NetApp

ONTAP

9.11.1P19, 9.12.1P17, 9.12.1P19, 9.13.1P19, 9.14.1.P15, 9.15.1P16, 9.17.1P2, 9.18.1

Integration Guide

ESKM

8.53.1, 8.53.3, 8.54.0

utimaco®

Imprint

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Table of Contents

1 Introduction

This guide is part of the information and support provided by Utimaco. It outlines the detailed process of integrating Utimaco ESKM with NetApp ONTAP, with an emphasis on secure, centralized encryption key management for protecting data at rest. The guide outlines the step-by-step configuration process required to establish and validate the integration.

1.1 About this Guide

This guide provides a detailed walkthrough of the integration process between Utimaco ESKM and NetApp ONTAP, focusing on establishing a secure and reliable encryption key management infrastructure. Utimaco ESKM plays a central role in the lifecycle of cryptographic keys. It generates, stores, and manages the keys that NetApp ONTAP utilizes to enable volume-level encryption through NetApp Volume Encryption (NVE). By leveraging the KMIP protocol, this integration ensures that sensitive data at rest is protected with strong encryption standards while also enabling centralized compliance and auditability across the storage environment.

1.2 Target Audience

This guide is intended for administrators of NetApp ONTAP and Utimaco ESKM.

1.3 Purpose of the Integration

Integrating NetApp ONTAP with Utimaco ESKM provides a powerful, secure, and standards-based approach to managing encryption keys for data-at-rest protection:

- Secure Key Storage: ONTAP protects data using volume-level encryption. Instead of storing encryption keys locally, it relies on Utimaco ESKM to securely generate, store, and serve keys, ensuring that sensitive data remains protected even if physical storage is compromised.
- KMIP-Based Interoperability: Utimaco ESKM supports the Key Management Interoperability Protocol (KMIP), allowing seamless communication with ONTAP. This standardization ensures compatibility and simplifies integration across diverse environments.
- Centralized Key Management: ESKM provides a single pane of glass for managing all cryptographic keys, which is especially useful in large or multi-cloud deployments. This centralization enhances control, simplifies audits, and supports compliance efforts.

- High Availability & Disaster Recovery: ONTAP supports configuring multiple KMIP servers for redundancy. This ensures that key access remains uninterrupted even during outages, which is critical for maintaining access to encrypted data.

In essence, this integration strengthens your data security posture by combining ONTAP's robust encryption with Utimaco's enterprise-grade key lifecycle management.

1.4 Document Conventions

The following conventions are used in this guide:

Convention	Use	Example
Bold	Items of the Graphical User Interface (GUI), e.g., menu options	Press **OK**
`Monospaced`	Code that is given for explanation or as an example, file paths	`chsm-create`
Italic	References and important terms	See *Sample Chapter* in the *CryptoServer - Sample Manual*

Table 1: Document Conventions

We use special icons to highlight the most important notes and information.

Here you will find important safety information that should be followed.

Here you will find additional notes or supplementary information.

This message indicates the expected result after the successful execution of an instruction.

1.5 Abbreviations

The following abbreviations are used in this guide.

Abbreviation	Meaning
CA	Certificate Authority
CN	Common Name
ESKM	Security Key Manager
GUI	Graphical User Interface
IP	Internet Protocol
KMIP	Key Management Interoperability Protocol
KMS	Key Management System
NVE	NetApp Volume Encryption
ONTAP	On Net Transport Activation Process
SM	System Manager
NAE	NetApp Aggregate Encryption

Abbreviation	Meaning
SVM	Storage Virtual Machine (also referred to as a Vserver)
RAM	Random Access Memory
VT	Virtualization Technology
BYOK	Bring Your Own Key
HYOK	Hold Your Own Key
TLS	Transport Layer Security
SSL	Secured Socket Layer
VE	Volume Encryption

Table 2: List of abbreviations

2 Product Overview

2.1 NetApp ONTAP

ONTAP software provides a rock-solid foundation for data management on the broadest range of deployments. With the NetApp Volume Encryption feature built into ONTAP, you can easily and efficiently protect your at-rest data by encrypting any volume. An encryption key accessible only to the storage system ensures that volume data cannot be read if the underlying device is repurposed, returned, misplaced, or stolen.

2.2 Utimaco ESKM (Enterprise Secure Key Manager)

The ESKM is a complete solution for generating, storing, serving, controlling and auditing access to encryption keys. It enables you to protect and preserve access to business-critical, sensitive data-at-rest encryption keys, either locally or remotely. ESKM is offering industry-certified Key Management Interoperability Protocol (KMIP)with market-leading support for partner applications and pre-qualified solutions, integrating out-of-the-box with varied deployments and custom integrations.

2.3 Joint Value Proposition

Integrating Utimaco ESKM with NetApp ONTAP lies in delivering a secure, scalable, and standards-based encryption solution for protecting data at rest across on-premises and multi-cloud environments.

Here's what makes this integration compelling:

- End-to-End Data Protection: ONTAP provides native volume-level encryption, while ESKM securely generates, stores, and manages the encryption keys. This ensures that even if storage media is lost or stolen, the data remains inaccessible without the keys.
- KMIP-Based Interoperability: The integration is built on the Key Management Interoperability Protocol (KMIP), enabling seamless and standardized communication between ONTAP and ESKM. This reduces complexity and ensures compatibility across diverse IT ecosystems.
- Centralized Key Governance: ESKM offers centralized control over key lifecycle operations—generation, rotation, revocation, and auditing—helping organizations meet compliance requirements like GDPR, HIPAA, and PCI-DSS.

- Multi-Cloud and BYOK/HYOK Support: The joint solution supports Bring Your Own Key (BYOK) and Hold Your Own Key (HYOK) models, giving enterprises full control over encryption keys in hybrid and multi-cloud deployments.
- High Availability and Resilience: ONTAP supports multiple external key servers, ensuring continuous access to encrypted data even during outages. ESKM's robust architecture complements this with high availability and disaster recovery capabilities.
- Regulatory Compliance and Certification: ESKM is industry-certified and integrates with NetApp's secure storage to meet stringent data protection standards, including those required for classified or regulated environments.

This integration empowers organizations to secure sensitive data with confidence, maintain operational agility, and simplify compliance—all while reducing the risk of data breaches.

3 Integration Requirements and Prerequisites

Ensure that the system environment you will be using meets the following hardware and software requirements.

This guide assumes that the user has already installed and configured the required software.

3.1 Tested Versions

These integrations have been successfully tested with the Utimaco ESKM and NetApp ONTAP.

NetApp ONTAP Version	Utimaco ESKM Version
9.11.1P19, 9.12.1P17, 9.12.1P19, 9.13.1P19, 9.14.1.P15, 9.15.1P16, 9.17.1P2, 9.18.1	8.53.1, 8.53.3, 8.54.0

Table 3: List of tested versions

3.2 Supported Platforms

- Utimaco ESKM hardware appliance
- Utimaco ESKM virtual/cloud appliance

3.3 Software Requirements

Software	Software Requirements
NetApp ONTAP	9.11.1P19, 9.12.1P17, 9.12.1P19, 9.13.1P19, 9.14.1.P15, 9.15.1P16, 9.17.1P2, 9.18.1
Utimaco ESKM	8.53.1, 8.53.3, 8.54.0

Table 4: List of software requirements

3.4 Hardware Requirements

Hardware	Hardware Requirements
ESKM	ESKM hardware appliance or virtual appliance with 2 vCPU and 4GB RAM
NetApp ONTAP	6 GB RAM and 40 GB free disk space for each instance of the simulator
VT	VT support for Intel system

Table 5: List of hardware requirements

3.5 Prerequisites

Before you begin, please ensure that you have:

- Installed/set up NetApp ONTAP as listed in Tested Versions.
- Installed/set up ESKM as listed in Tested Versions.
- Downloaded NetApp ONTAP file from NetApp Support.
- Familiarized yourself with the NetApp ONTAP documents and setup process. Visit ONTAP Documentation for more information related to ONTAP deployment and configuration.
- Deployed the Simulate ONTAP software. The Simulate ONTAP software is a set of VMware files that have been packaged in an .ova file. You need to download the appropriate software and license files from the NetApp Support Site.

4 Installation and Configuration

The following section outlines the procedures required to configure both ESKM and NetApp ONTAP components for seamless integration.

4.1 Installing and Configuring Utimaco ESKM Server

The ESKM server must be configured with specific values, such as the time zone, IP address, netmask, gateway, hostname, and port number used for the ESKM Management Console interface. For detailed configuration steps, see the installation guide "*ESKM_Installation and Replacement_Guide_8.54.0.*"

After successful installation and configuration log in to ESKM.

Figure 1 : ESKM login page

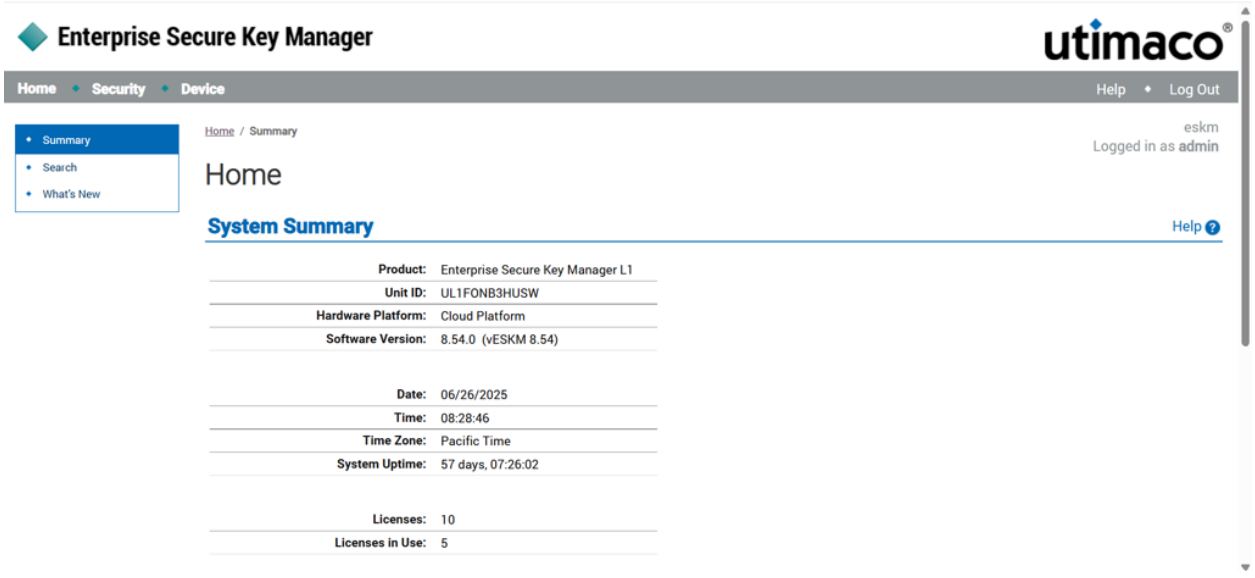


Figure 2 : ESKM Home page

4.2 Installing NetApp ONTAP Using Simulate ONTAP

Skip this section if you already have NetApp ONTAP deployed. For demonstration purposes, Simulate ONTAP has been used. You can download Simulate ONTAP ova file from NetApp Support and deploy it by importing the ova file on VMware Workstation Pro, VMware Workstation Player, or VMware Fusion.

4.2.1 Deploying and Configuring a Single Node ONTAP Cluster

Start and configure a single-node ONTAP cluster using Simulate ONTAP, VMware, System Manager, and the command line.

1. Create Simulate ONTAP virtual machine using .ova file.
2. After a few minutes of starting the virtual machine, you will receive a message asking you to log in to the system. Use System Manager to complete the cluster setup. This message includes an IP address. Copy and paste this IP address into your browser address bar to open System Manager.
3. System Manager will open. You can ignore the 'partner details were not found' error message.

4. If you have any issues with how System Manager displays pages, then try a different web browser or Java version on your laptop.
5. Enter these details as per your requirement, leaving the other checkboxes unchecked, then click **Submit**.

a) Storage System Name: cluster1

b) Administrative Password: Utimaco@123

c) Cluster IP Address: 192.168.182.61 Subnet Mask: 255.255.255.0 Gateway: 192.168.182.1

d) Node IP Addresses: 192.168.182.62

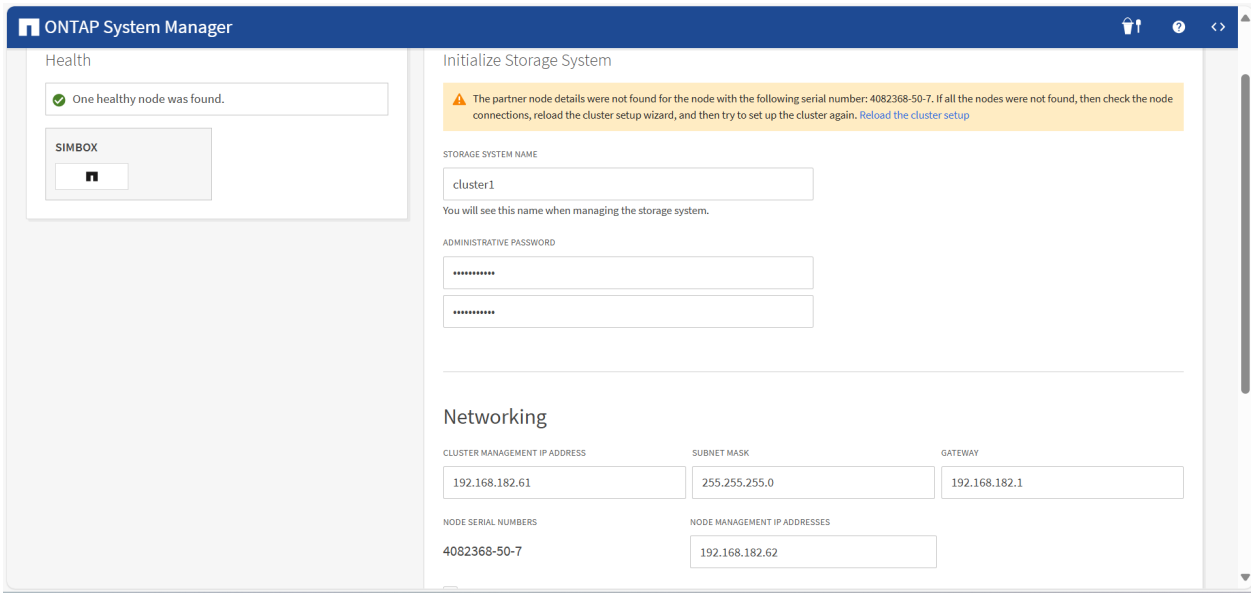


Figure 3 : System Manager Initialize Storage System page

6. in the VMware Workstation Player window.
7. Add all existing disks to Cluster 1 Node 1 with the below command.

>_Console

```
cluster1::> storage disk assign -all true -node cluster1-01
```

If you get an error message, it's because the system has already auto-assigned the disks; you can ignore it.

8. If necessary, add more disks to your root aggregate to increase its size and accommodate the additional space needed in your root volume.

>_Console

```
cluster1::> storage aggregate add-disks -diskcount 8 -aggregate
aggr0_cluster1_01
```

9. Set the root volume to a new size.

>_Console

```
cluster1::> volume modify -size 7.47GB -volume vol0 -vserver cluster1-01
```

10. Download a production data at rest encryption image from NetApp Support.

    a) Click download latest image, for example “Download Latest Release [9.12.1P17]”.

    b) Click **I read the EULA.** Click **Accept and Continue**.

    c) Click **“Download ONTAP 9.12.1P17 with NetApp Volume Encryption for FAS [2.54 GB] “**.

    d) Save the file and make it accessible via a web server.

    e) Download the package to ONTAP cluster and update the node using the below command.

>_Console

```
cluster1::> cluster image package get -url http://<web_server_ip>/
9121P17_q_image.tgz

cluster1::> cluster image package show

cluster1::> cluster image update -version 9.12.1P17 -nodes cluster1-01

cluster1::> cluster image show-update-progress
```

11. Unlock the diag account and set the password.

>_Console

```
cluster1::> security login unlock -username diag

cluster1::> security login password -username diag
```

12. Install the VE license.

>_Console

```
cluster1::> license add -license-code AAAAAAAAAAAAAAAAAAAAAAAAAAAA
```

13. Verify that the license is installed by displaying all the licenses on the cluster.

>_Console

```
cluster1::> system license show
```

```
cluster1::> system license show

Serial Number: 1-80-000011
Owner: cluster1
Installed License: Legacy Key
Capacity: -
Package           Type     Description           Expiration
----------------- -------- --------------------- -------------------
VE                demo     Volume Encryption License
                                                  7/14/2025 08:00:00
```

Figure 4 : System license show

5 Integration Steps

5.1 Configuration on Utimaco ESKM

Proper configuration of Utimaco ESKM is crucial for achieving secure and streamlined key management. This section guides you through the necessary steps to configure ESKM for ONTAP integration.

5.1.1 Local CA Creation

Inside ESKM create a local CA by following the below steps:

1. Go to **Security** tab.
2. Click on **Certificates** option listed under **Certificates & CAs**.
3. Scroll down to the **Create Certificate** section.
4. Enter a **Certificate Authority Name** and **Common Name**. These may have the same value, for example, ESKM Local CA.
5. Enter your **Organizational information**.
6. Select the **Algorithm** (e.g., RSA-2048).
7. Click on **Self-signed Root CA** and enter the **CA Certification Duration** and **Maximum User Certificate Duration**. These values determine when the certificate must be renewed and should be set in accordance with your company's security policies. The default value for both is 3650 days or 10 years.
8. Click on **Create.**

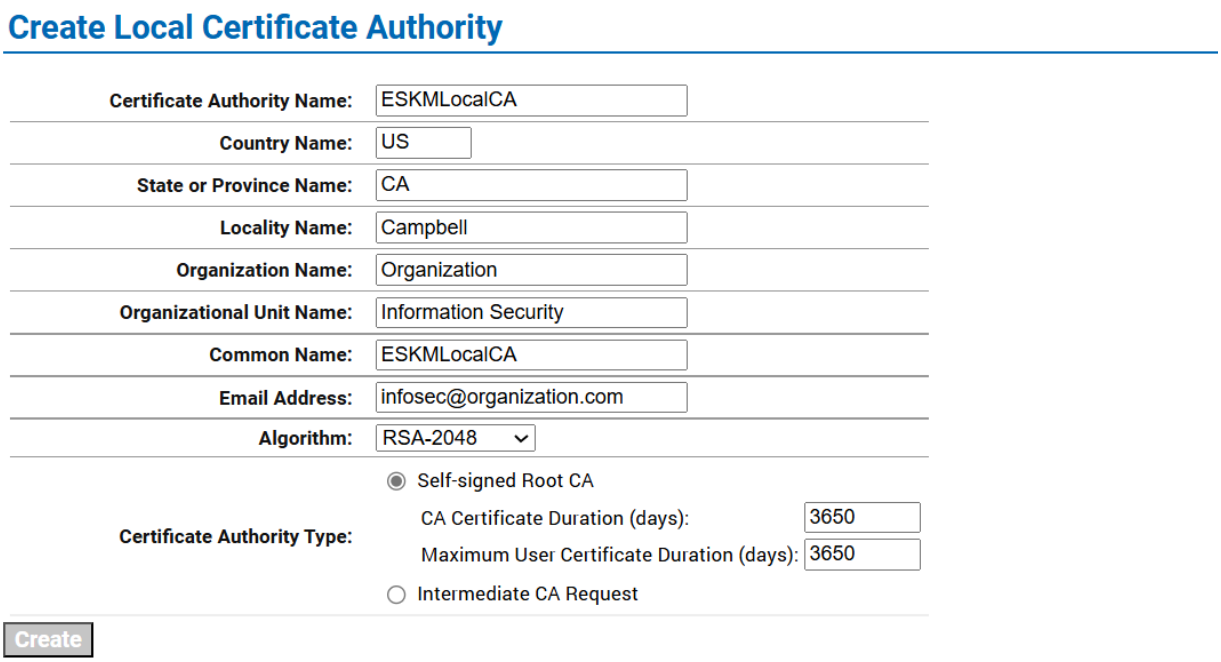


Figure 5 : Create Local CA

9. Click on **Local CA's** option listed under **Certificates & CA's** to view the created local CA certificate.

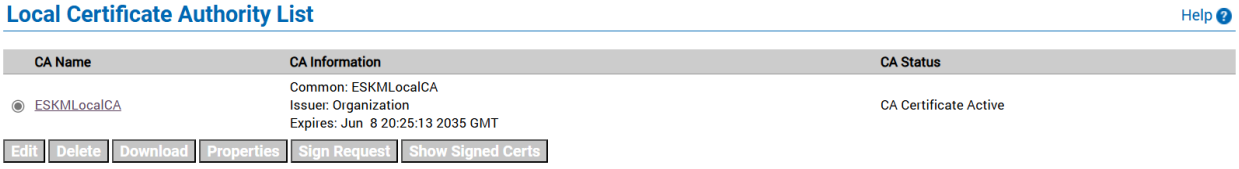


Figure 6 : Local Certificate Authority List

5.1.2 Server Certificate Creation

ESKM server certificates are used by the client to authenticate the ESKM server during the TLS/SSL handshake.

To create an ESKM server certificate, perform the following steps:

1. Go to **Security** tab.
2. Click on **Certificates** option listed under **Certificates & CAs**.
3. Scroll down to the **Create Certificate** section.

4. Enter **Certificate Name**, **Country Name**, **State and Province Name**, **Locality Name**, **Organization Name,** and **Organization Unit Name**
5. Select **RSA-2408** from the **Algorithm** dropdown list.
6. Select the previously created CA certificate name from the **Local CA** drop-down list.
7. Select **Server** from the **Certificate Purpose** dropdown list.
8. Click on **Create**.

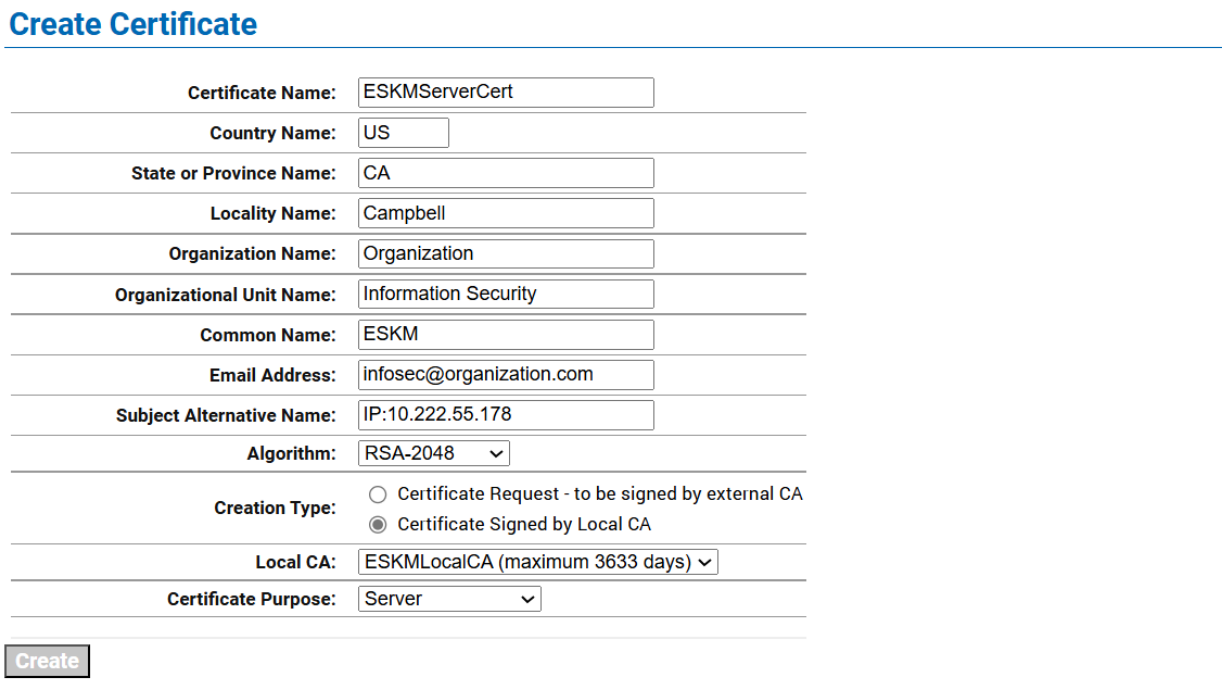


Figure 7 : Create Certificate

5.1.3 KMIP Server Configuration

1. Go to the **Device** tab.
2. From the left side panel, click on the **KMIP Server** option listed under **Device Configuration**.
3. Click the **Edit** button on the main page.
4. Choose the above-created server certificate as the **server certificate** for the KMIP server.
5. Click the **Save** button.

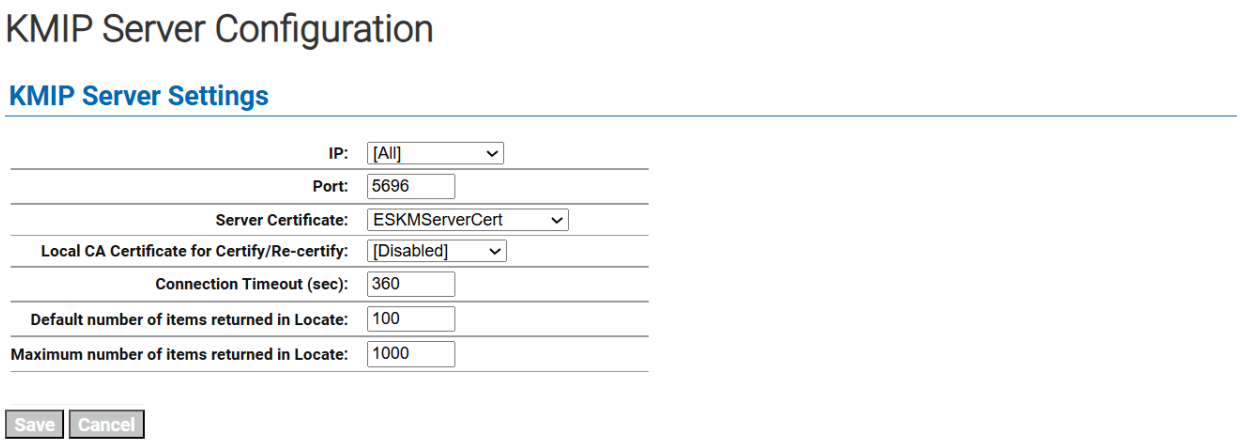


Figure 8 : KMIP Server Settings

5.1.4 Creating a Client Certificate for ONTAP (Using OpenSSL)

This section provides the step-by-step procedure for creating a client certificate for integrating ESKM with ONTAP.

5.1.4.1 Create a CSR

1. The certificate signing request (CSR) is created on a machine with OpenSSL installed.
2. Using OpenSSL, create a private key using the commands and syntax shown below. The example shows the creation of a 2048-bit RSA key.

>_Console

```
# openssl genrsa -out KMIP_client.key 2048
```

3. Generate a certificate signing request (CSR) using the private key.

>_Console

```
# openssl req -x509 -new -nodes -key KMIP_client.key -days 3650 -out
KMIP_client.cert -sha256
```

The following output appears.

>_Console

```
You are about to be asked to enter information that will be incorporated
into your certificate request. What you are about to enter is what is
called a Distinguished Name or a DN. There are quite a few fields but you
can leave some blank For some fields, there will be a default value, If you
enter '.', the field will be left blank. ----- Country
```

4. Enter the information in the fields as prompted.

Field	Example
Country Name	USA
State Name	CA
Locality Name	Campbell
Organization Name	Oraganization
Organization Unit Name	Information Security
Common Name	kmip_client_ontap
Email Address	infosec@organization.com

Table 7: List of Field with Example

The Common Name must match the name of the KMIP user.

This process creates a certificate request file called `KMIP_client.csr`. It also creates a private key file called `KMIP_client.key`.

5.1.4.2 Use the Local CA to Sign CSR

The CSR needs to be signed by the local CA.

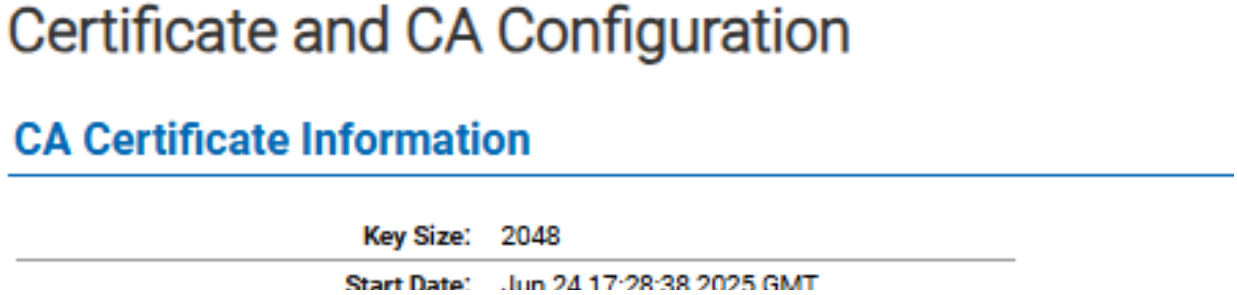
1. View the `KMIP_client.csr` file created above using the cat command (`cat kmip_client.csr`) or open it using any text editor.
2. Select the entire text and copy it to the clipboard.

Be sure to include the first and last lines (-----BEGIN CERTIFICATE REQUEST----- to -----END CERTIFICATE REQUEST-----)".

3. Log in to the Management Console and navigate to **Security > Certificates & CAs > Local CAs**.
4. Select the CA used by your ESKM (in this case, ESKMLocalCA), and click **Sign Request**. The Sign Request window is displayed.

Figure 9 : Sign Certificate Request

5. For **Certificate Purpose**, select **Client**.
6. Paste the CSR text that you have copied to your clipboard (Step 2 above) into the Certificate Request window.
7. Click **Sign Request**. The signed client certificate is displayed.



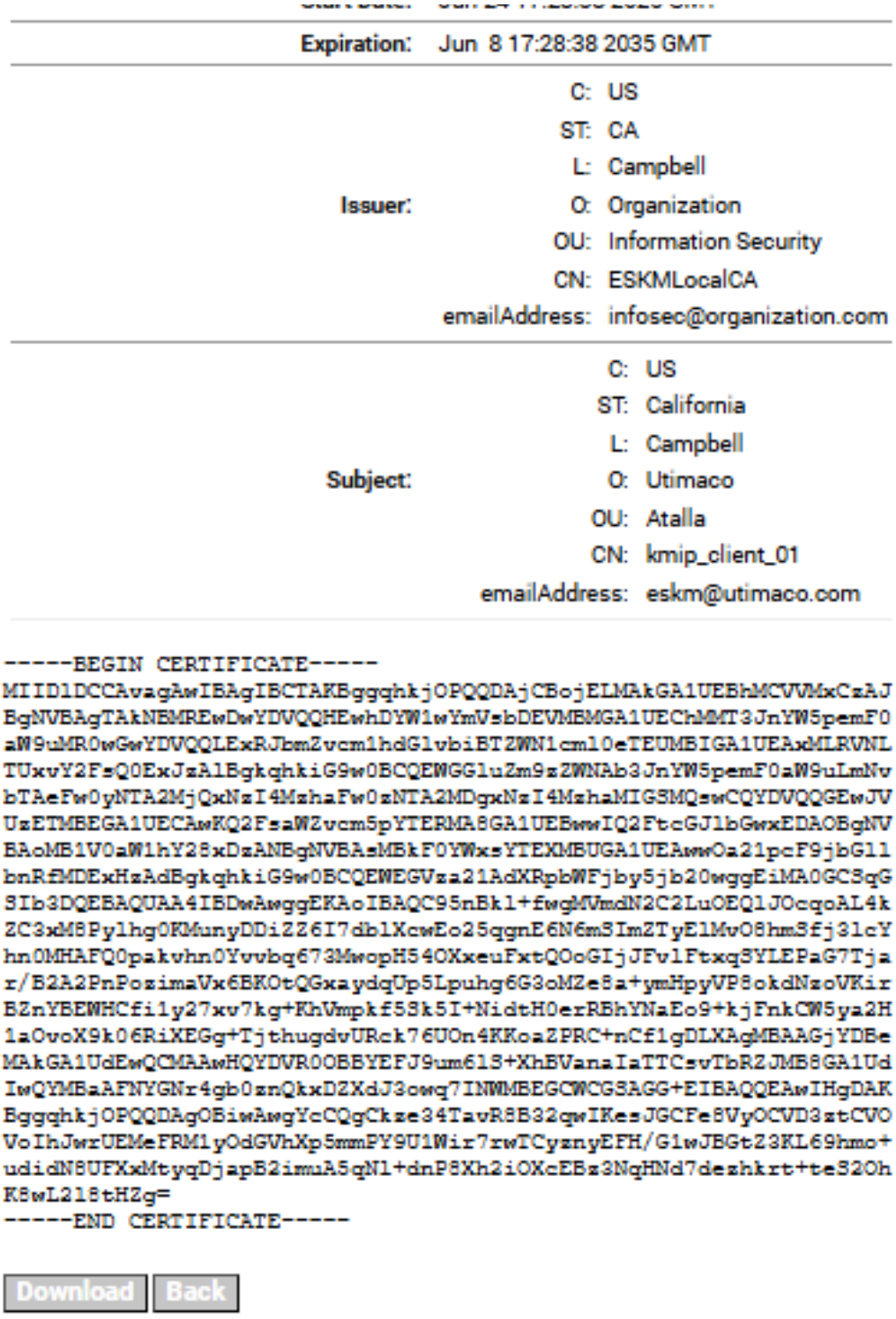


Figure 10 : Certificate Information

8. Copy the signed client certificate data to the clipboard.

5.1.5 Creating KMIP User

Perform the following steps to create a local KMIP user in the ESKM.

A client license is required for each user created on the ESKM server. See the ESKM Installation and Replacement Guide for information about how to request and install the license pack.

1. Log in to the Management Console, and navigate to **Security > Local Users & Groups > Local Users**.
2. At the bottom of the list, click **Add**.
3. Create a “username” and “password” for the KMIP user.

The “Username” must match the “Common Name (CN)” provided during the client certificate creation.

4. Click the **Enable KMIP** option.
5. If required, from the drop-down lists, select the **KMIP User Group** and **KMIP Object group** to which the user belongs.
6. Paste the signed client certificate into the **KMIP Client Certificate** field.

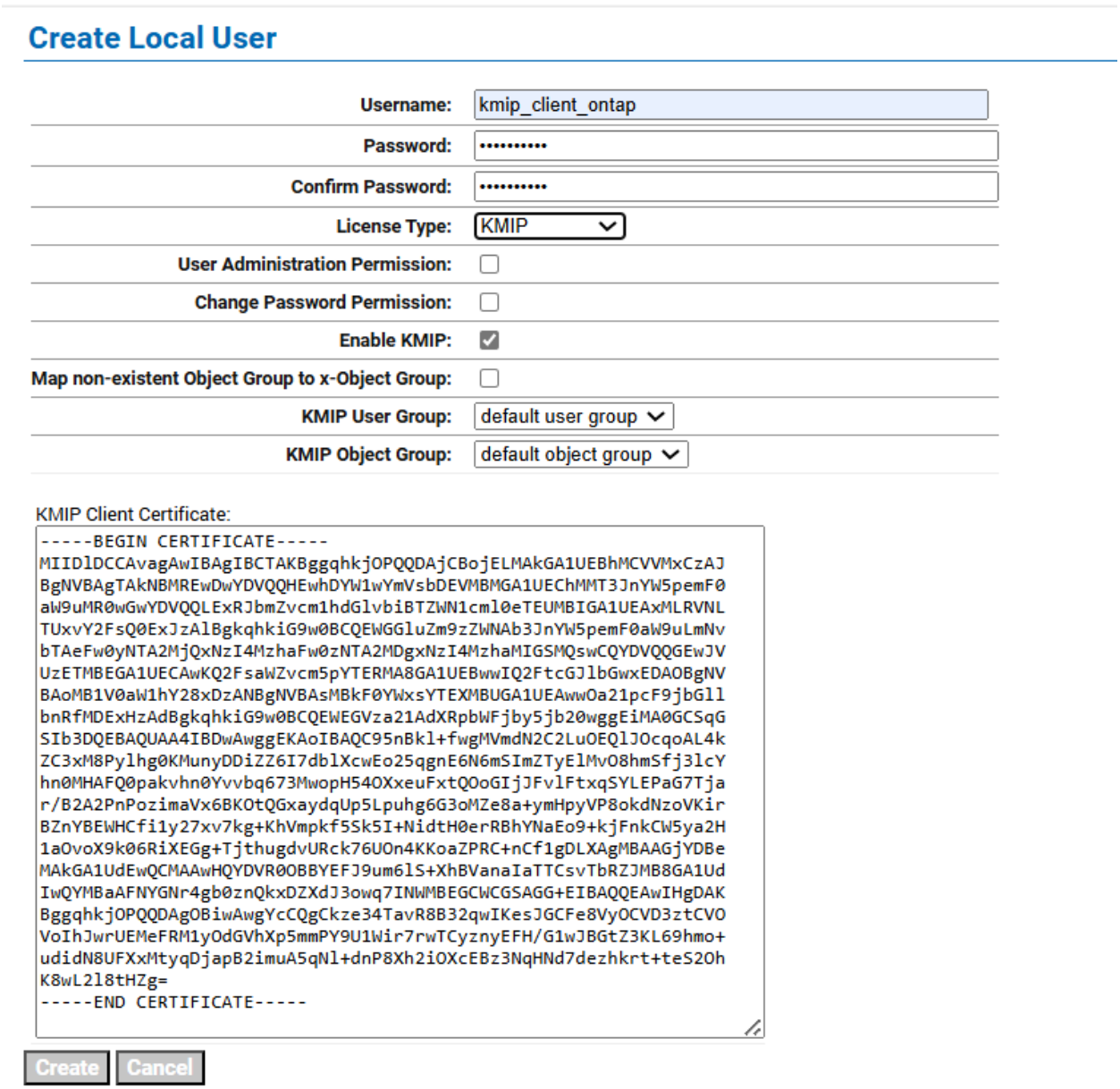


Figure 11 : Create Local User

7. Click **Create**.

The user `kmip_client_ontap` now appears on the list of Local Users.

The configuration of the ESKM server is now complete.

5.2 Configuration on ONTAP

5.2.1 Importing the Client Certificate to ONTAP

The client certificates must be installed before running the key manager setup.

1. Install the KMIP client certificate.

>_Console

```
cluster1::> security certificate install -type client
```

You will be prompted to paste the certificate and private key content.

Paste the signed client certificate, and the private key content from the private key file `KMIP_client.key` generated in Create a CSR.

```
cluster1::> security certificate install -type client

Please enter Certificate: Press <Enter> when done
-----BEGIN CERTIFICATE-----
MIIDmDCCAvmgAwIBAgIBDDAKBggqhkjOPQQDAjCBojELMAkGA1UEBhMCVVMxCzAJ
BgNVBAgTAkNBMREwDwYDVQQHEwhDYW1wYmVsbDEVMBMGA1UEChMMT3JnYW5pemF0
aW9uMR0wGwYDVQQLExRJbmZvcm1hdGlvbiBTZWN1cml0eTEUMBIGA1UEAxMLRVNL
TUxvY2FsQ0ExJzAlBgkqhkiG9w0BCQEWGGluZm9zZWNAb3JnYW5pemF0aW9uLmNv
bTAeFw0yNTA2MjQyMTE5MzZaFw0zNTA2MDgyMTE5MzZaMIGVMQswCQYDVQQGEwJV
UzETMBEGA1UECAwKQ2FsaWZvcm5pYTERMA8GA1UEBwwIQ2FtcGJlbGwxEDAOBgNV
BAoMB1V0aW1hY28xDzANBgNVBAsMBkF0YWxsYTEaMBgGA1UEAwwRa21pcF9jbGll
bnRfb250YXAxHzAdBgkqhkiG9w0BCQEWEGVza21AdXRpbWFjby5jb20wggEiMA0G
CSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQCvaOZ0Vy3wJCiTin1Sl9GCZtF1NFZT
KgkBzedyQ75dFbwKvWzbhSa/Q8BTjSX2CAyUHJMbbWSiwCmCOdEkvGdLIakStggJ
3lYfq8SH8EhGb3d4iMIhYy9VTOV0d8OJq3WX5ltaJ+zTmkNcSw9ftvew4JrcDGMa
DawEKxAxL5BUiD8SaZVIOErakw0WnHQe5gi+y1RTvhUXmsYxShVZQp5emWmqn8pG
MAv+RekQwSNkiDmsQ3LVLzgVP6DyAVqJQnd0IcKup1aCyyn0NQaelfTOz5d7QkpT
2KWBsRRw9MkmthOMN2AfXFhVk+glHPpJEpOlM//WahK/iq/i8i4YsxCTAgMBAAGj
YDBeMAkGA1UdEwQCMAAwHQYDVR0OBBYEFK/4qdT+lzRTTwPW6zjcGCGCmO0hMB8G
A1UdIwQYMBaAFNYGNr4gb0znQkxDZXdJ3owq7INWMBEGCWCGSAGG+EIBAQQEAwIH
gDAKBggqhkjOPQQDAgOBjAAwgYgCQgFMcLKh5yfwmuCsA9F6Wu90W9U6pnJMdWfC
losQ5O0nkVDQbessLYMuyfLPFW4n1CwPR4C8DJa5jmG6sxOAWa2nUAJCAO7ASmHp
gI9D/3dD0RouFwp5UaO8OfhSoWTWtEtVp7KeUYXL42+rcPQu7QZ3VHr3BYM/Wtkw
9a+jmyPgPbpKQi6y
-----END CERTIFICATE-----


Please enter Private Key: Press <Enter> when done
-----BEGIN PRIVATE KEY-----
MIIEvQIBADANBgkqhkiG9w0BAQEFAASCBKcwggSjAgEAAoIBAQCvaOZ0Vy3wJCiT
in1Sl9GCZtF1NFZTKgkBzedyQ75dFbwKvWzbhSa/Q8BTjSX2CAyUHJMbbWSiwCmC
OdEkvGdLIakStggJ3lYfq8SH8EhGb3d4iMIhYy9VTOV0d8OJq3WX5ltaJ+zTmkNc
Sw9ftvew4JrcDGMaDawEKxAxL5BUiD8SaZVIOErakw0WnHQe5gi+y1RTvhUXmsYx
ShVZQp5emWmqn8pGMAv+RekQwSNkiDmsQ3LVLzgVP6DyAVqJQnd0IcKup1aCyyn0
NQaelfTOz5d7QkpT2KWBsRRw9MkmthOMN2AfXFhVk+glHPpJEpOlM//WahK/iq/i
8i4YsxCTAgMBAAECggEAN4+7x8hBldpuO+XXMo1CYNLesAhm+6rJ9ZdaI5iPuP6E
```

Figure 12 : Security certificate install -type client

Figure 13 : Client certificate and private key installation

5.2.2 Installing the Utimaco ESKM Server Certification Authority (CA) Certificate

Run the below command to install the certificate.

>_Console

```
cluster1::> security certificate install -type server-ca
```

If prompted to enter the Server CA certificate, paste the ESKM Server CA certificate.

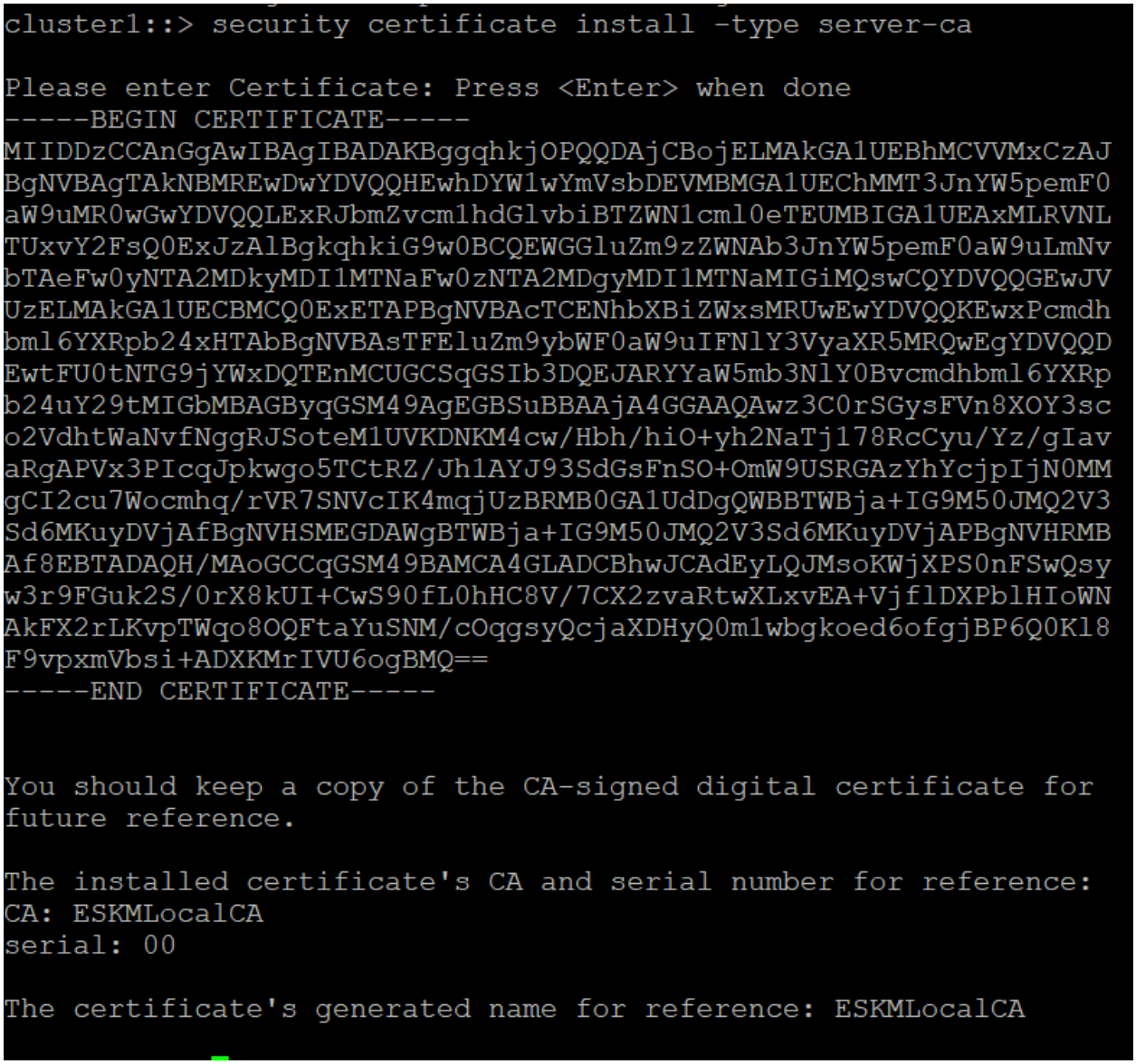


Figure 14 : Server CA certificate installation

5.2.3 Adding the Utimaco ESKM as Key Control Nodes on ONTAP

Run the command below to enable the external key manager.

>_Console

```
Cluster1::> security key-manager external enable -key-servers
192.168.182.164:5696 -client-cert kmip_client_ontap -server-ca-certs
ESKMLocalCA
```

5.2.4 Verifying the Communication Between the External Key Manager and ONTAP

Run the command below to show the status of the key manager.

>_Console

```
Cluster1::> security key-manager external show-status
```

```
cluster1::> security key-manager external show-status

              Node: cluster1-01
           Vserver: cluster1
    Key Server Port: 5696
 KMIP is operational: true

Key Server          Role          Server Status     Reason
------------------  ------------  ---------------   ------
10.222.55.173       primary       available         -
```

Figure 15 : Key manager status

6 Verification and Testing

In this chapter, we will validate the integration between Utimaco ESKM and NetApp ONTAP. This includes confirming KMIP-based connectivity, verifying that encryption keys are properly generated, stored, and retrieved by ONTAP, and ensuring that volume encryption workflows — such as enabling NVE (NetApp Volume Encryption) or transitioning volumes — function as expected. By the end of this section, you should be able to confirm that the integration is fully operational and that ONTAP volumes are securely encrypted using keys managed by Utimaco ESKM.

6.1 Performing NetApp Volume Encryption

6.1.1 Enabling Aggregate-level Encryption

If you plan to perform inline or background aggregate-level deduplication, you must use aggregate-level encryption. NVE does not support aggregate-level deduplication otherwise. When you encrypt a volume, ONTAP automatically “pushes” an encryption key to the Utimaco ESKM server.

Plain text volumes are not supported in NAE aggregates

Enable or disable aggregate-level encryption.

1. The following command enables aggregate-level encryption on aggr1.

>_Console

```
Cluster1::> storage aggregate create -aggregate aggr1 -diskcount 6
```

2. Verify that the aggregate aggr1 is enabled for encryption.

>_Console

```
Cluster1::> storage aggregate show -fields encrypt-with-aggr-key
```

```
cluster1::> storage aggregate show -fields encrypt-with-aggr-key
aggregate         encrypt-with-aggr-key
----------------- ---------------------
aggr0_cluster1_01 false
aggr1             true
2 entries were displayed.
```

Figure 16 : Verifying encryption on aggregate

6.1.2 Enabling Encryption on a New Volume

1. Create a new SVM (Storage Virtual Machine).

>_Cluster

```
Cluster1::> vserver create -vserver svm1
```

2. Create a new volume and verify whether encryption is enabled on the volume. If the new volume is in an NAE aggregate, by default, the volume will be an NAE volume.

>_Cluster

```
Cluster1::> volume create -vserver SVM_name -volume volume_name - aggregate aggregate_name
```

Example

```
Cluster1::> volume create -vserver svm1 -volume vol0 -aggregate aggr1
```

3. View the newly created NAE volume.

>_Cluster

```
Cluster1::> volume show -vserver svm1 -volume vol0
```

```
cluster1::>  volume show -vserver svm1 -volume vol0

                                    Vserver Name: svm1
                                     Volume Name: vol0
                                  Aggregate Name: aggr1
    List of Aggregates for FlexGroup Constituents: aggr1
                                Encryption Type: aggregate
               List of Nodes Hosting the Volume: cluster1-01
                                     Volume Size: 20MB
                              Volume Data Set ID: 1026
                       Volume Master Data Set ID: 2154299374
                                   Volume State: online
                                   Volume Style: flex
                          Extended Volume Style: flexvol
                        FlexCache Endpoint Type: none
                         Is Cluster-Mode Volume: true
                          Is Constituent Volume: false
                  Number of Constituent Volumes: -
                                  Export Policy: default
                                        User ID: 0
                                       Group ID: 0
                                  Security Style: unix
                                UNIX Permissions: ---rwxr-xr-x
                                   Junction Path: -
                            Junction Path Source: -
                                 Junction Active: -
                           Junction Parent Volume: -
                                        Comment:
                                  Available Size: 18.77MB
                                Filesystem Size: 20MB
                          Total User-Visible Size: 19MB
                                       Used Size: 240KB
                                  Used Percentage: 1%
            Volume Nearly Full Threshold Percent: 95%
                   Volume Full Threshold Percent: 98%
                                 Maximum Autosize: 24MB
                                 Minimum Autosize: 20MB
              Autosize Grow Threshold Percentage: 85%
            Autosize Shrink Threshold Percentage: 50%
                                   Autosize Mode: off
```

Figure 17 : Volume show output

4. Create an NVE volume.

>_Cluster

```
Cluster1::> volume create -vserver SVM_name -volume volume_name - aggregate aggregate_name -encrypt true
```

Example:

```
Cluster1::> volume create -vserver svm1 -volume vol1 -aggregate aggr1 -encrypt true
```

5. View the newly created NVE Volume.

>_Cluster

```
Cluster1::> volume show -vserver svm1 -volume vol1
```

```
cluster1::> volume show -vserver svm1 -volume vol1

                                    Vserver Name: svm1
                                     Volume Name: vol1
                                  Aggregate Name: aggr1
    List of Aggregates for FlexGroup Constituents: aggr1
                                Encryption Type: volume
              List of Nodes Hosting the Volume: cluster1-01
                                     Volume Size: 20MB
                               Volume Data Set ID: 1027
                        Volume Master Data Set ID: 2154299375
                                     Volume State: online
                                     Volume Style: flex
                            Extended Volume Style: flexvol
                          FlexCache Endpoint Type: none
                           Is Cluster-Mode Volume: true
                            Is Constituent Volume: false
                   Number of Constituent Volumes: -
                                   Export Policy: default
                                         User ID: 0
                                        Group ID: 0
                                  Security Style: unix
                                UNIX Permissions: ---rwxr-xr-x
                                   Junction Path: -
                            Junction Path Source: -
                                 Junction Active: -
                          Junction Parent Volume: -
                                         Comment:
                                  Available Size: 18.76MB
                                Filesystem Size: 20MB
                        Total User-Visible Size: 19MB
                                      Used Size: 248KB
                                Used Percentage: 1%
             Volume Nearly Full Threshold Percent: 95%
                    Volume Full Threshold Percent: 98%
                                Maximum Autosize: 24MB
                                Minimum Autosize: 20MB
```

Figure 18 : Volume show output

6. Verify that volumes are enabled for encryption.

>_Cluster

```
Cluster1::> volume show -is-encrypted true
```

```
cluster1::> volume show -is-encrypted true
Vserver   Volume       Aggregate    State      Type       Size  Available Used%
--------- ------------ ------------ ---------- ---- ---------- ---------- -----
svm1      svm1_root    aggr1        online     RW         20MB    18.72MB    1%
svm1      vol0         aggr1        online     RW         20MB    18.75MB    1%
svm1      vol1         aggr1        online     RW         20MB    18.74MB    1%
3 entries were displayed.
```

Figure 19 : Verifying encrypted volumes

6.1.3 Enabling Encryption on an Existing Volume with the Volume Encryption Conversion Start Command

1. Create a new aggregate aggr2 without encryption.

>_Console

```
Cluster1:> storage aggregate create aggr2 -diskcount 5 -encrypt-with-aggr-key false
```

```
cluster1::> storage aggregate create aggr2 -diskcount 5 -encrypt-with-aggr-key false

Info: The layout for aggregate "aggr2" on node "cluster1-01" would be:

      First Plex

        RAID Group rg0, 5 disks (block checksum, raid_dp)
                                                            Usable Physical
          Position   Disk                      Type           Size     Size
          ---------- ------------------------- ---------- -------- --------
          dparity    NET-1.15                  FCAL              -        -
          parity     NET-1.24                  FCAL              -        -
          data       NET-1.16                  FCAL        1000MB   1.00GB
          data       NET-1.25                  FCAL        1000MB   1.00GB
          data       NET-1.17                  FCAL        1000MB   1.00GB

      Aggregate capacity available for volume use would be 2.64GB.

Do you want to continue? {y|n}: y
[Job 44] Job succeeded: DONE
```

Figure 20 : Create aggregate without encryption

2. Create a plain text volume vol2 by running the command below.

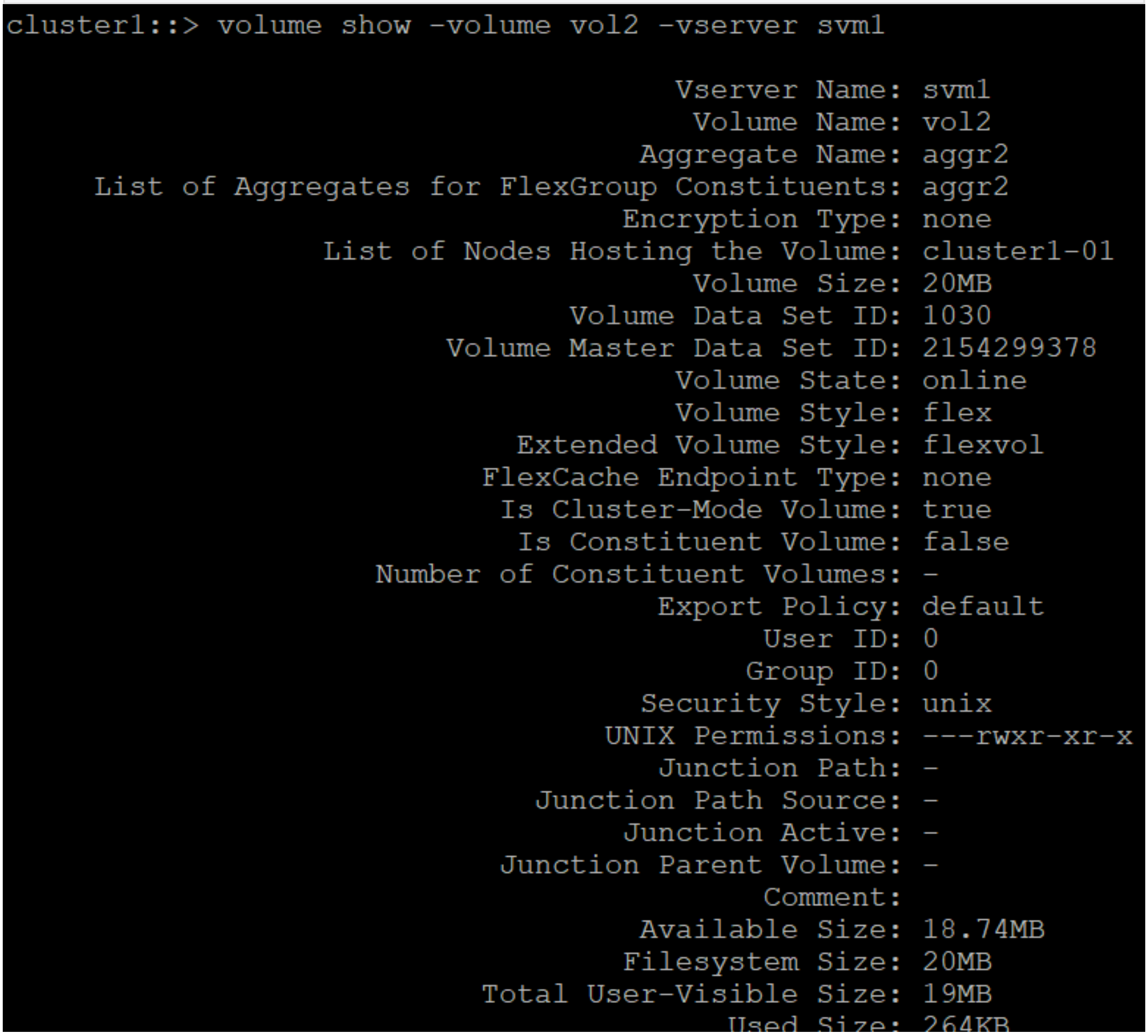
>_Console

```
Cluster1::> volume create -volume vol2 -aggregate aggr2 -encrypt false
```

3. View the volume vol2 by running the command below.

>_Console

```
Cluster::> volume show -volume vol2 -vserver svm1
```



```
cluster1::> volume show -volume vol2 -vserver svm1

                                      Vserver Name: svm1
                                       Volume Name: vol2
                                    Aggregate Name: aggr2
     List of Aggregates for FlexGroup Constituents: aggr2
                                   Encryption Type: none
                  List of Nodes Hosting the Volume: cluster1-01
                                       Volume Size: 20MB
                                Volume Data Set ID: 1030
                         Volume Master Data Set ID: 2154299378
                                      Volume State: online
                                      Volume Style: flex
                             Extended Volume Style: flexvol
                           FlexCache Endpoint Type: none
                            Is Cluster-Mode Volume: true
                             Is Constituent Volume: false
                     Number of Constituent Volumes: -
                                     Export Policy: default
                                           User ID: 0
                                          Group ID: 0
                                    Security Style: unix
                                  UNIX Permissions: ---rwxr-xr-x
                                     Junction Path: -
                              Junction Path Source: -
                                   Junction Active: -
                            Junction Parent Volume: -
                                           Comment:
                                    Available Size: 18.74MB
                                   Filesystem Size: 20MB
                           Total User-Visible Size: 19MB
                                         Used Size: 264KB
```

Figure 21 : Volume show output

4. Convert the existing volume vol2 (plain text volume) to an encrypted volume by running the command below.

>_Console

```
cluster1::> volume encryption conversion start -vserver SVM_name -volume volume_name
```

Example:

```
Cluster1::> volume encryption conversion start -vserver svm1 -volume vol2
```

```
cluster1::> volume encryption conversion start -vserver svm1 -volume vol2

Warning: Conversion from non-encrypted to encrypted volume scans and encrypts all of the data in the specified volume. It might take a significant amount of
         time, and might degrade performance during that time.
Do you want to continue? {y|n}: y
Conversion started on volume "vol2". Run "volume encryption conversion show -volume vol2 -vserver svm1" to see the status of this operation.

cluster1::> volume encryption conversion show -volume vol2 -vserver svm1

       Vserver Name: svm1
        Volume Name: vol2
         Start Time: 6/25/2025 20:07:56
             Status: running
```

Figure 22 : Volume encryption conversion start running

5. When the conversion operation is complete, verify that the volume is enabled for encryption.

>_Console

```
Cluster1::> volume show -is-encrypted true
```

```
cluster1::> volume show -is-encrypted true
Vserver   Volume       Aggregate    State      Type       Size  Available Used%
--------- ------------ ------------ ---------- ---- ---------- ---------- -----
svm1      svm1_root    aggr1        online     RW         20MB    18.69MB    1%
svm1      vol0         aggr1        online     RW         20MB    18.72MB    1%
svm1      vol1         aggr1        online     RW         20MB    18.71MB    1%
svm1      vol2         aggr2        online     RW         20MB    18.75MB    1%
4 entries were displayed.
```

Figure 23 : Verifying encrypted volumes

6.1.4 Enabling Encryption on an Existing Volume with the Volume Move Start command

You can use the volume move start command to enable encryption by moving an existing volume.

1. Move an NAE volume to an NVE volume (vol0 is an NAE volume will convert this to NVE volume) and verify its status.

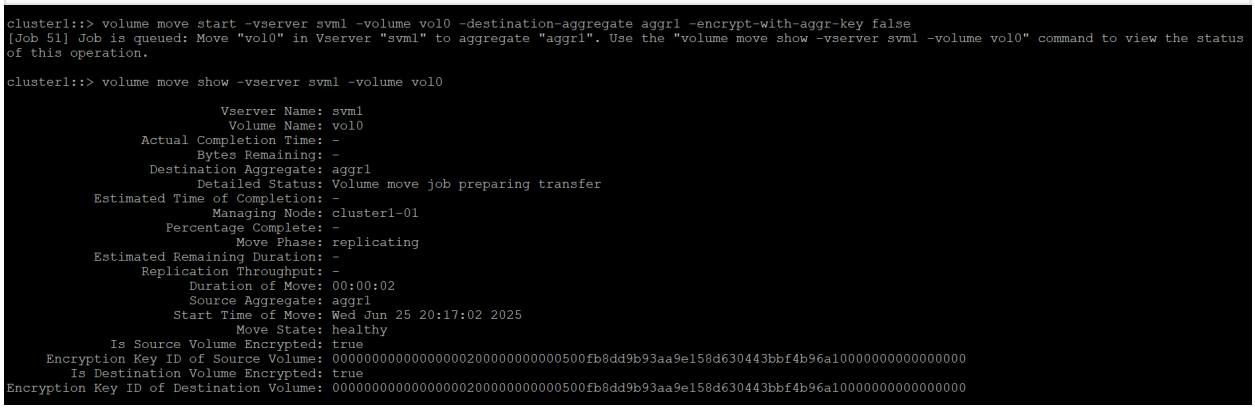
>_Console

```
cluster1::>volume move start -vserver SVM_name -volume volume_name -
destination-aggregate aggregate_name -encrypt-with-aggr-key false
```

Example:

```
Cluster1::> volume move start -vserver svm1 -volume vol0
-destinationaggregate aggr1 -encrypt-with-aggr-key false

Cluster1::> volume move show -vserver svm1 -volume vol0
```



```
cluster1::> volume move show -vserver svm1 -volume vol0

                          Vserver Name: svm1
                           Volume Name: vol0
                Actual Completion Time: Wed Jun 25 20:17:26 2025
                       Bytes Remaining: -
                  Destination Aggregate: aggr1
                       Detailed Status: Successful
           Estimated Time of Completion: -
                       Managing Node: cluster1-01
                 Percentage Complete: 100%
                          Move Phase: completed
           Estimated Remaining Duration: -
                 Replication Throughput: -
                      Duration of Move: 00:00:24
                      Source Aggregate: aggr1
                    Start Time of Move: Wed Jun 25 20:17:02 2025
                          Move State: done
             Is Source Volume Encrypted: true
     Encryption Key ID of Source Volume: 000000000000000020000000000500fb8dd9b93aa9e158d630443bbf4b96a10000000000000000
        Is Destination Volume Encrypted: true
Encryption Key ID of Destination Volume: 000000000000000020000000000500fb8dd9b93aa9e158d630443bbf4b96a10000000000000000
```

Figure 24 : Moving an NAE volume to an NVE volume

2. View the volume vol0 once the operation is completed.

>_Console

```
cluster1::> volume show -volume vol0 -vserver svm1
```

```
cluster1::> volume show -volume vol0 -vserver svm1

                                    Vserver Name: svm1
                                     Volume Name: vol0
                                  Aggregate Name: aggr1
    List of Aggregates for FlexGroup Constituents: aggr1
                                Encryption Type: volume
              List of Nodes Hosting the Volume: cluster1-01
                                     Volume Size: 20MB
                              Volume Data Set ID: 1032
                       Volume Master Data Set ID: 2154299374
                                   Volume State: online
                                   Volume Style: flex
                          Extended Volume Style: flexvol
                        FlexCache Endpoint Type: none
                         Is Cluster-Mode Volume: true
                          Is Constituent Volume: false
                 Number of Constituent Volumes: -
                                  Export Policy: default
                                        User ID: 0
                                       Group ID: 0
                                  Security Style: unix
                                UNIX Permissions: ---rwxr-xr-x
                                   Junction Path: -
                            Junction Path Source: -
                                 Junction Active: -
                          Junction Parent Volume: -
                                        Comment:
                                  Available Size: 18.66MB
                                Filesystem Size: 20MB
                          Total User-Visible Size: 19MB
```

Figure 25 : Volume show output

3. Move an NVE volume to an NAE volume (vol0 is an NVE volume will convert this to NAE volume) and verify its status.

>_Console

```
Cluster1::> volume move start -vserver SVM_name -volume volume_name -
destination-aggregate aggregate_name -encrypt-with-aggr-key true
```

For example:

```
Cluster1::> volume move start -vserver svm1 -volume vol0 -destination-
aggregate aggr1 -encrypt-with-aggr-key true

Cluster1::> volume move show -vserver svm1 -volume vol0
```

```
cluster1::> volume move start -vserver svm1 -volume vol0 -destination-aggregate aggr1 -encrypt-with-aggr-key true
[Job 52] Job is queued: Move "vol0" in Vserver "svm1" to aggregate "aggr1". Use the "volume move show -vserver svm1 -volume vol0" command to view the status
of this operation.

cluster1::> volume move show -vserver svm1 -volume vol0

                      Vserver Name: svm1
                       Volume Name: vol0
              Actual Completion Time: -
                     Bytes Remaining: -
                 Destination Aggregate: aggr1
                     Detailed Status: Volume move job preparing transfer
         Estimated Time of Completion: -
                     Managing Node: cluster1-01
                Percentage Complete: -
                       Move Phase: replicating
         Estimated Remaining Duration: -
              Replication Throughput: -
                   Duration of Move: 00:00:02
                   Source Aggregate: aggr1
                 Start Time of Move: Wed Jun 25 20:33:17 2025
                         Move State: healthy
           Is Source Volume Encrypted: true
    Encryption Key ID of Source Volume: 000000000000000020000000000500fb8dd9b93aa9e158d630443bbf4b96a10000000000000000
       Is Destination Volume Encrypted: true
Encryption Key ID of Destination Volume: 000000000000000020000000000500fb8dd9b93aa9e158d630443bbf4b96a10000000000000000

cluster1::> volume move show -vserver svm1 -volume vol0

                      Vserver Name: svm1
                       Volume Name: vol0
              Actual Completion Time: Wed Jun 25 20:33:39 2025
                     Bytes Remaining: -
                 Destination Aggregate: aggr1
                     Detailed Status: Successful
         Estimated Time of Completion: -
                     Managing Node: cluster1-01
                Percentage Complete: 100%
                       Move Phase: completed
         Estimated Remaining Duration: -
              Replication Throughput: -
                   Duration of Move: 00:00:22
                   Source Aggregate: aggr1
                 Start Time of Move: Wed Jun 25 20:33:17 2025
                         Move State: done
           Is Source Volume Encrypted: true
    Encryption Key ID of Source Volume: 000000000000000020000000000500fb8dd9b93aa9e158d630443bbf4b96a10000000000000000
       Is Destination Volume Encrypted: true
Encryption Key ID of Destination Volume: 000000000000000020000000000500fb8dd9b93aa9e158d630443bbf4b96a10000000000000000
```

Figure 26 : Moving an NVE volume to an NAE volume

4. View the volume vol0 once the operation is completed.

>_Console

```
cluster1::> volume show -volume vol0 -vserver svm1
```

```
cluster1::> volume show -volume vol0 -vserver svm1

                                    Vserver Name: svm1
                                     Volume Name: vol0
                                  Aggregate Name: aggr1
    List of Aggregates for FlexGroup Constituents: aggr1
                                Encryption Type: aggregate
               List of Nodes Hosting the Volume: cluster1-01
                                     Volume Size: 20MB
                              Volume Data Set ID: 1033
                       Volume Master Data Set ID: 2154299374
                                    Volume State: online
                                    Volume Style: flex
                           Extended Volume Style: flexvol
                         FlexCache Endpoint Type: none
                          Is Cluster-Mode Volume: true
                           Is Constituent Volume: false
                  Number of Constituent Volumes: -
                                   Export Policy: default
                                         User ID: 0
                                        Group ID: 0
                                  Security Style: unix
                                UNIX Permissions: ---rwxr-xr-x
                                   Junction Path: -
                            Junction Path Source: -
                                  Junction Active: -
                           Junction Parent Volume: -
                                         Comment:
                                  Available Size: 18.58MB
```

Figure 27 : Volume show output

7 Logs and Validation Steps

ONTAP volume encryption creates cryptographic keys on Utimaco ESKM, which are then used to encrypt and decrypt the volumes. You can verify the logs from Utimaco ESKM.

1. Open the Utimaco ESKM page and click on the **Device** tab.
2. Click on **Log Viewer** under **Logs & Statistics**.
3. Click on **KMIP** under **Log Viewer**.
4. Review the logs.

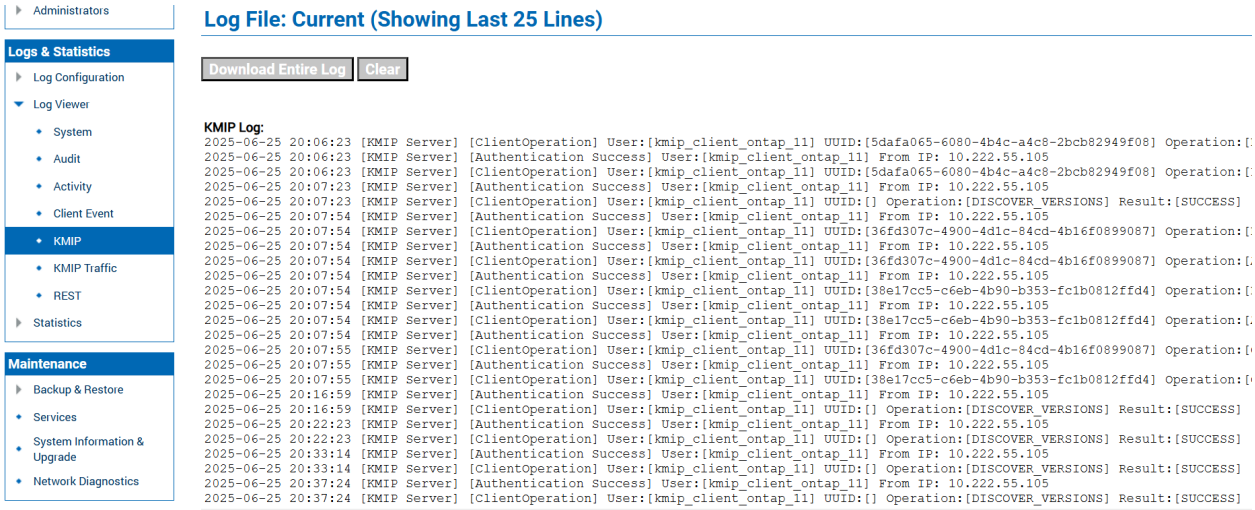


Figure 28 : KMIP logs

5. To view the keys, go to **the Security** tab
6. Select **KMIP Objects** under the **Keys & KMIP Objects** section
7. The generated keys will be displayed here.

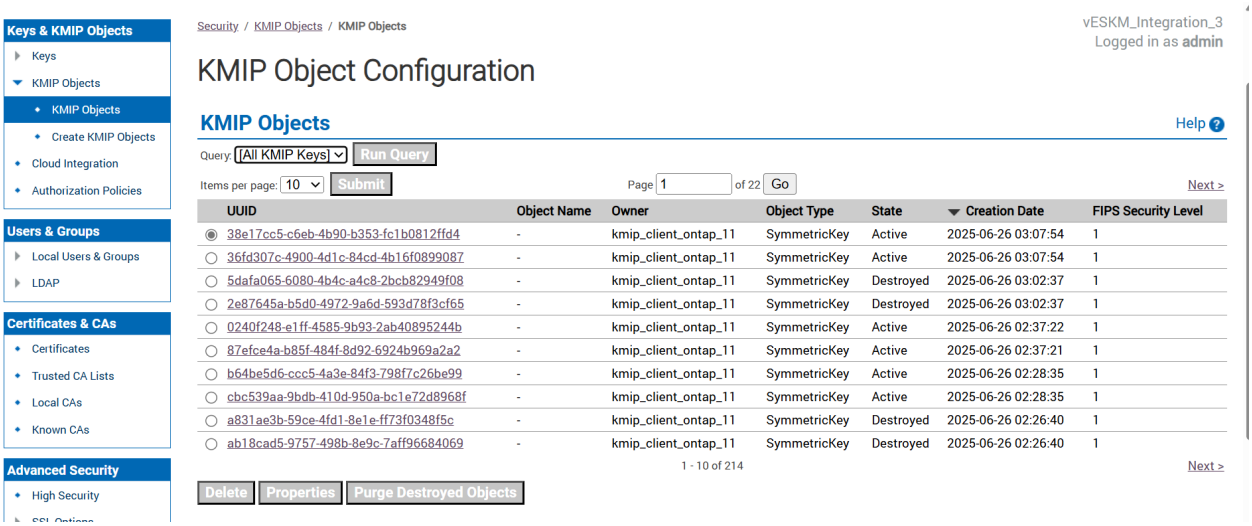


Figure 29 : KMIP Objects

8 Troubleshooting

8.1 Common Issues

Error	Diagnosis
volume move start -vserver svm1 -volume svm1_root -destination-aggregate aggr1 -encrypt-with-aggr-key false Error: command failed: Encryption of the Vserver root volume using NVE (NetApp Volume Encryption) is not supported. Vserver root volumes only support encryption using NAE (NetApp Aggregate Encryption). You can encrypt the volume by moving it to an aggregate that supports NAE, using the "volume move start svm_root -vserver svm1 -encrypt-destination true -encrypt-with-aggr-key true" command.	cluster1::> storage aggregate create -aggregate aggr2 -diskcount 6 -encrypt-with-aggr-key false

Table 6: List of errors and their diagnoses

8.2 Managing the Client and CA Certificates on ONTAP

8.2.1 Deleting Certificates

Before you begin installing the new certificates, you must remove the old certificates and make sure to use updated certificates.

1. Disable the connection to the key management (KMIP) server.

>_Console

```
Cluster1::> security key-manager delete -address
```

2. Remove certificates for the cluster.

>_Console

```
Cluster1::> security certificate delete -vserver cluster1 -type client
-common-name kmip_client_on_tap_11 -ca ESKMLocalCA -serial 0D
```

8.2.2 Replacing the ESKM Client Certificates

ESKM Client certificates have an expiration period after initial creation. After a predetermined time, the certificates are no longer valid. They should be replaced before the expiration date. Follow the steps in Creatng a Client Certificate for ONTAP (Using OpenSSL).

8.3 Contact for Support

8.3.1 Utimaco Technical Support

For technical questions, contact Utimaco Technical Support:

- E-mail: support-atalla@utimaco.com
- Telephone: 800-500-7858 (U.S.A.) +1-916-414-0216 (International)
- Website: https://support.utimaco.com/

Before contacting Utimaco with your questions, collect the following information:

- Product model names and numbers
- Technical support registration number or NonStop system number (if applicable)
- Service Agreement ID number (SAID)
- Product serial numbers
- Error messages
- Software version number

8.3.2 24-hour Support

24-hour emergency support is available to those customers who have valid service contracts. Use this service for product and system emergencies that occur after normal working hours or on weekends and U.S. holidays. Questions about product installation and setup are supported during normal working hours.

For 24-hour emergency support call: 800-500-7858 (U.S.A.) +1-916-414-0216 (International)

9 Appendices

9.1 References

This document serves as a comprehensive guide for integrating Utimaco's ESKM module with NetApp ONTAP.

For more information on other Utimaco products and offerings, please visit the official Utimaco Website.