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Introduction

This document describes the configuration walkthrough of L4-L7 Service Graph with Route Peering, where both the consumer and the provider are external to the Application Centric Infrastructure (ACI) fabric.

Contributed by Zahid Hassan, Cisco Advanced Services Engineer.

Prerequisites

Requirements

Cisco recommends that you have knowledge of these topics:

- Static VLAN Pools that will be used for the encapsulation VLAN between the external devices and the ACI fabric
- External Physical and Routed Domains that will tie together the location (leaf node/path) of the external devices and the VLAN pool
- Layer 3 Connection to an Outside Network (L3Out)

The preceding **Fabric Access** and **L3Out** configurations steps are not covered in this document and have been assumed that these have already been completed.

Components Used

The information in this document is based on these software versions:

- Cisco Application Policy Infrastructure Controller (Cisco APIC) - 1.2(1m)
- Adaptive Security Appliance (ASA) Device Package -
- ASA 5585 - 9.5(1)
- Nexus 3064 - 6.0(2)U3(7)

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, make sure that you understand the potential impact of any command.

Background Information

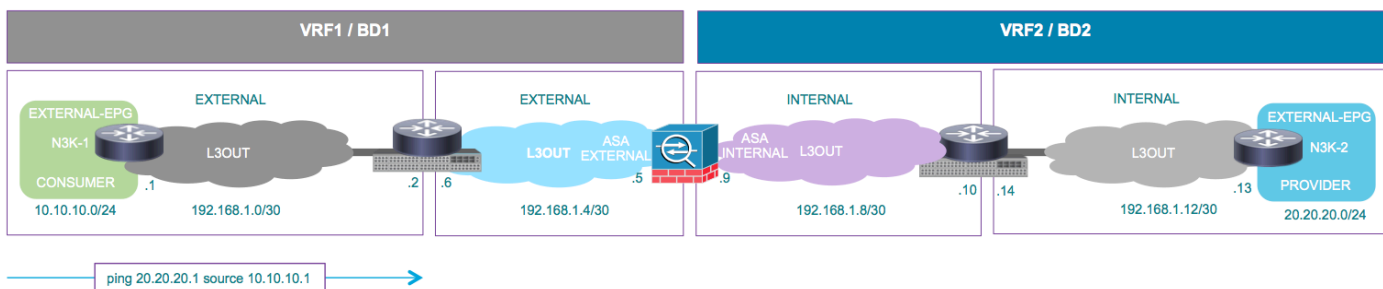
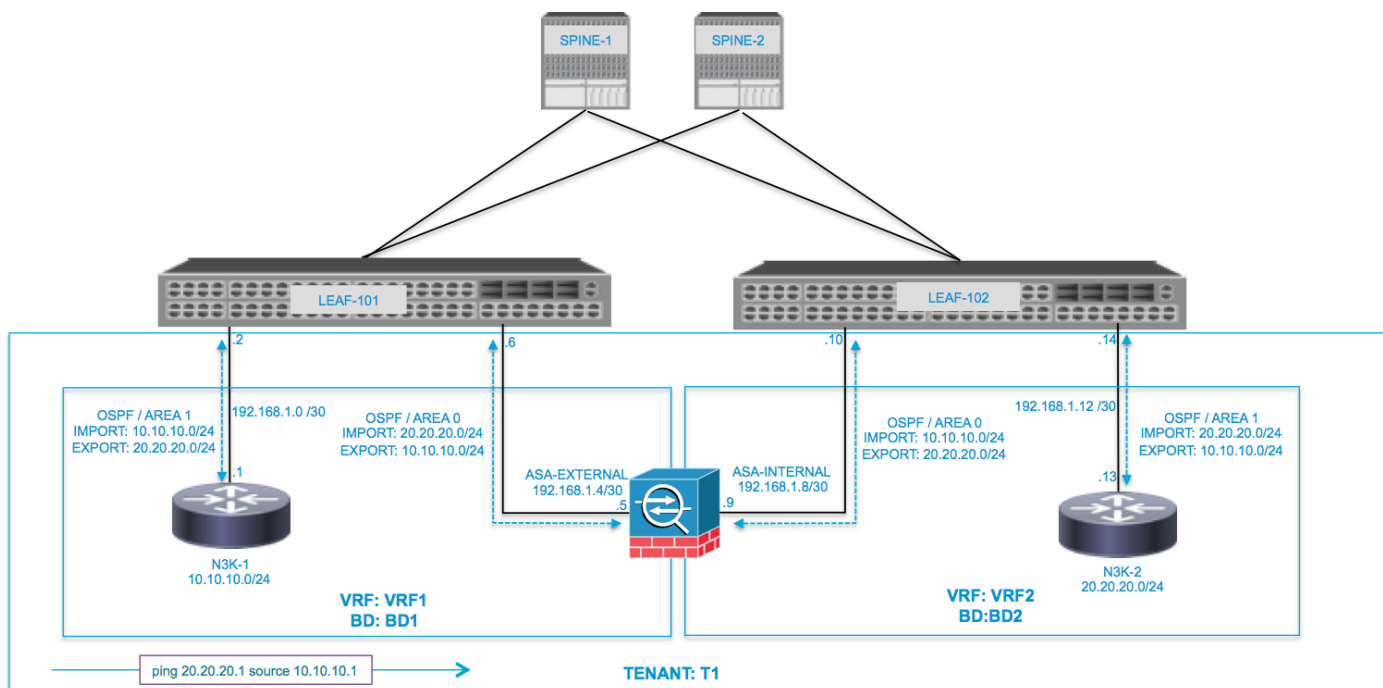
Route Peering is a feature which enables a service appliance such as a load balancer or a firewall to advertise its reachability through the ACI fabric to all the way to an external network.

The use case presented here is a physical firewall which is deployed as a two-arm Service Graph, in between two L3Outs or external End Point Groups (EPGs). The Service Graph is associated with a contract between the external EPG on Leaf 101 (N3K-1) and the external EPG on Leaf 102 (N3K-2). The ACI fabric is providing a transit service for the routers (N3K-1 and N3K-2) and Route Peering is used, with Open Shortest Path First (OSPF) as the routing protocol, to exchange routes between the firewall and the ACI fabric.

Configure

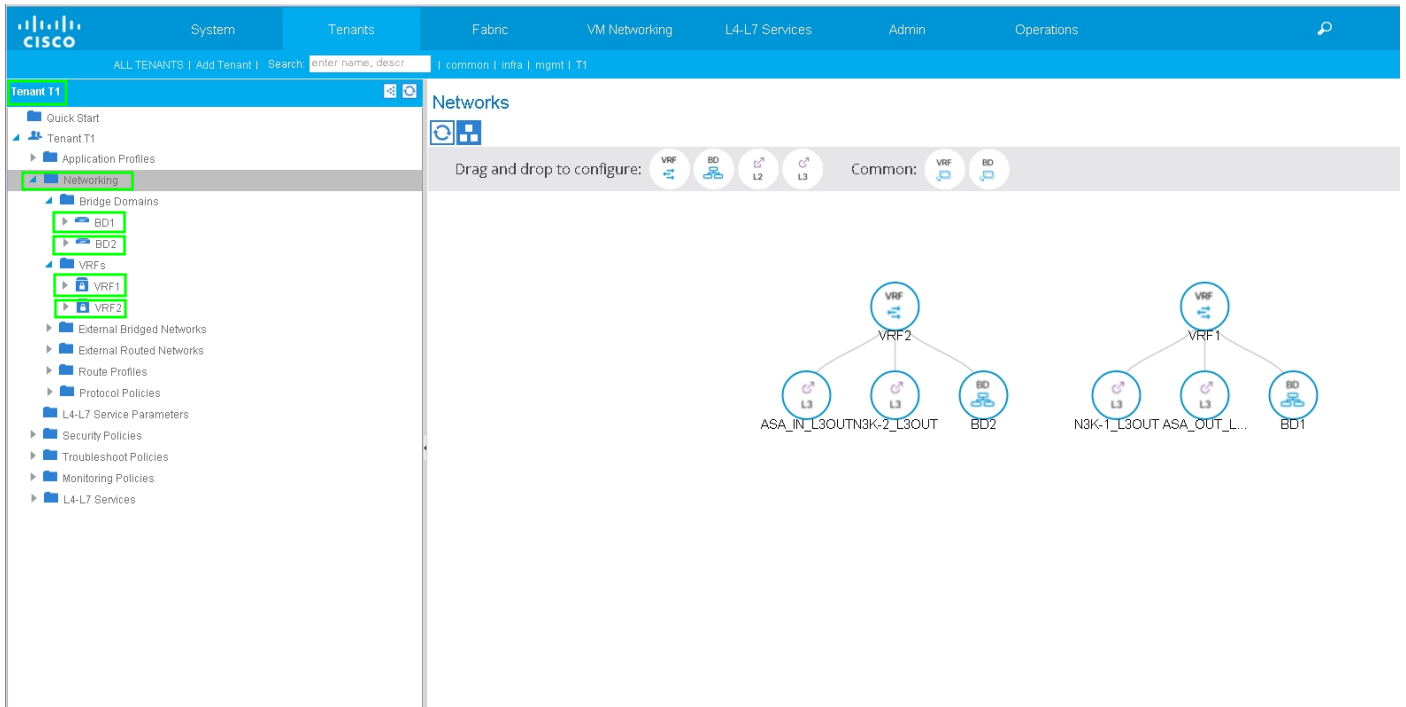
Network Diagram

The following image shows how Route Peering works end-to-end:

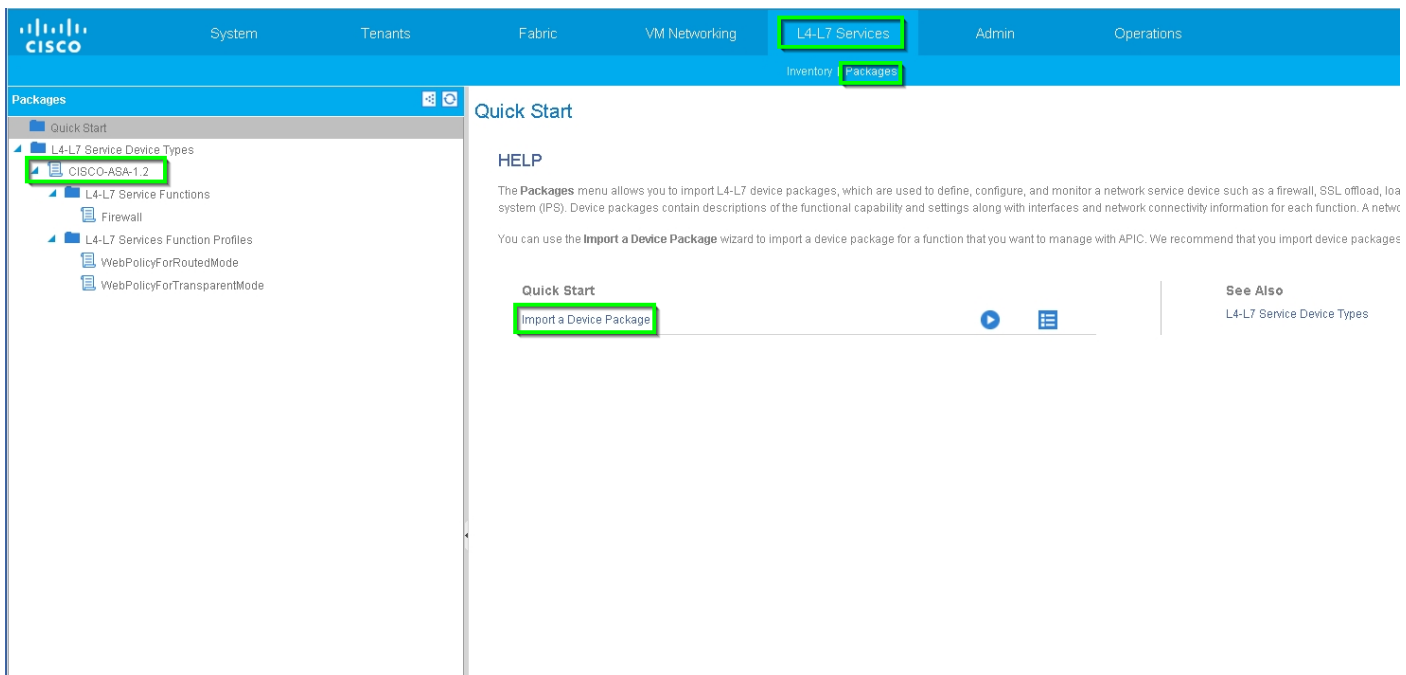


Configure

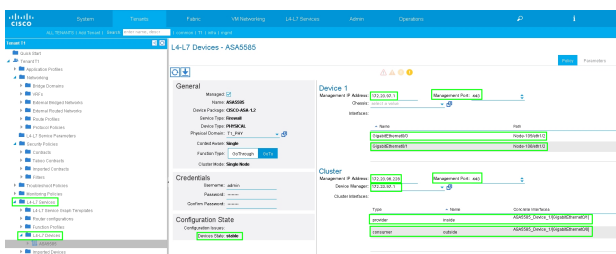
Step 1. Configure the Virtual Routing and Forwarding1 (VRF1), VRF2, Bridge Domain1 (BD1) and BD2. Associate BD1 to VRF1 and BD2 to VRF2, as shown in the image:



Step 2. U under L4-L7 Device, as shown in the image, :



Configure L4-L7 Device for physical ASA 585 (Routed), as shown in the image:



Step 3. Configure L3Out for N3K-1 and associate with BD1 and VRF1

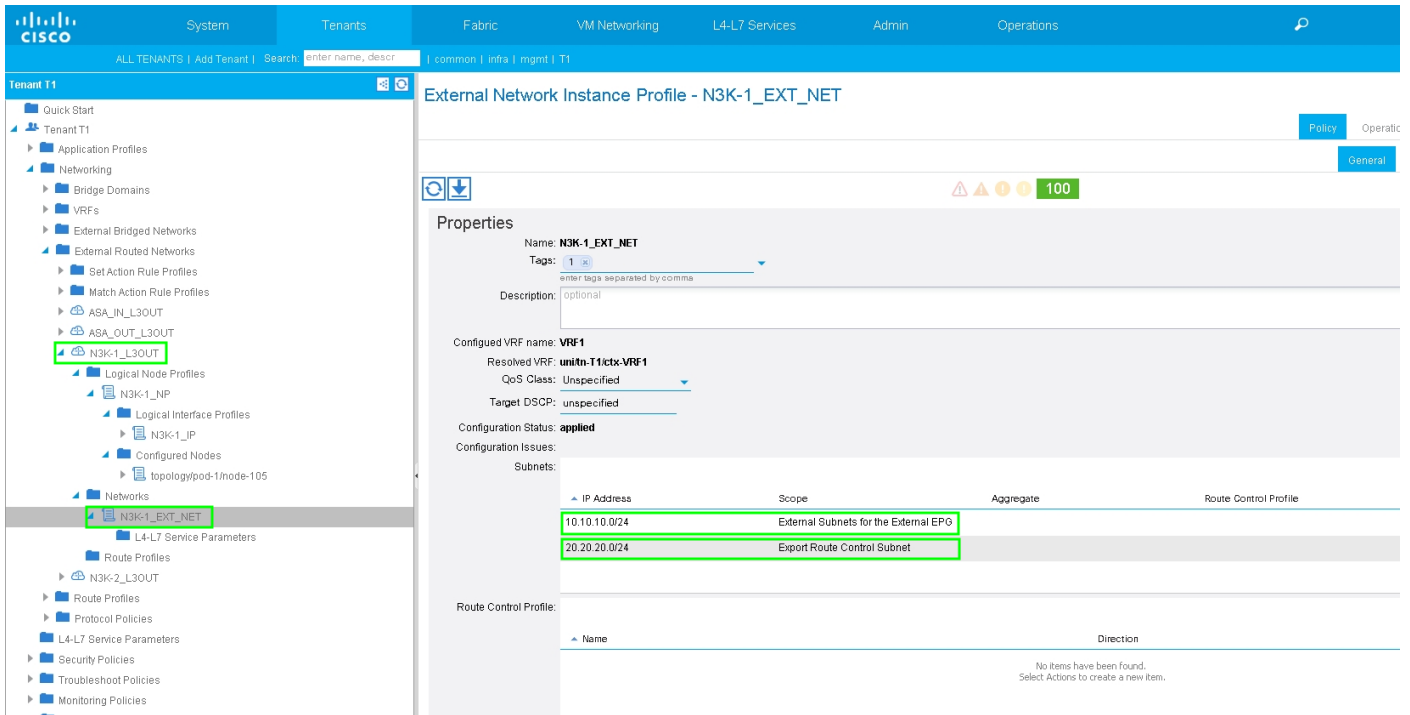
External routed network is used to specify the routing configuration in the ACI fabric for Route Peering, as shown in the image:

The screenshot displays the Cisco ACI GUI configuration for the L3 Outside - N3K-1_L3OUT. The left sidebar shows the navigation tree with 'N3K-1_L3OUT' selected. The main panel displays the 'Properties' section for this L3Out. Key configurations include: Name: N3K-1_L3OUT, Description: optional, Tags: (empty), Label: (empty), Target DSCP: unspecified, Route Control Enforcement: Import (unchecked), Export (checked), VRF: T1/VRF1, Resolved VRF: T1/VRF1, External Routed Domain: T1_L3OUT, Route Profile for Interleak: select a value, Route Control For Dampening: (empty), Address Family Type: (empty), Enable BGP/EIGRP/OSPF: BGP (unchecked), OSPF (checked), OSPF Area ID: 0.0.0.1, OSPF Area Control: Send redistributed LSAs into NSSA area (checked), Originate summary LSA (checked), Suppress forwarding address in translated LSA (unchecked), OSPF Area Type: NSSA area (selected), Regular area (highlighted), Stub area, OSPF Area Cost: 1.

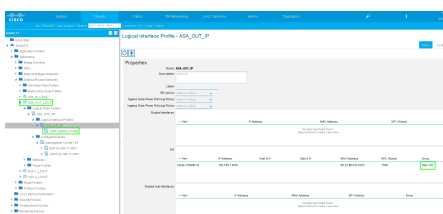
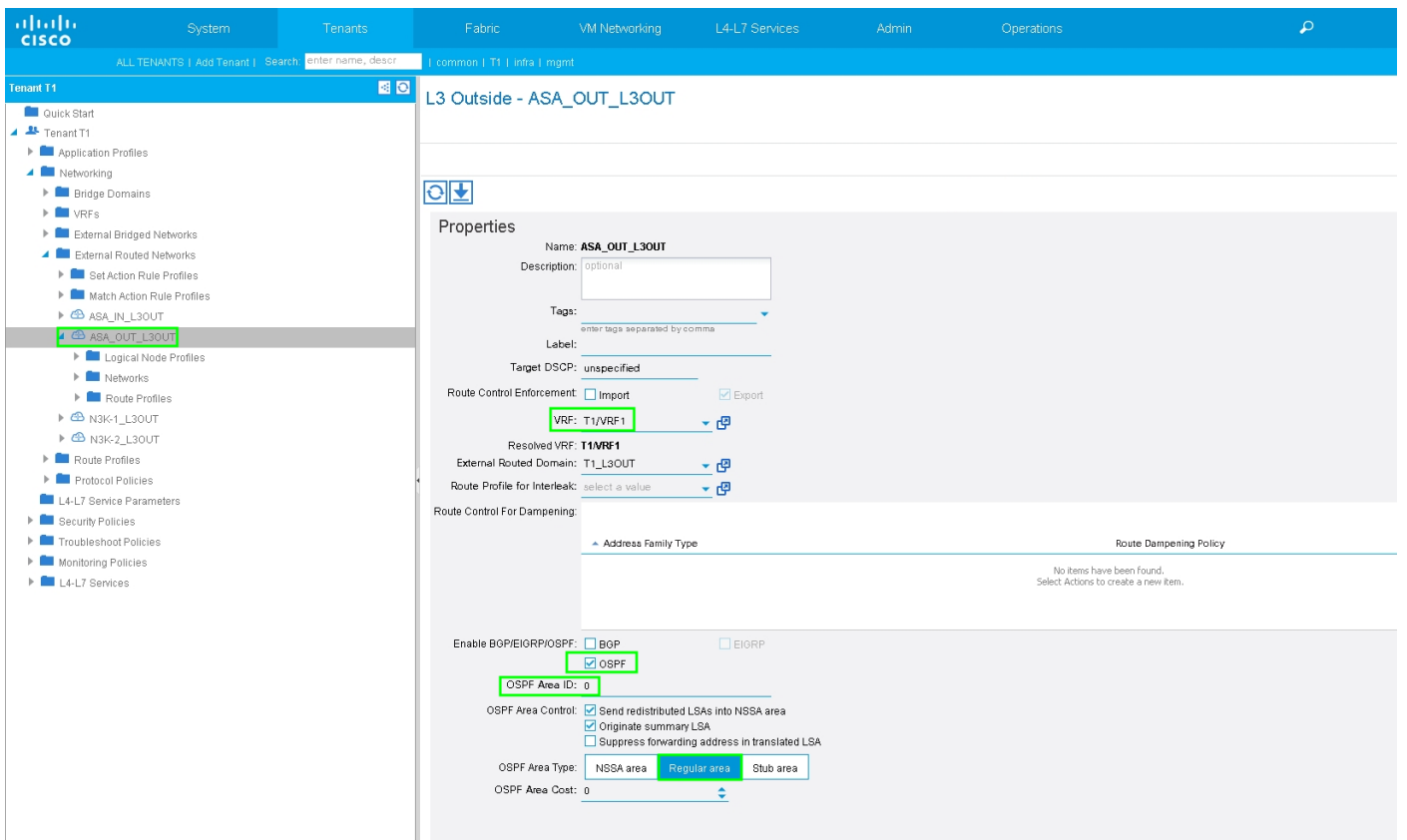
Note: All L3Out interfaces which are used for Route Peering, are required to be configured as a Switch Virtual Interface (SVI) with VLAN encap accordingly.

The screenshot displays the Cisco ACI GUI configuration for the Logical Interface Profile - N3K-1_IP. The left sidebar shows the navigation tree with 'N3K-1_IP' selected. The main panel displays the 'Properties' section for this Logical Interface Profile. Key configurations include: Name: N3K-1_IP, Description: optional, Label: (empty), ND policy: select a value, Egress Data Plane Policing Policy: select a value, Ingress Data Plane Policing Policy: select a value, Routed Interfaces: (empty table), SVI: Node-105/eth1/3, IP Address: 192.168.1.2/30, Side A IP: (empty), Side B IP: (empty), MAC Address: 00:22:BD:F8:19:FF, MTU (Bytes): 1500, Encap: vlan-100 (highlighted), Routed Sub-Interfaces: (empty table).

Configure Import/Export Route Control on Subnets for N3K-1 L3Out External EPG, as shown in the image:



Configure L3Out for ASA-External Interface and associate with BD1 and VRF1, as shown in the image:



Configure Import/Export Route Control on Subnets for ASA-External L3Out External EPG, as shown in the image:

The screenshot shows the configuration page for 'External Network Instance Profile - ASA_OUT_EXT_NET'. The 'Subnets' table is as follows:

IP Address	Scope	Aggregate	Route Control Profile	Route Summary
10.10.10.0/24	Export Route Control Subnet			
20.20.20.0/24	Shared Route Control Subnet			

Configure L3out for ASA-Internal and associate with BD2 and VRF2, as shown in the image:

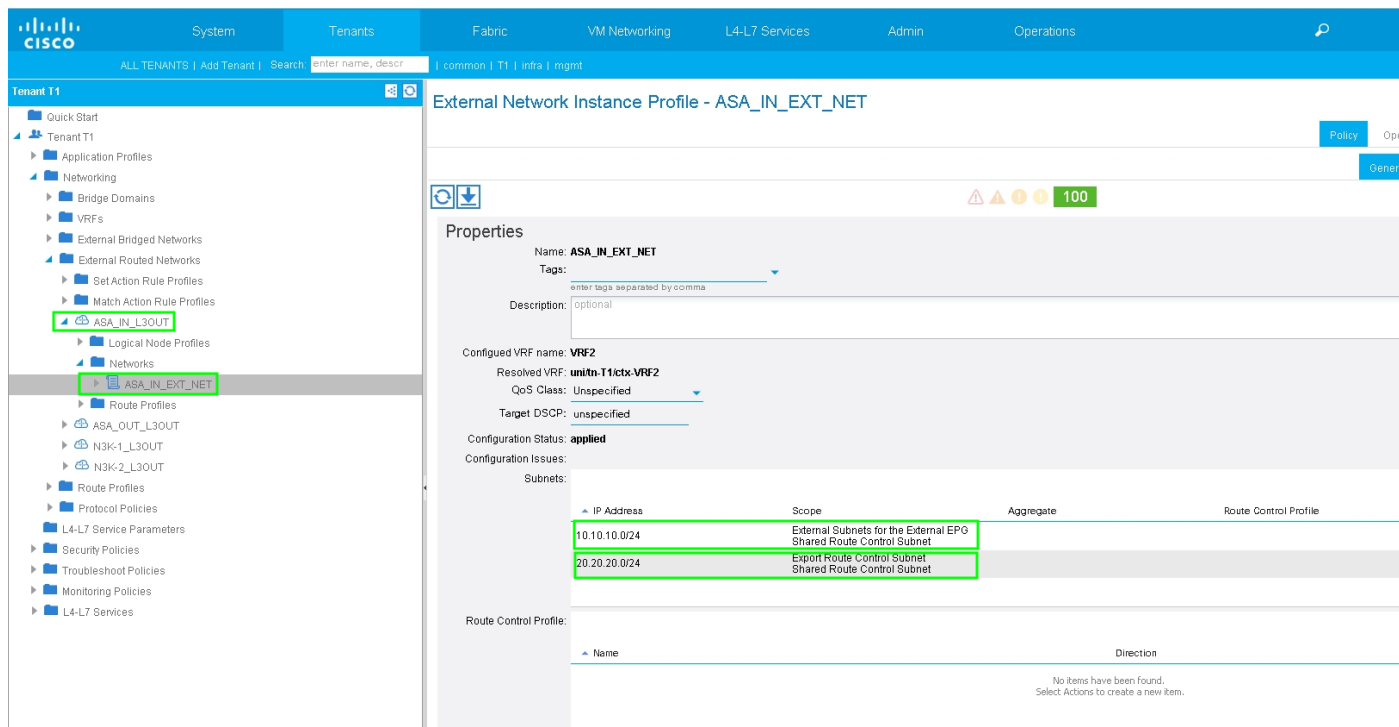
The screenshot shows the configuration page for 'L3 Outside - ASA_IN_L3OUT'. Key settings include:

- Name: ASA_IN_L3OUT
- Route Control Enforcement: Import, Export
- VRF: T1/VRF2
- Resolved VRF: T1/VRF2
- External Routed Domain: T1_L3OUT
- OSPF Area ID: 0
- OSPF Area Control: Send redistributed LSAs into NSSA area, Originate summary LSA, Suppress forwarding address in translated LSA
- OSPF Area Type: NSSA area, Regular area, Stub area

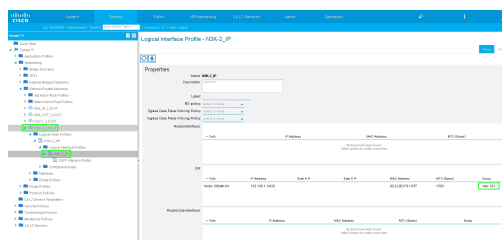
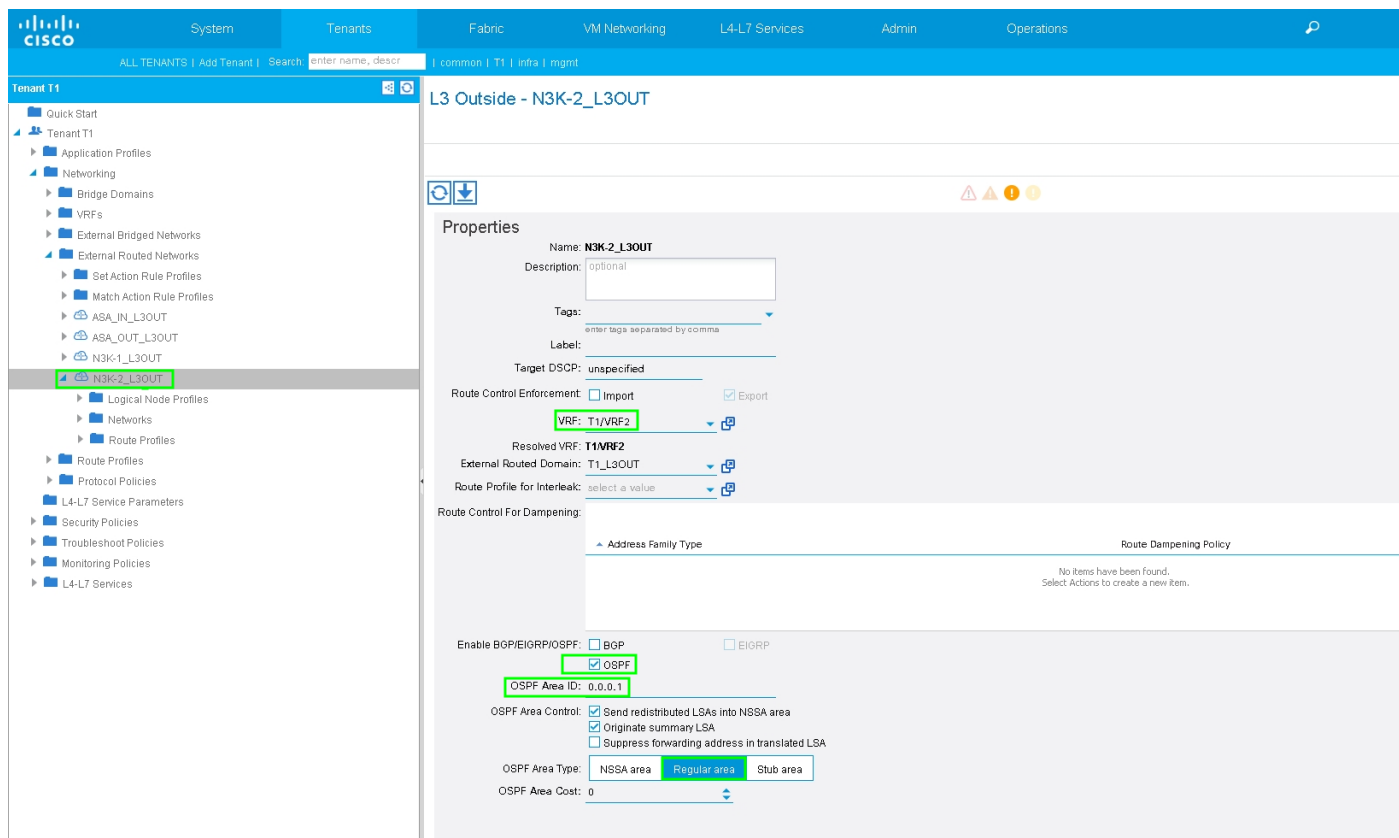
The screenshot shows the configuration page for 'Logical Interface Profile - ASA_IN_IP'. Key settings include:

- Name: ASA_IN_IP
- OSPF Area ID: 0

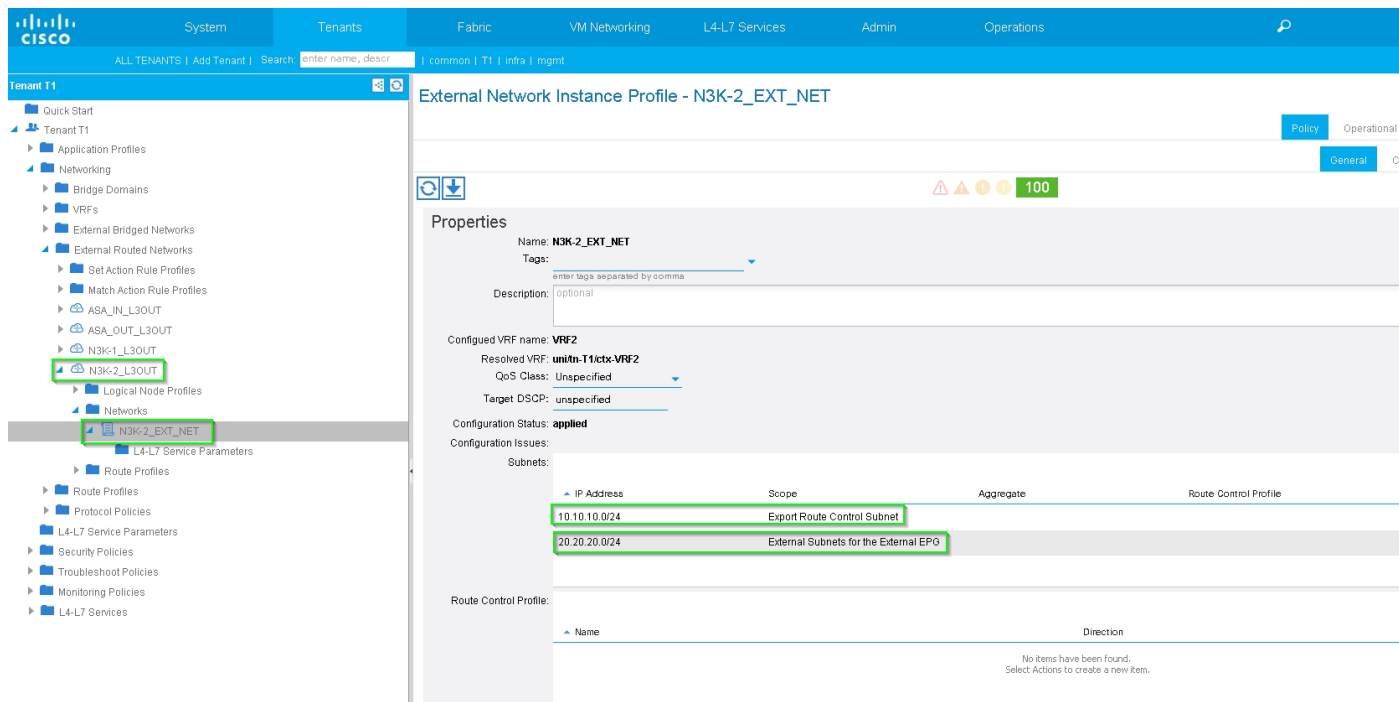
Configure Import/Export Route Control on Subnets for ASA-Internal L3Out External EPG, as shown in the image:



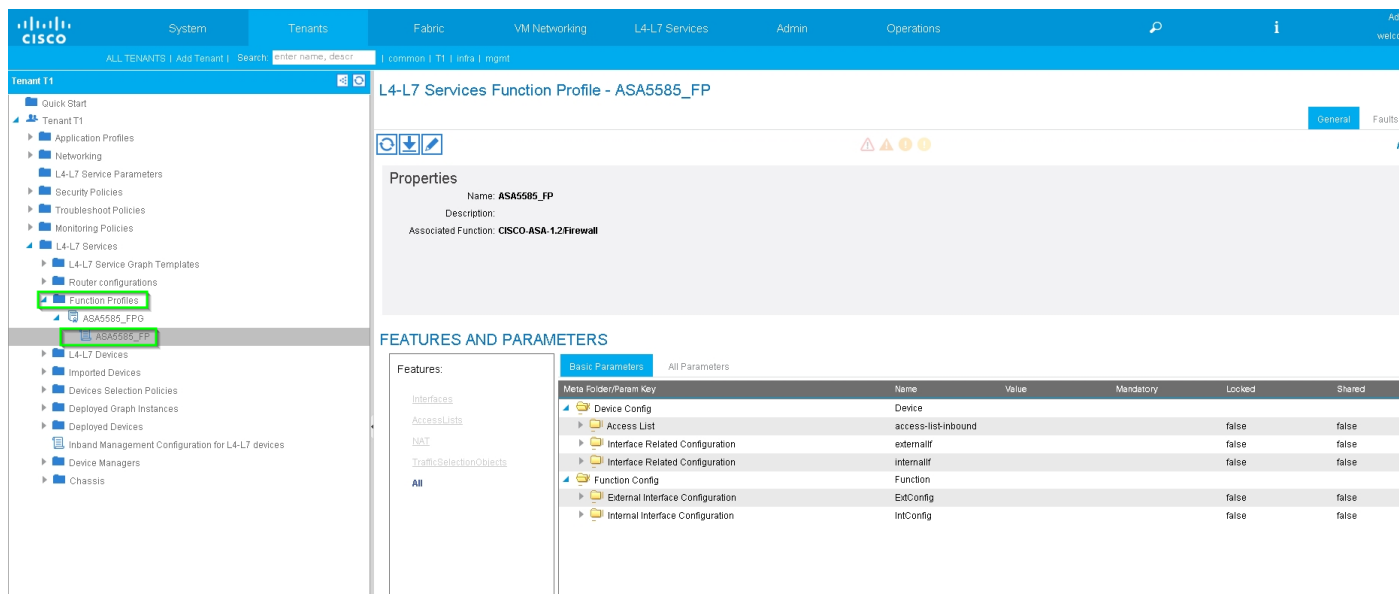
Configure L3Out for N3K-2 and associate with BD2 and VRF2, as shown in the image:



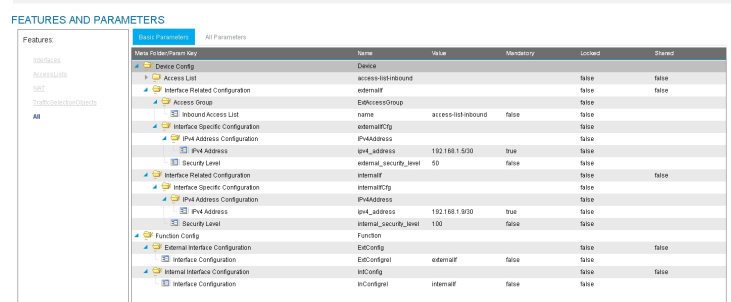
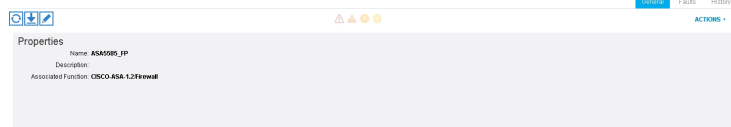
Configure Import/Export Route Control on Subnets for N3K-2 L3Out for External EPG, as shown in the image:



Step 4. Create Function Profile Group and configure Function Profile from existing template, as shown in the image:



L4-L7 Services Function Profile - ASA5585_FP



Step 5. Create a Contract and modify the Scope field to Tenant, as shown in the image:

The screenshot shows the Cisco SD-WAN GUI for Tenant T1. The left sidebar shows the navigation tree with 'Contracts' selected under 'Security Policies'. The main area displays the configuration for 'Contract - PERMIT_ALL'. The 'Properties' section shows:

- Name: PERMIT_ALL
- Label:
- Scope: **Tenant** (highlighted with a green box)
- QoS Class: Unspecified
- Target DSCP: unspecified
- Description: optional

Below the properties, a table lists the subjects:

Name	Filters
PERMIT_ALL	T1/PERMIT_ALL

Step 6. As shown in the image, create L4-L7 Service Graph Template where Service Graph association involves the association of an external routed network policy and router configuration with a Device Selection Policy.

:

The screenshot shows the 'L4-L7 Service Graph Template - ASA5585_SGT' configuration. The diagram illustrates the topology:

- Consumer:** EPG
- ASA5585:** N1 (Router)
- Provider:** EPG

The 'ASA5585 Information' box shows:

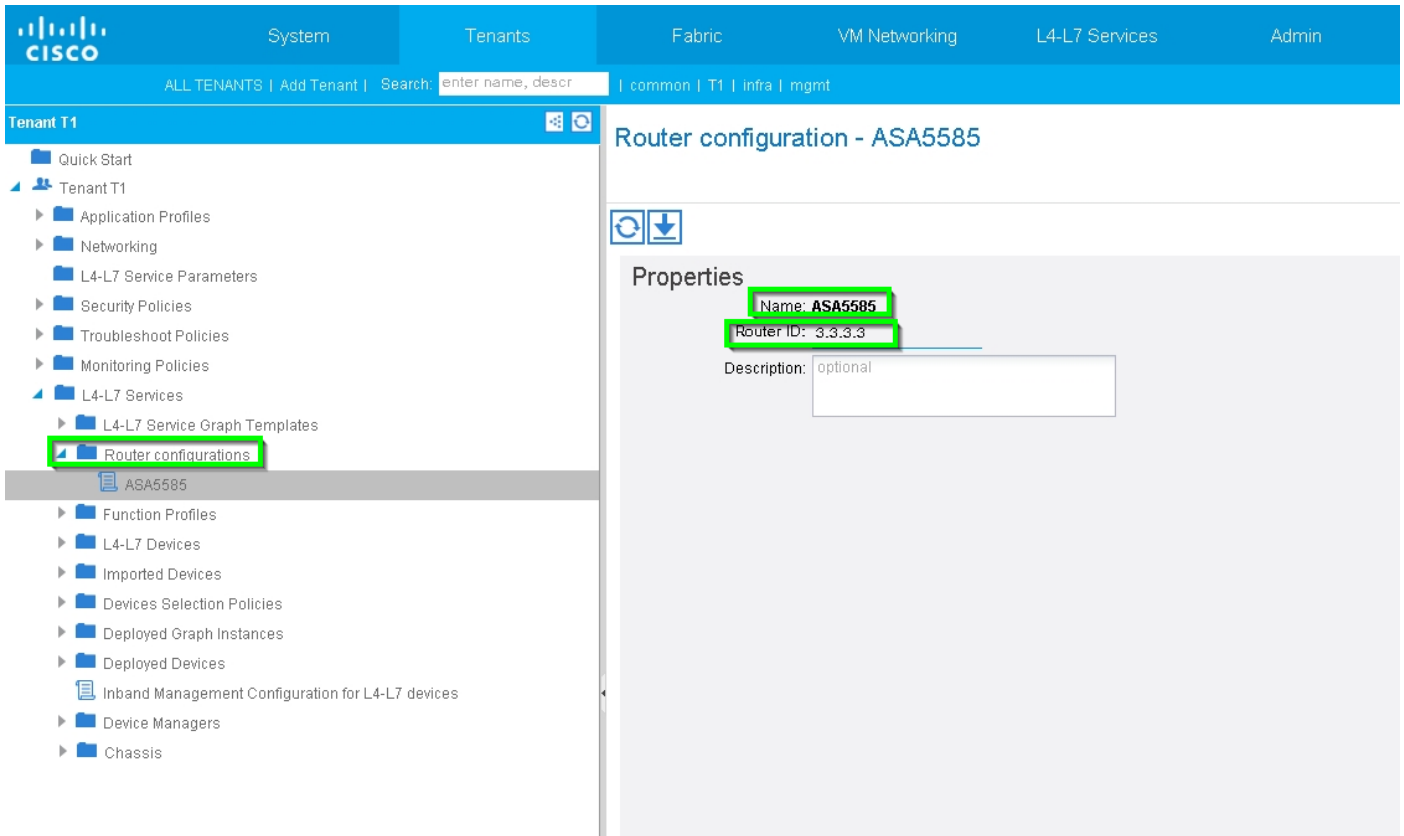
- Firewall: **Routed** (highlighted with a green box)
- Profile: **ASA5585_FP** (highlighted with a green box)

The 'Create L4-L7 Service Graph Template' dialog box shows the following configuration:

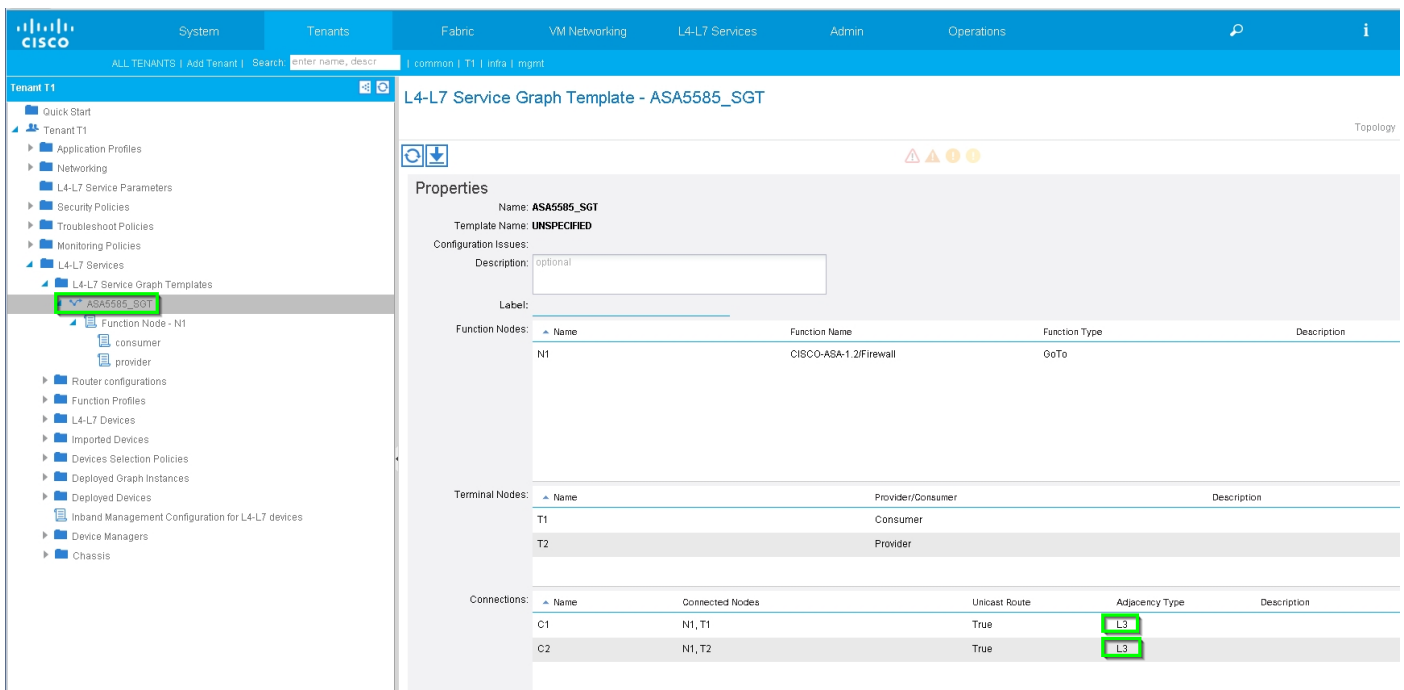
- Graph Name: **ASA5585_SGT** (highlighted with a green box)
- Graph Type: **Create A New One** (selected)
- Device Clusters: T1/ASA5585 (Managed Firewall) (highlighted with a green box)
- ASA5585 Information:
 - Firewall: **Routed** (highlighted with a green box)
 - Profile: **T1/ASA5585_FPQ/ASA5585_FP** (highlighted with a green box)

Buttons: **SUBMIT** (highlighted with a green box) and CANCEL.

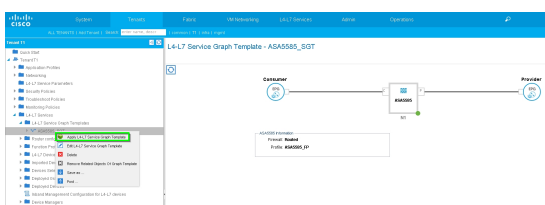
Router configuration to specify the Router ID that will be used on the Service Appliance (ASA 5585), as shown in the image:



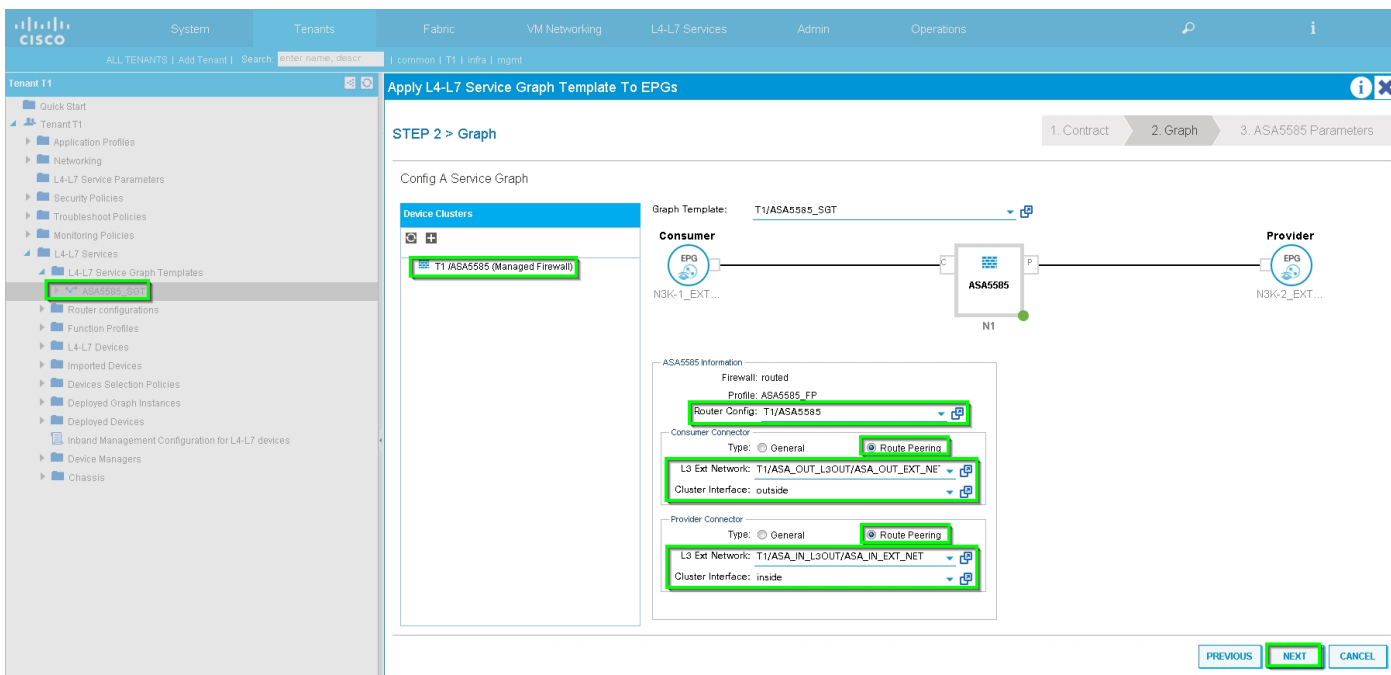
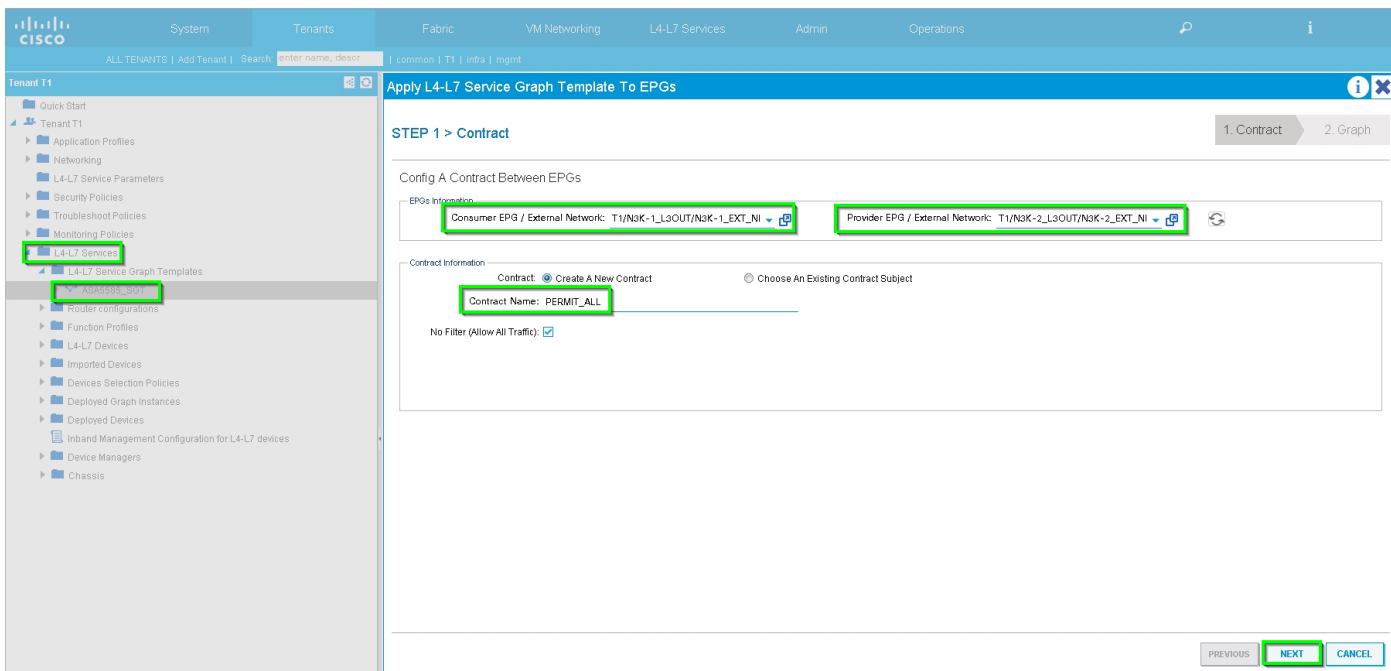
Change Adjacency Type from L2 to L3, as shown in the image:



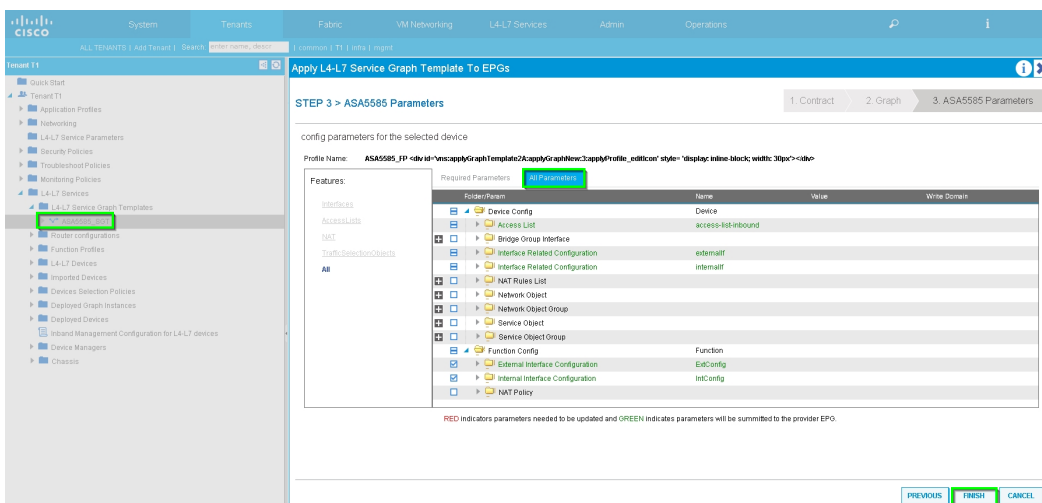
Apply Service Graph Template, as shown in the image:



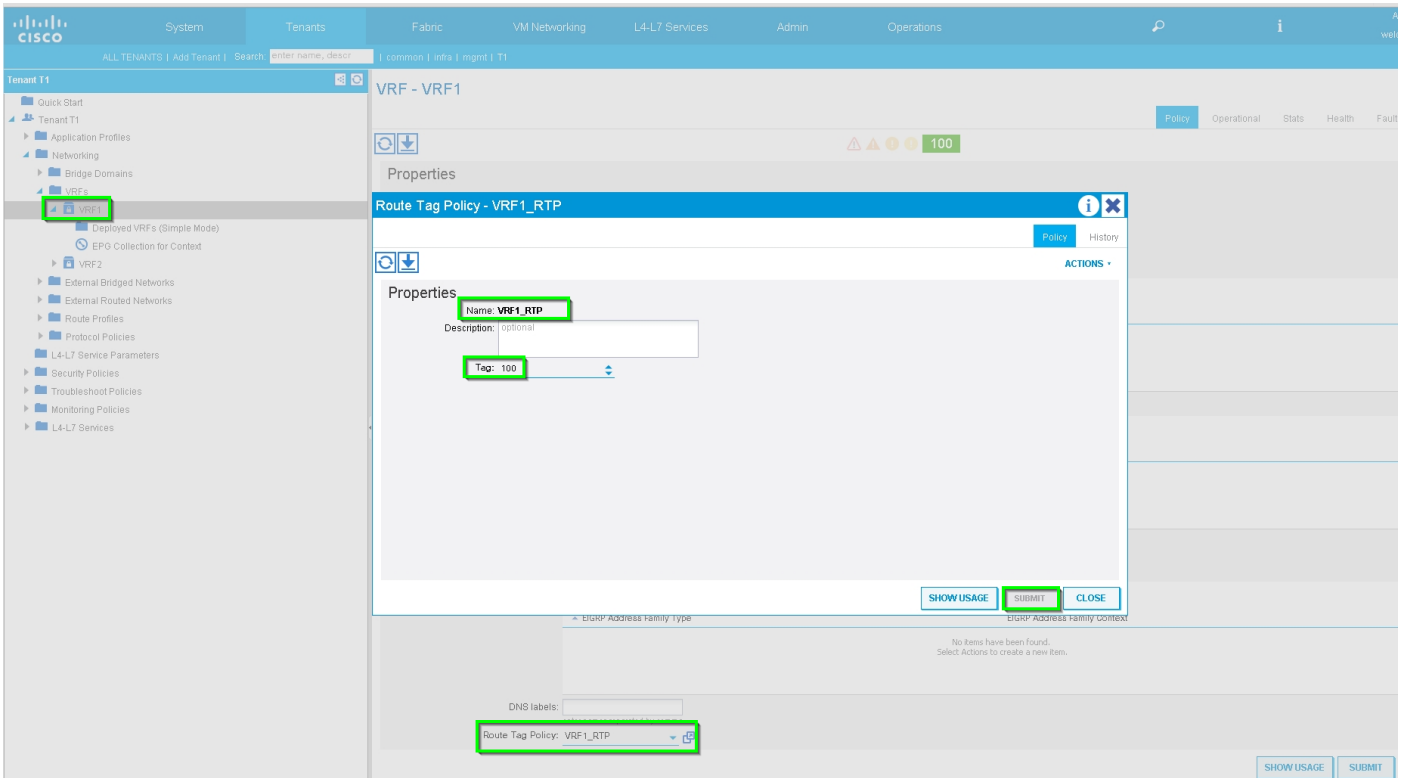
Attach the Service Graph to Contract, as shown in the image:



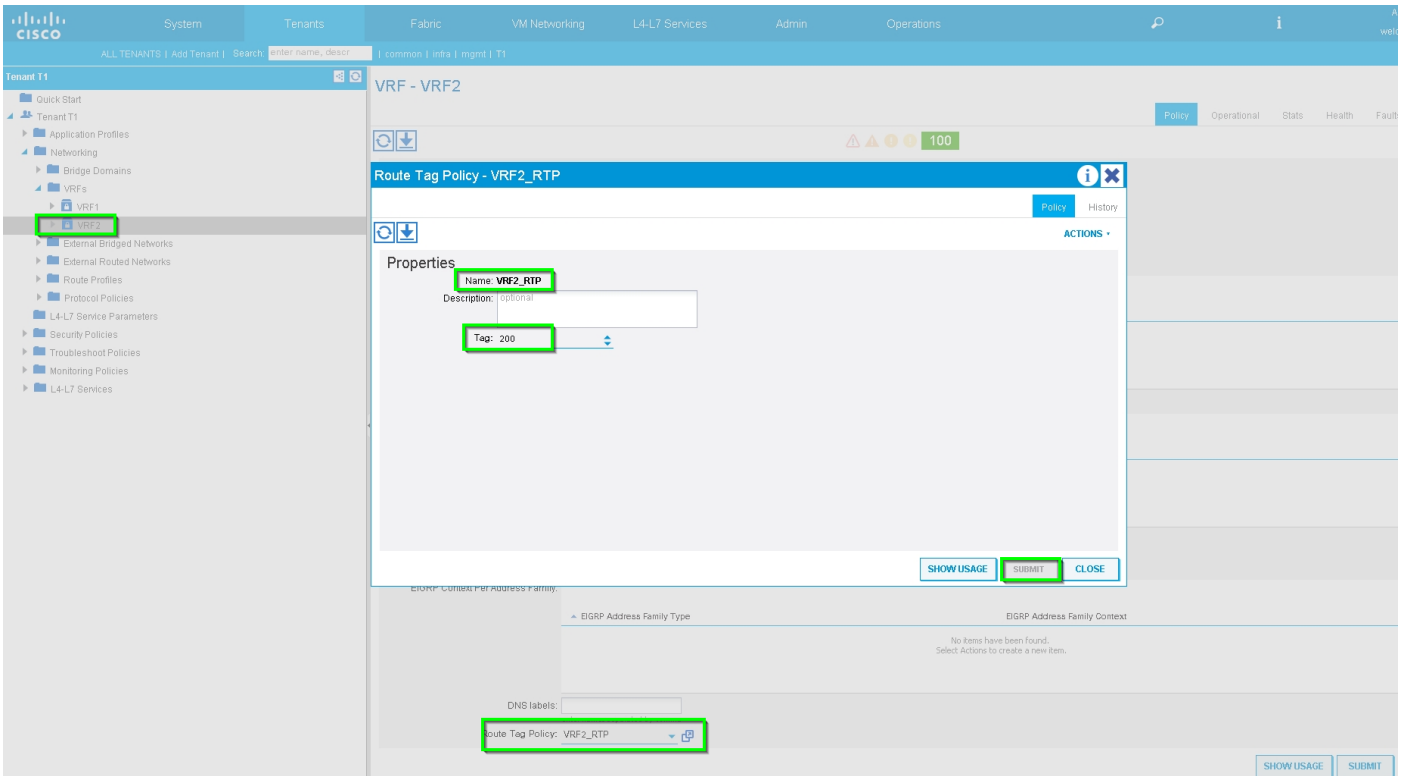
Add/Change L4-L7 Parameter if needed, as shown in the image:



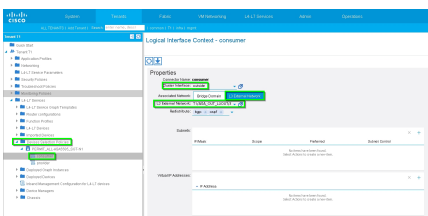
Step 7: Route-tag Policy, configure Route-tag Policy for VRF1 (Tag:100), as shown in the image:



Configure Route-tag Policy for VRF2 (Tag:200), as shown in the image:



Step 8: Check the status and verify Device Selection Policy, as shown in the image:



Verify Deployed Graph instance, as shown in the image:

System | Tenants | Fabric | VM Networking | L4-L7 Services | Admin | Operations

ALL TENANTS | Add Tenant | Search: enter name, descr | common | T1 | infra | mgmt

Tenant T1

- Quick Start
- Tenant T1
 - Application Profiles
 - Networking
 - L4-L7 Service Parameters
 - Security Policies
 - Troubleshoot Policies
 - Monitoring Policies
 - L4-L7 Services
 - L4-L7 Service Graph Templates
 - Router configurations
 - Function Profiles
 - L4-L7 Devices
 - Imported Devices
 - Devices Selection Policies
 - PERMIT_ALL-ASA5585_SGT-N1
 - consumer
 - provider
 - Deployed Graph Instances
 - PERMIT_ALL-ASA5585_SGT-T1
 - Function Node-N1
 - Deployed Devices
 - Inband Management Configuration for L4-L7 devices
 - Device Managers
 - Chassis

Function Node - N1

Policy | Faults | Hist

Properties

Name: N1
Function Type: GoTo
Devices: ASA5585

Cluster Interfaces:	Name	Concrete Interfaces	Encap
	inside	ASA5585_Device_1f(0)gabitEthernet0/1	unknown
	outside	ASA5585_Device_1f(0)gabitEthernet0/0	unknown

Function Connectors:	Name	Encap	Class ID
	consumer	vlan-101	32773
	provider	vlan-102	49156

Folders And Parameters

Features:

Basic Parameters | All Parameters

Meta Folder/Param Key	Name	Value	Override Name/Value To
-----------------------	------	-------	------------------------

System | Tenants | Fabric | VM Networking | L4-L7 Services | Admin | Operations

ALL TENANTS | Add Tenant | Search: enter name, descr | common | T1 | infra | mgmt

Tenant T1

- Quick Start
- Tenant T1
 - Application Profiles
 - Networking
 - L4-L7 Service Parameters
 - Security Policies
 - Troubleshoot Policies
 - Monitoring Policies
 - L4-L7 Services
 - L4-L7 Service Graph Templates
 - Router configurations
 - Function Profiles
 - L4-L7 Devices
 - Imported Devices
 - Devices Selection Policies
 - PERMIT_ALL-ASA5585_SGT-N1
 - consumer
 - provider
 - Deployed Graph Instances
 - PERMIT_ALL-ASA5585_SGT-T1
 - Function Node - N1
 - Deployed Devices
 - ASA5585-none
 - BGP Device Configuration
 - OSPF Device Configuration
 - PERMIT_ALL-ASA5585_SGT-T1
 - BGP Graph Instance Configuration
 - OSPF Graph Instance Configuration
 - N1
 - Connector N1/consumer
 - Connector N1/provider
 - Inband Management Configuration for L4-L7 devices
 - Device Managers
 - Chassis

Deployed Devices

| Device Name | VRF |
|-------------|------|
| ASA5585 | none |

System | Tenants | Fabric | VM Networking | L4-L7 Services | Admin | Operations

ALL TENANTS | Add Tenant | Search: enter name, descr | common | T1 | infra | mgmt

Tenant T1

- Quick Start
- Tenant T1
 - Application Profiles
 - Networking
 - L4-L7 Service Parameters
 - Security Policies
 - Troubleshoot Policies
 - Monitoring Policies
 - L4-L7 Services
 - L4-L7 Service Graph Templates
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 - Imported Devices
 - Devices Selection Policies
 - PERMIT_ALL-ASA5585_SGT-N1
 - consumer
 - provider
 - Deployed Graph Instances
 - PERMIT_ALL-ASA5585_SGT-T1
 - Function Node - N1
 - Deployed Devices
 - ASA5585-none
 - BGP Device Configuration
 - OSPF Device Configuration
 - PERMIT_ALL-ASA5585_SGT-T1
 - BGP Graph Instance Configuration
 - OSPF Graph Instance Configuration
 - N1
 - Connector N1/consumer
 - Connector N1/provider
 - Inband Management Configuration for L4-L7 devices
 - Device Managers
 - Chassis

Device OSPF Configurations

| Name | Device | Instance Name | Address Family | Area | Area Control | Area Type | Networks |
|----------------------|--------|---------------|----------------|---------------|--------------------------------------|--------------|-------------------------------|
| ASA_IN_L3OUT_area_0 | True | VRF2 | IPv4 | Backbone area | OSPF REDISTRIBUTION FROM REDIST-AREA | Regular area | ASA_IN_SGT_NET (0.0.10.0/24) |
| ASA_OUT_L3OUT_area_0 | True | VRF1 | IPv4 | Backbone area | OSPF REDISTRIBUTION FROM REDIST-AREA | Regular area | ASA_OUT_SGT_NET (0.0.20.0/24) |

Verify and Troubleshoot

APIC configuration for Tenant:

```
apic1# sh running-config tenant T1
# Command: show running-config tenant T1
# Time: Thu Feb 25 16:05:14 2016
tenant T1
  access-list PERMIT_ALL
    match ip
    exit
  contract PERMIT_ALL
    scope tenant
    subject PERMIT_ALL
      access-group PERMIT_ALL both
      1417 graph ASA5585_SGT
    exit
  exit
  vrf context VRF1
    exit
  vrf context VRF2
    exit
  l3out ASA_IN_L3OUT
    vrf member VRF2
    exit
  l3out ASA_OUT_L3OUT
    vrf member VRF1
    exit
  l3out N3K-1_L3OUT
    vrf member VRF1
    exit
  l3out N3K-2_L3OUT
    vrf member VRF2
    exit
  bridge-domain BD1
    vrf member VRF1
    exit
  bridge-domain BD2
    vrf member VRF2
    exit
  application AP1
    epg EPG1
      bridge-domain member BD1
    exit
    epg EPG2
      bridge-domain member BD2
    exit
  exit
  external-l3 epg ASA_IN_EXT_NET l3out ASA_IN_L3OUT
    vrf member VRF2
    match ip 10.10.10.0/24
    exit
  external-l3 epg ASA_OUT_EXT_NET l3out ASA_OUT_L3OUT
    vrf member VRF1
    match ip 20.20.20.0/24
    exit
  external-l3 epg N3K-1_EXT_NET l3out N3K-1_L3OUT
    vrf member VRF1
    match ip 10.10.10.0/24
    contract consumer PERMIT_ALL
    exit
  external-l3 epg N3K-2_EXT_NET l3out N3K-2_L3OUT
```

```

vrf member VRF2
match ip 20.20.20.0/24
contract provider PERMIT_ALL
exit
interface bridge-domain BD1
exit
interface bridge-domain BD2
exit
1417 cluster name ASA5585 type physical vlan-domain T1_PHY service FW function go-to
cluster-device ASA5585_Device_1
cluster-interface inside
member device ASA5585_Device_1 device-interface GigabitEthernet0/1
interface ethernet 1/2 leaf 106
exit
exit
cluster-interface outside
member device ASA5585_Device_1 device-interface GigabitEthernet0/0
interface ethernet 1/2 leaf 105
exit
exit
exit
1417 graph ASA5585_SGT contract PERMIT_ALL
service N1 device-cluster-tenant T1 device-cluster ASA5585 mode FW_ROUTED
connector consumer cluster-interface outside
1417-peer tenant T1 out ASA_OUT_L3OUT epg ASA_OUT_EXT_NET redistribute bgp,ospf
exit
connector provider cluster-interface inside
1417-peer tenant T1 out ASA_IN_L3OUT epg ASA_IN_EXT_NET redistribute bgp,ospf
exit
rtr-cfg ASA5585
exit
connection C1 terminal consumer service N1 connector consumer
connection C2 terminal provider service N1 connector provider
exit
rtr-cfg ASA5585
router-id 3.3.3.3
exit
exit
apic1#

```

Verify OSPF neighbor relationship and routing table on leaf 101:

```

leaf101# show ip ospf neighbors vrf T1:VRF1
OSPF Process ID default VRF T1:VRF1
Total number of neighbors: 2
Neighbor ID      Pri State                Up Time  Address           Interface
1.1.1.1          1 FULL/BDR              02:07:19 192.168.1.1      Vlan8
3.3.3.3          1 FULL/BDR              00:38:35 192.168.1.5      Vlan9

leaf101# show ip route vrf T1:VRF1
IP Route Table for VRF "T1:VRF1"
'*' denotes best ucast next-hop
*** denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

10.10.10.0/24, ubest/mbest: 1/0
  *via 192.168.1.1, vlan8, [110/8], 01:59:50, ospf-default, intra
20.20.20.0/24, ubest/mbest: 1/0
  *via 192.168.1.5, vlan9, [110/22], 00:30:20, ospf-default, inter
100.100.100.100/32, ubest/mbest: 2/0, attached, direct
  *via 100.100.100.100, lo1, [1/0], 02:21:22, local, local
  *via 100.100.100.100, lo1, [1/0], 02:21:22, direct

```

```

192.168.1.0/30, ubest/mbest: 1/0, attached, direct
    *via 192.168.1.2, vlan8, [1/0], 02:35:53, direct
192.168.1.2/32, ubest/mbest: 1/0, attached
    *via 192.168.1.2, vlan8, [1/0], 02:35:53, local, local
192.168.1.4/30, ubest/mbest: 1/0, attached, direct
    *via 192.168.1.6, vlan9, [1/0], 02:20:53, direct
192.168.1.6/32, ubest/mbest: 1/0, attached
    *via 192.168.1.6, vlan9, [1/0], 02:20:53, local, local
192.168.1.8/30, ubest/mbest: 1/0
    *via 192.168.1.5, vlan9, [110/14], 00:30:20, ospf-default, intra
200.200.200.200/32, ubest/mbest: 1/0
    *via 192.168.1.5, vlan9, [110/15], 00:30:20, ospf-default, intra

```

Verify OSPF neighbor relationship and routing table on leaf 102:

```

leaf102# show ip ospf neighbors vrf T1:VRF2
OSPF Process ID default VRF T1:VRF2
Total number of neighbors: 2
Neighbor ID      Pri State           Up Time  Address      Interface
3.3.3.3          1 FULL/BDR         00:37:07 192.168.1.9  Vlan14
2.2.2.2          1 FULL/BDR         02:09:59 192.168.1.13 Vlan15

```

```

leaf102# show ip route vrf T1:VRF2
IP Route Table for VRF "T1:VRF2"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

```

```

10.10.10.0/24, ubest/mbest: 1/0
    *via 192.168.1.9, vlan14, [110/22], 00:35:22, ospf-default, inter
20.20.20.0/24, ubest/mbest: 1/0
    *via 192.168.1.13, vlan15, [110/8], 02:08:13, ospf-default, intra
192.168.1.4/30, ubest/mbest: 1/0
    *via 192.168.1.9, vlan14, [110/14], 00:35:22, ospf-default, intra
192.168.1.8/30, ubest/mbest: 1/0, attached, direct
    *via 192.168.1.10, vlan14, [1/0], 02:14:29, direct
192.168.1.10/32, ubest/mbest: 1/0, attached
    *via 192.168.1.10, vlan14, [1/0], 02:14:29, local, local
192.168.1.12/30, ubest/mbest: 1/0, attached, direct
    *via 192.168.1.14, vlan15, [1/0], 02:09:04, direct
192.168.1.14/32, ubest/mbest: 1/0, attached
    *via 192.168.1.14, vlan15, [1/0], 02:09:04, local, local
200.200.200.200/32, ubest/mbest: 2/0, attached, direct
    *via 200.200.200.200, lo4, [1/0], 02:10:02, local, local
    *via 200.200.200.200, lo4, [1/0], 02:10:02, direct

```

Verify configuration, OSPF neighbor relationship and routing table on ASA 5585:

```

ASA5585# sh run interface
!
interface GigabitEthernet0/0
no nameif
security-level 0
no ip address
!
interface GigabitEthernet0/0.101
nameif externalIf
security-level 50
ip address 192.168.1.5 255.255.255.252
!
interface GigabitEthernet0/1
no nameif
security-level 100

```



```

no ip address
!
interface GigabitEthernet0/1.102
 nameif internalIf
 security-level 100
 ip address 192.168.1.9 255.255.255.252
!
interface Management0/0
 management-only
 nameif management
 security-level 0
 ip address 172.23.97.1 255.255.254.0

```

```

ASA5585# sh run router
router ospf 1
 router-id 3.3.3.3
 network 192.168.1.4 255.255.255.252 area 0
 network 192.168.1.8 255.255.255.252 area 0
 area 0
 log-adj-changes
!

```

```

ASA5585# sh ospf neighbor

```

| Neighbor ID | Pri | State | Dead Time | Address | Interface |
|-----------------|-----|---------|-----------|--------------|------------|
| 100.100.100.100 | 1 | FULL/DR | 0:00:38 | 192.168.1.6 | externalIf |
| 200.200.200.200 | 1 | FULL/DR | 0:00:33 | 192.168.1.10 | internalIf |

```

ASA5585# sh route ospf

```

```

Routing Table: T1

```

```

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
       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
Gateway of last resort is not set

```

```

O IA    10.10.10.0 255.255.255.0
        [110/18] via 192.168.1.6, 00:22:57, externalIf
O IA    20.20.20.0 255.255.255.0
        [110/18] via 192.168.1.10, 00:22:47, internalIf
O       200.200.200.200 255.255.255.255
        [110/11] via 192.168.1.10, 00:22:47, internalIf

```

```

ASA5585# sh access-list

```

```

access-list cached ACL log flows: total 0, denied 0 (deny-flow-max 4096)
 alert-interval 300
access-list access-list-inbound; 3 elements; name hash: 0xcb5bd6c7
access-list access-list-inbound line 1 extended permit tcp any any eq www (hitcnt=0) 0xc873a747
access-list access-list-inbound line 2 extended permit tcp any any eq https (hitcnt=0)
0x48bedbdd
access-list access-list-inbound line 3 extended permit icmp any any (hitcnt=6) 0xe4b5a75d

```

Verify configuration, OSPF neighbor relationship and routing table on N3K-1

```
N3K-1# sh run ospf
```

```
!Command: show running-config ospf  
!Time: Thu Feb 25 15:40:55 2016
```

```
version 6.0(2)U3(7)  
feature ospf
```

```
router ospf 1  
router-id 1.1.1.1
```

```
interface Ethernet1/21  
ip router ospf 1 area 0.0.0.1
```

```
interface Ethernet1/47  
ip router ospf 1 area 0.0.0.1
```

```
N3K-1# sh ip ospf neighbors
```

```
OSPF Process ID 1 VRF default  
Total number of neighbors: 1
```

| Neighbor ID | Pri | State | Up Time | Address | Interface |
|-----------------|-----|---------|----------|-------------|-----------|
| 100.100.100.100 | 1 | FULL/DR | 01:36:24 | 192.168.1.2 | Eth1/47 |

```
N3K-1# sh ip ospf route
```

```
OSPF Process ID 1 VRF default, Routing Table
```

```
(D) denotes route is directly attached (R) denotes route is in RIB
```

```
10.10.10.0/24 (intra)(D) area 0.0.0.1  
via 10.10.10.0/Eth1/21* , cost 4  
20.20.20.0/24 (inter)(R) area 0.0.0.1  
via 192.168.1.2/Eth1/47 , cost 62  
100.100.100.100/32 (intra)(R) area 0.0.0.1  
via 192.168.1.2/Eth1/47 , cost 41  
192.168.1.0/30 (intra)(D) area 0.0.0.1  
via 192.168.1.1/Eth1/47* , cost 40
```

Verify configuration, OSPF neighbor relationship and routing table on N3K-2

```
N3K-2# sh run ospf
```

```
!Command: show running-config ospf  
!Time: Thu Feb 25 15:44:47 2016
```

```
version 6.0(2)U3(7)  
feature ospf
```

```
router ospf 1  
router-id 2.2.2.2
```

```
interface loopback0  
ip ospf network point-to-point  
ip router ospf 1 area 0.0.0.0
```

```
interface Ethernet1/21  
ip router ospf 1 area 0.0.0.1
```

```
interface Ethernet1/47  
ip router ospf 1 area 0.0.0.1
```

```
N3K-2# sh ip ospf neighbors
```

```
OSPF Process ID 1 VRF default
```

Total number of neighbors: 1

| Neighbor ID | Pri | State | Up Time | Address | Interface |
|-----------------|-----|---------|----------|--------------|-----------|
| 200.200.200.200 | 1 | FULL/DR | 01:43:50 | 192.168.1.14 | Eth1/47 |

N3K-2# sh ip ospf route

```
OSPF Process ID 1 VRF default, Routing Table
(D) denotes route is directly attached      (R) denotes route is in RIB
2.2.2.0/30 (intra)(D) area 0.0.0.0
  via 2.2.2.0/Lo0* , cost 1
10.10.10.0/24 (inter)(R) area 0.0.0.1
  via 192.168.1.14/Eth1/47 , cost 62
20.20.20.0/24 (intra)(D) area 0.0.0.1
  via 20.20.20.0/Eth1/21* , cost 4
192.168.1.12/30 (intra)(D) area 0.0.0.1
  via 192.168.1.13/Eth1/47* , cost 40
```

Verify contract filter rules on leaf and the packet hit counts:.

leaf101# show system internal policy-mgr stats

Requested Rule Statistics

[CUT]

| | |
|--|----------------|
| Rule (4107) DN (sys/actrl/scope-3112964/rule-3112964-s-32773-d-49158-f-33) | Ingress: 1316, |
| Egress: 0, Pkts: 0 RevPkts: 0 | |
| Rule (4108) DN (sys/actrl/scope-3112964/rule-3112964-s-49158-d-32773-f-33) | Ingress: 1317, |
| Egress: 0, Pkts: 0 RevPkts: 0 | |

leaf101# show system internal policy-mgr stats

Requested Rule Statistics

[CUT]

| | |
|--|----------------|
| Rule (4107) DN (sys/actrl/scope-3112964/rule-3112964-s-32773-d-49158-f-33) | Ingress: 2317, |
| Egress: 0, Pkts: 0 RevPkts: 0 | |
| Rule (4108) DN (sys/actrl/scope-3112964/rule-3112964-s-49158-d-32773-f-33) | Ingress: 2317, |
| Egress: 0, Pkts: 0 RevPkts: 0 | |

```
leaf102# show system internal policy-mgr stats Requested Rule Statistics [CUT] Rule (4103) DN
(sys/actrl/scope-2752520/rule-2752520-s-49156-d-6019-f-default) Ingress: 3394, Egress: 0, Pkts:
0 RevPkts: 0 Rule (4104) DN (sys/actrl/scope-2752520/rule-2752520-s-6019-d-49156-f-default)
Ingress: 3394, Egress: 0, Pkts: 0 RevPkts: 0 [CUT] leaf102# show system internal policy-mgr
stats Requested Rule Statistics [CUT] Rule (4103) DN (sys/actrl/scope-2752520/rule-2752520-s-
49156-d-6019-f-default) Ingress: 4392, Egress: 0, Pkts: 0 RevPkts: 0 Rule (4104) DN
(sys/actrl/scope-2752520/rule-2752520-s-6019-d-49156-f-default) Ingress: 4392, Egress: 0, Pkts:
0 RevPkts: 0 [CUT]
```

Reachability test between N3K-1 and N3K-2:

```
N3K-1# ping 20.20.20.1 source 10.10.10.1
PING 20.20.20.1 (20.20.20.1) from 10.10.10.1: 56 data bytes
64 bytes from 20.20.20.1: icmp_seq=0 ttl=250 time=2.098 ms
64 bytes from 20.20.20.1: icmp_seq=1 ttl=250 time=0.922 ms
64 bytes from 20.20.20.1: icmp_seq=2 ttl=250 time=0.926 ms
64 bytes from 20.20.20.1: icmp_seq=3 ttl=250 time=0.893 ms
64 bytes from 20.20.20.1: icmp_seq=4 ttl=250 time=0.941 ms
```

--- 20.20.20.1 ping statistics ---

5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 0.893/1.156/2.098 ms

N3K-2# ping 10.10.10.1 source 20.20.20.1

```
PING 10.10.10.1 (10.10.10.1) from 20.20.20.1: 56 data bytes
```

```
64 bytes from 10.10.10.1: icmp_seq=0 ttl=250 time=2.075 ms
64 bytes from 10.10.10.1: icmp_seq=1 ttl=250 time=0.915 ms
64 bytes from 10.10.10.1: icmp_seq=2 ttl=250 time=0.888 ms
64 bytes from 10.10.10.1: icmp_seq=3 ttl=250 time=1.747 ms
64 bytes from 10.10.10.1: icmp_seq=4 ttl=250 time=0.828 ms
```

```
--- 10.10.10.1 ping statistics ---
```

```
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 0.828/1.29/2.075 ms
```

Attached is the XML configuration file for the Tenant and the ASA Function Profile, used for this demonstration.