Layer 1 Encryption

This chapter describes how to configure the IKEv2 protocol and layer 1 encryption for NCS 1004.

Note In this chapter, "layer 1 encryption" is referred to as "OTNSec".

Table 1: Feature History

Feature Name	Release Information	Feature Description
Encryption Support on 1.2TL Card	Cisco IOS XR Release 7.3.1	AES 256 GCM authenticated OTNSec encryption on 1.2TL line cards is supported. It uses only pre-shared keys for authentication. Optical encryption secures the communications link in and out of a facility, rendering all data undecipherable to hackers who tap into networks.

The Need for High Speed Encryption

Most of the emphasis on protecting networks today is focused on protecting data within data center. However, the infrastructure of networks that connect these data centers are as vulnerable to calculated attacks as the data centers themselves. As more sensitive information gets transmitted across fiber-optic networks, cyber criminals are increasingly turning their attention to intercepting the data when it travels across the network.

With the increase in network or fiber optic hacks, the need for data protection is paramount. Encryption of any data that leaves the data centers is becoming an important requirement for cloud operators. Optical encryption secures everything on the communications link in and out of a facility rendering all data undecipherable to any hacker that taps into the fiber strand. *Protecting data at high speeds or lines rates is a requirement for data centers today.*

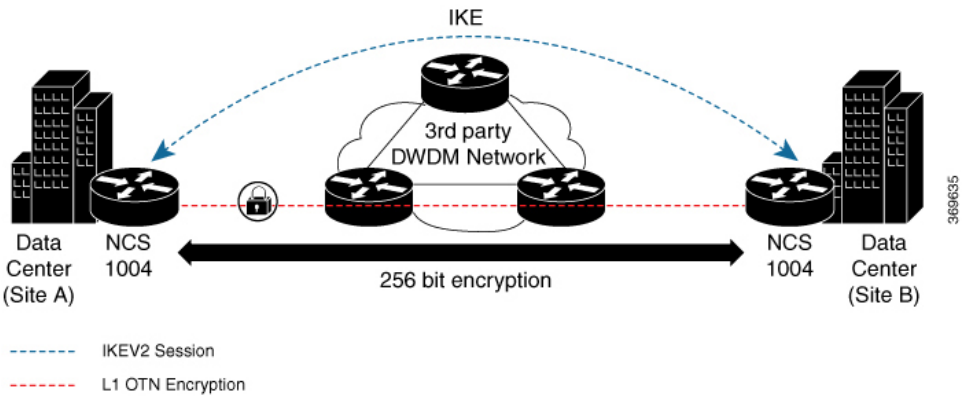
The Cisco NCS 1004 brings to you AES256 based OTNSec encryption for 100GE clients. Encryption is supported on the 1.2T cards.

OTNSec encryption uses the IKEv2 protocol to negotiate and establish the IKEv2 and OTNSec Security Associations (SA). IKEv2 is used for authentication of the devices in an encryption session, and the protocol

provides pre-shared keys (PSK) authentication. The IKEv2 datagrams are carried as payloads using the point-to-point protocol (PPP) over the GCC channel.

To implement this, an IKE session is established between the two endpoints, Site A and Site B, for overhead control plane communication between the two data centers. Data is then encrypted at Site A using OTNSec encryption and decrypted at Site B.

Figure 1: OTNSec Site-to-Site Example and Components



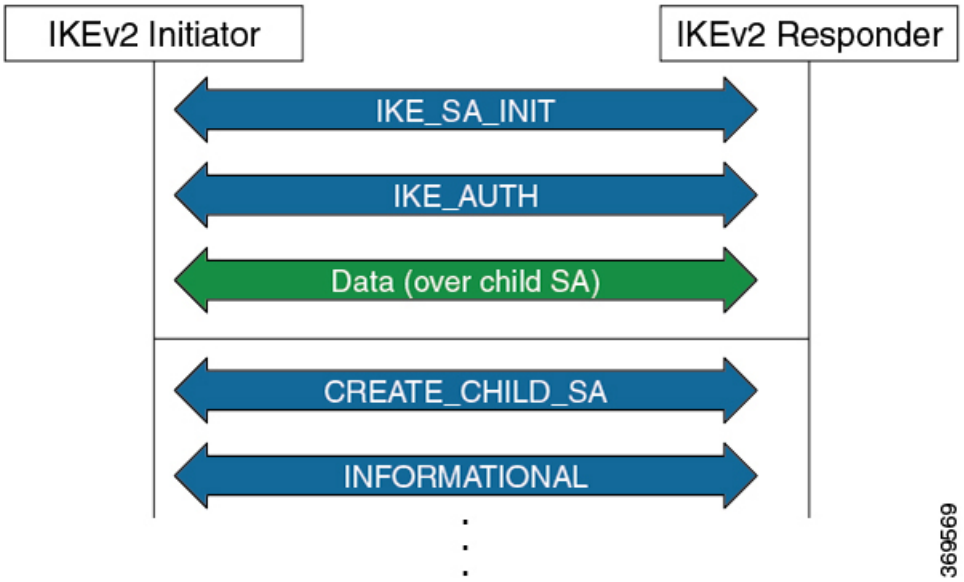
The recommended deployment is to have a single IKEv2 session running over a GCC2 channel per trunk port which creates the child SAs for each of the OTNSec controllers that are configured on the trunk port.

- IKEv2 Overview, on page 2
- OTNSec Encryption Overview, on page 4
- Prerequisites, on page 5
- Limitations, on page 5
- Configuration Workflow, on page 5
- Configuration Example, on page 13
- Verification, on page 16
- Troubleshooting, on page 16
- You May Be Interested In, on page 17

IKEv2 Overview

Internet Key Exchange Version 2 (IKEv2) is a request and response encryption that establishes and handles security associations (SA) in an authentication suite, such as OTNSec, to ensure secure traffic. IKE performs mutual authentication between two endpoints and establishes an IKE Security Association (SA). All IKE communications consist of pairs of messages that include a request and a response. The pair is called an exchange or a request-response pair. The first two exchanges of messages establishing an IKE SA are called the IKE_SA_INIT exchange and the IKE_AUTH exchange; subsequent IKE exchanges are called either CREATE_CHILD_SA exchanges or INFORMATIONAL exchanges. IKEv2 uses sequence numbers and acknowledgments to provide reliability, and mandates some error-processing logistics and shared state management (windowing). IKEv2 does not process a request until it determines the requester. This helps to mitigate DoS attacks. IKEv2 provides built-in support for Dead Peer Detection (DPD), which periodically confirms the availability of the peer node. When there is no response from the peer node, the system attempts to establish the session again.

Figure 2: IKEv2 Exchanges



IKEv2 is defined in RFC 7296 and consists of the following constructs:

- **Keyring**

  A keyring is a repository of symmetric and asymmetric pre-shared keys that is configured for a peer and identified using the IP address of the peer. The keyring is associated with an IKEv2 profile and therefore, caters to a set of peers that match the IKEv2 profile. This is a required configuration for the pre-shared keys authentication method that is used for NCS 1004.

- **IKEv2 Profile**

  An IKEv2 profile is a repository of nonnegotiable parameters of the IKE SA, such as authentication method and services that are available to the authenticated peers that match the profile. The profile match lookup is done based on the IP address of the remote identity. For security purposes, the IKE SAs have a lifetime that is defined in the IKEv2 profile. The lifetime range, in seconds, is from 120 to 86400. The SAs are rekeyed proactively before the expiry of the lifetime. The default lifetime is 86400. An IKEv2 profile must be attached to an OTNSec configuration on the ODU4 controllers on both the IKEv2 initiator and responder. This is a required configuration.

- **IKEv2 Proposal**

  An IKEv2 proposal is a collection of transforms that are used in the negotiation of IKE SAs as part of the IKE_SA_INIT exchange. The IKE2 proposal must be attached to an IKEv2 policy. This is an optional configuration. The transform types used in the negotiation are as follows:

  - Encryption algorithm
  - Integrity algorithm
  - Pseudo-Random Function (PRF) algorithm
  - Diffie-Hellman (DH) group

Note The IKEv2 proposal must have at least one algorithm of each type. It is possible to specify multiple algorithms for each type; the order in which the algorithms are specified determines the precedence.

- **IKEv2 Policy**

  IKEv2 employs policies that are configured on each peer to negotiate handshakes between the two peers. An IKEv2 policy contains proposals that are used to negotiate the encryption, integrity, PRF algorithms, and DH group in the SA_INIT exchange. An IKEv2 policy is selected based on the local IP address. This is an optional configuration.

Note The default IKEv2 proposal is used with default IKEv2 policy in the absence of any user-defined policy.

OTNSec Encryption Overview

OTNSec encryption in NCS 1004 has the following characteristics:

- The OTN layer 1 security is supported over the OPU client payload.
- The Galois-Counter-Mode (GCM) AES 256-bit security is the default cipher used for encryption and decryption of the OPU payloads.
- Each client offers an independent encrypted channel in each direction.
- There are two banks of 256-bit programmable key registers (current key and future key) that permit key updates through the software without interrupting traffic.

  Each key is associated with an Association Number [AN(1:0)] allowing up to four different numbers.
- Interhost key exchange is supported through communication over GCC.
- The encryption is supported in headless mode.

The OTNSec control plane generates two different keys, one for the transmit (Tx) side and the other for the receive (Rx) side. These keys are used by the line card to program the encryptor and decryptor blocks. These blocks encrypt and decrypt the data packets between the trunk ports of the two nodes. For security purposes, the keys have a lifetime. A key's lifetime specifies the time the key expires.

The key lifetime for the child SAs can be configured using the sak-rekey-interval which ranges from 30 seconds to 14 days. For example, if the sak-rekey-interval is configured for five minutes, a new key is generated by the OTNSec layer every five minutes. In the absence of a lifetime configuration, the default lifetime is 14.18 days. When the key reaches the maximum lifetime, it becomes invalid and the CRYPTO-KEY-EXPIRED alarm is raised. Volume-based rekeying is supported; it prevents the key from reaching the maximum lifetime. This allows the OTNSec layer to generate a new key when 70% of the lifetime (11 days) of the current key is over.

When the lifetime of the first key expires, it automatically rolls over to the next key. To achieve a hitless rollover, the lifetimes of the keys need to be overlapped so that for a certain period of time both keys are

active. To maintain this seamless switchover, a key index table is maintained. Each key pair (Tx and Rx) is associated with an Association Number (AN). The index table allows up to four numbers (0,1, 2, and 3). When the keys are installed, the Rx AN number of node A must match the Tx AN number of node B. Also, the Tx AN number of node A must match the Rx AN number of node B. If there is a mismatch of the AN numbers between the peer nodes, the CRYPTO-INDEX-MISMATCH alarm is raised.

Prerequisites

- Ensure that the required k9sec.rpm package is installed.
- Configure the line card in the muxponder or muxponder slice mode using the following commands:
  - **1.2T Card:**
    - muxponder mode:

      hw-module location *location* **mxponder client-rate 100GE** | **OTU4**

      hw-module location *location* **mxponder trunk-rate** {**100G** | **200G** | **300G** | **400G** | **500G** | **600G**}

    - muxponder slice mode:

      hw-module location *location* **mxponder-slice** *mxponder-slice-number* **client-rate 100GE**

      hw-module location *location* **mxponder-slice trunk-rate** { **100G** | **200G** | **300G** | **400G** | **500G** | **600G** }

Limitations

- Traffic is impacted for a few seconds if the RP fails or GCC2 control plane goes down, during a key rollover.
- The sak-rekey-interval must be configured on the initiator and responder node.

Configuration Workflow

This section describes the workflow to configure IKEv2 and OTNSec encryption on NCS 1004. The authentication method used is pre-shared keys (PSKs).

Figure 3: L1 Encryption Workflow

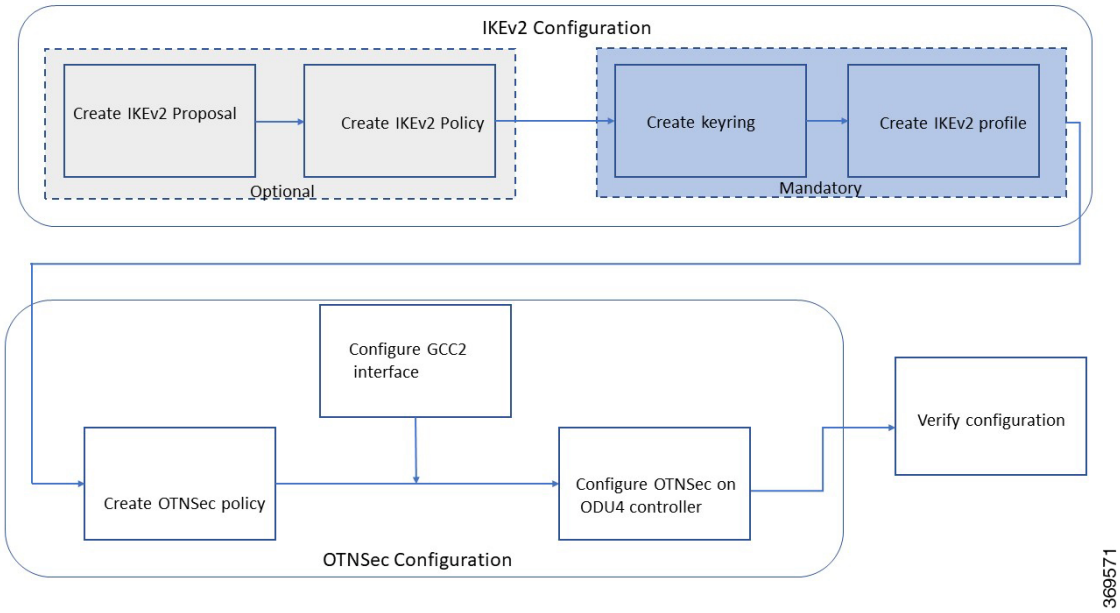


Table 2: Workflow for Configuring IKEv2 and OTNSec Encryption on NCS 1004

Workflow Sequence	Details
IKE Configuration	

Configuring an IKEv2 Proposal, on page 7	(Optional) Configure an IKEv2 proposal manually;otherwise, the default IKEv2 proposal is used in the default IKEv2 policy.
	The default IKEv2 proposal requires no configuration and is a collection of commonly used transforms types, which are as follows:
	`encryption cbc-aes-256`
	`integrity sha512, sha384`
	`prf sha512, sha384`
	`dh 19, 20, 21`

Configuring an IKEv2 Policy, on page 8	(Optional) Configure an IKEv2 policy manually;otherwise, the default proposal associated with the default policy is used for negotiation. **Note** An IKEv2 policy with no proposal is considered incomplete.
Configuring a Keyring, on page 9	Configure a keyring as the local or remote authentication method is a preshared key.

Workflow Sequence	Details
Configuring a IKEv2 Profile, on page 10	Configure an IKEv2 profile. **Note** • The IKEv2 profile must be attached to the OTNSec profile on both the IKEv2 initiator and the responder. • The DPD interval is 10 seconds. If there is no response from the peer node, it retries every two seconds with a maximum of five attempts. After five retries, the IKE session is brought down. NCS 1004 supports headless mode. Therefore, even though the control plane is down, traffic is not impacted because the encryption and decryption keys are still active on the line cards. The data path functions in a locally secure mode and the OTNSEC-LOCALLY-SECURED alarm is raised.
OTNSec Configuration	
Configuring an OTNSec Policy, on page 10	(Optional) Configure the OTNSec policy.
Configuring the GCC Interface, on page 11	Configure the GCC2 interface.
Configuring OTNSec on ODU4 Controllers, on page 12	Configure the ODU4 controller that is mapped to the HundredGigE controller .
Verification	
Verification, on page 16	Verify the IKEv2 and OTNSec configuration.

Configuring an IKEv2 Proposal

To configure an IKEv2 proposal, use the following commands:

config

ikev2 proposal *proposal-name*

encryption {aes-gcm-256} {aes-gcm-128} {aes-cbc-256} {aes-cbc-192} {aes-cbc-128}

integrity {sha-1} {sha-256} {sha-384} {sha-512}

prf {sha-1} {sha-256} {sha-384} {sha-512}

dh {19} {20} {21}

Note Configuring an AES-GCM encryption algorithm does not require configuring an integrity algorithm. AES-GCM and non-GCM algorithms cannot be configured in the same proposal. However, you can configure the AES-GCM and non-GCM algorithms under two different proposals and attach both the proposals to the same IKEv2 policy.

The following sample displays how to configure an IKEv2 proposal.

```
RP/0/RP0/CPU0:ios#configure
Thu Mar  7 19:19:30.259 UTC
RP/0/RP0/CPU0:ios(config)#ikev2 proposal proposal1
RP/0/RP0/CPU0:ios(config-ikev2-proposal-proposal1)#encryption aes-cbc-256
RP/0/RP0/CPU0:ios(config-ikev2-proposal-proposal1)#integrity sha-1
RP/0/RP0/CPU0:ios(config-ikev2-proposal-proposal1)#prf sha-256
RP/0/RP0/CPU0:ios(config-ikev2-proposal-proposal1)#dh 20
RP/0/RP0/CPU0:ios(config-ikev2-proposal-proposal1)#commit
Thu Mar  7 19:20:30.916 UTC
RP/0/RP0/CPU0:ios(config-ikev2-proposal-proposal1)#exit
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#show ikev2 proposal proposal1
Thu Mar  7 19:20:48.929 UTC

Proposal Name              : proposal1
================================================================================
Status                     : Complete
--------------------------------------------------------------------------------
Total Number of Enc. Alg.  : 1
   Encr. Alg.              : CBC-AES-256
--------------------------------------------------------------------------------
Total Number of Hash. Alg. : 1
   Hash. Alg.              : SHA 1
--------------------------------------------------------------------------------
Total Number of PRF. Alg.  : 1
   PRF. Alg.               : SHA 256
--------------------------------------------------------------------------------
Total Number of DH Group   : 1
   DH Group                : Group 20
```

Configuring an IKEv2 Policy

To configure an IKEv2 policy, use the following commands:

config

ikev2 policy *policy-name*

proposal *proposal-name1 proposal-name2 proposal-name3*

match address local *{ ipv4-address}*

The following sample displays how to configure an IKEv2 policy.

```
RP/0/RP0/CPU0:ios#configure
Thu Mar  7 19:26:45.752 UTC
RP/0/RP0/CPU0:ios(config)#ikev2 policy mypolicy
RP/0/RP0/CPU0:ios(config-ikev2-policy-mypolicy)#proposal proposal1
RP/0/RP0/CPU0:ios(config-ikev2-policy-mypolicy)#match address local 10.1.1.1
RP/0/RP0/CPU0:ios(config-ikev2-policy-mypolicy)#commit
Thu Mar  7 19:29:25.043 UTC
RP/0/RP0/CPU0:ios(config-ikev2-policy-mypolicy)#exit
```

```
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#show ikev2 policy mypolicy
Thu Mar  7 19:30:30.343 UTC

Policy Name                           : mypolicy
================================================================================
Total number of match local addr      : 1
   Match address local                : 10.1.1.1
--------------------------------------------------------------------------------
Total number of proposal attached     : 1
   Proposal Name                      : proposal1
```

Configuring a Keyring

To configure a keyring, use the following commands:

config

keyring *keyring-name*

peer *peer-block name*

address *{ipv4-address [mask]}*

Note The IP address of the far-end node (remote node) must be used.

pre-shared-key {{*key***} {clear** *clear-text key***} {local** *local key***} {password***encrypted key***}}**

Note The key input can either be in clear text or in type 7 encrypted password format.

The following sample displays how to configure a keyring.

```
RP/0/RP0/CPU0:ios#configure
Thu Mar  7 19:33:14.594 UTC
RP/0/RP0/CPU0:ios(config)#keyring kyr1
RP/0/RP0/CPU0:ios(config-keyring-kyr1)#peer peer1
RP/0/RP0/CPU0:ios(config-keyring-kyr1-peer-peer1)#address 10.1.1.2 255.255.255.0
RP/0/RP0/CPU0:ios(config-keyring-kyr1-peer-peer1)#pre-shared-key password 106D000A064743595F
RP/0/RP0/CPU0:ios(config-keyring-kyr1-peer-peer1)#commit
Thu Mar  7 19:54:33.314 UTC
RP/0/RP0/CPU0:ios(config-keyring-kyr1-peer-peer1)#exit
RP/0/RP0/CPU0:ios(config-keyring-kyr1)#exit
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#show keyring kyr1
Thu Mar  7 19:58:07.135 UTC

Keyring Name                          : kyr1
================================================================================
Total Peers                           : 1
--------------------------------------------------------------------------------
   Peer Name                          : peer1
   IP Address                         : 10.1.1.2
   Subnet Mask                        : 255.255.255.0
   Local PSK                          : Configured
   Remote PSK                         : Configured
```

Configuring a IKEv2 Profile

To configure an IKEv2 profile, use the following commands:

config

ikev2 profile *profile-name*

match identity remote address *{ipv4-address [mask]}*

keyring *keyring-name*

lifetime *seconds*

Note The lifetime range, in seconds, is from 120 to 86400.

The following sample displays how to configure an IKEv2 profile.

```
RP/0/RP0/CPU0:ios#configure
Thu Mar  7 20:00:36.490 UTC
RP/0/RP0/CPU0:ios(config)#ikev2 profile profile1
RP/0/RP0/CPU0:ios(config-ikev2-profile-profile1)#match identity remote address 10.1.1.2
255.255.255.0
RP/0/RP0/CPU0:ios(config-ikev2-profile-profile1)#keyring kyr1
RP/0/RP0/CPU0:ios(config-ikev2-profile-profile1)#lifetime 86400
RP/0/RP0/CPU0:ios(config-ikev2-profile-profile1)#commit
Thu Mar  7 20:15:03.401 UTC
RP/0/RP0/CPU0:ios(config-ikev2-profile-profile1)#exit
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#show ikev2 profile profile1
Thu Mar  7 20:15:25.776 UTC

Profile Name                          : profile1
================================================================================
Keyring                               : kyr1
Lifetime(Sec)                         : 120
DPD Interval(Sec)                     : 10
DPD Retry Interval(Sec)               : 2
Match ANY                             : NO
Total Match remote peers              : 1
   Addr/Prefix                        : 10.1.1.2/255.255.255.0
```

Configuring an OTNSec Policy

To configure an OTNSec policy, use the following commands:

config

otnsec-policy *policy-name*

cipher-suite AES-GCM-256

security-policy must-secure

sak-rekey-interval *seconds*

Note The interval range, in seconds, is from 30 to 1209600. SAK rekey timer does not start by default until it is configured.

The following sample displays how to configure an OTNSec policy.

```
RP/0/RP0/CPU0:ios#configure
Mon Mar 11 15:16:58.417 UTC
RP/0/RP0/CPU0:ios(config)#otnsec policy otnsec-policy1
RP/0/RP0/CPU0:ios(config-otnsec-policy)#cipher-suite AES-GCM-256
RP/0/RP0/CPU0:ios(config-otnsec-policy)#security-policy must-secure
RP/0/RP0/CPU0:ios(config-otnsec-policy)#sak-rekey-interval 120
RP/0/RP0/CPU0:ios(config-otnsec-policy)#commit
```

The following is a sample of an OTNSec policy.

```
RP/0/RP0/CPU0:ios#show run otnsec policy otnsec-policy1
Tue Mar 12 11:14:03.591 UTC
otnsec policy otnsec-policy1
 cipher-suite AES-GCM-256
 security-policy must-secure
 sak-rekey-interval 120
!
```

Configuring the GCC Interface

To configure the GCC interface, use the following commands:

config

interface GCC2 *R/S/I/P*

ipv4 address *ipv4-address*

The following sample displays how to configure the GCC2 interface.

```
RP/0/RP0/CPU0:ios#config
Tue Mar 12 12:06:32.547 UTC
RP/0/RP0/CPU0:ios(config)#controller odu4 0/1/0/0/1
RP/0/RP0/CPU0:ios(config-odu4)#gcc2
RP/0/RP0/CPU0:ios(config-odu4)#commit
RP/0/RP0/CPU0:ios(config-odu4)#exit
```

```
RP/0/RP0/CPU0:ios#config
Tue Mar 12 11:16:04.749 UTC
RP/0/RP0/CPU0:ios(config)#interface GCC2 0/1/0/0/1
P/0/RP0/CPU0:ios(config-if)#ipv4 address 10.1.1.1 255.255.255.0
RP/0/RP0/CPU0:ios(config-if)#commit
Tue Mar 12 11:18:32.867 UTC
RP/0/RP0/CPU0:ios(config-if)#exit
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#sh run interface gcc2 0/1/0/0/1
Tue Mar 12 11:19:00.475 UTC
interface GCC20/1/0/0/1
 ipv4 address 10.1.1.1 255.255.255.0
!
```

```
RP/0/RP0/CPU0:ios#config
Wed Sep 28 23:10:28.258 UTC
RP/0/RP0/CPU0:ios(config)#controller ODUC4 0/0/0/12
RP/0/RP0/CPU0:ios(config-oduc4)#gcc2
```

```
RP/0/RP0/CPU0:ios(config-oduc4)#commit
RP/0/RP0/CPU0:ios(config-oduc4)#exit

RP/0/RP0/CPU0:ios#config
Wed Sep 28 23:10:29.808 UTC
RP/0/RP0/CPU0:ios(config)#interface GCC2 0/0/0/12
P/0/RP0/CPU0:ios(config-if)#ipv4 address 10.1.1.1 255.255.255.0
RP/0/RP0/CPU0:ios(config-if)#commit
Wed Sep 28 23:10:30.260 UTC UTC
RP/0/RP0/CPU0:ios(config-if)#exit
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#sh run interface gcc2 0/0/0/12
Tue Mar 12 11:19:00.475 UTC
interface GCC20/0/0/12
 ipv4 address 10.1.1.1 255.255.255.0
!
```

Configuring OTNSec on ODU4 Controllers

To configure the OTNSec on ODU4 controller, use the following commands:

config

controller ODU4 *rack/slot/instance/port*

otnsec

source ipv4 *ipv4-address*

destination ipv4 *ipv4-address*

session-id *session-id*

policy *policy-name*

ikev2 *profile-name*

Note The session ID ranges 1–65535.

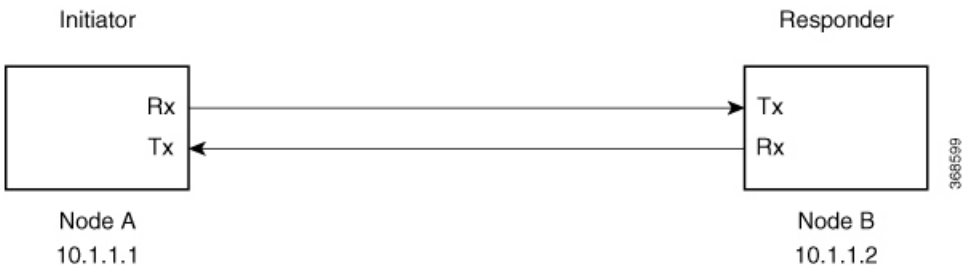
The following sample displays how to configure OTNSec on the ODU4 controller.

```
RP/0/RP0/CPU0:ios#configure
Mon Mar 12 12:10:21.374 UTC
RP/0/RP0/CPU0:ios(config)#controller ODU4 0/1/0/0/1
RP/0/RP0/CPU0:ios(config-odu4)#otnsec
RP/0/RP0/CPU0:ios(config-otnsec)#source ipv4 10.1.1.1
RP/0/RP0/CPU0:ios(config-otnsec)#destination ipv4 10.1.1.2
RP/0/RP0/CPU0:ios(config-otnsec)#session-id 9000
RP/0/RP0/CPU0:ios(config-otnsec)#policy otnsec-policy1
RP/0/RP0/CPU0:ios(config-otnsec)#ikev2 profile1
RP/0/RP0/CPU0:ios(config-otnsec)#commit
Mon Mar 12 12:14:17.609 UTC
RP/0/RP0/CPU0:ios(config-otnsec)#exit
RP/0/RP0/CPU0:ios(config)#exit
```

Configuration Example

In the following example, there are two nodes. The node with the lower IP address always acts as the initiator. In this case, node A (SITE-A) has the role of an initiator while Node B (SITE-B) has the role of a responder. In this example, the default IKE proposal and policy have been used on both nodes.

Figure 4: Configuration Schema



The configuration on Node A is displayed below.

Node A (Initiator)
Keyring

`RP/0/RP0/CPU0:SITE-A#configure`
`RP/0/RP0/CPU0:SITE-A(config)#keyring KR1`
`RP/0/RP0/CPU0:SITE-A(config-keyring-KR1)#peer SITE-B`
`RP/0/RP0/CPU0:SITE-A(config-keyring-KR1-peer-SITE-B)#address 10.1.1.2 255.255.255.0`
`RP/0/RP0/CPU0:SITE-A(config-keyring-KR1-peer-SITE-B)#pre-shared-key password 106D000A064743595`
`RP/0/RP0/CPU0:SITE-A(config-keyring-KR1-peer-SITE-B)#commit`
`RP/0/RP0/CPU0:SITE-A(config-keyring-KR1-peer-SITE-B)#exit`
`RP/0/RP0/CPU0:SITE-A(config-keyring-KR1)#exit`

IKEv2 profile

`RP/0/RP0/CPU0:SITE-A(config)#ikev2 profile IP1`
`RP/0/RP0/CPU0:SITE-A(config-ikev2-profile-IP1)#match identity remote address 10.1.1.2 255.255.255.0`
`RP/0/RP0/CPU0:SITE-A(config-ikev2-profile-IP1)#keyring KR1`
`RP/0/RP0/CPU0:SITE-A(config-ikev2-profile-IP1)#lifetime 86400`
`RP/0/RP0/CPU0:SITE-A(config-ikev2-profile-IP1)#commit`
`RP/0/RP0/CPU0:SITE-A(config-ikev2-profile-IP1)#exit`

OTNSec policy

`RP/0/RP0/CPU0:SITE-A(config)#otnsec policy OP1`
`RP/0/RP0/CPU0:SITE-A(config-otnsec-policy)#cipher-suite AES-GCM-256`
`RP/0/RP0/CPU0:SITE-A(config-otnsec-policy)#security-policy must-secure`
`RP/0/RP0/CPU0:SITE-A(config-otnsec-policy)#sak-rekey-interval 120`
`RP/0/RP0/CPU0:SITE-A(config-otnsec-policy)#commit`
`RP/0/RP0/CPU0:SITE-A(config-otnsec-policy)#exit`

GCC interface

Node A (Initiator)

```
RP/0/RP0/CPU0:SITE-A(config)#controller odu4 0/1/0/0/1
RP/0/RP0/CPU0:SITE-A(config-odu4)#gcc2
RP/0/RP0/CPU0:SITE-A(config-odu4)#commit
RP/0/RP0/CPU0:SITE-A(config-odu4)#exit
RP/0/RP0/CPU0:SITE-A(config)#interface GCC2 0/1/0/0/1
RP/0/RP0/CPU0:SITE-A(config-if)#ipv4 address 10.1.1.1 255.255.255.0
RP/0/RP0/CPU0:SITE-A(config-if)#commit
RP/0/RP0/CPU0:SITE-A(config-if)#exit
```

OTNSec on ODU4 controller

```
RP/0/RP0/CPU0:SITE-A(config)#controller odu4 0/1/0/0/1
RP/0/RP0/CPU0:SITE-A(config-odu4)#otnsec
RP/0/RP0/CPU0:SITE-A(config-otnsec)#source ipv4 10.1.1.1
RP/0/RP0/CPU0:SITE-A(config-otnsec)#destination ipv4 10.1.1.2
RP/0/RP0/CPU0:SITE-A(config-otnsec)#session-id 9000
RP/0/RP0/CPU0:SITE-A(config-otnsec)#policy OP1
RP/0/RP0/CPU0:SITE-A(config-otnsec)#ikev2 IP1
RP/0/RP0/CPU0:SITE-A(config-otnsec)#commit
RP/0/RP0/CPU0:SITE-A(config-otnsec)#exit
RP/0/RP0/CPU0:SITE-A(config-odu4)#exit
RP/0/RP0/CPU0:SITE-B(config)#exit
```

The configuration on Node B is displayed below.

Node B (Responder)

Keyring

```
RP/0/RP0/CPU0:SITE-B#configure
RP/0/RP0/CPU0:SITE-B(config)#keyring KR1
RP/0/RP0/CPU0:SITE-B(config-keyring-KR1)#peer SITE-A
RP/0/RP0/CPU0:SITE-B(config-keyring-KR1-peer-SITE-A)#address 10.1.1.1 255.255.255.0
RP/0/RP0/CPU0:SITE-B(config-keyring-KR1-peer-SITE-A)#pre-shared-key password
14341B180F547B7977
RP/0/RP0/CPU0:SITE-B(config-keyring-KR1-peer-SITE-A)#commit
RP/0/RP0/CPU0:SITE-B(config-keyring-KR1-peer-SITE-A)#exit
RP/0/RP0/CPU0:SITE-B(config-keyring-KR1)#exit
```

IKEv2 profile

```
RP/0/RP0/CPU0:SITE-B(config)#ikev2 profile IP1
RP/0/RP0/CPU0:SITE-B(config-ikev2-profile-IP1)#match identity remote address 10.1.1.1
255.255.255.0
RP/0/RP0/CPU0:SITE-B(config-ikev2-profile-IP1)#keyring KR1
RP/0/RP0/CPU0:SITE-B(config-ikev2-profile-IP1)#lifetime 86400
RP/0/RP0/CPU0:SITE-B(config-ikev2-profile-IP1)#commit
RP/0/RP0/CPU0:SITE-B(config-ikev2-profile-IP1)#exit
```

OTNSec policy

Node B (Responder)

```
RP/0/RP0/CPU0:SITE-B(config)#otnsec policy OP1
RP/0/RP0/CPU0:SITE-B(config-otnsec-policy)#cipher-suite AES-GCM-256
RP/0/RP0/CPU0:SITE-B(config-otnsec-policy)#security-policy must-secure
RP/0/RP0/CPU0:SITE-B(config-otnsec-policy)#sak-rekey-interval 120
RP/0/RP0/CPU0:SITE-B(config-otnsec-policy)#commit
RP/0/RP0/CPU0:SITE-B(config-otnsec-policy)#exit
```

GCC interface

```
RP/0/RP0/CPU0:SITE-B(config)#controller odu4 0/1/0/0/1
RP/0/RP0/CPU0:SITE-B(config-odu4)#gcc2
RP/0/RP0/CPU0:SITE-B(config-odu4)#commit
RP/0/RP0/CPU0:SITE-B(config-odu4)#exit
RP/0/RP0/CPU0:SITE-B(config)#interface GCC2 0/1/0/0/1
RP/0/RP0/CPU0:SITE-B(config-if)#ipv4 address 10.1.1.2 255.255.255.0
RP/0/RP0/CPU0:SITE-B(config-if)#commit
RP/0/RP0/CPU0:SITE-B(config-if)#exit
```

GCC interface for OTN-XP card

```
RP/0/RP0/CPU0:SITE-B(config)#controller oduc4 0/0/0/12
RP/0/RP0/CPU0:SITE-B(config-oduc4)#gcc2
RP/0/RP0/CPU0:SITE-B(config-oduc4)#commit
RP/0/RP0/CPU0:SITE-B(config-oduc4)#exit
RP/0/RP0/CPU0:SITE-B(config)#interface GCC2 0/0/0/12
RP/0/RP0/CPU0:SITE-B(config-if)#ipv4 address 10.1.1.2 255.255.255.0
RP/0/RP0/CPU0:SITE-B(config-if)#commit
RP/0/RP0/CPU0:SITE-B(config-if)#exit
```

OTNSec on ODU4 controller

```
RP/0/RP0/CPU0:SITE-B(config)#controller odu4 0/1/0/0/1
RP/0/RP0/CPU0:SITE-B(config-odu4)#otnsec
RP/0/RP0/CPU0:SITE-B(config-otnsec)#source ipv4 10.1.1.2
RP/0/RP0/CPU0:SITE-B(config-otnsec)#destination ipv4 10.1.1.1
RP/0/RP0/CPU0:SITE-B(config-otnsec)#session-id 9000
RP/0/RP0/CPU0:SITE-B(config-otnsec)#policy OP1
RP/0/RP0/CPU0:SITE-B(config-otnsec)#ikev2 IP1
RP/0/RP0/CPU0:SITE-B(config-otnsec)#commit
RP/0/RP0/CPU0:SITE-B(config-otnsec)#exit
RP/0/RP0/CPU0:SITE-B(config-odu4)#exit
RP/0/RP0/CPU0:SITE-B(config)#exit
```

OTNSec on ODUC4 controller

Node B (Responder)
RP/0/RP0/CPU0:SITE-B(config)#controller oduc4 0/0/0/12 RP/0/RP0/CPU0:SITE-B(config-oduc4)#otnsec RP/0/RP0/CPU0:SITE-B(config-otnsec)#source ipv4 10.1.1.2 RP/0/RP0/CPU0:SITE-B(config-otnsec)#destination ipv4 10.1.1.1 RP/0/RP0/CPU0:SITE-B(config-otnsec)#session-id 99 RP/0/RP0/CPU0:SITE-B(config-otnsec)#policy OP1 RP/0/RP0/CPU0:SITE-B(config-otnsec)#ikev2 IP1 RP/0/RP0/CPU0:SITE-B(config-otnsec)#commit RP/0/RP0/CPU0:SITE-B(config-otnsec)#exit RP/0/RP0/CPU0:SITE-B(config-oduc4)#exit RP/0/RP0/CPU0:SITE-B(config)#exit

Verification

- Verify that there are no alarms on the ports of the NCS 1004.
- Use the **show** commands listed in the table below to verify the IKEv2 and OTNSec configuration. For details of these commands, see the *Command Reference for Cisco NCS 1004*.

Table 3: Show Commands

Show Commands	Purpose
`show run ikev2`	Displays the running configuration of IKEv2
`show ikev2 session`	Displays the child SAs created for the session
`show ip interface brief`	Displays the status of the GCC interfaces
`show run controller ODU4 0/1/0/0/1`	Displays the running configuration of the ODU4 controller
`show controllers ODU4 0/1/0/0/1 otnsec`	Displays the OTNSec configuration on the ODU4 controller
`show controllers ODU4 0/1/0/0/1 pm current 15-min otnsec`	Displays the PM statistics that help verify the encrypted and decrypted blocks.

Troubleshooting

Problem: The IKE session is not established between the two nodes.

Solution: Check the status of the GCC interface using the **show ip interface brief** command.

To gather logs and traces, use the **show tech-support ncs1004 detail**, **show tech-support ikev2**, and **show tech-support otnsec** commands.

You May Be Interested In

- For more information about IKEv2, see RFC 7296.
- For more information about NCS 1004, see the NCS 1004 datasheet.