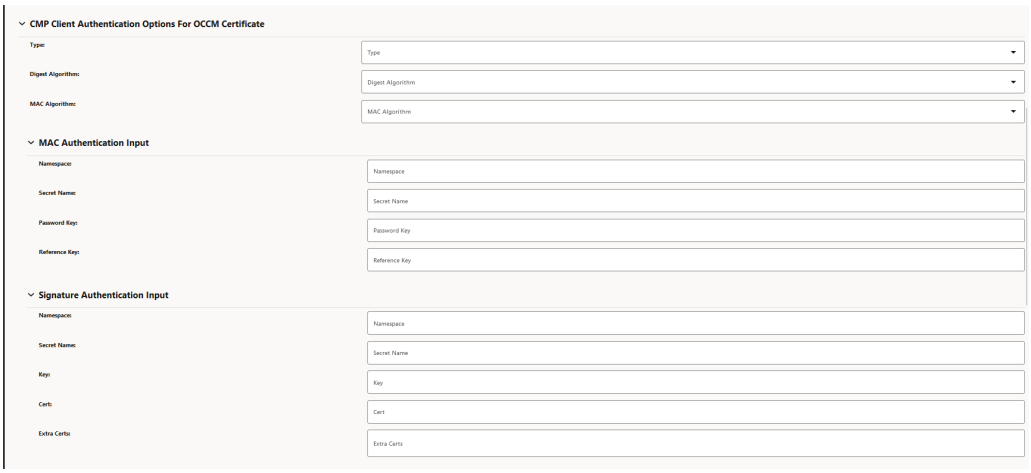
This section describes the sequence of steps to be performed to generate a signed certificate (NF certificate) using OCCM

1. **Create the Issuer**:
   The following screenshots provide a sample configuration for creating the issuer using CNC Console GUI

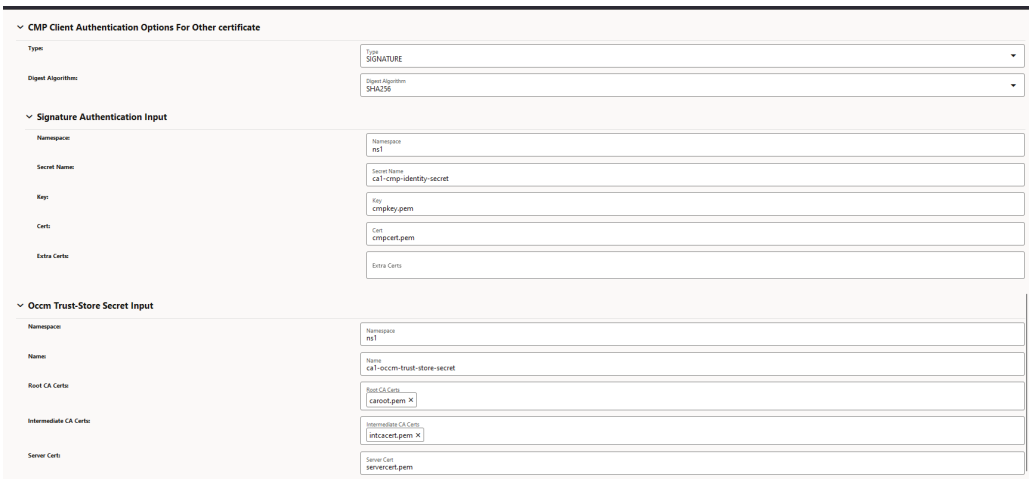
   a. **Figure 3 Create Issuer**




   b. **Figure 4 CMP Client Authentication Options for OCCM Certificate**

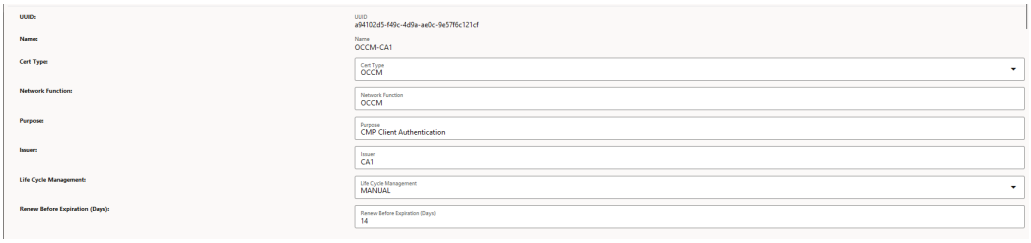



   c. **Figure 5 CMP Client Authentication Options for Other Certificate**

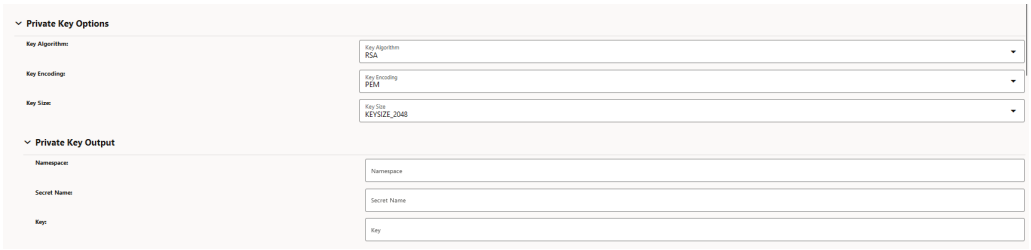


2. **Create OCCM Certificate:**
The following screenshots provide a sample configuration for creating OCCM Certificate using CNC Console GUI. Here, OCCM certificate is configured manually.

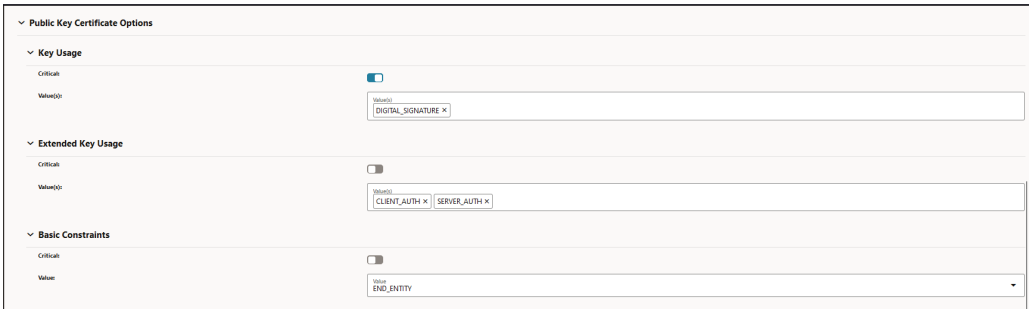
a. **Figure 6 Create OCCM Certificate**



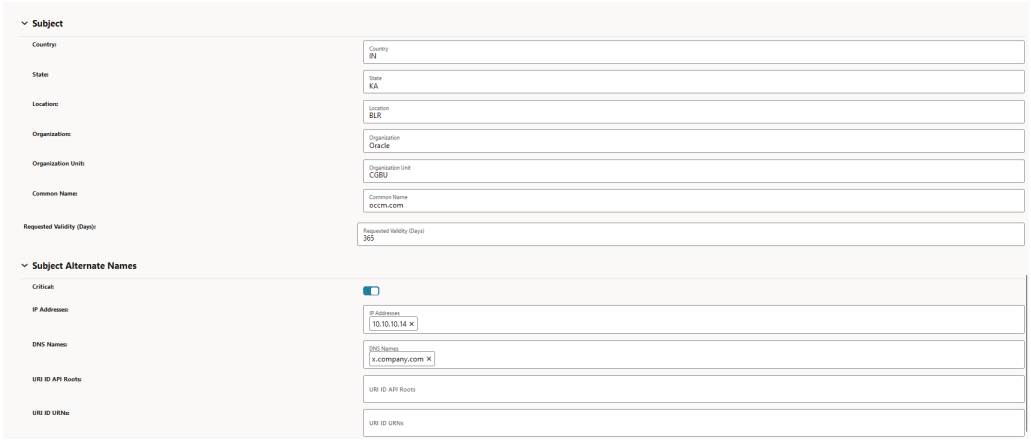

b. **Figure 7 Private Key Options**



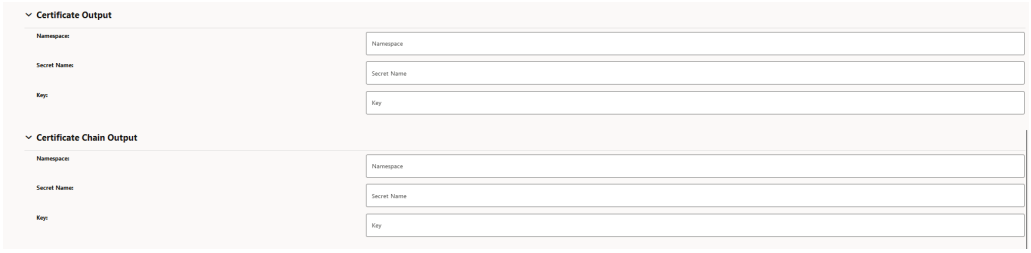

c. **Figure 8 Public Key Certificate Options**




d. **Figure 9 Subject and Subject Alternate Name**

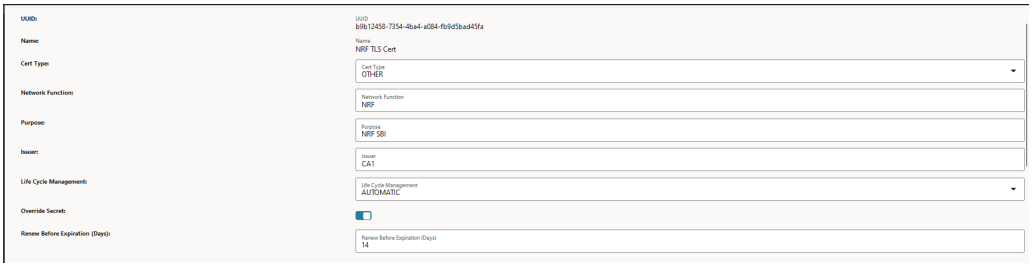


e. **Figure 10 Certificate Output**

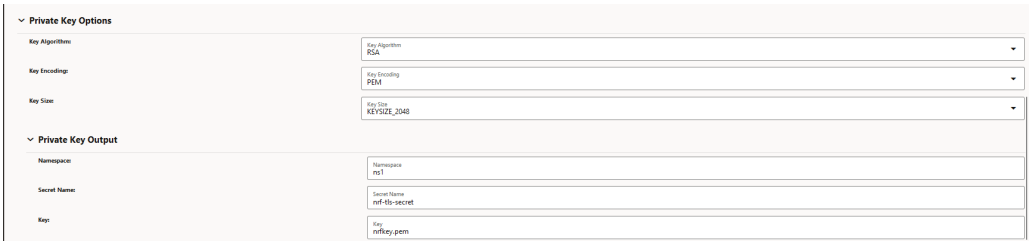



3. **Create NF Certificate:**
The following screenshots provide a sample configuration for creating NF Certificate using CNC Console GUI.

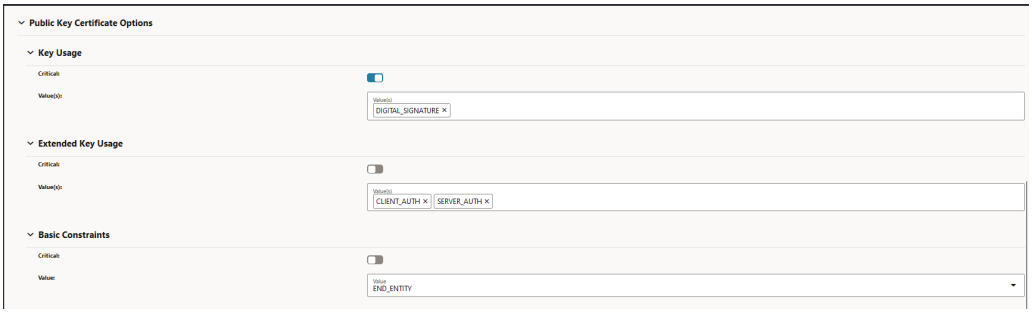
a. **Figure 11 Create NF Certificate**



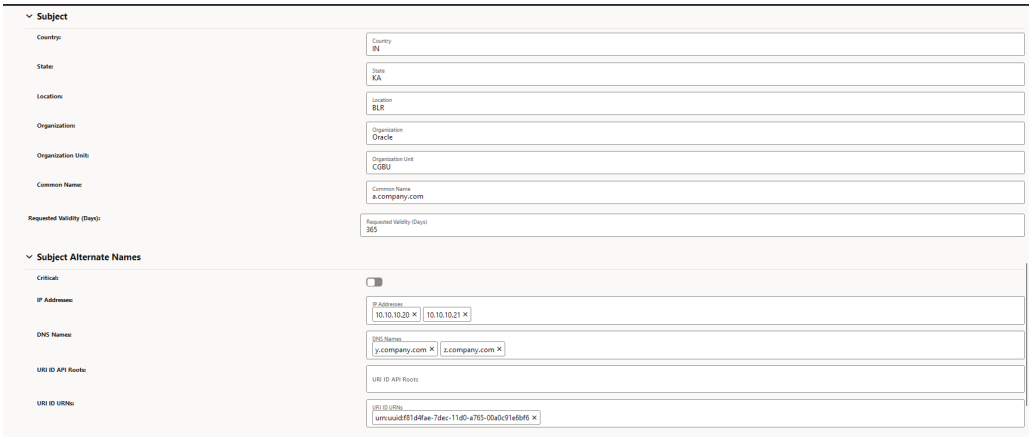

b. **Figure 12 Private Key Options**



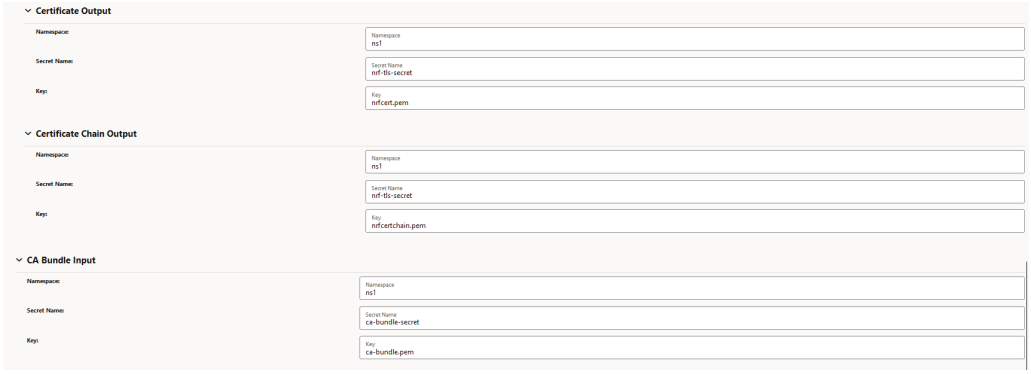

c. **Figure 13 Public Key Options**



d. **Figure 14 Subject and Subject Alternate Names**

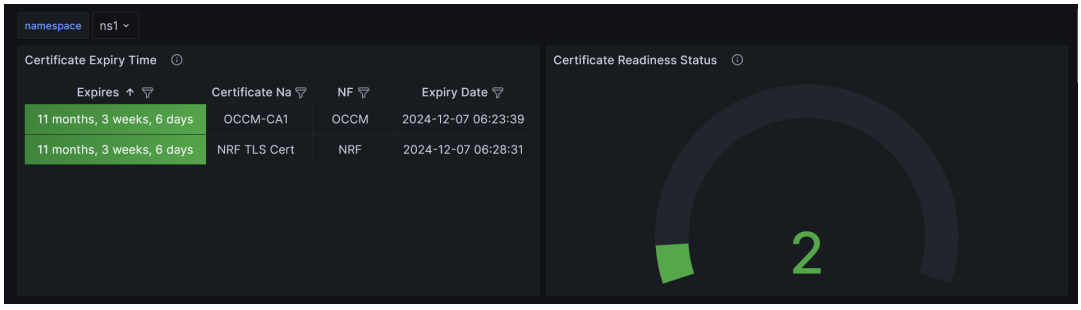



e. **Figure 15 Certificate Output**




4. **Check Grafana Dashboard**
Check the grafana dashboard to view the certificates created.

**Figure 16 Sample Grafana Dasboard**




The screenshot shows that NRF TLS Cert and CA1 certificates are created successfully. The left panel indicates their expiry time and the right panel shows that both are ready to be consumed.

5. **Verify Kubernetes secret**
After the certificate request is submitted, verify whether the k8s secret specified under private key output and certificate output location is created or not.

Run the following command to get the content of the Kubernetes secret:

```
kubectl get secret <k8s-secret-name> -n <namespace> -o yaml
```

For example:

```
[scp-user@thrust5-bastion-1 ~]$ kubectl get secret nrf-tls-secret -n ns1 -
o yaml
apiVersion: v1
data:
  nrfcert.pem: LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0tLS0tCkXXXXXXXXXX
  nrfcertchain.pem: LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0tXXXXXXXXXX
  nrfkey.pem: LS0tLS1CRUdJTiBQUklWQVRFIEtFWS0tLS0tCk1XXXXXXXXXX
kind: Secret
metadata:
  creationTimestamp: ""2023-12-08T06:29:46Z"
  name: nrf-tls-secret
  namespace: ns1
  resourceVersion: "563348905"
  uid: f0eb452d-e977-4809-99b0-c541b154dabe
type: Opaque
```

Output of openssl x509 command for the certificate:

```
kubectl get secret <k8s-secret-name> -n <namespace> -o=go-
template='{{index .data "<certificate-output-K8s-secret-key>"}}' | base64 -
d | openssl x509 -text -noout
```

For example:

```
[scp-user@thrust5-bastion-1 ~]$ kubectl get secret nrf-tls-secret -n ns1 -
o=go-template='{{index .data "nrfcert.pem"}}' | base64 -d | openssl x509 -
text -noout


Certificate:
  Data:
    Version: 3 (0x2)
    Serial Number:
      XXXXXXXXX
    Signature Algorithm: sha256WithRSAEncryption
    Issuer: CN = x.company.com
    Validity
      Not Before: Sep 25 05:46:31 2023 GMT
      Not After : Sep 24 05:46:31 2024 GMT
    Subject: C = IN, ST = KA, L = BLR, O = Oracle, OU = CGBU, CN =
a.company.com
    Subject Public Key Info:
      Public Key Algorithm: rsaEncryption
        Public-Key: (2048 bit)
        Modulus:
          00:c9:1b:35:bf:21:e6:1f:69:9e:78:25:07:4b:6e:
         XXXXXXXXX
```

```
        Exponent: 65537 (0x10001)
    X509v3 extensions:
      X509v3 Key Usage:
        Digital Signature
      X509v3 Extended Key Usage:
        TLS Web Client Authentication, TLS Web Server Authentication
      X509v3 Basic Constraints:
        CA:FALSE
      X509v3 Subject Alternative Name:
                IP Address:10.10.10.20, IP Address:10.10.10.21,
DNS:y.commpany.com, DNS:z.commpany.com, URI:urn:uuid:f81d4fae-7dec-11d0-
a765-00a0c91e6bf6
      X509v3 Subject Key Identifier:
        2B:0D:XXXXXXXXXXXX
      X509v3 Authority Key Identifier:
        20:03:XXXXXXXXXX
  Signature Algorithm: sha256WithRSAEncryption
  Signature Value:
   XXXXXXXXXXXXXXXXXXXXXX
```