Configure Route-Based Site-To-Site VPN Between ASA and FTD with BGP as Overlay

Contents

Introduction

This document describes how to configure a route-based Site-to-Site VPN tunnel between Adaptive Security Appliance (ASA) and Firepower Threat Defense managed (FTD) by a Firepower Management Center (FMC) with dynamic routing Border Gateway Protocol (BGP) as an overlay.

Prerequisites

Requirements

Cisco recommends that you have knowledge of these topics:

- Basic understanding of IPsec site-to-site VPN
- BGP configurations on FTD and ASA
- Experience with FMC

Components Used

- Cisco ASAv version 9.20(2)2
- Cisco FMC version 7.4.1
- Cisco FTD version 7.4.1

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Background Information

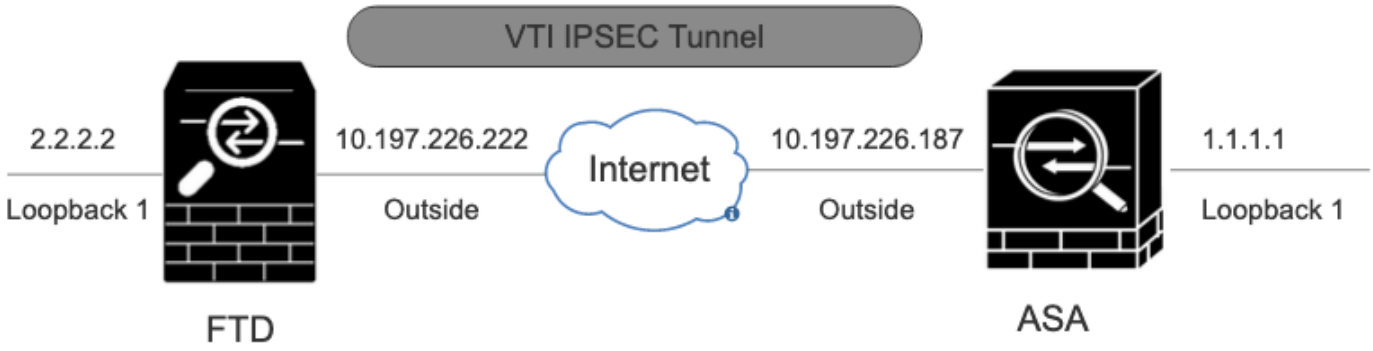
Route-based VPN allows the determination of interesting traffic to be encrypted, or sent over a VPN tunnel, and uses traffic routing instead of policy/access-list as in a Policy-based or Crypto-map-based VPN. The encryption domain is set to allow any traffic which enters the IPsec tunnel. IPsec Local and remote traffic selectors are set to 0.0.0.0/0.0.0.0. Any traffic routed into the IPsec tunnel is encrypted regardless of the source/destination subnet.

This document focuses on Static Virtual Tunnel Interface (SVTI) configuration with dynamic routing BGP as an overlay.

Configure

This section describes the configuration needed on the ASA and FTD to bring up BGP neighborship through an SVTI IPSec Tunnel.

Network Diagram



Network Diagram

Configurations

Configure IPSec VPN on FTD using FMC

Step 1. Navigate to Devices > VPN > Site To Site .

Step 2. Click on +Site to Site VPN .

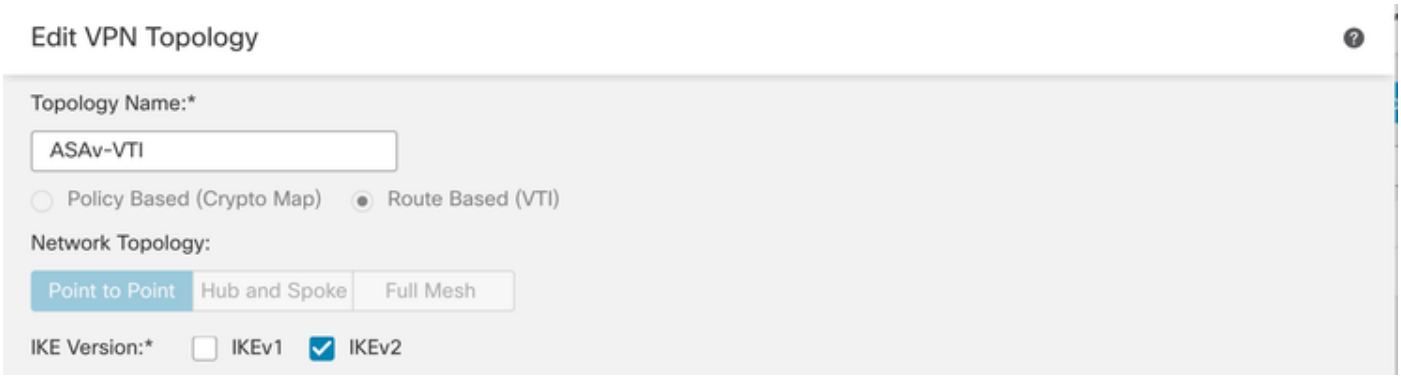
Site-To-Site VPN

Step 3. Provide a Topology Name and select the Type of VPN as Route Based (VTI). Choose the IKE Version.

For this demonstration:

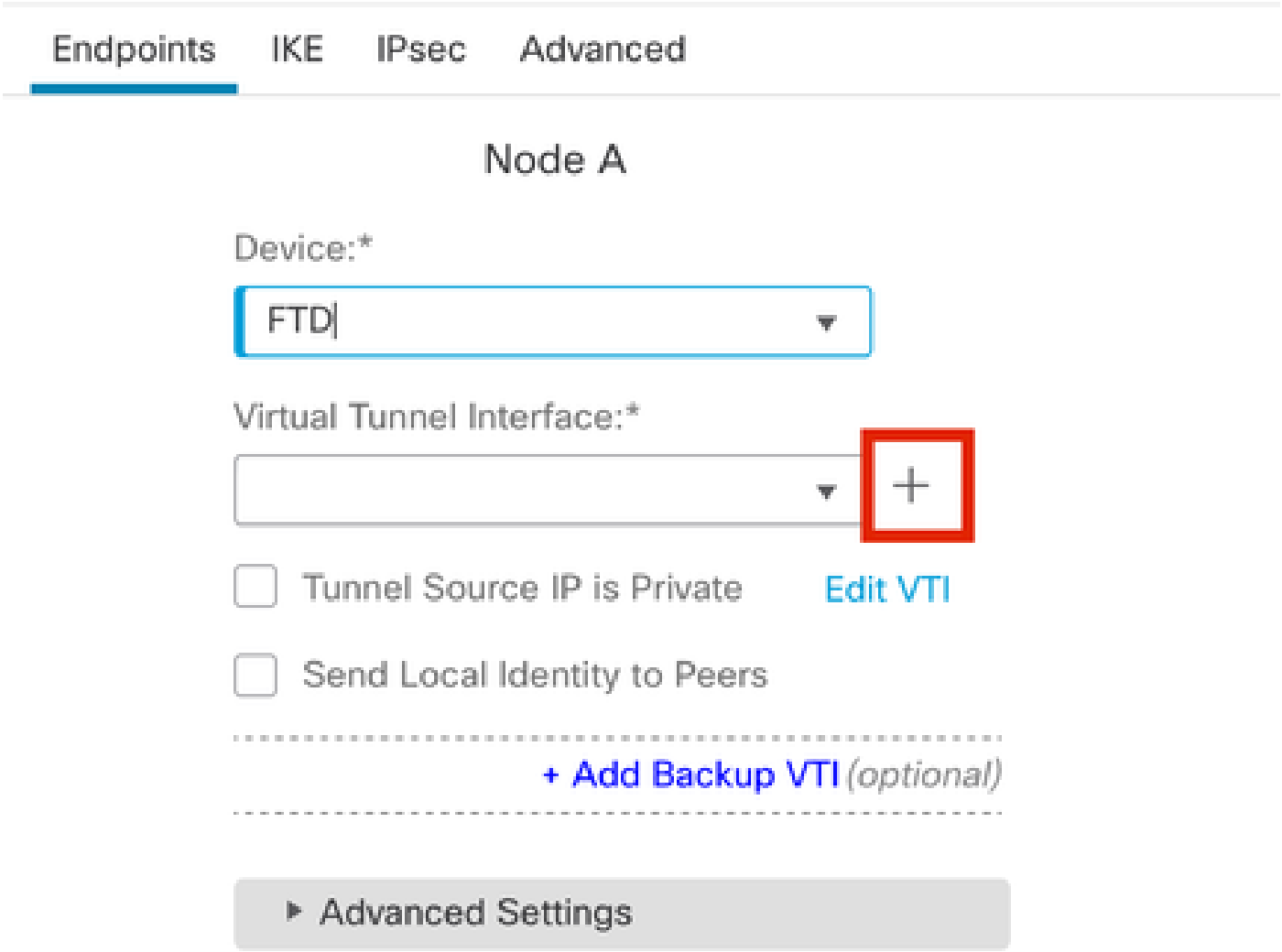
Topology Name: ASAv-VTI

IKE Version: IKEv2



VPN-Topology

Step 4. Choose the Deviceon which the tunnel needs to be configured. You can add a new Virtual Tunnel Interface (click on the + icon), or select one from the existing list.



Endpoint Node A

Step 5. Define the parameters of the New Virtual Tunnel Interface. Click Ok.

For this demonstration:

Name: ASA-VTI

Description (Optional): VTI Tunnel with Extranet ASA

Security Zone: VTI-Zone

Tunnel ID: 1

IP Address: 169.254.2.1/24

Tunnel Source: GigabitEthernet0/1 (Outside)

IPsec Tunnel mode: IPv4

Add Virtual Tunnel Interface

General | Path Monitoring

Tunnel Type

(•) Static ( ) Dynamic

Name:*

ASAv-VTI

[x] Enabled

Description:

VTI Tunnel with Extranet ASA

Security Zone:

VTI-Zone

Priority:

0 (0 - 65535)

Virtual Tunnel Interface Details

An interface named Tunnel<ID> is configured. Tunnel Source is a physical interface where VPN tunnel terminates for the VT

Tunnel ID:*

3 (0 - 10413)

Tunnel Source:*

GigabitEthernet0/1 (Outside) | 10.197.226.222

IPsec Tunnel Details

IPsec Tunnel mode is decided by VPN traffic IP type. Configure IPv4 and IPv6 addresses accordingly.

IPsec Tunnel Mode:*

(•) IPv4 ( ) IPv6

IP Address:*

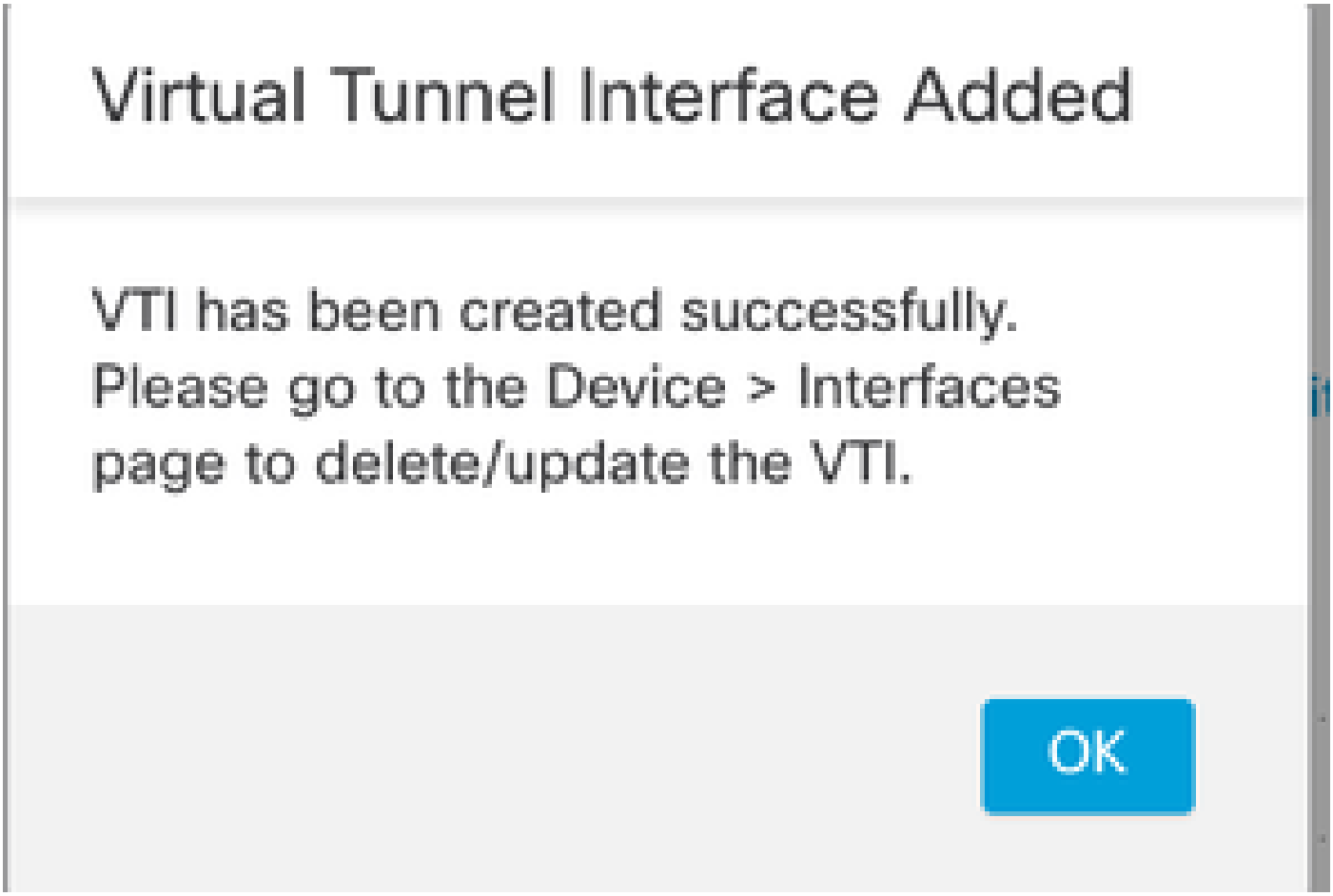
(•) Configure IP 169.254.2.1/24

( ) Borrow IP (IP unnumbered) Loopback1 (loopback)

Cancel OK

Virtual Tunnel Interface

Step 6. Click OK on the popup mentioning that the new VTI has been created.



Virtual Tunnel Interface Added

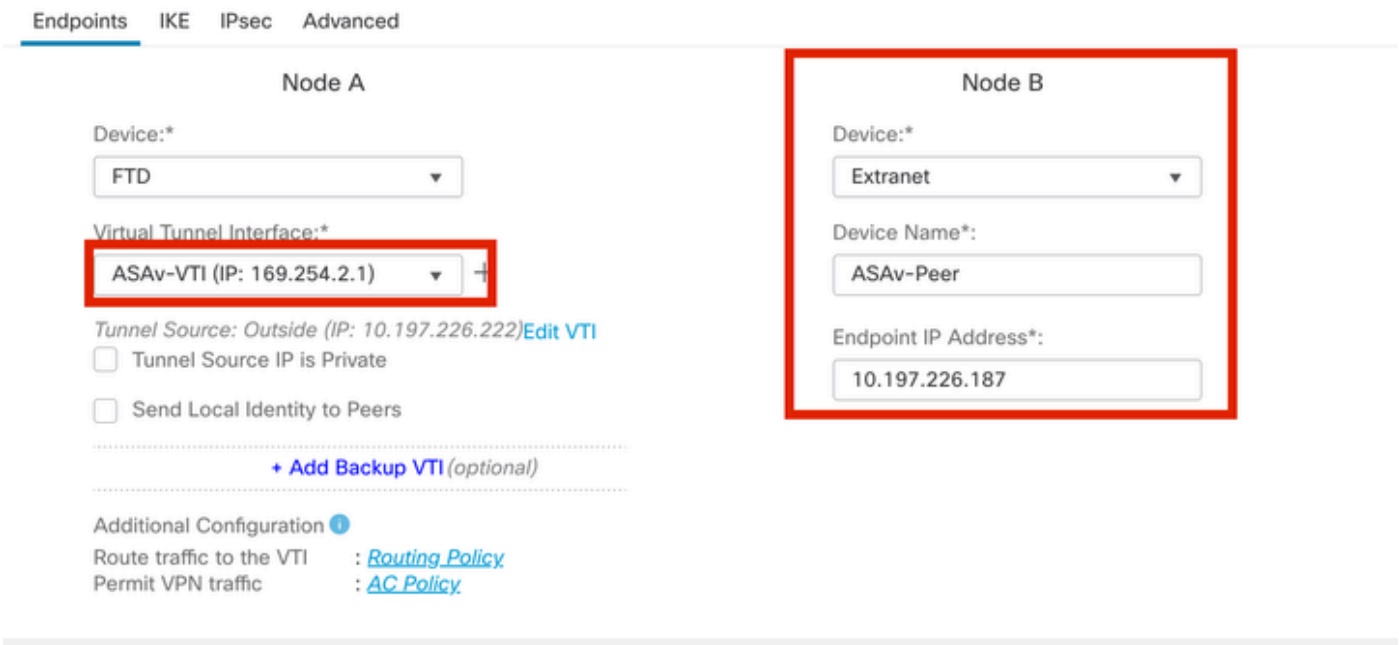
Step 7. Choose the newly created VTI or a VTI under Virtual Tunnel Interface. Provide the information for Node B (which is the peer device).

For this demonstration:

Device: Extranet

Device Name: ASAv-Peer

Endpoint IP Address: 10.197.226.187



Endpoint Node B

Step 8. Navigate to the **IKE** tab. Click on . You can choose to use a pre-defined Policy or click the +button next to the Policytab to create a new one.

Step 9. (Optional, if you create a new IKEv2 Policy.) Provide a Namefor the Policy and select the Algorithms to be used in the policy. Click Save.

For this demonstration:

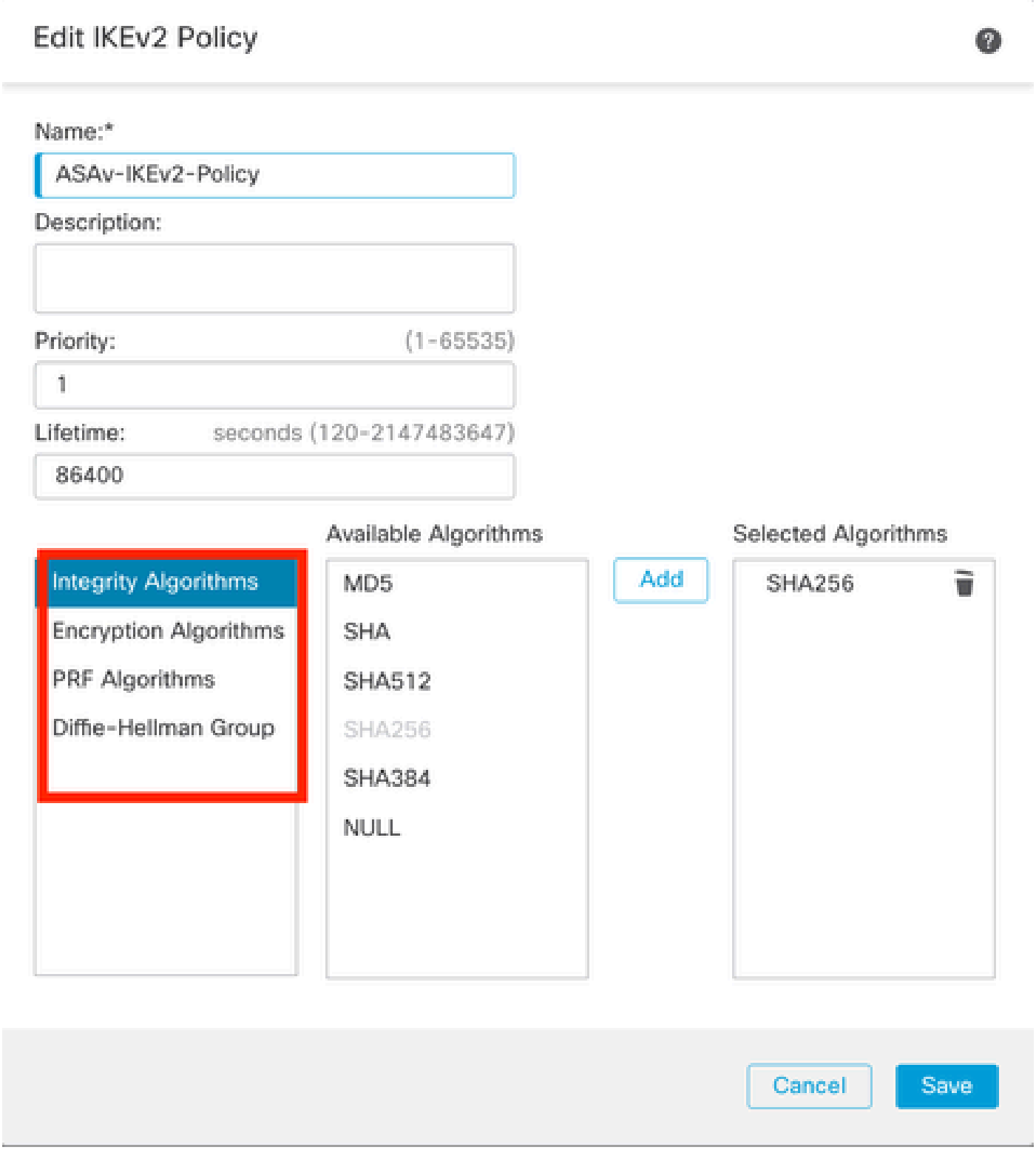
Name: ASAv-IKEv2-policy

Integrity Algorithms: SHA-256

Encryption Algorithms: AES-256

PRF Algorithms: SHA-256

Diffie-Hellman Group: 14



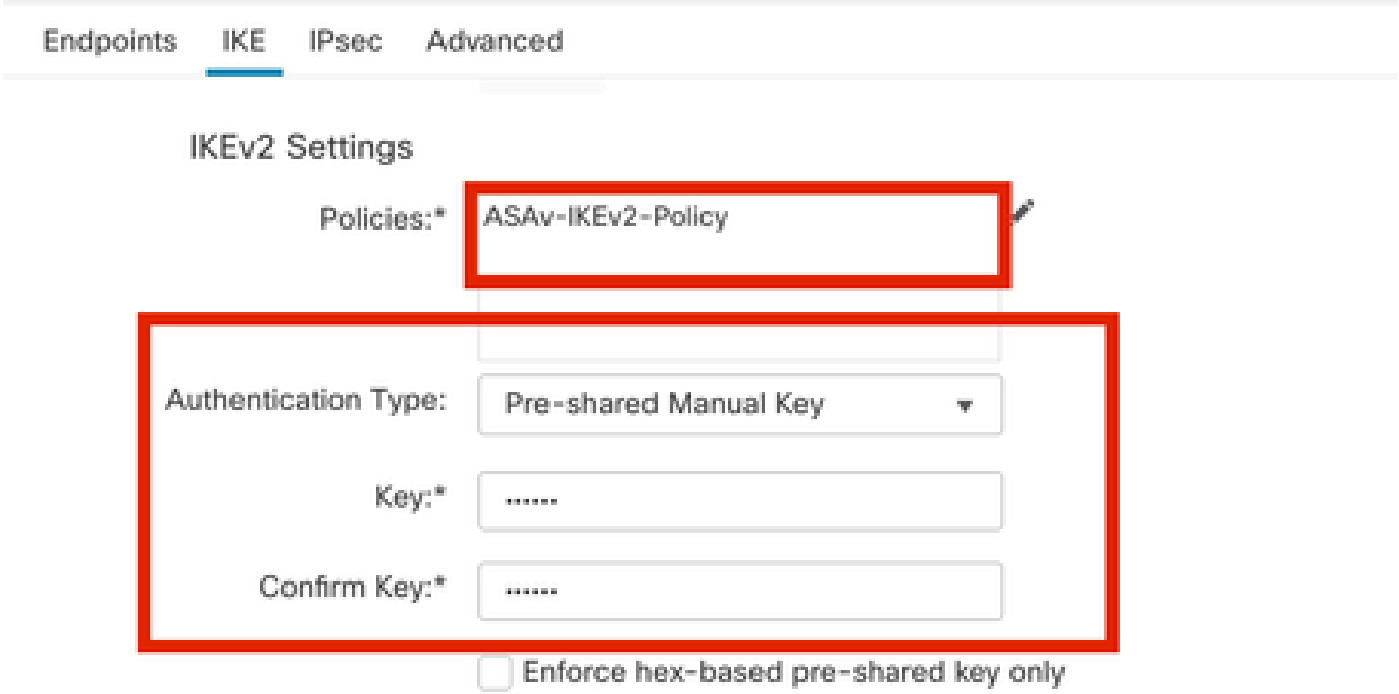
IKEv2-Policy

Step 10. Choose the newly created Policy or the Policythat exists. Select the Authentication Type. If a Pre-shared Manual Key is used, enter the key in the Keyand Confirm Key box.

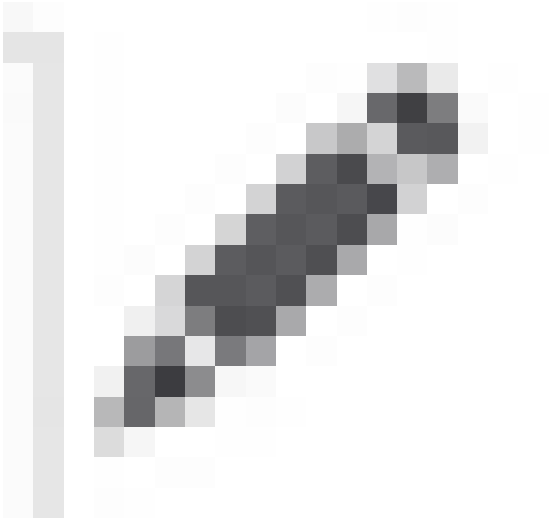
For this demonstration:

Policy: ASAv-IKEv2-Policy

Authentication Type: Pre-shared Manual Key



Authentication



Step 11. Navigate to the IPsec tab. Click on can choose to use a pre-defined IKEv2 IPsec Proposal or create a new one. Click the +button next to the IKEv2 IPsec Proposal tab.

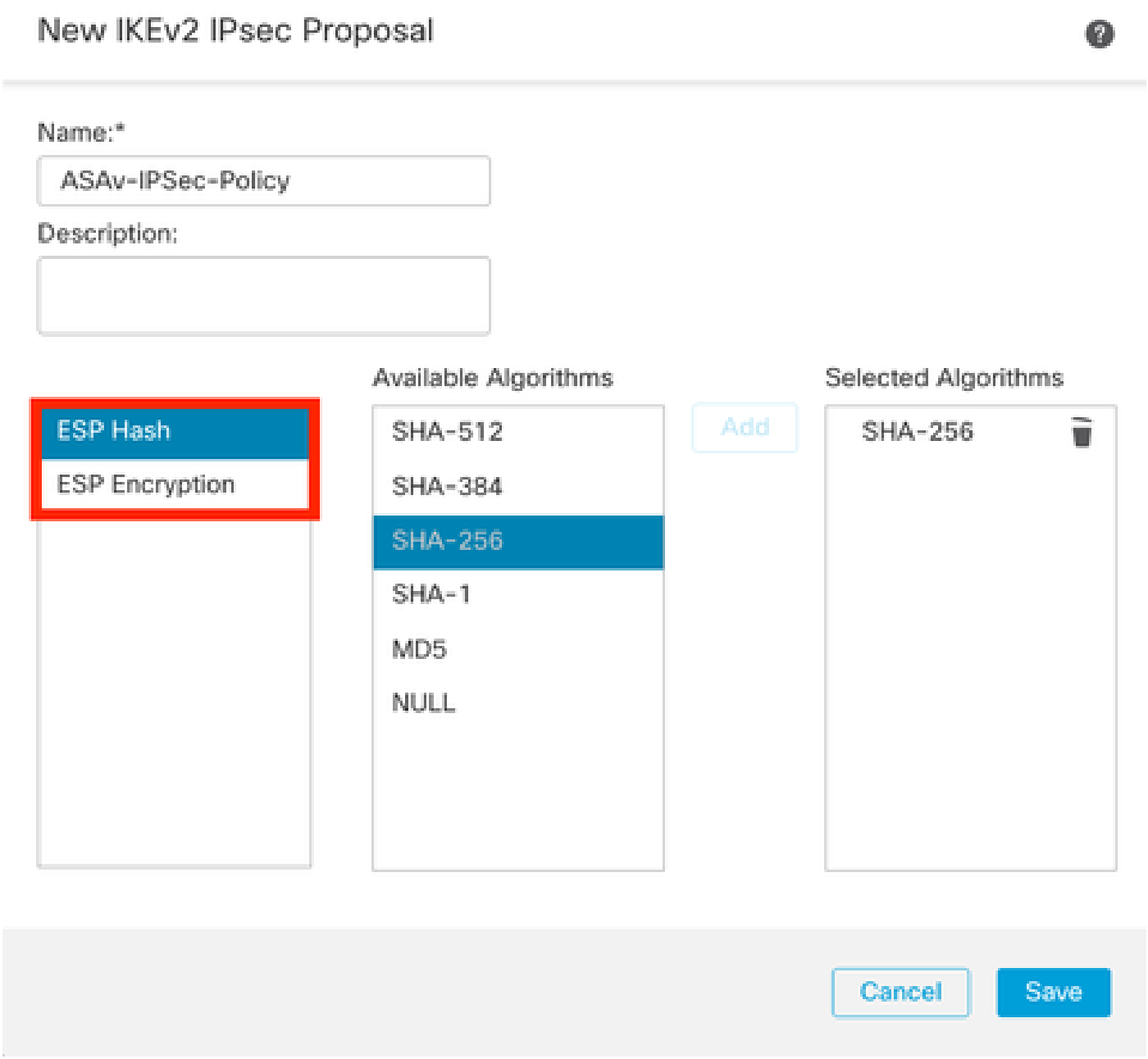
Step 12. (Optional, if you create a new IKEv2 IPsec Proposal.) Enter a Namefor the Proposal and select the Algorithms to be used in the Proposal. Click Save.

For this demonstration:

Name: ASAv-IPSec-Policy

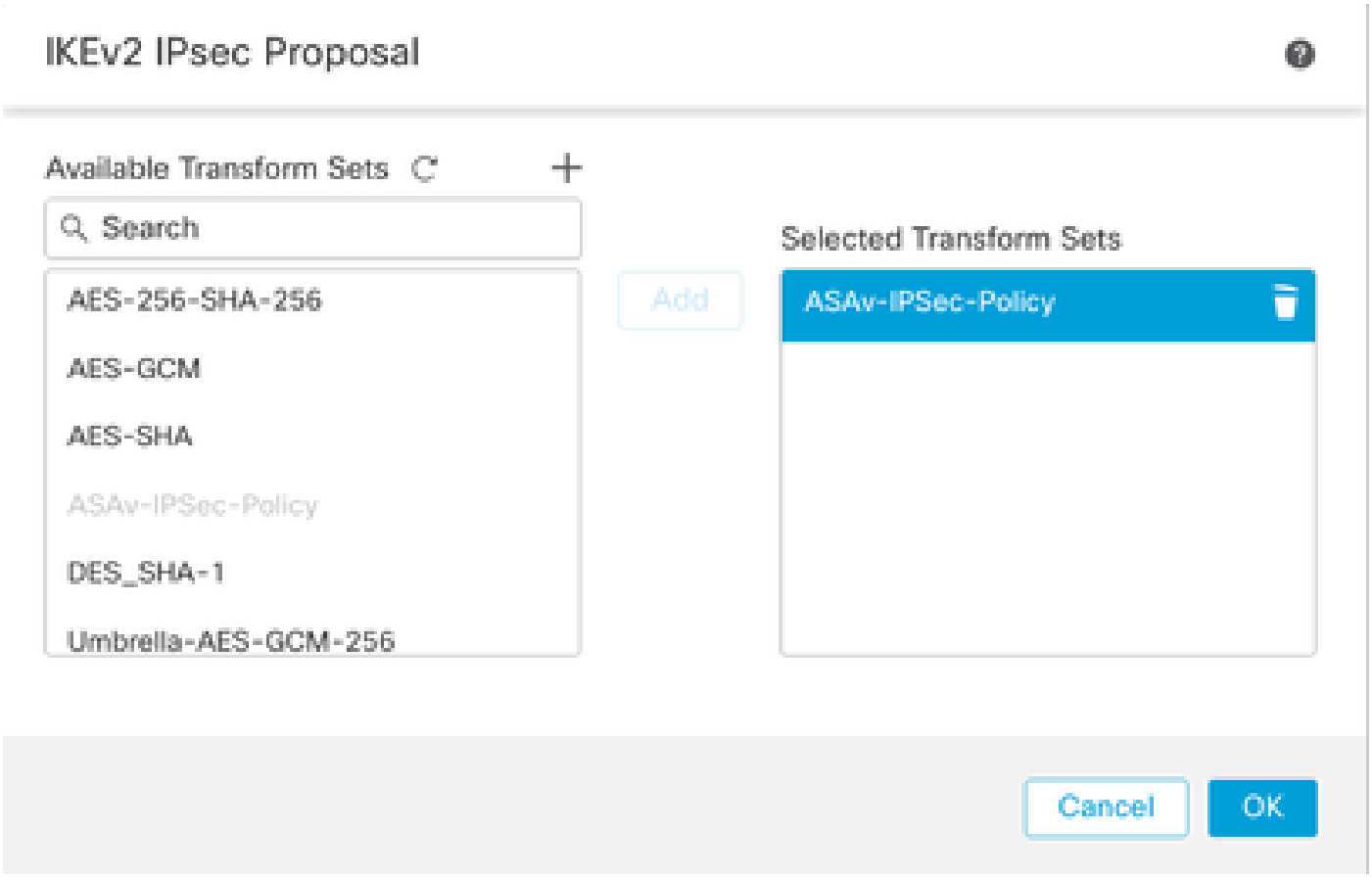
ESP Hash: SHA-256

ESP Encryption: AES-256



IKEv2-IPsec-Proposal

Step 13. Choose the newly created Proposal or Proposalthat exists from the list of proposals available. Click OK.



Transform Set

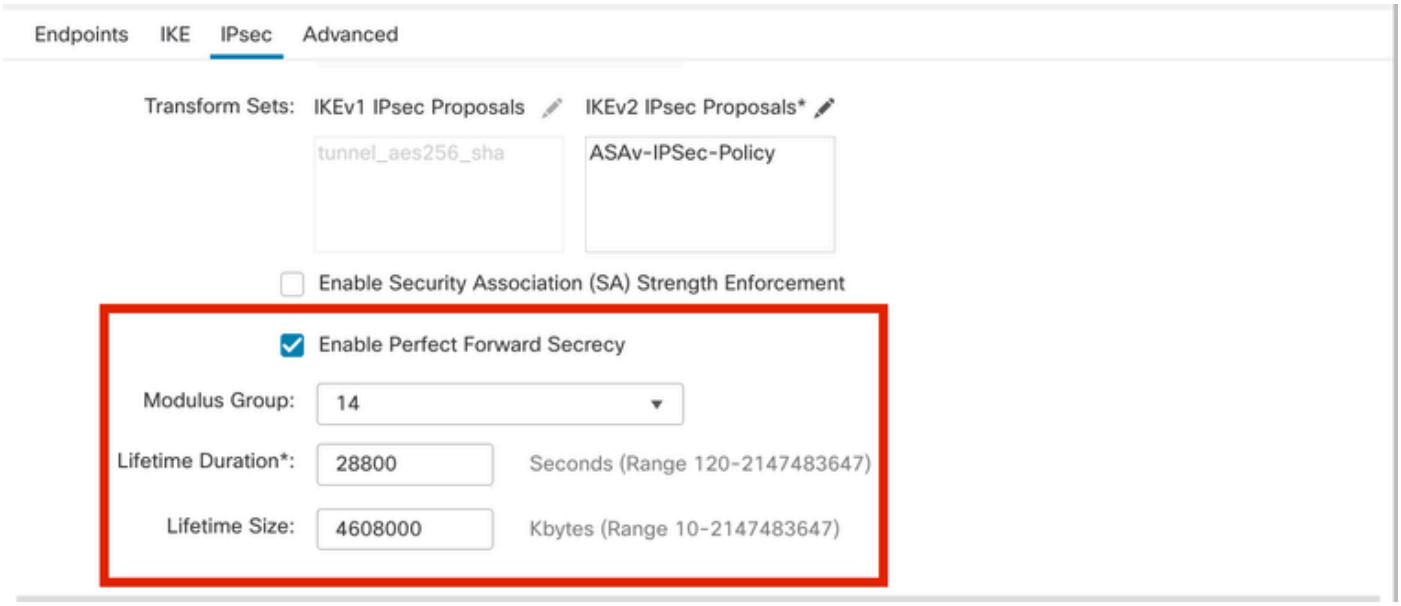
Step 14. (Optional) Choose the Perfect Forward Secrecy settings. Configure the IPsec Lifetime Duration and Lifetime Size.

For this demonstration:

Perfect Forward Secrecy: Modulus Group 14

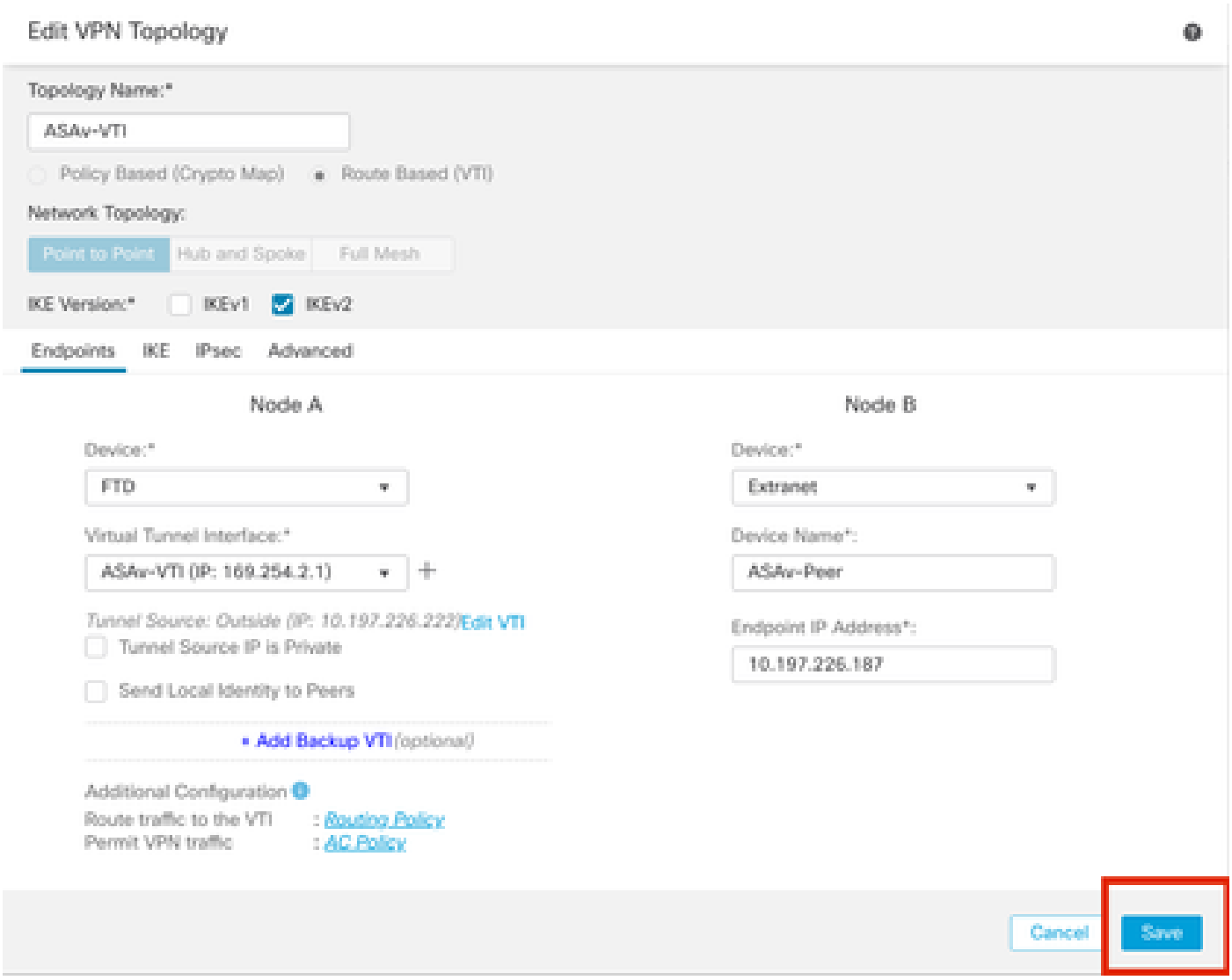
Lifetime Duration: 28800 (Default)

Lifetime Size: 4608000 (Default)



PFS-Configuration

Step 15. Check the configured settings. Click Save, as shown in this image.



Saving the configuration

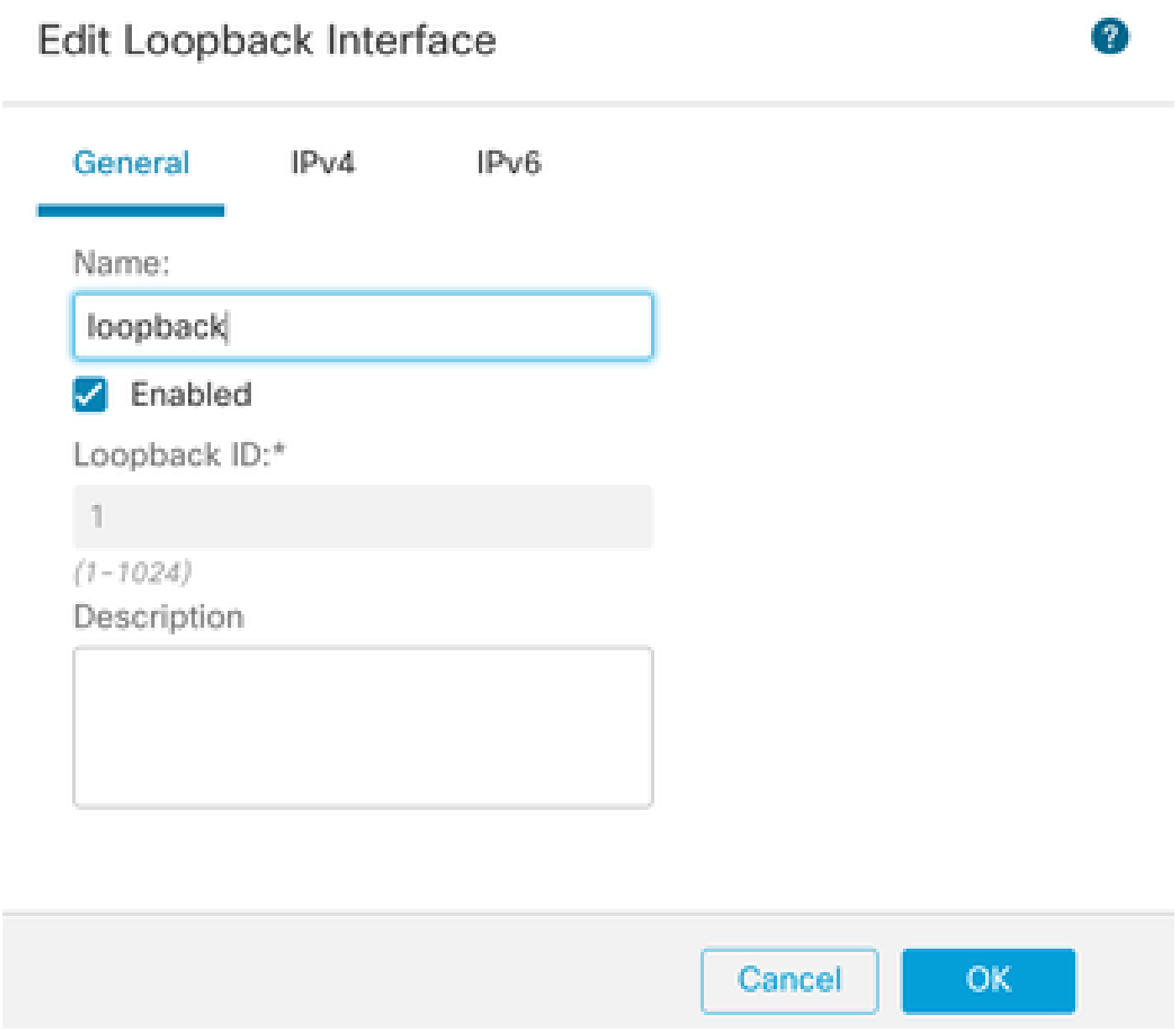
Configure Loopback Interface on FTD using FMC

Navigate to Devices > Device Management . Edit the device where the loopback needs to be configured.

Step 1. Go to Interfaces > Add Interfaces > Loopback Interface .

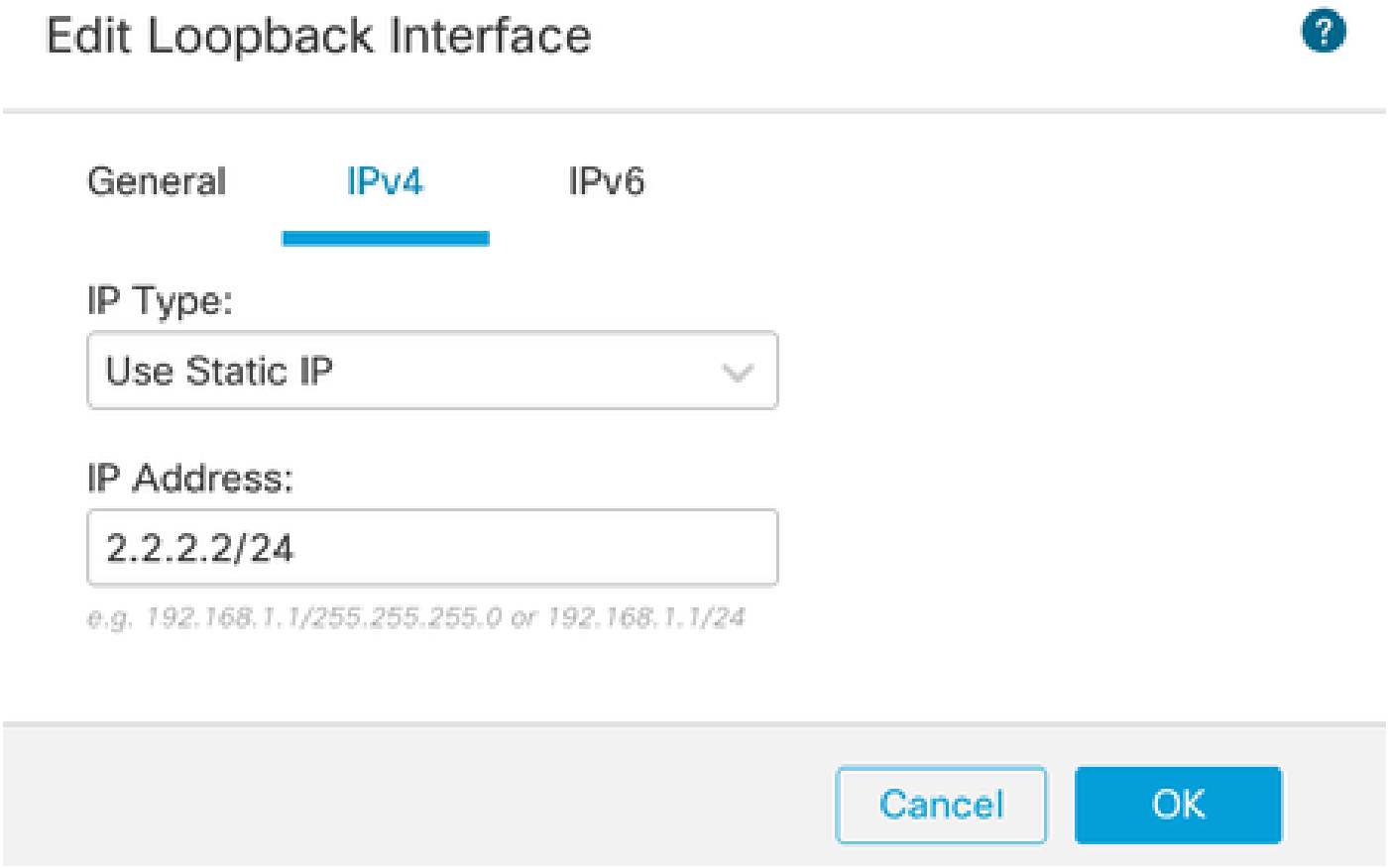
Navigate to Loopback interface

Step 2. Enter the name "loopback", provide a loopback ID "1" and enable the interface.



Enabling Loopback interface

Step 3. Configure the IP address for the interface, click OK.



Provide Ip address to loopback interface

Configure IPSec VPN on ASA

```
!--- Configure IKEv2 Policy ---!

crypto ikev2 policy 1
encryption aes-256
integrity sha256
group 14
prf sha256
lifetime seconds 86400



!--- Enable IKEv2 on the outside interface ---!

crypto ikev2 enable outside



!---Configure Tunnel-Group with pre-shared-key---!

tunnel-group 10.197.226.222 type ipsec-l2l
tunnel-group 10.197.226.222 ipsec-attributes
ikev2 remote-authentication pre-shared-key *****
ikev2 local-authentication pre-shared-key *****
```

```
!--- Configure IPSec Policy ---!

crypto ipsec ikev2 ipsec-proposal ipsec_proposal_for_FTD
protocol esp encryption aes-256
protocol esp integrity sha-256




!--- Configure IPSec Profile ---!

crypto ipsec profile ipsec_profile_for_FTD
set ikev2 ipsec-proposal FTD-ipsec-proposal
set pfs group14




!--- Configure VTI ---!

interface Tunnel1
nameif FTD-VTI
ip address 169.254.2.2 255.255.255.0
tunnel source interface outside
tunnel destination 10.197.226.222
tunnel mode ipsec ipv4
tunnel protection ipsec profile ipsec_profile_for_FTD




!--- Configure the WAN routes ---!

route outside 0.0.0.0 0.0.0.0 10.197.226.1 1
```

Configure Loopback Interface on ASA

```
interface Loopback1
nameif loopback
ip address 1.1.1.1 255.255.255.0
```

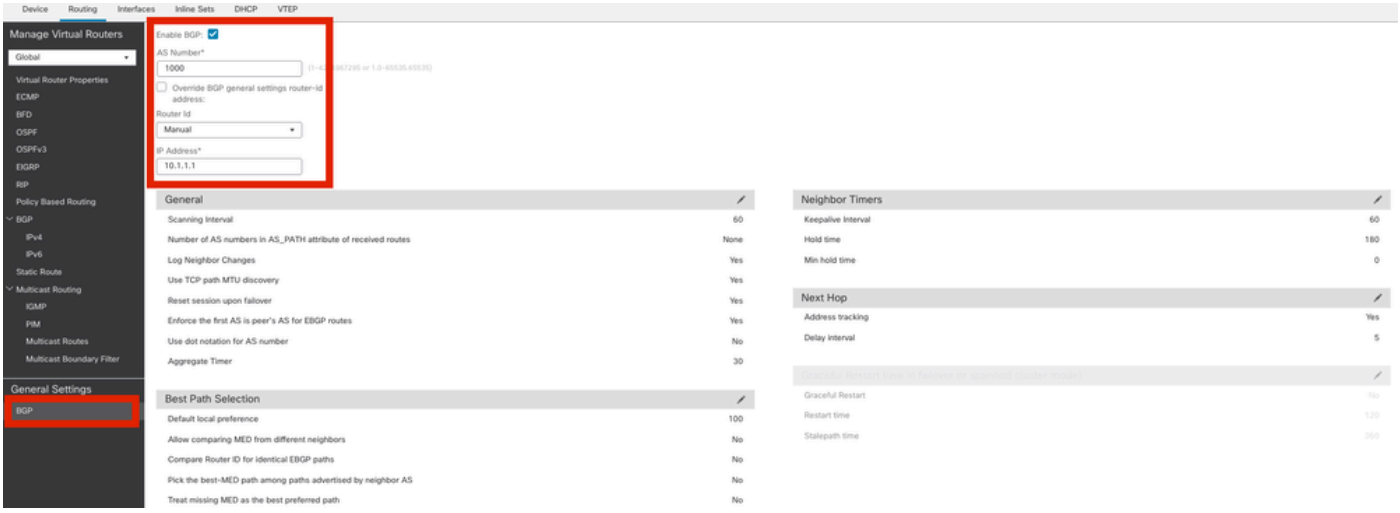
Configure Overlay BGP on FTD using FMC

Navigate to Devices > Device Management.Edit the device where the VTI tunnel is configured, then navigate to Routing >General Settings > BGP.

Step 1. Enable BGP and configure the Autonomous System (AS) Number and Router ID, as shown in this image.

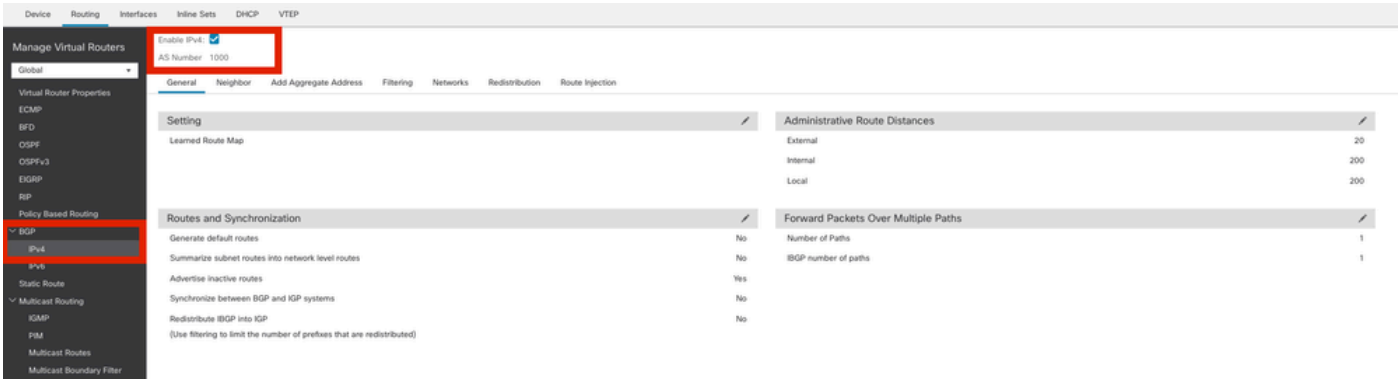
AS number needs to be the same on both the devices FTD and ASA.

Router ID is used to identify each router participating in BGP.



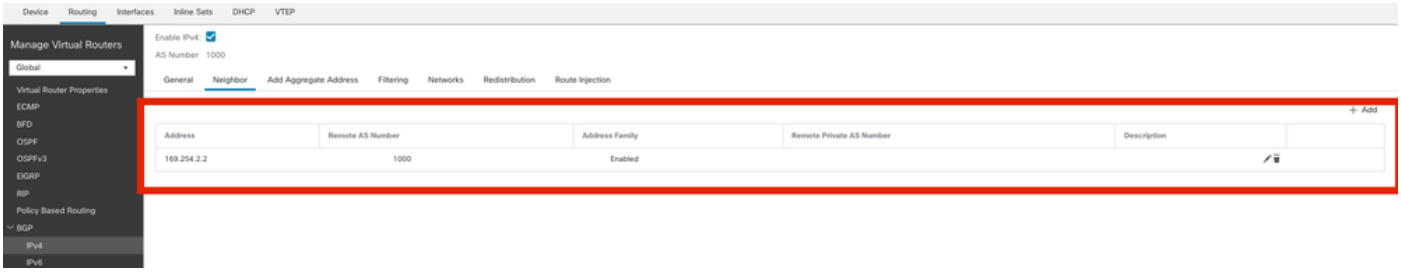
Navigate to configure BGP

Step 2. Navigate to BGP > IPv4 and enable BGP IPv4 on the FTD.



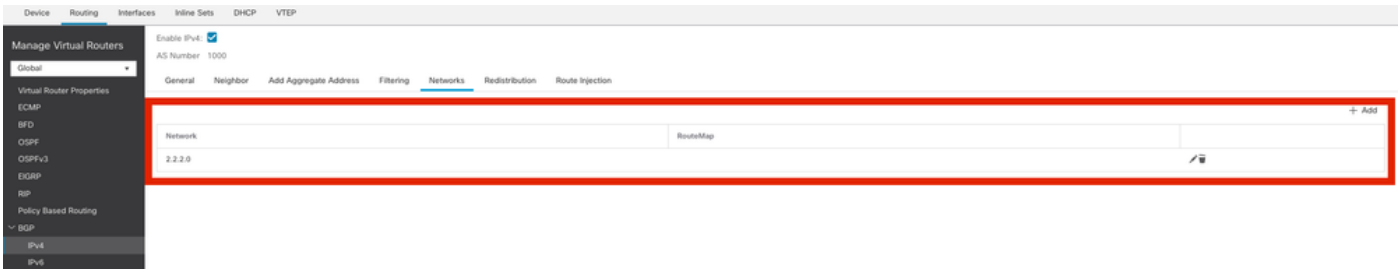
Enable BGP

Step 3. Under theNeighbor Tab, add the ASAv VTI tunnel ip address as a neighbor and enable the neighbor.



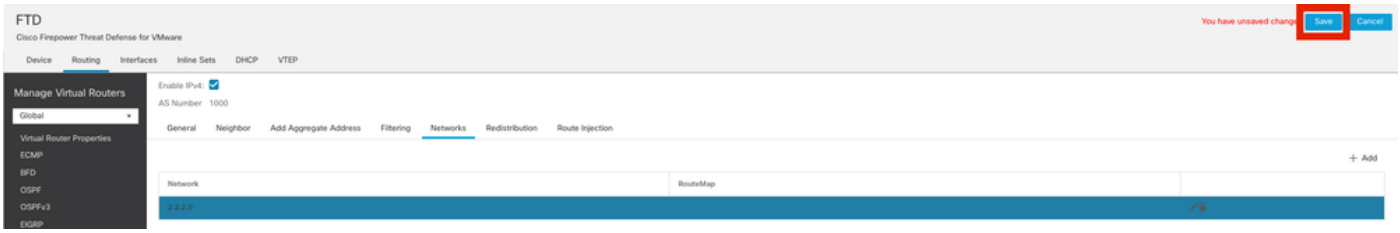
Add BGP neighbor

Step 4. Under Networks , add the networks you want to advertise through BGP that need to go through the VTI tunnel, in this case, loopback1.



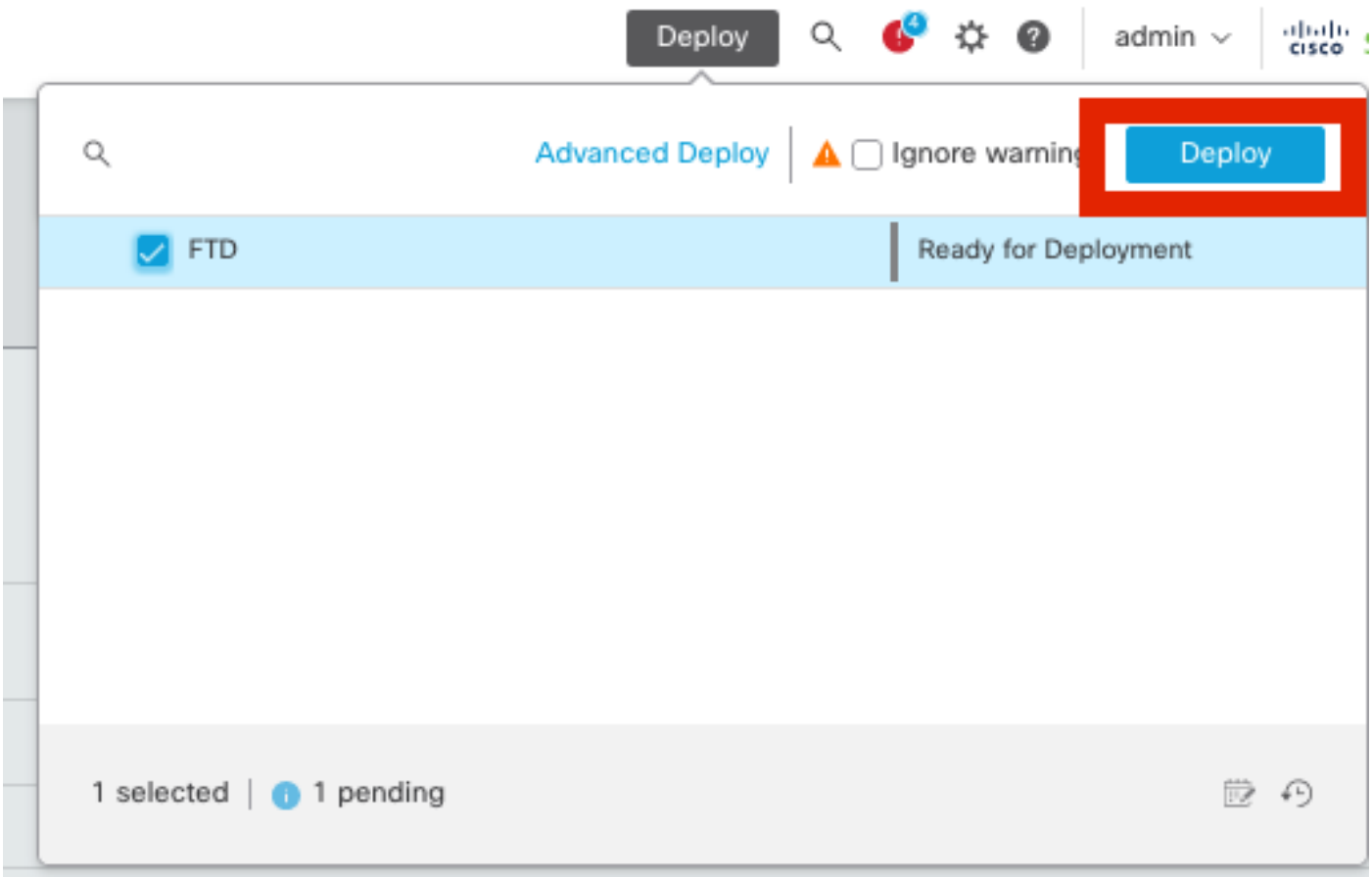
Add BGP Networks

Step 5. All other BGP settings are optional and you may configure them as per your environment. Verify the configuration and Click Save.



Save BGP configuration

Step 6. Deploy all the configurations.



Deployment

Configure Overlay BGP on ASA

```
router bgp 1000
bgp log-neighbor-changes
bgp router-id 10.1.1.2
address-family ipv4 unicast
neighbor 169.254.2.1 remote-as 1000
neighbor 169.254.2.1 transport path-mtu-discovery disable
neighbor 169.254.2.1 activate
network 1.1.1.0 mask 255.255.255.0
no auto-summary
no synchronization
exit-address-family
```

Verify

Use this section in order to confirm that your configuration works properly.

Outputs on FTD

<#root>

```
#show crypto ikev2 sa
```

```
IKEv2 SAs:
Session-id:20, Status:UP-ACTIVE, IKE count:1, CHILD count:1

Tunnel-id         Local                  Remote                fvrf/ivrf          Status       Role
666846307         10.197.226.222/500     10.197.226.187/500    Global/Global      READY        RESPOND
Encr: AES-CBC, keysize: 256, Hash: SHA256, DH Grp:14, Auth sign: PSK, Auth verify: PSK
Life/Active Time: 86400/1201 sec
Child sa: local selector 0.0.0.0/0 - 255.255.255.255/65535
          remote selector 0.0.0.0/0 - 255.255.255.255/65535
          ESP spi in/out: 0xa14edaf6/0x8540d49e
```

```
#show crypto ipsec sa
```

```
interface: ASAv-VTI
Crypto map tag: __vti-crypto-map-Tunnel1-0-1, seq num: 65280, local addr: 10.197.226.222

  Protected vrf (ivrf): Global
  local ident (addr/mask/prot/port): (0.0.0.0/0.0.0.0/0/0)
  remote ident (addr/mask/prot/port): (0.0.0.0/0.0.0.0/0/0)
  current_peer: 10.197.226.187

  #pkts encaps: 45, #pkts encrypt: 45, #pkts digest: 45
  #pkts decaps: 44, #pkts decrypt: 44, #pkts verify: 44
  #pkts compressed: 0, #pkts decompressed: 0
  #pkts not compressed:0, #pkts comp failed: 0, #pkts decomp failed: 0
  #pre-frag successes: 0, #pre-frag failures: 0, #fragments created: 0
  #PMTUs sent: 0, #PMTUs rcvd: 0, #decapsulated frgs needing reassembly: 0
  #TFC rcvd: 0, #TFC sent: 0
  #Valid ICMP Errors rcvd: 0, #Invalid ICMP Errors rcvd: 0
  #send errors: 0, #recv errors: 0

  local crypto endpt.: 10.197.226.222/500, remote crypto endpt.: 10.197.226.187/500
  path mtu 1500, ipsec overhead 78(44), media mtu 1500
```

```
  PMTU time remaining (sec): 0, DF policy: copy-df
  ICMP error validation: disabled, TFC packets: disabled
  current outbound spi: 8540D49E
  current inbound spi : A14EDAF6

inbound esp sas:
 spi: 0xA14EDAF6 (2706299638)
  SA State: active
  transform: esp-aes-256 esp-sha-256-hmac no compression
  in use settings ={L2L, Tunnel, PFS Group 14, IKEv2, VTI, }
  slot: 0, conn_id: 49, crypto-map: __vti-crypto-map-Tunnel1-0-1
  sa timing: remaining key lifetime (kB/sec): (4331517/27595)
  IV size: 16 bytes
  replay detection support: Y
  Anti replay bitmap:
  000001FFF 0xFFFFFFFF
outbound esp sas:
 spi: 0x8540D49E (2235618462)
  SA State: active
  transform: esp-aes-256 esp-sha-256-hmac no compression
  in use settings ={L2L, Tunnel, PFS Group 14, IKEv2, VTI, }
  slot: 0, conn_id: 49, crypto-map: __vti-crypto-map-Tunnel1-0-1
  sa timing: remaining key lifetime (kB/sec): (4101117/27595)
  IV size: 16 bytes
  replay detection support: Y
  Anti replay bitmap:
  0x00000000 0x00000001
```

#show bgp summary

```
BGP router identifier 10.1.1.1, local AS number 1000
BGP table version is 5, main routing table version 5
2 network entries using 400 bytes of memory
2 path entries using 160 bytes of memory
2/2 BGP path/bestpath attribute entries using 416 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 976 total bytes of memory
BGP activity 21/19 prefixes, 24/22 paths, scan interval 60 secs

Neighbor           V         AS      MsgRcvd      MsgSent       TblVer      InQ      OutQ      Up/Down
169.254.2.2      4         1000   22               22                  5            0         0
```

#show bgp neighbors

```
BGP neighbor is 169.254.2.2, vrf single_vf, remote AS 1000, internal link
   BGP version 4, remote router ID 10.1.1.2
   BGP state = Established, up for 00:19:49
   Last read 00:01:04, last write 00:00:38, hold time is 180, keepalive interval is 60 seconds
   Neighbor sessions:
      1 active, is not multisession capable (disabled)
   Neighbor capabilities:
      Route refresh: advertised and received(new)
      Four-octets ASN Capability: advertised and received
      Address family IPv4 Unicast: advertised and received
      Multisession Capability:
  Message statistics:
      InQ depth is 0
      OutQ depth is 0
```

```
                        Sent    Rcvd
Opens                   1        1
Notifications:          0        0
Updates:                2        2
Keepalives:             19      19
Route Refresh:          0        0
Total:                  22      22
Default minimum time between advertisement runs is 0 seconds

For address family: IPv4 Unicast
   Session: 169.254.2.2
   BGP table version 5, neighbor version 5/0
   Output queue size : 0
   Index 15
  15 update-group member
                            Sent     Rcvd
Prefix activity:            ----    ----
Prefixes Current:           1          1         (Consumes 80 bytes)
Prefixes Total:             1          1
Implicit Withdraw:          0          0
Explicit Withdraw:          0          0
Used as bestpath:           n/a        1
Used as multipath:          n/a        0
                               Outbound           Inbound
Local Policy Denied Prefixes:   --------            -------
Bestpath from this peer:         1                          n/a
Invalid Path:                    1                          n/a
Total:                           2                            0
Number of NLRIs in the update sent: max 1, min 0

Address tracking is enabled, the RIB does have a route to 169.254.2.2
Connections established 7; dropped 6
Last reset 00:20:06, due to Peer closed the session of session 1
Transport(tcp) path-mtu-discovery is disabled
Graceful-Restart is disabled


#show route bgp


Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
            D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
            N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
            E1 - OSPF external type 1, E2 - OSPF external type 2, V - VPN
            i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
            ia - IS-IS inter area, * - candidate default, U - per-user static route
            o - ODR, P - periodic downloaded static route, + - replicated route
            SI - Static InterVRF, BI - BGP InterVRF
Gateway of last resort is 10.197.226.1 to network 0.0.0.0

B        1.1.1.0 255.255.255.0 [200/0] via 169.254.2.2, 00:19:55
```

Outputs on ASA

<#root>

```
#show crypto ikev2 sa
```

```
IKEv2 SAs:

Session-id:7, Status:UP-ACTIVE, IKE count:1, CHILD count:1

Tunnel-id    Local                       Remote                      fvrf/ivrf             Status
442126361    10.197.226.187/500          10.197.226.222/500          Global/Global          READY
Encr: AES-CBC, keysize: 256, Hash: SHA256, DH Grp:14, Auth sign: PSK, Auth verify: PSK
Life/Active Time: 86400/1200 sec
Child sa: local selector 0.0.0.0/0 - 255.255.255.255/65535
          remote selector 0.0.0.0/0 - 255.255.255.255/65535
          ESP spi in/out: 0x8540d49e/0xa14edaf6


#show crypto ipsec sa


interface: FTD-VTI
Crypto map tag: __vti-crypto-map-Tunnel1-0-1, seq num: 65280, local addr: 10.197.226.187

  Protected vrf (ivrf): Global
  local ident (addr/mask/prot/port): (0.0.0.0/0.0.0.0/0/0)
  remote ident (addr/mask/prot/port): (0.0.0.0/0.0.0.0/0/0)
 current_peer: 10.197.226.222


 #pkts encaps: 44 #pkts encrypt: 44, #pkts digest: 44
 #pkts decaps: 45, #pkts decrypt: 45, #pkts verify: 45
 #pkts compressed: 0, #pkts decompressed: 0
 #pkts not compressed:0, #pkts comp failed: 0, #pkts decomp failed: 0
 #pre-frag successes: 0, #pre-frag failures: 0, #fragments created: 0
 #PMTUs sent: 0, #PMTUs rcvd: 0, #decapsulated frgs needing reassembly: 0
 #TFC rcvd: 0, #TFC sent: 0
 #Valid ICMP Errors rcvd: 0, #Invalid ICMP Errors rcvd: 0
 #send errors: 0, #recv errors: 0

 local crypto endpt.: 10.197.226.187/500, remote crypto endpt.: 10.197.226.222/500
 path mtu 1500, ipsec overhead 78(44), media mtu 1500
 PMTU time remaining (sec): 0, DF policy: copy-df
 ICMP error validation: disabled, TFC packets: disabled
 current outbound spi: A14EDAF6
 current inbound spi : 8540D49E

inbound esp sas:
 spi: 0x8540D49E (2235618462)
     SA State: active
      transform: esp-aes-256 esp-sha-256-hmac no compression
      in use settings ={L2L, Tunnel, PFS Group 14, IKEv2, VTI, }
     slot: 0, conn_id: 9, crypto-map: __vti-crypto-map-Tunnel1-0-1
     sa timing: remaining key lifetime (kB/sec): (4147198/27594)
     IV size: 16 bytes
     replay detection support: Y
    Anti replay bitmap:
    0x00000000 0x007FFFFF
outbound esp sas:
  spi: 0xA14EDAF6 (2706299638)
    SA State: active
    transform: esp-aes-256 esp-sha-256-hmac no compression
    in use settings ={L2L, Tunnel, PFS Group 14, IKEv2, VTI, }
    slot: 0, conn_id: 9, crypto-map: __vti-crypto-map-Tunnel1-0-1
    sa timing: remaining key lifetime (kB/sec): (3916798/27594)
    IV size: 16 bytes
    replay detection support: Y
```

```
    Anti replay bitmap:
    0x00000000 0x00000001
```

#show bgp summary

```
BGP router identifier 10.1.1.2, local AS number 1000
BGP table version is 7, main routing table version 7
2 network entries using 400 bytes of memory
2 path entries using 160 bytes of memory
2/2 BGP path/bestpath attribute entries using 416 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 976 total bytes of memory
BGP activity 5/3 prefixes, 7/5 paths, scan interval 60 secs

Neighbor        V      AS      MsgRcvd      MsgSent     TblVer    InQ     OutQ     Up/Down     State/Pf
169.254.2.1      4     1000       22             22       7       0         0      00:19:42      1
```

#show bgp neighbors

```
BGP neighbor is 169.254.2.1, context single_vf, remote AS 1000, internal link
    BGP version 4, remote router ID 10.1.1.1
    BGP state = Established, up for 00:19:42
    Last read 00:01:04, last write 00:00:38, hold time is 180, keepalive interval is 60 seconds
    Neighbor sessions:
    1 active, is not multisession capable (disabled)
Neighbor capabilities:
    Route refresh: advertised and received(new)
    Four-octets ASN Capability: advertised and received
    Address family IPv4 Unicast: advertised and received
    Multisession Capability:
Message statistics:
   InQ depth is 0
   OutQ depth is 0
                    Sent     Rcvd
Opens:              1         1
Notifications:      0         0
Updates:            2         2
Keepalives:         19       19
Route Refresh:      0         0
Total:              22       22
Default minimum time between advertisement runs is 0 seconds
For address family: IPv4 Unicast
  Session: 169.254.2.1
  BGP table version 7, neighbor version 7/0
  Output queue size : 0

  Index 5
  5 update-group member
                      Sent      Rcvd
Prefix activity:      ----      ----
Prefixes Current:     1         1         (Consumes 80 bytes)
Prefixes Total:       1         1
Implicit Withdraw:    0         0
Explicit Withdraw:    0         0
Used as bestpath:     n/a       1
Used as multipath:    n/a       0

                                  Outbound        Inbound
```

```
Local Policy Denied Prefixes:     --------        -------
Bestpath from this peer:           1              n/a
Invalid Path:                      1              n/a
Total:                             2              0
Number of NLRIs in the update sent: max 1, min 0

Address tracking is enabled, the RIB does have a route to 169.254.2.1
Connections established 5; dropped 4
Last reset 00:20:06, due to Peer closed the session of session 1
Transport(tcp) path-mtu-discovery is disabled
Graceful-Restart is disabled
```

#show route bgp

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
           D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
           N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
           E1 - OSPF external type 1, E2 - OSPF external type 2, V - VPN
           i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
           ia - IS-IS inter area, * - candidate default, U - per-user static route
           o - ODR, P - periodic downloaded static route, + - replicated route
           SI - Static InterVRF, BI - BGP InterVRF
Gateway of last resort is 10.197.226.1 to network 0.0.0.0

B       2.2.2.0 255.255.255.0 [200/0] via 169.254.2.1, 00:19:55
```

Troubleshoot

This section provides information you can use in order to troubleshoot your configuration.

```
debug crypto ikev2 platform 255
debug crypto ikev2 protocol 255
debug crypto ipsec 255
debug ip bgp all
```

- Supports only IPv4 interfaces, as well as IPv4, protected networks, or VPN payload (No Support for IPv6).