Deploying Layer 4 to Layer 7 Services

Overview

The Cisco Cloud APIC enables you to deploy Layer 4 to Layer 7 service devices to the public cloud. The initial release (4.2(x)), supports Azure Application Gateway (Application Load Balancer) deployments in Azure. Beginning with release 5.0(2), Azure Load Balancer (Network Load Balancer) and Third Party Firewall deployments in Azure are supported.

Two types of Load Balancers are supported for Layer 4 - Layer 7 deployments in Azure:

- ALB refers to Azure Application gateway or Application Load balancer
- NLB refers to Azure Load balancer or Network Load balancer.

About Service Graphs

A service graph is used to represent a set of Layer 4- Layer 7 service devices inserted between two or more pair of EPGs. EPGs can represent your applications running within a cloud (e.g. Cloud EPG) or internet (cloudExtEPG) or from other sites (e.g. on-prem or remote cloud sites). Layer 4- Layer 7 devices can be NLB, ALB or a cluster of Third party firewalls.

A service graph in conjunction with contracts (and filters) is used to specify communication between two EPGs. A cloud APIC automatically derives security rules (network security group/NSG and ASG) and forwarding routes (UDRs) based on the policy specified in Contract and Service Graph

Multiple service graphs can be specified to represent a different represent different traffic flows or topologies.

Following combinations are possible with service graphs:

- Same device can be used in multiple service graphs.
- Same service graph can be used between multiple consumer and provider EPGs.

By using a service graph, the user can specify the policy once and deploy the service chain within regions or inter-regions. Each time the graph is deployed, Cisco ACI takes care of changing the network configuration to enable the forwarding in the new logical topology.

For Third party firewalls, the configuration inside the device is not managed by cloud APIC.

A service graph represents the network using the following elements:

- Service Graph Nodes—A node represents a function that is applied to the traffic, such as a load balancer. A function within the service graph might require one or more parameters and have one or more connectors.
- Connector—A connector enables input and output from a node.

After the graph is configured, the Cisco APIC automatically configures the services according to the service function requirements that are specified in the service graph. The Cisco APIC also automatically configures the network according to the needs of the service function that is specified in the service graph, which does not require any change in the service device.

About Application Load Balancers

Application Load Balancer (also called Azure Application Gateway or ALB) is a Layer 7 load balancer, which balances the web traffic based on attributes like HTTP request, URL filtering etc. For more details please refer to Microsoft Documentation.

In Cisco ACI, there are two ways to deploy an Application Load Balancer:

- Internet-facing: inserts the Application Load Balancer as a service between the consumer external EPG and the provider cloud EPG.
- Internal-facing: inserts the Application Load Balancer as a service between the consumer cloud EPG and the provider cloud EPG.

You can consume an Application Load Balancer using a service graph. A typical configuration involves:

- Creation of L4L7 device as Application Load Balancer
- Consume the ALB as a node in the service graph
- Creation of one or more listeners in EPG communication when a service graph is associated with a contract.

Listeners enable you to specify the ports and protocols (HTTP or HTTPS) that the Application Load Balancer accepts traffic on. When specifying HTTPS, you also choose a security policy and an SSL certificate.

Note A listener can have multiple certificates.

All listeners require you to configure at least one rule (a default rule, which does not have a condition). Rules enable you to specify the action that the load balancer takes when a condition is met. For example, you can create a rule that redirects traffic to a specified URL when a request is made to a specified hostname or path.

An Application load balancer (ALB) should be in a separate subnet which should not be used to deploy other applications. Cloud APIC creates and attaches ALB's NSG to the subnet associated with the ALB. Cloud APIC supports Standard and Standard_v2 SKUs of Azure Application Gateway.

About Network Load Balancer

A Network Load Balancer (Azure Load Balancer or NLB) is a Layer 4 device that distributes the in-bound flow packets based on L4 ports. For more details, please refer to Microsoft Documentation.

Similar to ALB, NLB can be deployed using a service graph. You can specify these actions by configuring one or more listeners.

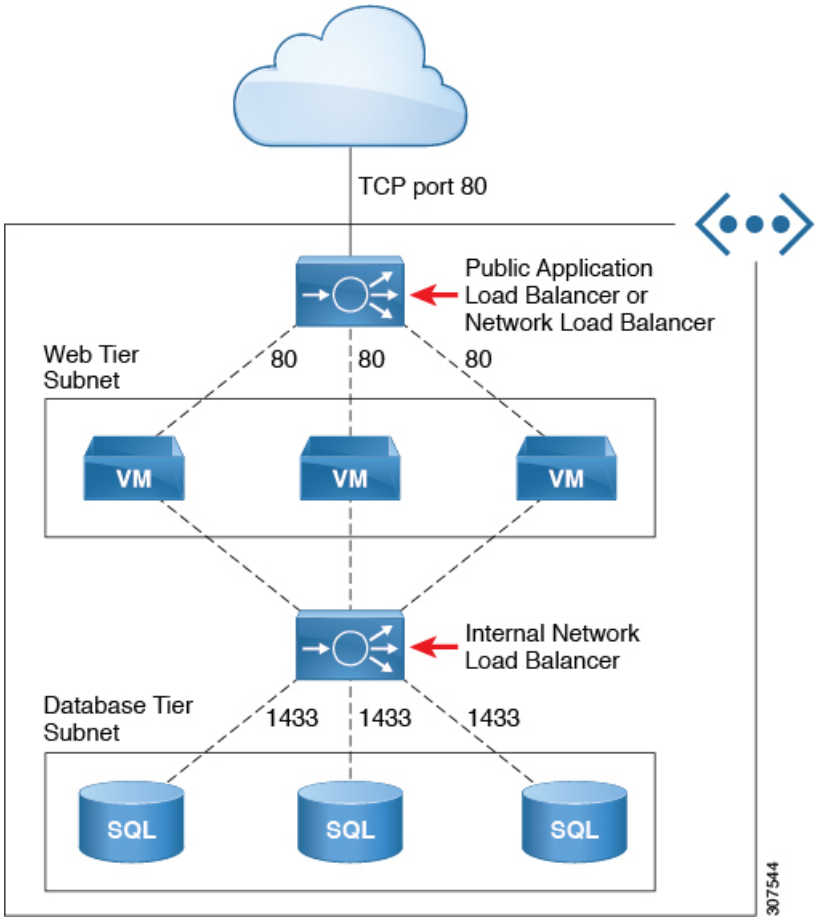
Listeners enable you to specify the ports and protocols (TCP or UDP) that the load balancer accepts and forwards traffic on. All listeners require you to configure at least one rule (a default rule, which does not have a condition). Rules enable you to specify the action that the load balancer takes when a condition is met. Unlike application gateway, here a rule can only forward traffic to specific port of the backend pool. NLB should be in a separate subnet similar to ALB. There are two modes of operation in Network load balancer:

- Forward mode: Traffic is forwarded from a specific listener port to the specified backend port.
- HA Port mode: Network load balancer will load balance TCP and UDP flows on all the ports simultaneously.

Cloud APIC supports Standard SKU Network Load Balancer only.

In Figure1, the frontend load balancer (ALB/NLB) - VM or firewall - backend load (ALB/NLB) balancer as a service are inserted between the consumer external EPG and the provider cloud EPG.

Figure 1: Internet-Facing and Internal-Facing Deployment



Dynamic Server Attachment to Server Pool

Servers in provider EPG are dynamically added to the target groups. In Azure, the target groups are referenced as the backend pool. Listeners and rule configuration that define the frontend and backend protocol and port number, and load balancing action are provided by the user. When configuring listener rule as part of service graph configuration, user can select provider EPG for a given rule. The endpoints from that EPG would be dynamically added to the target group of the load balancer. You do not need to specify the endpoints or FQDN for the targets.

About Inter-VNet Services

Beginning with Release 5.0(2), support is available for the deployment and automation of the inter-VNet services. This is both for the East-West and North-South use cases within the cloud.

Note the following considerations for this support:

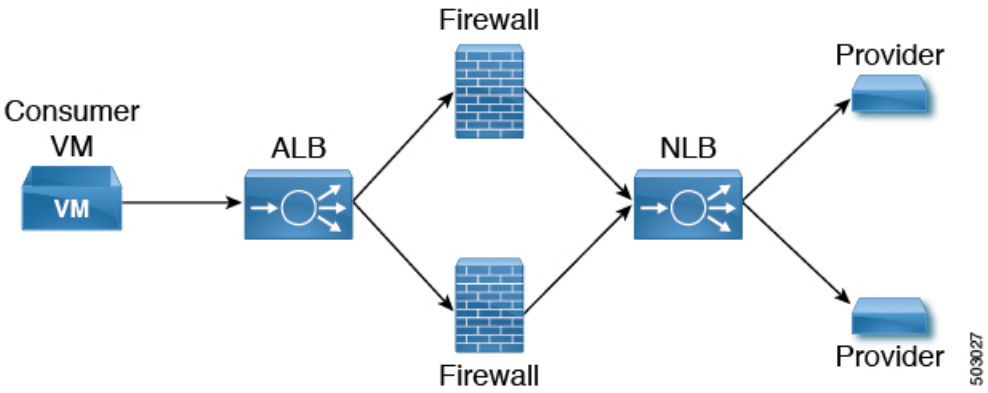
- VNet peering needs to be configured for hub-spoke topology. For more information, refer to Configuring VNet Peering for Cloud APIC for Azure.

- For multi-node services with redirect: The service device has to be present in the infra VNet. Service devices such as ALB fronting the provider can be present in the provider VNet.
- For multi-node service without redirect: The service device can be in the provider VNet or spread across the hub VNet and the provider VNet.

- Inter-VNet traffic is supported with an Application gateway in the infra VNet and the provider in a non-infra VNet. VNets should be peered together and they should be from the same region.

About Multinodes

Beginning with release 5.0(2), Multinode service graph is supported. Multinodes enable multiple deployment scenarios with service graphs.



Service devices that can be deployed are Application Load Balancer, Network Load Balancer and Third Party Firewall.

Two types of nodes are admitted in a graph.

- Non-redirect: Traffic is destined to service devices (Load Balancers, Thirdparty firewalls with DNAT and SNAT, Network Load Balancer).
- Redirect: Service device is a passthrough device (Network Load Balancer or Firewall).

About Layer 4 to Layer 7 Service Redirect

Beginning with Release 5.0(2), the Layer 4 to Layer 7 Service Redirect feature is available for Cisco Cloud APIC, similar to the policy-based redirect (PBR) feature available for Cisco APIC. The Layer 4 to Layer 7 Service Redirect feature is configured using the **Redirect** option in the Cisco Cloud APIC.

Note Throughout this section, the term "consumer-to-provider" is sometimes used as a blanket term to describe traffic going from point A to point B, where a redirect service device might be inserted between those two points. However, this does not mean that only consumer-to-provider traffic is supported for redirect; traffic might also be from provider-to-consumer, such as in the use case described in Spoke to Spoke, on page 11.

With redirect, policies are used to redirect traffic through specific service devices, where service devices can be deployed as a Network Load Balancer or a third-party firewall. This traffic isn't necessarily destined for the service device as part of the standard consumer-to-provider configuration; rather, you would configure the consumer-to-provider traffic as you normally would, and you would then configure service graphs to redirect that consumer-to-provider traffic to a specific service device.

Support for redirect for Cisco Cloud APIC is only available in conjunction with the VNet peering feature, taking advantage of the hub-and-spoke topology used in VNet peering. For more information on the VNet peering feature, see the *Configuring VNet Peering for Cloud APIC for Azure* document.

About the Overlay-1 and Overlay-2 VRFs

The overlay-1 and overlay-2 VRFs are automatically created in the infra tenant for Cloud APIC. In the Azure portal, CIDRs and subnets from the overlay-1 and overlay-2 VRFs are deployed in the Azure cloud on the overlay-1 VNet. The overlay-2 VRF is used to hold additional CIDRs. You shouldn't consider overlay-2 as a separate VNet.

The following sections provide more information on the overlay-1 and overlay-2 VRFs.

Requirement for Separate VRFs in the Infra Hub

Prior to Release 5.0(2), the infra hub VNet was used to achieve transit routing functionality for inter-spoke communications within the site through CSRs in the hub, and to send VxLAN packets for EPG communication across sites.

There are situations where you might want to deploy a certain number of EPGs configured with shared services and layer 4 to layer 7 service graphs in a common hub that can be shared across spokes. In some situations, you might have multiple hub networks deployed separately (for example, for production, pre-production, and core services). You might want to deploy all of these hub networks in the same infra hub VNet (in the same infra cloud context profile), along with the existing cloud CSRs.

Thus, for these kind of requirements, you might need to split the hub VNet into multiple VRFs for network segmentation while keeping the security intact.

About the Infra Hub Services VRF (Overlay-2 VRF in the Infra VNet)

Beginning with Release 5.0(2), the overlay-2 VRF is now created in the infra tenant implicitly during the Cisco Cloud APIC bringup. In order to keep the network segmentation intact between the infra subnets used by the cloud site (for CSRs and network load balancers) and the user subnets deployed for shared services, different VRFs are used for infra subnets and user-deployed subnets:

- **Overlay-1**: Used for infra CIDRs for the cloud infra, along with Cisco Cloud Services Routers (CSRs), the infra network load balancer, and the Cisco Cloud APIC
- **Overlay-2**: Used for user CIDRs to deploy shared services, along with layer 4 to layer 7 service devices in the infra VNet (the overlay-1 VNet in the Azure cloud)

All the user-created EPGs in the infra tenant can only be mapped to the overlay-2 VRF in the infra VNet. You can add additional CIDRs and subnets to the existing infra VNet (the existing infra cloud context profile). They are implicitly mapped to overlay-2 VRF in the infra VNet, and are deployed in the overlay-1 VNet in the Azure cloud.

Prior to Release 5.0(2), any given cloud context profile would be mapped to a cloud resource of a specific VNet. All the subnets and associated route tables of the VNet would be have a one-to-one mapping with a single VRF. Beginning with Release 5.0(2), the cloud context profile of the infra VNet can be mapped to multiple VRFs (the overlay-1 and overlay-2 VRFs in the infra VNet).

In the cloud, the subnet's route table is the most granular entity for achieving network isolation. So all system-created cloud subnets of the overlay-1 VRF and the user-created subnets of the overlay-2 VRF will be mapped to separate route tables in the cloud for achieving the network segmentation.

Note On Azure cloud, you cannot add or delete CIDRs in a VNet when it has active peering with other VNets. Therefore, when you need to add more CIDRs to the infra VNet, you need to first disable VNet peering in it, which removes all the VNet peerings associated with the infra VNet. After adding new CIDRs to the infra VNet, you need to enable VNet peering again in the infra VNet.

You do not have to disable VNet peering if you are adding a new subnet in an existing CIDR in the hub VNet.

See Adding a New CIDR to Overlay-2 Using the Cloud APIC GUI, on page 24 for more information.

Passthrough Rules

When redirect is enabled, the rules in the NSGs (Network Security Groups) attached to the service devices are updated to permit traffic from consumer to provider. These rules are called "passthrough rules". In general, the passthrough rule is to permit traffic from consumer IP to provider IP. If the destination IP is an application load balancer (ALB) VIP, the rule is to permit traffic from consumer IP to the ALB VIP.

Redirect Programming

Redirect programming depends on the classification of the destination EPG (tag-based or subnet-based):

- For a subnet-based EPG, subnets of the destination EPGs are used to program redirects
- For a tag-based EPGs, CIDRs of the destination VNet are used to program redirects

As a result of this, the redirect affects traffic from other EPGs going to the same destination in the redirect, even if the EPG is not part of the service graph with the redirect. Traffic from EPGs that are not part of the redirect will also get redirected to the service device.

The following table describes how redirect is programmed in different scenarios.

Consumer	Provider	Redirect on Consumer VNet	Redirect on Provider VNet
Tag-based	Tag-based	Redirect for the provider are the CIDRs of the provider's VNet	Redirect for the consumer are the CIDRs of the consumer's VNet
Tag-based	Subnet-based	Redirect for the provider are the subnets of the provider	Redirect for the consumer are the CIDRs of the consumer's VNet
Subnet-based	Tag-based	Redirect for the provider are the CIDRs of the provider's VNet	Redirect for the consumer are the subnets of the consumer
Subnet-based	Subnet-based	Redirect for the provider are the subnets of the provider	Redirect for the consumer are the subnets of the consumer

Redirect Policy

To support the Layer 4 to Layer 7 Service Redirect feature, a new redirect flag is now available for service device connectors. The following table provides information on the existing and new flags for the service device connectors.

ConnType	Description
redir	This value means the service node is in redirect node for that connection. This value is only available or valid for third-party firewalls and Network Load Balancers.
snat	This value tells the service graph that the service node is performing source NAT on traffic. This value is only available or valid for the provider connector of third-party firewalls and only on the provider connector of a node.
snat_dnat	This value tells the service graph that the service node is performing both source NAT and destination NAT on traffic. This value is only available or valid for the provider connector of third-party firewalls and only on the provider connector of a node.
none	Default value.

Workflow for Configuring Redirect

Following is the typical workflow for configuring redirect:

1. Create one or more service devices to use with the service graph:
   - Network load balancer (NLB)
   - Application load balancer (ALB)
   - Third-party firewall
2. Create a service graph and select the appropriate service devices for this particular service graph.

   You will configure redirect at this point in the procedures:

   a. Drag and drop a network load balancer, application load balancer, or firewall icon to the **Drop Device** area to select that service device for the service graph.

   b. To enable the redirect feature, in the **Service Node** window that appears, check the box next to the **Redirect** option under the **Consumer Connector Type** and/or under the **Provider Connector Type** areas, depending on where you want to enable the redirect function.

Note Even though you might have an application load balancer in the service graph, you cannot enable redirect on an application load balancer service device.

c. Complete the remaining configurations in the **Service Node** window, then click **Add**.

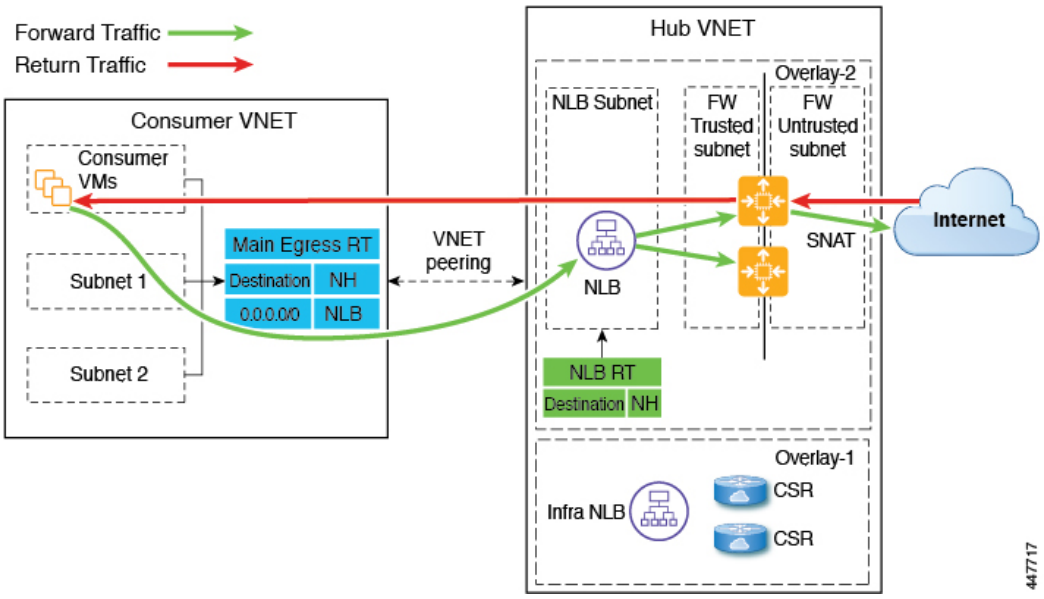
3. Configure the EPG communication, where you create a contract between the consumer and the provider EPGs.
4. Attach the service graph to the contract.
5. Configure the service device parameters.

Example Use Cases

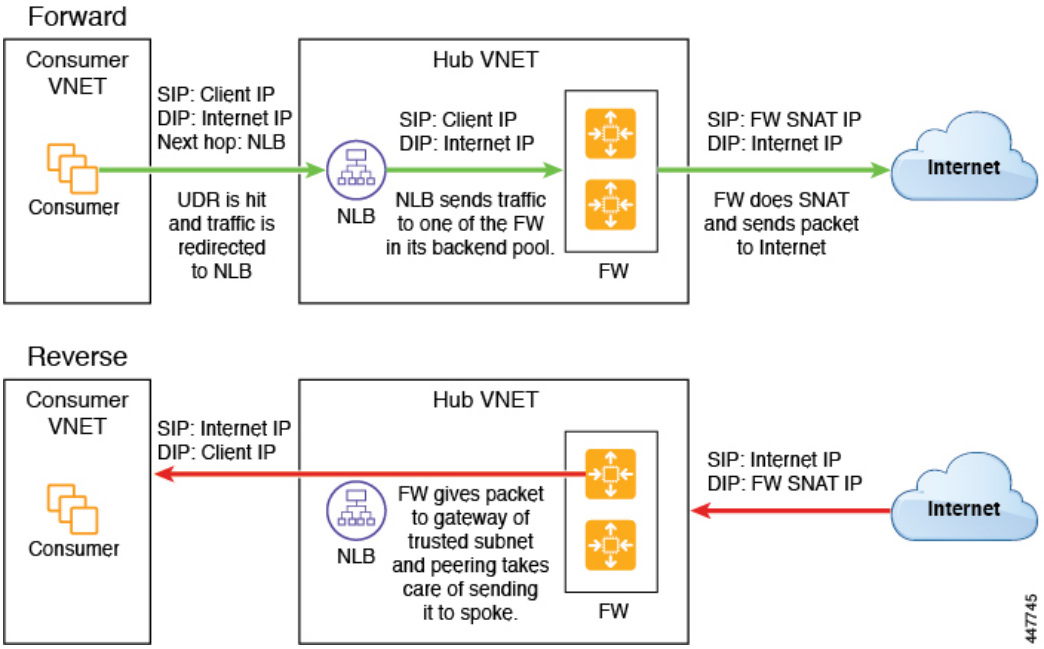
Following are several example use cases:

Spoke to Internet

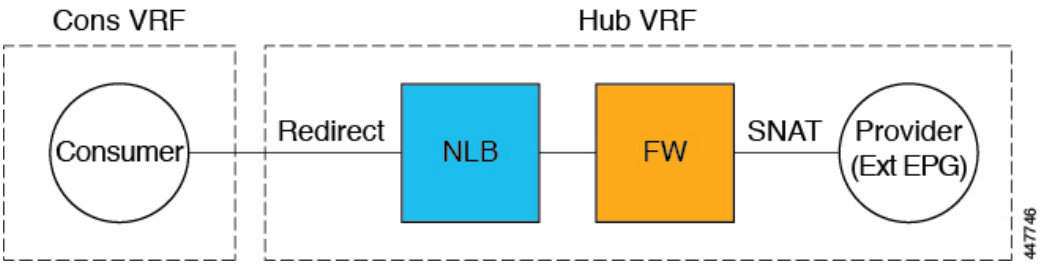
In this use case, the consumer VNet (with consumer VMs) and the hub VNet are peered using VNet peering. A network load balancer is also deployed, fronting two firewalls for scaling. In this use case, the consumer VMs need access to the internet for a certain reason, such as patch updates. In the consumer VNet, the route table is modified to include a redirect for the internet in this case, and traffic is redirected to the NLB in front of firewalls in the hub VNet. Any traffic from this consumer that is part of the service graph that is going to the internet goes to the NLB as the next-hop. With VNet peering, traffic first goes to the NLB, then the NLB forwards the traffic to one of the firewalls in the back end. The firewalls also perform source network address translation (SNAT) when sending traffic to the internet.



The following figure shows the packet flow for this use case.



The following figure shows the service graph for this use case.

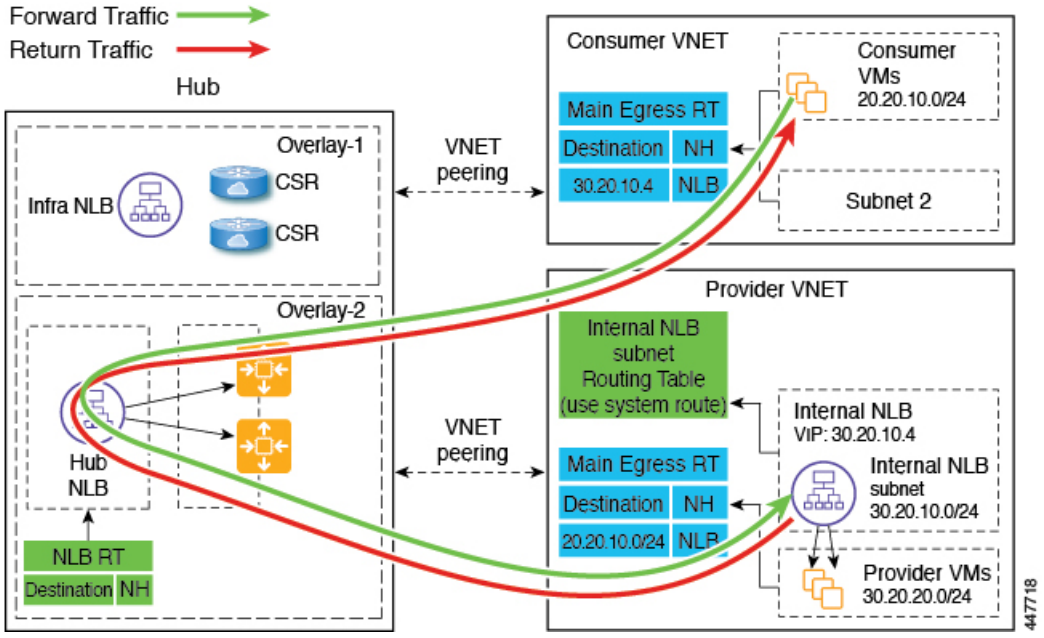


As part of the redirect configuration for this use case, you would make the following selections:

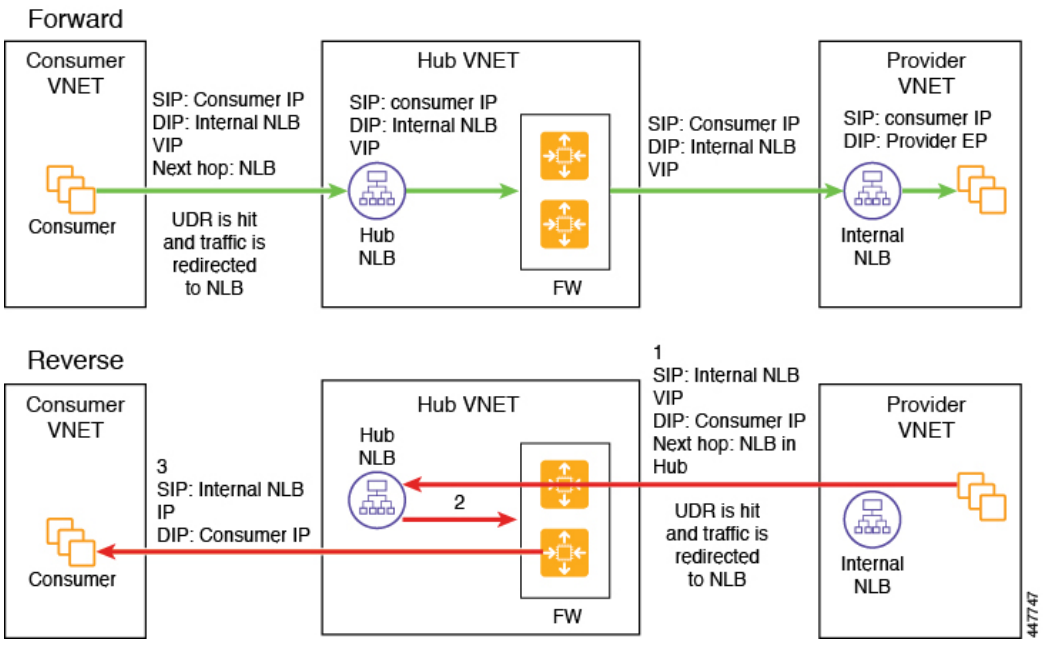
- In the **Create Device** window
  - In the **Tenant** field, choose the **infra** tenant.
  - Choose the type of service device in the **Service Type** field:
    - Choose **Network Load Balancer** as the **Service Type**, and in the **Subnets** area, click **Add Subnet**, then choose the appropriate region, cloud context profille, and the subnet created in the overlay-2 VRF.
    - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the **overlay-2** VRF.
- In the **Create Service Graph** window, drag-and-drop the following service devices, in this order:
  - Network Load Balancer
  - Third-Party Firewall
- In the **Service Node** window for the Network Load Balancer:
  - In the **Consumer Connector Type** field, place a check in the box next to the **Redirect** option to enable the redirect function on the consumer side.
  - In the **Provider Connector Type** field, leave the boxes unchecked.
- In the **Service Node** window for the Third-Party Firewall:
  - In the **Consumer Connector Type** field, leave the boxes unchecked.
  - Because the firewall performs SNAT when sending traffic to the internet in this use case, in the **Provider Connector Type** field, place a check in the box next to the **SNAT** option.

Spoke to Spoke

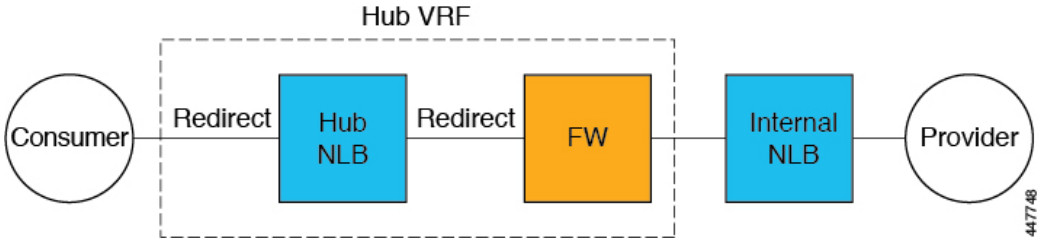
In this use case, traffic flows from spoke to spoke, through the hub firewall fronted by a hub NLB. Consumer endpoints are in the consumer VNet, and the provider VNet has VMs fronted by an internal NLB. The egress route table is modified in the consumer and provider VNets so that traffic is redirected to the firewall device fronted by the NLB. Redirect is applied in both directions in this use case. The NLB must have a dedicated subnet in this case.



The following figure shows the packet flow for this use case.



The following figure shows the service graph for this use case.

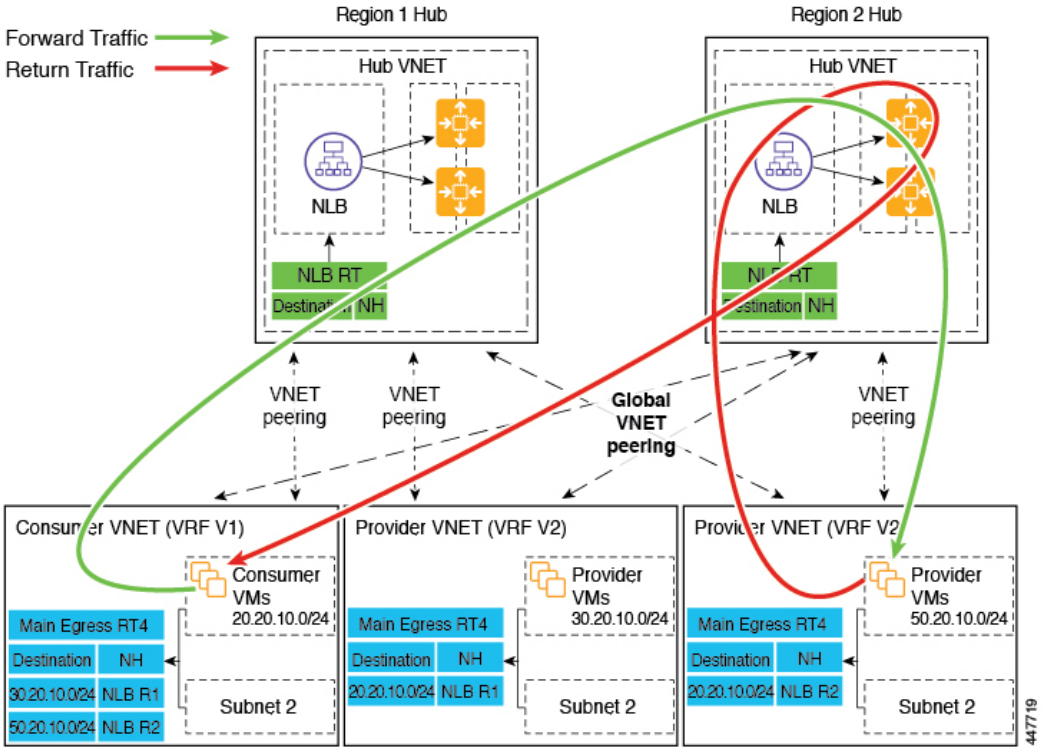


As part of the redirect configuration for this use case, you would make the following selections:

- In the **Create Device** window, first create the service devices for the hub VNet:
  - In the **Tenant** field, choose the **infra** tenant.
  - Choose the type of service device in the **Service Type** field:
    - Choose **Network Load Balancer** as the **Service Type**, and in the **Subnets** area, click **Add Subnet**, then choose the appropriate region, cloud context profile, and the subnet created in the overlay-2 VRF.
    - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the **overlay-2** VRF.
- In the **Create Device** window, next create the service devices for the provider VNet:
  - In the **Tenant** field, choose the provider tenant.
  - In the **Service Type** field, choose **Network Load Balancer**, and in the **Subnets** area, click **Add Subnet**, then choose the appropriate region, cloud context profille, and the subnet for the provider VRF.
- In the **Create Service Graph** window, drag-and-drop the following service devices, in this order:
  - Network Load Balancer (for the hub VNet)
  - Third-Party Firewall (for the hub VNet)
  - Network Load Balancer (for the provider VNet)
- In the **Service Node** window for the Network Load Balancer in the hub VNet:
  - In the **Consumer Connector Type** field, place a check in the box next to the **Redirect** option to enable the redirect function on the consumer side.
  - In the **Provider Connector Type** field, place a check in the box next to the **Redirect** option to enable the redirect function on the provider side.
- In the **Service Node** window for the Third-Party Firewall, leave the boxes unchecked for the **Consumer Connector Type** and the **Provider Connector Type**.
- In the **Service Node** window for the Network Load Balancer in the provider VNet, leave the boxes unchecked for the **Consumer Connector Type** and the **Provider Connector Type**.

Inter-Region Spoke to Spoke

In this use case, both regions must have service devices,. The consumer VNet is in region 1, the provider is stretched across both regions (regions 1 and 2), and some endpoints are in region 1 and some endpoints are in region 2. Different redirects are programmed for local provider endpoints and for remote region endpoints. In this case, the firewall that is used will be the firewall that is closest to the provider endpoint side.



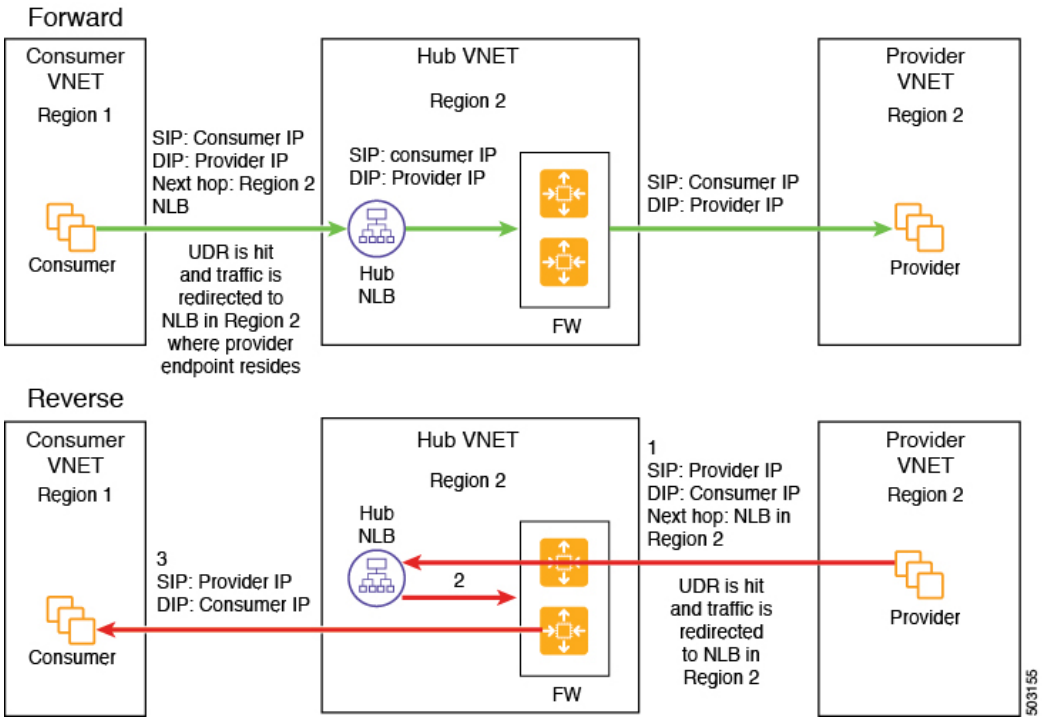
For example, consider the two subnets in the consumer VNet (VRF 1) egress route table (RT):

- 30.20.10.0/24 (NLB in region 1 [R1])
- 50.20.10.0/24 (NLB in region 2 [R2])

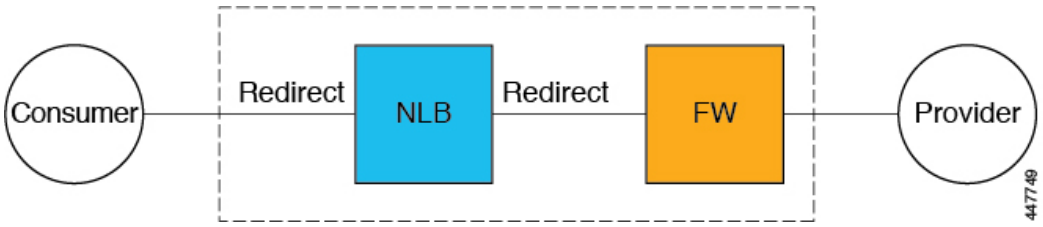
Assume the consumer wants to send traffic to the provider VMs 30.20.10.0/24, which are local to it. In that case, traffic will get redirected to the region 1 hub NLB and firewall, and will then go to the provider.

Now assume the consumer wants to send traffic to the provider VMs 50.20.10.0/24. In this case, the traffic will get redirected to the region 2 hub NLB and firewall, because that firewall is local to the provider endpoint.

The following figure shows the packet flow for this use case.



The following figure shows the service graph for this use case.



As part of the redirect configuration for this use case, you would make the following selections:

- In the **Create Device** window, first create the service devices for the hub VNet:
  - In the **Tenant** field, choose the **infra** tenant.
  - Choose the type of service device in the **Service Type** field:
    - Choose **Network Load Balancer** as the **Service Type**, and in the **Subnets** area, click **Add Subnet**, then choose the appropriate region, cloud context profile, and the subnet created in the overlay-2 VRF.
    - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the **overlay-2** VRF.

- In the **Create Service Graph** window, drag-and-drop the following service devices, in this order:
  - Network Load Balancer
  - Third-Party Firewall

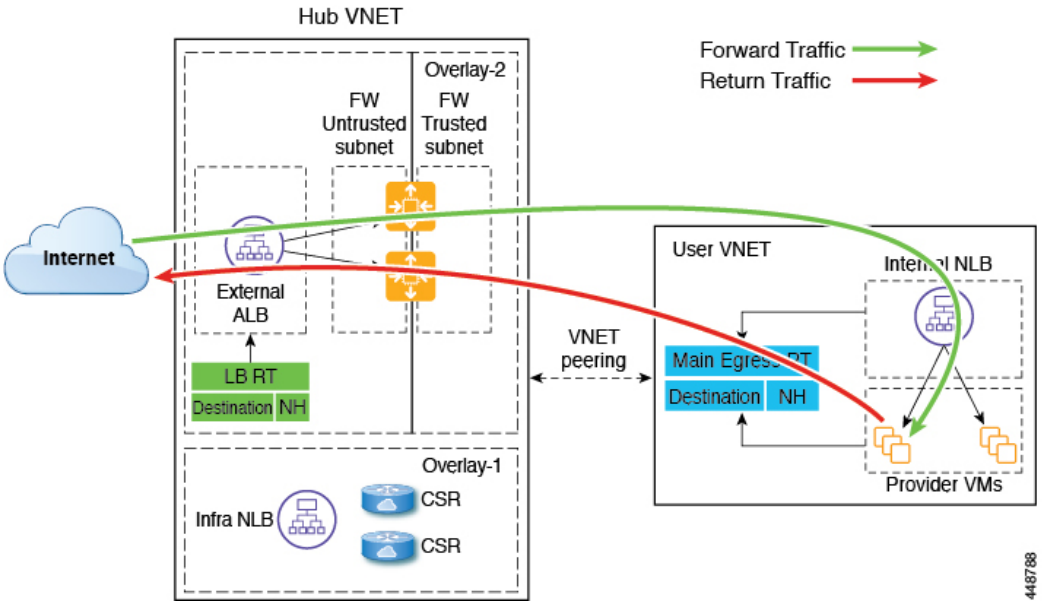
- In the **Service Node** window for the hub NLB:
  - In the **Consumer Connector Type** field, place a check in the box next to the **Redirect** option to enable the redirect function on the consumer side.
  - In the **Provider Connector Type** field, place a check in the box next to the **Redirect** option to enable the redirect function on the provider side.
- In the **Service Node** window for the Third-Party Firewall, leave the boxes unchecked for the **Consumer Connector Type** and the **Provider Connector Type**.

Internet to Spoke (Inter-VRF)

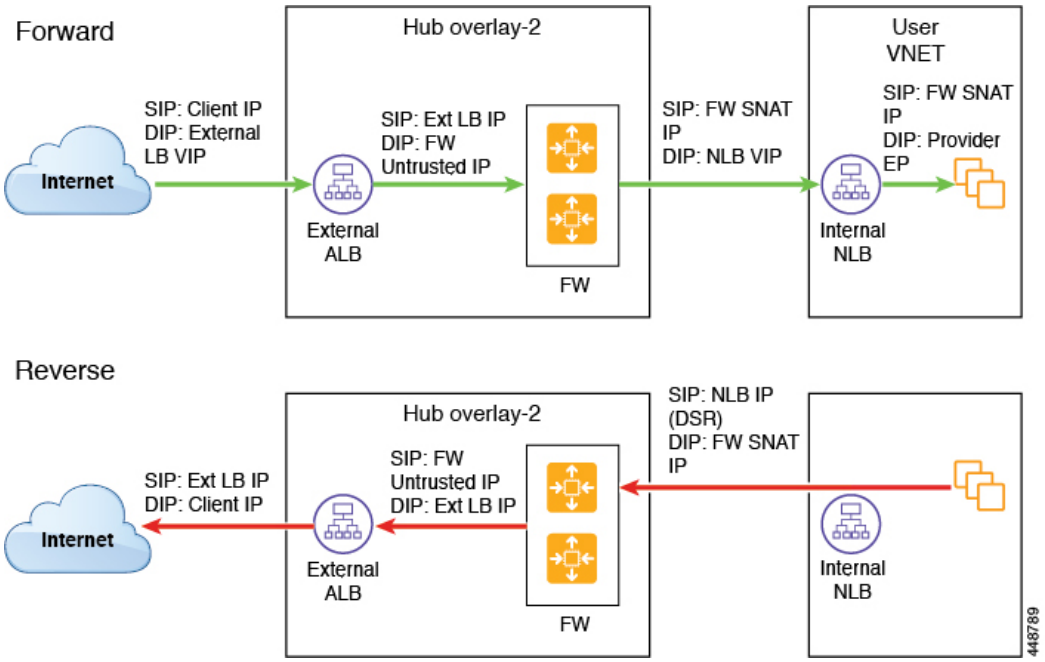
In this use case, traffic coming from the internet needs to go through the firewall before hitting the provider endpoints. Redirect is not used in this use case.

Note The general term "external load balancer" is used in this section because in this use case, the external load balancer could be either an NLB or an ALB. The following examples provide configurations using an ALB, but keep in mind that the external load balancer could be an NLB instead.

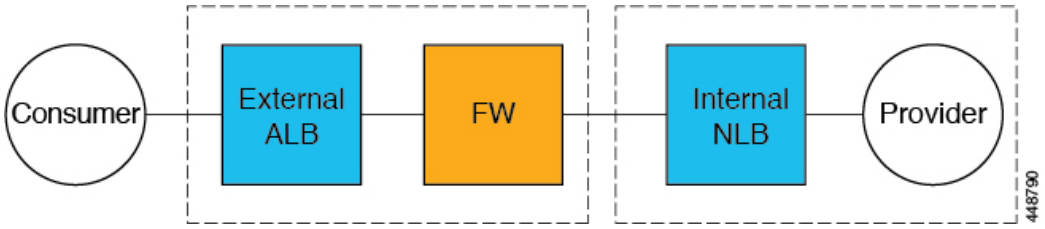
The external load balancer exposes the service through VIP. Internet traffic is directed to that VIP, then external load balancers direct traffic to the firewalls in the backend pool (the external load balancers have the firewall's untrusted interface as its backend pool). The firewall performs SNAT and DNAT, and the traffic goes to the internal NLB VIP. The internal NLB then sends traffic to one of the provider endpoints.



The following figure shows the packet flow for this use case.



The following figure shows the service graph for this use case.



As part of the redirect configuration for this use case, you would make the following selections:

- In the **Create Device** window, first create the service devices for the hub VNet:
  - In the **Tenant** field, choose the **infra** tenant.
  - Choose the type of service device in the **Service Type** field:
    - Choose **Application Load Balancer** or **Network Load Balancer** as the **Service Type**, and in the **Subnets** area, click **Add Subnet**, then choose the appropriate region, cloud context profile, and the subnet created in the overlay-2 VRF.
    - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the **overlay-2** VRF.

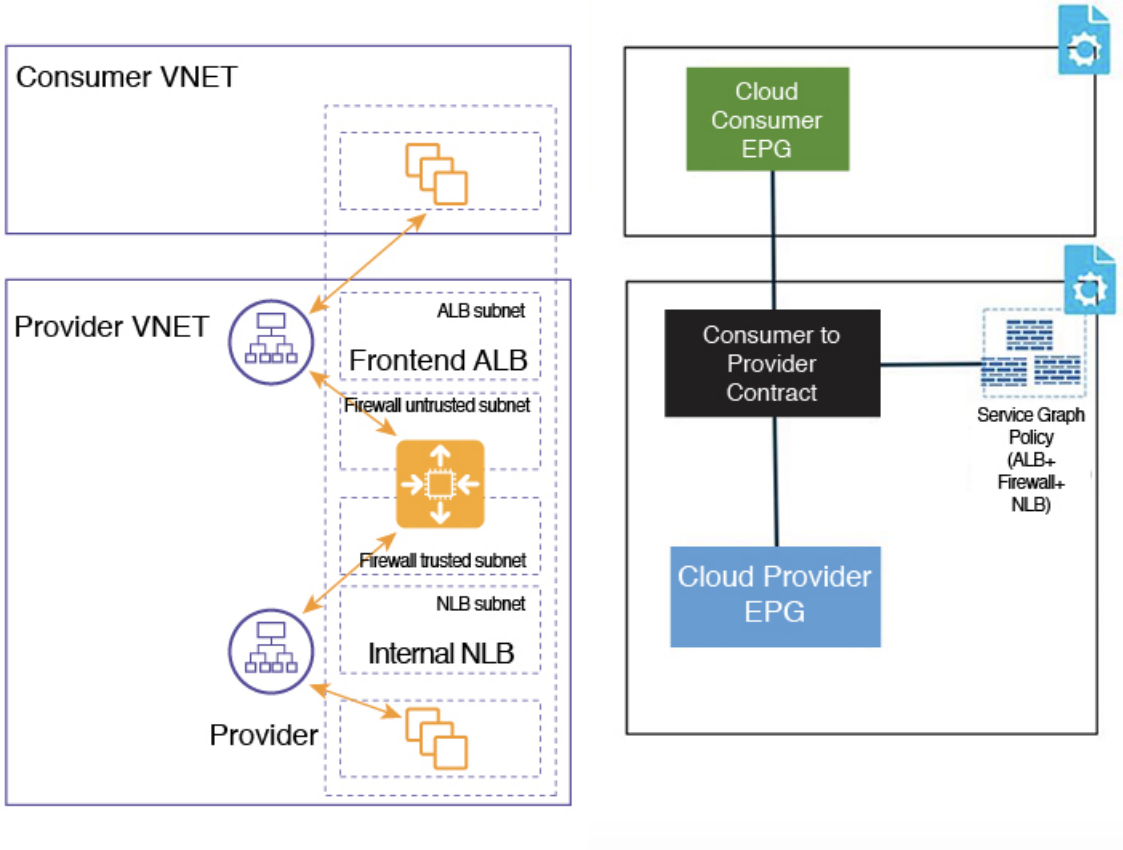
- In the **Create Device** window, next create the service devices for the provider VNet:
  - In the **Tenant** field, choose the provider tenant.
  - In the **Service Type** field, choose **Network Load Balancer**, and in the **Subnets** area, click **Add Subnet**, then choose the appropriate region, cloud context profille, and the subnet for the provider VRF.

- In the **Create Service Graph** window, drag-and-drop the following service devices, in this order:
  - Network Load Balancer or Application Load Balancer (for the hub VNet)
  - Third-Party Firewall (for the hub VNet)
  - Network Load Balancer (for the provider VNet)
- In the **Service Node** window for the Network Load Balancer or Application Load Balancer for the hub VNet, leave the boxes unchecked for the **Consumer Connector Type** and the **Provider Connector Type**.
- In the **Service Node** window for the Third-Party Firewall:
  - In the **Consumer Connector Type** field, leave the boxes unchecked.
  - Because the firewall performs SNAT and DNAT when sending traffic to the internet in this use case, in the **Provider Connector Type** field, place a check in the box next to the **SNAT** and **DNAT** options.
- In the **Service Node** window for the Network Load Balancer for the provider VNet, leave the boxes unchecked for the **Consumer Connector Type** and the **Provider Connector Type**.

Consumer and Provider EPGs in Two Separate VNets

This use case is an example configuration with two VNets, with a consumer EPG and provider EPG in separate VNets.

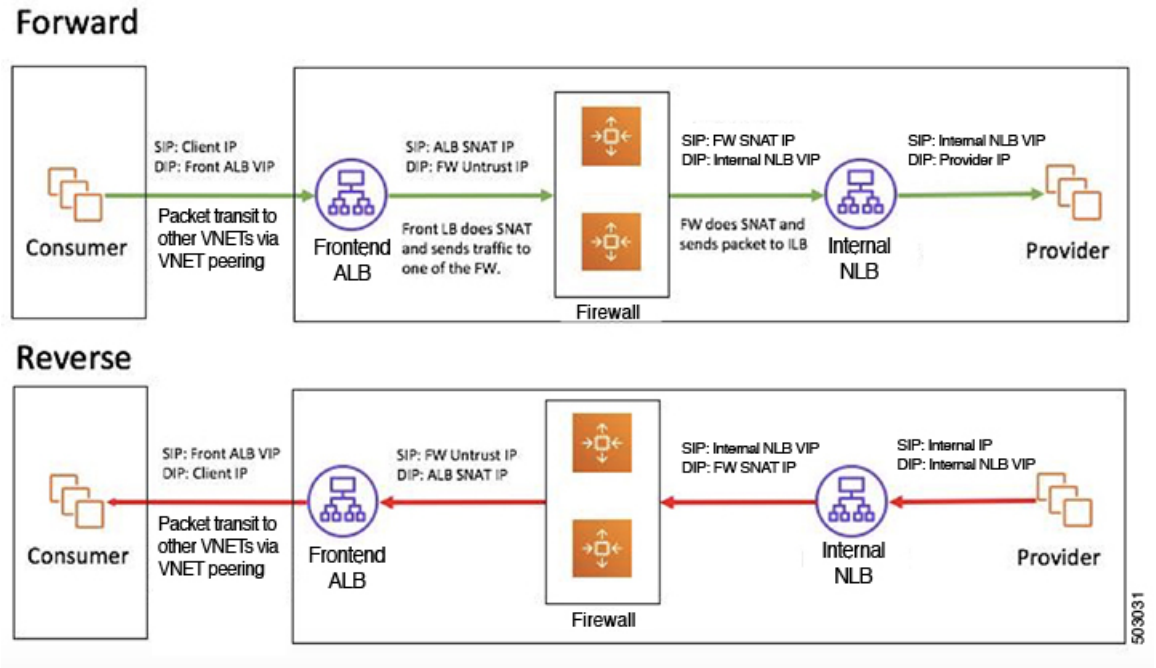
- A frontend ALB, firewall, and internal NLB are inserted between the consumer and provider EPGs.
- A consumer endpoint sends traffic to the frontend ALB VIP and it is forwarded to the firewall.
- The firewall performs SNAT and DNAT, and the traffic flows to internal NLB VIP.
- The internal NLB load balances the traffic to the backend provider endpoints.



In the figure:

- The consumer EPG is in a consumer VNet.
- The provider EPG and all the service devices are in the provider VNet.
- The application load balancer, network load balancer, and firewall need to have their own subnet in the VNet.

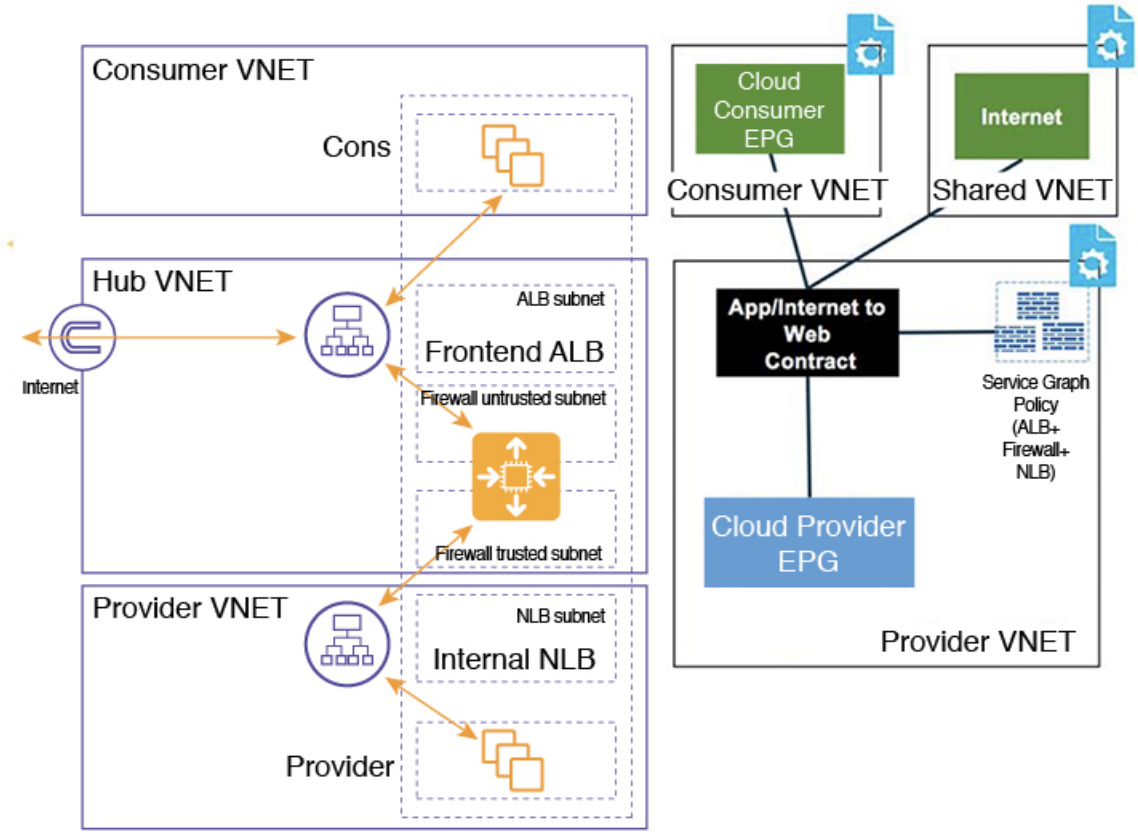
Packet flow for both the directions is shown in the following figure:



Hub VNet with Consumer and Provider EPGs in Two Separate VNets

This use case is an example configuration with three VNets: a hub VNet, and a consumer EPG and provider EPG in two separate VNets.

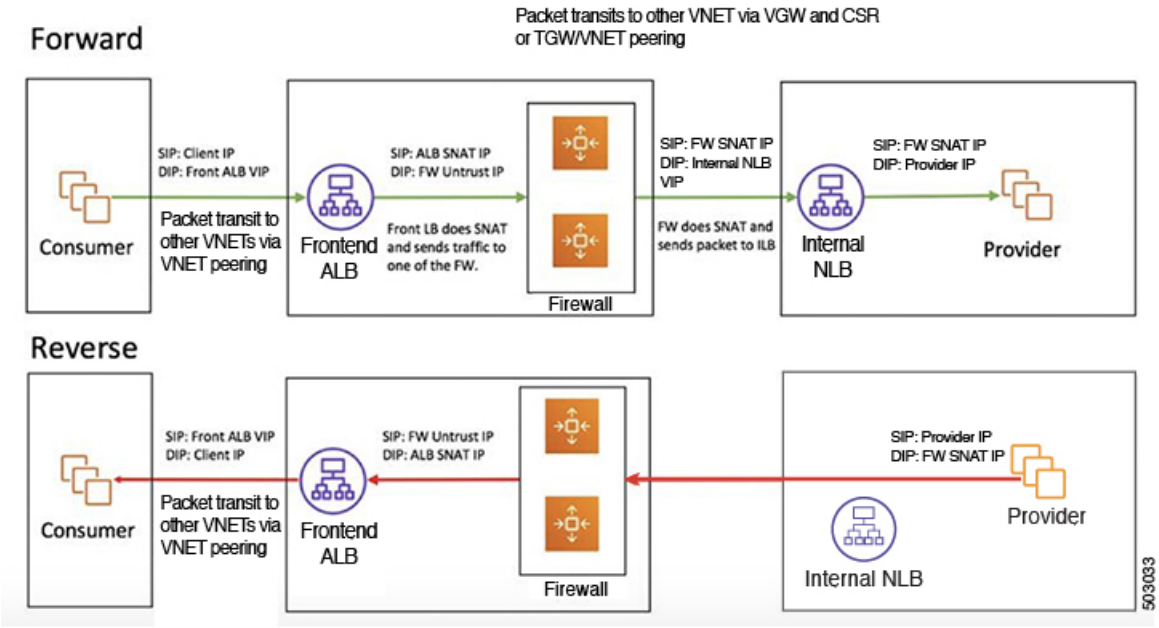
- A frontend ALB and firewall are inserted within the hub VNet, which is between the consumer and provider EPGs.
- An internal NLB is inserted in the provider EPG.
- A consumer endpoint sends traffic to the frontend ALB VIP and it is forwarded to the firewall.
- The firewall performs SNAT and DNAT, and the traffic flows to internal NLB VIP.
- The internal NLB load balances the traffic to the backend provider endpoints.



In the figure:

- The consumer EPG is in a consumer VNet.
- The provider EPG and the internal NLB are in the provider VNet.
- The frontend ALB and firewall are in the hub VNet
- The application load balancer, network load balancer, and firewall need to have their own subnet in the VNet.

Packet flow for both the direction is shown in the following figure:



Guidelines and Limitations for Redirect

Following are the guidelines and limitations for redirect:

- All the Layer 4 - Layer 7 service devices should have their own dedicated subnet.
- Intra VRF Layer 4 - Layer 7 redirection within a region:
  - Layer 4 - Layer 7 redirect is not supported for east-west deployment when the consumer EPG and provider EPG are in the same VNet.
  - Layer 4 - Layer 7 redirect is supported for north-south deployment if the external EPG is a provider EPG, regardless of whether the consumer EPG and provider EPG are in same VNet or not.
- Intra-VRF Layer 4 - Layer 7 redirection across regions:
  - Inter-Region Layer 4 - Layer 7 redirection are supported. However, the Consumer EPG and the Provider EPG should not stretch.
  - A region shouldn't have both a consumer EPG and a provider EPG in the same VRF. For example, if region 1 has a consumer EPG only and region 2 has a provider EPG only, this is supported, but region 1 can't have both the consumer EPG and the provider EPG.
  - Consumer and Provider EPG should be a subnet-based EPG.
- For the inter-region service graphs with Layer 4 - Layer 7 redirection, service devices should be deployed in the provider EPG’s region. If provider EPG is stretched across regions, service devices should be deployed in each region .
- For the external EPG as provider, service devices need to be deployed in the region local to consumer EPG. If the consumer EPG is stretched across regions, service devices should be deployed in each region.

- Between a consumer VNet and a provider EPG, only one redirect device can be inserted through a service graph. For example, if consumer EPG1 and consumer EPG2 are in a consumer VNet, and a provider EPG3 is in a provider VNet, you must use the same redirect device for a contract between EPG1 and EPG3, and a contract between EPG2 and EPG3.

Note The limitation is because of the cloud provider allows only one next hop for a given destination in user-defined routes.

- The following table provides information on the specific redirect configurations that are supported or unsupported, where:
  - NLB stands for network load balancer
  - ALB stands for application load balancer
  - FW stands for firewall

Service Chain Option	Spoke-to-Spoke		Spoke-to-External (consumer is spoke)		External-to-Spoke (consumer is external)	
	Intra-VNet	Inter-VNet	Intra-VNet	Inter-VNet	Intra-VNet	Inter-VNet
NLB/ALB[1]	Supported	Supported	Not supported	Not supported	Supported	Supported
FW (no SNAT)[2]	Not supported	Supported	Not supported	Not supported	Not supported	Not supported
FW (w/SNAT)[3]	Supported	Supported	Supported	Supported	Not supported	Not supported
• NLB[2]-FW(no SNAT)[1] • NLB[2]-FW(no SNAT)[1]-NLB/ALB[1]	Not supported	Supported	Not supported	Not supported	Not supported	Not supported
NLB[4]-FW(SNAT)[5]	Not supported	Supported	Supported	Supported	Not supported	Not supported
NLB/ALB[1]-FW(SNAT+DNAT)[6]-NLB/ALB[1] (No redirection)	Supported	Supported	Supported	Supported	Supported	Supported

[1] Unchecked on both consumer and provider connector or options are not applicable for ALB.
[2] Redirect is enabled on both consumer and provider connector.
[3] Redirect is enabled on consumer connector. SNAT is enabled on provider connector.
[4] Redirect is enabled on consumer connector. Unchecked on provider connector.
[5] Unchecked on consumer connector. SNAT is enabled on provider connector.
[6] Unchecked on consumer connector. SNAT+DNAT is enabled on provider connector.

Adding a New CIDR to Overlay-2 Using the Cloud APIC GUI

After an installation, you will see overlay-1 and overlay-2 in the Cisco Cloud APIC. However, on the Azure portal, you will only see overlay-1. This is because overlay-2 is simply a logical extension of overlay-1, and is used to hold additional the CIDRs that you might need if you are deploying firewalls or load balancers on the infra VNet. This section provides instructions for adding new CIDRs to overlay-2.

In some situations, you might have to disable VNet peering before adding new CIDRs or editing existing CIDRs in overlay-2. This is due to a limitation in Azure, where you cannot update a CIDR on a VNet if it has active VNet peerings. To add the CIDRs, you first have to remove VNet peerings for that VNet, then you can update the CIDRs. Once you have updated the CIDRs, you can then re-enable the VNet peerings.

These procedures provide instructions for disabling Hub Network Peering, which removes all of the VNet peerings associated with a particular infra VNet.

- If you have an additional CIDR already created on the infra VNet, but you simply need to add additional subnets to that existing CIDR, you do not have to disable Hub Network Peering for that particular infra VNet before adding those subnets. To add additional subnets to an existing CIDR:

  1. Navigate to the appropriate cloud context profile in that case (**Application Management** > **Cloud Context Profiles**).
  2. Double-click the cloud context profile where you want to add a subnet to an existing CIDR, then go to Step 10, on page 25 to add the new subnets to an existing CIDR.

- If you are adding a new CIDR in the infra VNet, or if you are deleting a CIDR or editing a CIDR in the infra VNet in some other way (other than adding subnets), then you must disable Hub Network Peering for that particular infra VNet. You will then re-enable Hub Network Peering again after you have added the CIDR. The following procedure provides those instructions.

Step 1 Log in to the Cloud APIC, if you are not logged in already.

Step 2 In the left navigation bar, navigate to **Application Management** > **Cloud Context Profiles**.

The existing cloud context profiles are displayed.

Step 3 Double-click the cloud context profile where you want to disable Hub Network Peering.

The overview window for that cloud context profile appears. You should see **Enabled** in the **Hub Network Peering** area in this overview window, which indicates that Hub Network Peering is enabled.

Step 4 Click the pencil icon to edit this cloud context profile.

The **Edit Cloud Context Profile** window appears.

Step 5 In the **Edit Cloud Context Profile** window, locate the **Hub Network Peering** field and click the check box to remove the checkmark from the **Enabled** field.

Disabling the **Hub Network Peering** option does not remove VNet peering at the global level, but rather removes all of the VNet peerings associated with this particular infra VNet.

Step 6 Click **Save**.

The overview window for that cloud context profile appears again. You should see **Disabled** in the **Hub Network Peering** area in this overview window, which indicates that Hub Network Peering is now disabled.

Step 7 To add a new CIDR, click the pencil icon to edit this cloud context profile again.

The **Edit Cloud Context Profile** window appears again.

Step 8 Click **Add CIDR**.

The **Add CIDR** dialog box appears.

Step 9 Add the new CIDR in the **CIDR Block Range** field.

Do not click the box in the **Primary** field (do not put a check in the box next to **yes** in the **Primary** field).

Step 10 Click **Add Subnet** and enter the necessary subnet addresses in the **Address** field.

Continue to click **Add Subnet** for additional subnets, if necessary.

Step 11 When you have finished adding all of the necessary information in the **Add CIDR** window, click **Add**.

The **Edit Cloud Context Profile** window appears again.

Step 12 Confirm the information in the **Edit Cloud Context Profile** window, then click **Save**.

The overview window for that cloud context profile appears. You should now see the new CIDR listed in the **CIDR Block Range** area.

Step 13 If you disabled Hub Network Peering at the beginning of these procedures, re-enable it at this time.

a) Click the pencil icon to edit this cloud context profile.

The **Edit Cloud Context Profile** window appears.

b) In the **Edit Cloud Context Profile** window, locate the **Hub Network Peering** field and click the check box to add the checkmark in the **Enabled** field to re-enable VNet peerings for this particular infra VNet.

c) Click **Save**.

The overview window for that cloud context profile appears again. You should see **Enabled** in the **Hub Network Peering** area in this overview window, which indicates that Hub Network Peering is now re-enabled again.

As described previously, if you were to go to the Azure portal at this point, you will see any additional CIDRs and subnets that you added in these procedures in the overlay-1 VNet in Azure, which is the correct and expected behavior.

Deploying a Service Graph

The service graph enables you to define how traffic flows between devices, how the traffic comes into the network, which devices the traffic passes through, and how the traffic leaves the network.

The Service graph can be deployed in two ways:

- Single node service graph: Only one device is deployed.
- Multinode service graph: Upto three nodes can be added to the service chain.

Before you can deploy a service graph in either a single node or multinode, you must configure the following:

1. A tenant
2. An application profile

3. A consumer EPG
4. A provider EPG
5. A cloud context profile
6. A contract with a filter

Deploying a Service Graph Using the GUI

The following sections describe how to deploy a service graph using the GUI.

Creating Service Devices Using The Cloud APIC GUI

Before you begin

This section explains how to create service devices that can be used in a service graph through the Cisco Cloud APIC GUI.

Step 1 Click the **Intent** icon. The **Intent** menu appears.

Step 2 Click the drop-down arrow below the **Intent** search box and choose **Application Management**.

A list of **Application Management** options appear in the **Intent** menu.

Step 3 From the **Application Management** list in the **Intent** menu, click **Services** > **Devices** > **Create Device**. The **Create Device** dialog box appears.

Step 4 Enter the appropriate values in each field as listed in the following *Create Device Dialog Box Fields* table then continue.

Table 1: Create Device Dialog Box Fields for Application Load Balancer

Properties	Description
General	
Name	Enter the name of the device.
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog appears. **b.** From the column on the left, click to choose a tenant. **c.** Click **Select**. You return to the **Create Device** dialog box.
Settings	
Service Type	Choose the device type: • Application Load Balancer

Properties	Description
ALB SKU	Choose from: • Standard • Standard V2
VM Instance Count	Enter a number in the *VM Instance Count* text box. **Note** This is applicable only for the Application Gateway.
VM Instance Size	Click the radio button for the VM instance size you want to choose: **large**, **medium**, or **small**. **Note** This is applicable only for the Application Gateway.
Scheme	Choose **Internet Facing** or **Internal**. • **Internet Facing**— This is used for configuring a public IP for the balancer. This is assigned by Azure. • **Internal**—Click to choose either **Dynamic** or **Static** under IP Address Assignment. • **Dynamic**—Dynamic IP addresses are assigned by Azure. Dynamic IP addresses change each time the VMs boot up. • **Static**—Enter an IP address based on the CIDRs defined in Cloud Context Profile and check that the IP address is in the same subnet as the ALB. ALB SKU Standard supports static and dynamic IP addresses. ALB SKU Standard V2 support static IP addresses only.
Subnet	To choose a subnet: **a.** Click **Select Region**. The **Select Region** dialog box appears. From the **Select Region** dialog, click to choose a region in the left column then click **Select**. **b.** Click **Select Cloud Context Profile**. The **Select Cloud Context Profile** dialog box appears. **c.** Click **Select Subnet**. The **Select Subnet** dialog box appears. The Static IP Addresses text box is displayed. Enter the IP address of the load balancer. Click the tick mark on the right to confirm. **d.** To add additional subnets, repeat steps a-c.

Step 5 Click **Save** when finished.

Step 6 The **Create Service Graph** dialog box appears. Click on the **Create another Application Load Balancer** to create another device. The **Create Device** dialog box appears.

Note The UI usually asks to create a previously created device. However, on clicking it we return back to the **Create Device** page. Here we can choose the device that needs to be created. The first device should never be the Third Party Firewall.

Step 7 Enter the appropriate values in each field as listed in the following *Create Device Dialog Box Fields* table then continue.

Table 2: Create Device Dialog Box Fields for Third party firewall

Properties	Description
General	
Name	Enter the name of the device.
Settings	
Service Type	Choose the device type: • Third party firewall **Note** Third party firewall cannot be the first device in a multinode service graph.
VRF	To choose a VRF: **a.** Click **Select VRF**. The **Select VRF** dialog box appears. **b.** From the **Select VRF** dialog, click to choose a VRF in the left column then click **Select**.
Interfaces	Click **Add Interface selectors** **a.** In the **Settings** page, enter the name of the interface. **b.** Click **Add Interface**. **c.** Enter the name of the interface selector. **d.** Click on **Match Expressions** and select • the **Key**: This can be IP, region or a custom based tag selector. • **Operator**: This can be equal, not equals, in, not in, has key, or does not have key. • **Value**: IP address of the app, web, internal network, management network, or external network. **e.** Click **Add**. **f.** Repeat steps a - d to add more interfaces.

Step 8 Click **Save** when finished.

Step 9 The **Create Service Graph** dialog box appears. Click on the **Create another Third Party Firewall** to create another device. The **Create Device** dialog box appears.

Note The UI usually asks to create a previously created device. However, on clicking it we return back to the **Create Device** page. Here we can choose the device that needs to be created. The first device should never be the Third Party Firewall.

Step 10 Enter the appropriate values in each field as listed in the following *Create Device Dialog Box Fields* table then continue.

Table 3: Create Device Dialog Box Fields for Network Load Balancer

Properties	Description
General	
Name	Enter the name of the load balancer.
Settings	
Service Type	Choose the device type: • Network Load Balancer
If you are choosing Network Load Balancer, use the steps below.	
Scheme	Choose **Internet Facing** or **Internal**. • **Internet Facing**— This is used for configuring a public IP for the balancer. This is assigned by Azure. • **Internal**—Click to choose either **Dynamic** or **Static** under IP Address Assignment. • **Dynamic**—Dynamic IP addresses are assigned by Azure. Dynamic IP addresses change each time the VMs boot up. • **Static**—Enter an IP address based on the CIDRs defined in Cloud Context Profile and check that the IP address is in the same subnet as the NLB. Static IP addresses are associated to load balancers. **Note** Cloud APIC creates standard SKU NLBs only.
Subnet	To choose a subnet: **a.** Click **Select Region**. The **Select Region** dialog box appears. From the **Select Region** dialog, click to choose a region in the left column then click **Select**. **b.** Click **Select Cloud Context Profile**. The **Select Cloud Context Profile** dialog box appears. **c.** Click **Select Subnet**. The **Select Subnet** dialog box appears. The Static IP Addresses text box is displayed. Enter the IP address of the load balancer. Click the tick mark on the right to confirm. **d.** To add additional subnets, repeat steps a-c.

Step 11 Click **Save** when finished.

Creating a Service Graph Template Using the Cisco Cloud APIC GUI

This section explains how to configure a service graph template for a single node or a multinode, using the Cisco Cloud APIC GUI .

Before you begin

You have already created the devices.

Step 1 Click the **Intent** icon. The **Intent** menu appears.

Step 2 Click the drop-down arrow below the **Intent** search box and choose **Application Management**.

A list of **Application Management** options appear in the **Intent** menu.

Step 3 From the **Application Management** list in the **Intent** menu, click **Services** > **Service Graph** > **Create Service Graph**. The **Create Service Graph** pop-up appears. Click on **Let's Get Started**.

Step 4 Enter the appropriate values in each field as listed in the following *Create Service Graph Dialog Box Fields* table then continue.

Table 4: Create Service Graph Dialog Box Fields (for single node)

Properties	Description
General	
Name	Enter the name of service graph template.
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog appears. **b.** From the column on the left, click to choose a tenant. **c.** Click **Select**. You return to the **Create Service Graph** dialog box.
Description	Enter a description of the service graph template.
Settings	
Select a Device	To choose a device: **a.** Click **Select Device**. The **Select Device** dialog appears. **b.** From the column on the left, click to choose a device. Drag and drop the device in the **Drop Device** space below. This will open a small window where the actual device for this device type can be selected. **c.** Click **Select**. You return to the **Create Service Graph** dialog box.

Table 5: Create Service Graph Dialog Box Fields (for multinode)

Properties	Description
General	
Name	Enter the name of service graph template.

Properties	Description
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog appears. **b.** From the column on the left, click to choose a tenant. **c.** Click **Select**. You return to the **Create Service Graph** dialog box.
Description	Enter a description of the service graph template.
Settings: Based on the required topology, drag and drop the devices in the box below	
Application Load Balancer	**a.** Drag and drop the Application load balancer device into the box below. **b.** In the **Service node** dialog box, click on the **Select Application Load Balancer** and click to choose a Application Load Balancer in the left column then click **Add**.
Third Party Firewall	**a.** Drag and drop the Third Party Firewall next to the device in the box below. **b.** In the **Service node** dialog box, click on the **Third Party Firewall** and click to choose a Third Party Firewall in the left column then click **Add**. **Note** Third Party Firewall cannot be the first node on the service graph. **c.** If you want to enable the user-based redirect function on the *consumer* side of the Third Party Firewall, in the **Consumer Connector Type** field, place a check in the box next to the **Redirect** option. **d.** If you want to enable the user-based redirect function on the *provider* side of the Third Party Firewall, in the **Provider Connector Type** field, place a check in the box next to the **Redirect** option. **e.** In the **Provider Connector Type**, place a check next to the applicable option. Refer to About Layer 4 to Layer 7 Service Redirect for information. **f.** Click **Add**.
Network Load Balancer	**a.** Drag and drop the Network load balancer device into the box below. **b.** In the **Service node** dialog box, click on the **Select Network Load Balancer** and click to choose a Network Load Balancer in the left column then click **Add**. **c.** If you want to enable the user-based redirect function on the *consumer* side of the network load balancer, in the **Consumer Connector Type** field, place a check in the box next to the **Redirect** option. **d.** If you want to enable the user-based redirect function on the *provider* side of the network load balancer, in the **Provider Connector Type** field, place a check in the box next to the **Redirect** option. **e.** Click **Add**.

Step 5 Click **Save** when finished.

Step 6 The **EPG Communication** dialog box appears. Click on the **Go to details** to verify the Service Graph template.

Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI

This section explains how to deploy Layer 4 to Layer 7 services. This procdure is applicable for single node as well multinode deployments.

Before you begin

- You have configured the devices.
- You have configured a service graph.

Step 1 Click the **Intent** icon. The **Intent** menu appears.

Step 2 Click the drop-down arrow below the **Intent** search box and choose **Configuration**.

A list of **Configuration** options appear in the **Intent** menu.

Step 3 From the **Configuration** list in the **Intent** menu, click **EPG Communication**. The **EPG Communication** dialog box appears with the **Consumer EPGs**, **Contract**, and **Provider EPGs** information.

Step 4 To choose a contract:

a) Click **Select Contract**. The **Select Contract** dialog appears.
b) In the pane on the left side of the **Select Contract** dialog, click to choose a contract then click **Select**. The **Select Contract** dialog box closes.

Step 5 To add a consumer EPG:

a) Click **Add Consumer EPGs**. The **Select Consumer EPGs** dialog appears.
b) In the pane on the left side of the **Select Consumer EPGs** dialog, click the check box to choose a cloud EPG (for an internal facing load balancer) or a cloud external EPG (for an internet facing load balancer) then click **Select**. The **Select Consumer EPGs** dialog box closes.

Step 6 To add a provider EPG:

a) Click **Add Provider EPGs**. The **Select Provider EPGs** dialog appears.
b) In the pane on the left side of the **Select Provider EPGs** dialog, click the check box to choose a provider EPG then click **Select**. The **Select Provider EPGs** dialog box closes.

Step 7 To choose a service graph:

a) From the **EPG Communication Configuration** dialog, click **Select Service Graph**. The **Select Service Graph** dialog box appears.
b) In the pane on the left side of the **Select Service Graph** dialog, click to choose a service graph then click **Select**. The **Select Service Graph** dialog box closes.

Step 8 Under **Service Graph Preview**, click **Add Cloud Load Balancer Listener**. The **Add Cloud Load Balancer Listener** dialog appears that enables you to add listeners.

Listeners are the ports and protocols that the device will work on.

Step 9 Enter the appropriate values in each field as listed in the following *Add Cloud Load Balancer Listener Dialog Box Fields* table then continue.

Table 6: Add Cloud Load Balancer Listener Dialog Box Fields For Application Gateway

Properties	Description
Name	Enter the name of the listener.
Port	Enter the port that the device will accept traffic on.
Protocol	For Application Gateway, click to choose **HTTP** or **HTTPS**.
Security Policy	Click the drop-down list and choose a security policy (only available when **HTTPS** is chosen).
SSL Certificate	To choose an SSL certificate(only available when **HTTPS** is chosen): **a.** Click **Add SSL Certificates**. **b.** Click to place a check mark in the check box of the certificates you want to add. **c.** Choose a key ring: **1.** Click **Select Key Ring**. The **Select Key Ring** dialog appears. **2.** From the **Select Key Ring** dialog, click to choose a key ring in the left column then click **Select**. The **Select Key Ring** dialog box closes. **d.** Click the **Certificate Store** drop-down list and choose a certificate. **Note** A listener can have multiple certificates.
Add Rule	To add rule settings to the device listener, click **Add Rule**. A new row appears in the **Rules** list an the **Rules Settings** fields are enabled.

Properties	Description
Rule Settings	The **Rule Settings** pane contains the following options: • **Name**—Enter a name for the rule. • **Host**—Enter a hostname to create a host-based condition. When a request is made for this hostname, the action you specify is taken. • **Path**—Enter a path to create a path-based condition. When a request is made for this path, the action you specify is taken. • **Type**—The action type tells the device which action to take. The action type options: • **Return fixed response**—Returns a response using the following options: • **Fixed Response Body**—Enter a response message. • **Fixed Response Code**—Enter a response code. • **Fixed response Content-Type**—Choose a content type. • **Forward**—Forwards traffic using the following options: • **Port**—Enter the port that the device will accept traffic on. • **Protocol**—Click to choose **HTTP** or **HTTPS**. • **Provider EPG**—The EPG with the web server that handles the traffic. • **EPG**—To choose an EPG: **a.** Click **Select EPG**. The **Select EPG** dialog box appears. **b.** From the **Select EPG** dialog ox, click to choose an EPG in the left column then click **Select**. The **Select EPG** dialog box closes. • **Redirect**—Redirects requests to another location using the following options: • **Redirect Code**—Click the **Redirect Code** drop-down list and choose a code. • **Redirect Hostname**—Enter a hostname for the redirect. • **Redirect Path**—Enter a redirect path. • **Redirect Port**—Enter the port that the device will accept traffic on. • **Redirect Protocol**—Click to the **Redirect Protocol** drop-down list and choose **HTTP**, **HTTPS**, or **Inherit**. • **Redirect Query**—Enter a redirect query.

Properties	Description
Health Checks	The Application load balancer performs health checks on its backend pool targets for high availability.This can be configured under health checks: • **Protocol**-Click to choose **HTTP** or **HTTPS**. • **Path** - Enter the path. Default is / • **Port**-Enter a port on which health checks should be performed. • **Advanced Settings**- **Unhealthy Threshold**-Configure this threshold to determine when a backend target is advertised as unhealthy. • **Timeout** - Enter the value for health check timeout. • **Interval**-Enter a time in seconds to determine at what intervals checks should be performed. • **Success Code** - Enter the success code. Default is 200-399. • **Use host from rule** - Click on the checkbox if the hostname needs to be picked from the rule. • **Host** - If **Use host from rule** is not checked, provide the hostname to be used for health check. Click **Add Rule** when finished.

Table 7: Add Cloud Load Balancer Listener Dialog Box Fields for Network Load Balancer

Properties	Description
Name	Enter the name of the listener.
Port	Enter the port that the device will accept traffic on.
Protocol	Click to choose **TCP** or **UDP**.

Properties	Description
Rule Settings	The **Rule Settings** pane contains the following options: • **Name**—Enter a name for the rule. • **Port**—Enter the port on which the backend pool servers will accept traffic from the load balancer. • **Protocol**-Click to choose **TCP** or **UDP**. • **Provider EPG**-The EPG with the web servers handling traffic. • **Type** • **Forward**-The action type tells the device which action to take. The action type here is always **Forward**. Here the traffic is forwarded to the Port for EPG selected using the protocol chosen above. • **HA Port**- If you want to load balance traffic incoming on all the ports, instead of adding those many listeners a listener rule type 'HA Ports' can be configured for the same. This is a feature of ONLY the internal-facing load balancer.
Health Checks	The load balancer performs health checks on its backend pool targets for high availability. This can be configured here. · • **Protocol**-Click to choose **TCP**, **HTTP** or **HTTPS**. • **Port**-Enter a port on which health checks should be performed. • **Advanced Settings**- **Unhealthy Threshold**-Configure this threshold to determine when a backend target is advertised as unhealthy. • **Interval**-Enter a time in seconds to determine at what intervals checks should be performed. Click **Add Rule** when finished.

Step 10 Click **Add** when finished.
The service graph is deployed.

Deploying a Service Graph Using the REST API

The following sections describe how to deploy a service graph using the REST API.

Creating an Internal-Facing Load Balancer Using the REST API

This example demonstrates how to create an internal-facing load balancer using the REST API.

Step 1 To create an internal-facing load balancer for Application Gateway:

Example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- api/node/mo/uni/.xml -->
<polUni>
    <fvTenant name="tn15">
        <fvRsCloudAccount tDn="uni/tn-infra/act-[<subscription id>]-vendor-azure" />

        <cloudLB scheme="internal" type="application" name="alb-151-15" status="">
            <cloudRsLDevToCloudSubnet
tDn="uni/tn-tn15/ctxprofile-cProfilewestus151/cidr-[15.151.0.0/16]/subnet-[15.151.2.0/24]"/>
        </cloudLB>

      </fvTenant>
</polUni>
```

Step 2 To create an internal-facing load balancer for Azure Load Balancing:

Example:

```
<?xml version="1.0" encoding="UTF-8"?>

<!-- api/node/mo/uni/.xml -->

<polUni>

<fvTenant name="tn15">

<fvRsCloudAccount tDn="uni/tn-infra/act-[subscription id]-vendor-azure" />

<cloudLB scheme="internal" type="network" name="nlb-151-15" status="">

<cloudRsLDevToCloudSubnet
tDn="uni/tn-tn15/ctxprofile-cProfilewestus151/cidr-[15.151.0.0/16]/subnet-[15.151.2.0/24]" />

</cloudLB>

</fvTenant>

</polUni>
```

Configuring an Internet-Facing Load Balancer Using the REST API

This example demonstrates how to create an internet-facing load balancer using the REST API.

Step 1 To create an internet-facing load balancer for Application Gateway:

Example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- api/node/mo/uni/.xml -->
<polUni>
    <fvTenant name="tn15">
        <fvRsCloudAccount tDn="uni/tn-infra/act-[<subscription id>]-vendor-azure" />

        <cloudLB scheme="internet" type="application" name="alb-151-15" status="">
```

```
            <cloudRsLDevToCloudSubnet
tDn="uni/tn-tn15/ctxprofile-cProfilewestus151/cidr-[15.151.0.0/16]/subnet-[15.151.2.0/24]"/>
        </cloudLB>


      </fvTenant>
</polUni>
```

Step 2 To create an internet-facing load balancer for Azure Load Balancing:

Example:

```
<?xml version="1.0" encoding="UTF-8"?>

<!-- api/node/mo/uni/.xml -->

<polUni>

<fvTenant name="tn15">

<fvRsCloudAccount tDn="uni/tn-infra/act-[<subscription id>]-vendor-azure" />

<cloudLB scheme="internet" type="network" name="nlb-151-15" status="">

<cloudRsLDevToCloudSubnet
tDn="uni/tn-tn15/ctxprofile-cProfilewestus151/cidr-[15.151.0.0/16]/subnet-[15.151.2.0/24]" />

</cloudLB>

</fvTenant>

</polUni>
```

Creating a Third-Party Firewall Using the REST API

This example demonstrates how to create a third-party firewall using the REST API.

This example demonstrates how to create a third-party firewall using the REST API:

Example:

```
<cloudLDev name="HubFW" svcType="FW" status="">
    <cloudRsLDevToCtx tDn="uni/tn-infra/ctx-overlay-2"/>
    <cloudLIf name="provider">
        <cloudEPSelector name="east" matchExpression="IP=='{{eastus_FwUntrustSubnet}}'" status=""/>
    </cloudLIf>
    <cloudLIf name="consumer">
        <cloudEPSelector name="east" matchExpression="IP=='{{eastus_FwTrustSubnet}}'" status=""/>
    </cloudLIf>
</cloudLDev>
```

Creating a Service Graph Using the REST API

This example demonstrates how to create a service graph using the REST API.

Step 1 To create a service graph for Application Gateway:

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- api/node/mo/uni/.xml -->
<polUni>
    <fvTenant name="tn15">

       <vnsAbsGraph name="c15_g1" type="cloud" status="">
      <vnsAbsTermNodeProv name="p1">
        <vnsAbsTermConn/>
      </vnsAbsTermNodeProv>
      <vnsAbsTermNodeCon name="c1">
        <vnsAbsTermConn/>
      </vnsAbsTermNodeCon>
      <vnsAbsNode managed="yes" name="N1" funcType="GoTo">
          <vnsRsNodeToCloudLDev tDn="uni/tn-tn15/clb-alb-151-15"/>
        <vnsAbsFuncConn name="provider"/>
        <vnsAbsFuncConn name="consumer"/>
      </vnsAbsNode>
      <vnsAbsConnection  connDir="consumer" connType="external" name="con1">
          <vnsRsAbsConnectionConns tDn="uni/tn-tn15/AbsGraph-c15_g1/AbsTermNodeCon-c1/AbsTConn"/>
          <vnsRsAbsConnectionConns tDn="uni/tn-tn15/AbsGraph-c15_g1/AbsNode-N1/AbsFConn-consumer"/>
      </vnsAbsConnection>
      <vnsAbsConnection connDir="provider" connType="internal"  name="con2">
          <vnsRsAbsConnectionConns tDn="uni/tn-tn15/AbsGraph-c15_g1/AbsTermNodeProv-p1/AbsTConn"/>
          <vnsRsAbsConnectionConns tDn="uni/tn-tn15/AbsGraph-c15_g1/AbsNode-N1/AbsFConn-provider"/>
      </vnsAbsConnection>
  </vnsAbsGraph>

  </fvTenant>
</polUni>
```

Step 2 To create a service graph for Azure Load Balancing:

```
<?xml version="1.0" encoding="UTF-8"?>

<!-- api/node/mo/uni/.xml -->

<polUni>

<fvTenant name="tn15">

<vnsAbsGraph name="c15_g1" type="cloud" status="">

<vnsAbsTermNodeProv name="p1">

<vnsAbsTermConn />

</vnsAbsTermNodeProv>

<vnsAbsTermNodeCon name="c1">

<vnsAbsTermConn />

</vnsAbsTermNodeCon>

<vnsAbsNode managed="yes" name="N1" funcType="GoTo">

<vnsRsNodeToCloudLDev tDn="uni/tn-tn15/clb-nlb-151-15" />
```

```
<vnsAbsFuncConn name="provider" />

<vnsAbsFuncConn name="consumer" />

</vnsAbsNode>

<vnsAbsConnection connDir="consumer" connType="external" name="con1">

<vnsRsAbsConnectionConns tDn="uni/tn-tn15/AbsGraph-c15_g1/AbsTermNodeCon-c1/AbsTConn" />

<vnsRsAbsConnectionConns tDn="uni/tn-tn15/AbsGraph-c15_g1/AbsNode-N1/AbsFConn-consumer" />

</vnsAbsConnection>

<vnsAbsConnection connDir="provider" connType="internal" name="con2">

<vnsRsAbsConnectionConns tDn="uni/tn-tn15/AbsGraph-c15_g1/AbsTermNodeProv-p1/AbsTConn" />

<vnsRsAbsConnectionConns tDn="uni/tn-tn15/AbsGraph-c15_g1/AbsNode-N1/AbsFConn-provider" />

</vnsAbsConnection>

</vnsAbsGraph>

</fvTenant>

</polUni>
```

Creating a Multi-Node Service Graph Using the REST API

This example demonstrates how to create a multi-node service graph using the REST API.

To create a multi-node service graph, enter a post such as the following example;

```
<polUni>
 <fvTenant name="tn12_iar_iavpc" status="">
  <fvRsCloudAccount  tDn="uni/tn-infra/[SubscriptionId]-vendor-azure"/>
  <fvCtx name="vrf50" status=""/>
  <fvCtx name="vrf60" status=""/>
  <cloudVpnGwPol name="VgwPol0"/>
  <cloudCtxProfile name="c50" status="">
   <cloudRsCtxProfileToRegion tDn="uni/clouddomp/provp-azure/region-westus"/>
   <cloudRsToCtx tnFvCtxName="vrf50"/>
   <cloudRsCtxProfileToGatewayRouterP tDn="uni/tn-infra/gwrouterp-default" status=""/>
   <cloudCidr addr="12.3.0.0/16" primary="true" status="">
    <cloudSubnet ip="12.3.30.0/24" status="" name="GatewaySubnet" usage="gateway">
     <cloudRsZoneAttach tDn="uni/clouddomp/provp-azure/region-westus/zone-default"/>
    </cloudSubnet>
    <cloudSubnet ip="12.3.2.0/24" status="" name="ALBSubnet">
     <cloudRsZoneAttach tDn="uni/clouddomp/provp-azure/region-westus/zone-default"/>
    </cloudSubnet>
    <cloudSubnet ip="12.3.1.0/24" status="" name="FwMgmtSubnet">
     <cloudRsZoneAttach tDn="uni/clouddomp/provp-azure/region-westus/zone-default"/>
    </cloudSubnet>
    <cloudSubnet ip="12.3.3.0/24" status="" name="FwUntrustSubnet">
     <cloudRsZoneAttach tDn="uni/clouddomp/provp-azure/region-westus/zone-default"/>
    </cloudSubnet>
    <cloudSubnet ip="12.3.4.0/24" status="" name="FwTrustSubnet">
```

```
    <cloudRsZoneAttach tDn="uni/clouddomp/provp-azure/region-westus/zone-default"/>
   </cloudSubnet>
   <cloudSubnet ip="12.3.5.0/24" status="" name="ConsumerSubnet">
    <cloudRsZoneAttach tDn="uni/clouddomp/provp-azure/region-westus/zone-default"/>
   </cloudSubnet>
  </cloudCidr>
 </cloudCtxProfile>
 <cloudCtxProfile name="c60" status="">
  <cloudRsCtxProfileToRegion tDn="uni/clouddomp/provp-azure/region-westus2"/>
  <cloudRsToCtx tnFvCtxName="vrf60"/>
  <cloudRsCtxProfileToGatewayRouterP tDn="uni/tn-infra/gwrouterp-default" status=""/>
  <cloudCidr addr="12.4.0.0/16" primary="true" status="">
   <cloudSubnet ip="12.4.1.0/24" status="" name="ProviderSubnet">
    <cloudRsZoneAttach tDn="uni/clouddomp/provp-azure/region-westus2/zone-default"/>
   </cloudSubnet>
   <cloudSubnet ip="12.4.2.0/24" status="" name="NLBSubnet">
    <cloudRsZoneAttach tDn="uni/clouddomp/provp-azure/region-westus2/zone-default"/>
   </cloudSubnet>
   <cloudSubnet ip="12.4.30.0/24" status="" name="GatewaySubnet" usage="gateway">
    <cloudRsZoneAttach tDn="uni/clouddomp/provp-azure/region-westus2/zone-default"/>
   </cloudSubnet>
  </cloudCidr>
 </cloudCtxProfile>
 <cloudApp name="ap50" status="">
  <cloudEPg name="ap50vrf50epg1" status="">
   <cloudRsCloudEPgCtx tnFvCtxName="vrf50"/>
   <fvRsCons tnVzBrCPName="con50"/>
   <fvRsProv tnVzBrCPName="con60"/>
   <cloudEPSelector matchExpression="IP=='12.3.5.0/24'" name="100"/>
  </cloudEPg>
  <cloudEPg name="ap50vrf50epg2" status="">
   <cloudRsCloudEPgCtx tnFvCtxName="vrf50"/>
   <fvRsProv tnVzBrCPName="con60"/>
   <cloudEPSelector matchExpression="IP=='12.3.1.0/24'" name="100"/>
  </cloudEPg>
  <cloudExtEPg routeReachability="internet" name="ap50extepg1">
   <cloudExtEPSelector name="1" subnet="0.0.0.0/0"/>
   <cloudRsCloudEPgCtx tnFvCtxName="vrf50"/>
   <fvRsCons tnVzBrCPName="con60"/>
  </cloudExtEPg>
 </cloudApp>
 <cloudApp name="ap60" status="">
  <cloudEPg name="ap60vrf60epg1" status="">
   <cloudRsCloudEPgCtx tnFvCtxName="vrf60"/>
   <fvRsProv tnVzBrCPName="con50"/>
   <fvRsProv tnVzBrCPName="con70"/>
   <cloudEPSelector matchExpression="IP=='12.4.1.0/24'" name="100"/>
  </cloudEPg>
  <cloudExtEPg routeReachability="internet" name="ap60extepg1">
   <cloudExtEPSelector name="1" subnet="0.0.0.0/0"/>
   <cloudRsCloudEPgCtx tnFvCtxName="vrf60"/>
   <fvRsCons tnVzBrCPName="con70"/>
  </cloudExtEPg>
 </cloudApp>
 <vzBrCP name="con50" scope="tenant" status="">
  <vzSubj name="con50">
   <vzRsSubjFiltAtt tnVzFilterName="f10"/>
   <vzRsSubjGraphAtt tnVnsAbsGraphName="g1" status=""/>
  </vzSubj>
 </vzBrCP>
 <vzBrCP name="con60" scope="tenant" status="">
  <vzSubj name="con60">
   <vzRsSubjFiltAtt tnVzFilterName="f20"/>
  </vzSubj>
```

```
  </vzBrCP>
  <vzBrCP name="con70" scope="context" status="">
   <vzSubj name="con70">
    <vzRsSubjFiltAtt tnVzFilterName="f20"/>
   </vzSubj>
  </vzBrCP>
  <vzFilter name="f10" status="">
   <vzEntry etherT="ip" prot="icmp" name="f10entry1" status=""/>
   <vzEntry etherT="ip" prot="udp" dFromPort="1" dToPort="65535" name="f10entry2" status=""/>
   <vzEntry etherT="ip" prot="tcp" dFromPort="1" dToPort="65535" name="f10entry3" status=""/>
  </vzFilter>
  <vzFilter name="f20" status="">
   <vzEntry etherT="ip" prot="tcp" dFromPort="http" dToPort="http" name="f20entry1" status=""/>
   <vzEntry etherT="ip" prot="tcp" dFromPort="https" dToPort="https" name="f20entry2" status=""/>
   <vzEntry etherT="ip" prot="tcp" dFromPort="22" dToPort="22" name="f20entry3" status=""/>
  </vzFilter>
  <cloudLB name="FrontALB" type="application" scheme="internal" >
   <cloudRsLDevToCloudSubnet
tDn="uni/tn-tn12_iar_iavpc/ctxprofile-c50/cidr-[12.3.0.0/16]/subnet-[12.3.2.0/24]"/>
  </cloudLB>
  <cloudLDev name="FW" svcType="FW" status="">
   <cloudRsLDevToCtx tDn="uni/tn-tn12_iar_iavpc/ctx-vrf50" />
   <cloudLIf name="provider" >
    <cloudEPSelector name="1" matchExpression="custom:tagp=='trustFW'"/>
   </cloudLIf>
   <cloudLIf name="consumer" >
    <cloudEPSelector name="1" matchExpression="custom:tagp=='untrustFW'"/>
   </cloudLIf>
  </cloudLDev>
  <cloudLB name="BackNLB" type="network" scheme="internal" >
   <cloudRsLDevToCloudSubnet
tDn="uni/tn-tn12_iar_iavpc/ctxprofile-c60/cidr-[12.4.0.0/16]/subnet-[12.4.2.0/24]"/>
  </cloudLB>
  <vnsAbsGraph name="g1" type="cloud" status=""  >
   <vnsAbsTermNodeProv name="Input1" >
    <vnsAbsTermConn  name="C1"/>
   </vnsAbsTermNodeProv>
   <vnsAbsTermNodeCon descr="" name="Output1" nameAlias="" ownerKey="" ownerTag="">
    <vnsAbsTermConn name="C2" />
   </vnsAbsTermNodeCon>
   <vnsAbsNode funcType="GoTo" name="N1" managed="yes" funcTemplateType="ADC_ONE_ARM" >
    <vnsRsNodeToCloudLDev tDn="uni/tn-tn12_iar_iavpc/clb-FrontALB" />
    <vnsAbsFuncConn attNotify="no" descr="" name="provider" nameAlias="" ownerKey="" ownerTag=""/>
    <vnsAbsFuncConn attNotify="no" descr="" name="consumer" nameAlias="" ownerKey="" ownerTag=""/>
    <cloudSvcPolicy tenantName="tn12_iar_iavpc" contractName="con50" subjectName="con50" >
     <cloudListener name="http_listener1" port="80" protocol="http">
      <cloudListenerRule name="rule1" priority="20" default="yes" >
       <cloudRuleAction type="forward" port="80" protocol="http"/>
      </cloudListenerRule>
     </cloudListener>
    </cloudSvcPolicy>
   </vnsAbsNode>
   <vnsAbsNode funcType="GoTo" name="N2" managed="no" funcTemplateType="ADC_TWO_ARM" >
    <vnsRsNodeToCloudLDev tDn="uni/tn-tn12_iar_iavpc/cld-FW" />
    <vnsAbsFuncConn attNotify="no" descr="" connType="snat_dnat" name="provider" nameAlias=""
ownerKey="" ownerTag=""/>
    <vnsAbsFuncConn attNotify="no" descr="" connType="none" name="consumer" nameAlias="" ownerKey=""
 ownerTag=""/>
   </vnsAbsNode>
   <vnsAbsNode funcType="GoTo" name="N3" managed="yes" funcTemplateType="ADC_ONE_ARM" >
    <vnsRsNodeToCloudLDev tDn="uni/tn-tn12_iar_iavpc/clb-BackNLB" />
    <vnsAbsFuncConn attNotify="no" descr="" name="provider" nameAlias="" ownerKey="" ownerTag=""/>
    <vnsAbsFuncConn attNotify="no" descr="" name="consumer" nameAlias="" ownerKey="" ownerTag=""/>
    <cloudSvcPolicy tenantName="tn12_iar_iavpc" contractName="con50" subjectName="con50" >
```

```
     <cloudListener name="http_listener1" port="80" protocol="tcp">
      <cloudListenerRule name="rule1" priority="20" default="yes" >
       <cloudRuleAction type="forward" port="80" protocol="tcp"
epgdn="uni/tn-tn12_iar_iavpc/cloudapp-ap60/cloudepg-ap60vrf60epg1"/>
      </cloudListenerRule>
     </cloudListener>
    </cloudSvcPolicy>
   </vnsAbsNode>
   <vnsAbsConnection connDir="provider" connType="external" name="CON4">
    <vnsRsAbsConnectionConns tDn="uni/tn-tn12_iar_iavpc/AbsGraph-g1/AbsNode-N3/AbsFConn-provider"/>
    <vnsRsAbsConnectionConns tDn="uni/tn-tn12_iar_iavpc/AbsGraph-g1/AbsTermNodeProv-Input1/AbsTConn"/>

   </vnsAbsConnection>
   <vnsAbsConnection  connDir="consumer" connType="external" name="CON1">
    <vnsRsAbsConnectionConns tDn="uni/tn-tn12_iar_iavpc/AbsGraph-g1/AbsTermNodeCon-Output1/AbsTConn"/>

    <vnsRsAbsConnectionConns tDn="uni/tn-tn12_iar_iavpc/AbsGraph-g1/AbsNode-N1/AbsFConn-consumer"/>
   </vnsAbsConnection>
   <vnsAbsConnection  connDir="consumer" connType="external" name="CON2">
    <vnsRsAbsConnectionConns tDn="uni/tn-tn12_iar_iavpc/AbsGraph-g1/AbsNode-N1/AbsFConn-provider"/>
    <vnsRsAbsConnectionConns tDn="uni/tn-tn12_iar_iavpc/AbsGraph-g1/AbsNode-N2/AbsFConn-consumer"/>
   </vnsAbsConnection>
   <vnsAbsConnection  connDir="consumer" connType="external" name="CON3">
    <vnsRsAbsConnectionConns tDn="uni/tn-tn12_iar_iavpc/AbsGraph-g1/AbsNode-N2/AbsFConn-provider"/>
    <vnsRsAbsConnectionConns tDn="uni/tn-tn12_iar_iavpc/AbsGraph-g1/AbsNode-N3/AbsFConn-consumer"/>
   </vnsAbsConnection>
  </vnsAbsGraph>
 </fvTenant>
</polUni>
```

Creating a Multi-Node Service Graph With Redirect Using the REST API

This example demonstrates how to create a multi-node service graph with redirect using the REST API.

Step 1 To set up the infra tenant:

```
<polUni>
    <fabricInst>
        <commPol name="default">
            <commSsh name="ssh" adminSt="enabled" passwordAuth="enabled" />
        </commPol>
        <dnsProfile name="default">
            <dnsProv addr="172.23.136.143" preferred="yes" status=""/>
        </dnsProfile>
    </fabricInst>
   <fvTenant name="infra">
      <fvRsCloudAccount tDn="uni/tn-infra/act-[{{subscriptionId}}]-vendor-azure"/>
      <cloudAccount name="insbu" id="{{subscriptionId}}" vendor="azure" accessType="credentials"
status="">
        <cloudRsCredentials tDn="uni/tn-infra/credentials-cApicApp"/>
      </cloudAccount>
      <cloudCredentials name="cApicApp" keyId="{{accessKeyId}}" key="{{accessKey}}" httpProxy="">
        <cloudRsAD tDn="uni/tn-infra/ad-{{adId}}"/>
      </cloudCredentials>
    <cloudAD name="CiscoINSBUAd" id="{{adId}}" />
    <cloudApicSubnetPool subnet="10.10.1.0/24" />
    <cloudtemplateInfraNetwork name="default" numRoutersPerRegion="2" vrfName="overlay-1"
numRemoteSiteSubnetPool="1" status="">
         <cloudtemplateProfile name="default" routerUsername="cisco" routerPassword="ins3965" />
```

```
         <cloudtemplateExtSubnetPool subnetpool="11.11.0.0/16" status=""/>
         <cloudtemplateExtNetwork name="default" status="">
            <cloudRegionName provider="azure" region="{{region}}" />
            <cloudtemplateVpnNetwork name="default">
               <cloudtemplateIpSecTunnel peeraddr="{{peerAddress}}"/>
               <cloudtemplateOspf area="0.0.0.1" />
            </cloudtemplateVpnNetwork>
         </cloudtemplateExtNetwork>
         <cloudtemplateIntNetwork name="default">
            <cloudRegionName provider="azure" region="{{region}}"/>
         </cloudtemplateIntNetwork>
    </cloudtemplateInfraNetwork>
   </fvTenant>
   <cloudDomP>
      <cloudBgpAsP asn="1111"/>
      <cloudProvP vendor="azure">
         <cloudRegion adminSt="managed" name="{{region}}">
            <cloudZone name="default"/>
         </cloudRegion>
      </cloudProvP>
  </cloudDomP>
</polUni>
```

Step 2 To configure the service device in the hub VNet:

```
<polUni>
    <fvTenant name="infra">
        <fvRsCloudAccount tDn="uni/tn-infra/act-[{{subscriptionId}}]-vendor-azure"/>
        <cloudCtxProfile name="ct_ctxprofile_{{region}}" status="modified">
           <cloudRsCtxProfileToRegion status="" tDn="uni/clouddomp/provp-azure/region-{{region}}"/>

            <cloudCidr name="cidr1" addr="{{HubCidrSvc}}" primary="no" status="">
                <cloudSubnet ip="{{HubNLBSubnet}}" name="HubNLBSubnet" status="">
                    <cloudRsZoneAttach status=""
tDn="uni/clouddomp/provp-azure/region-{{region}}/zone-default"/>
                </cloudSubnet>
                <cloudSubnet ip="{{HubFWSubnetInt}}" name="HubFWSubnetInt" status="">
                    <cloudRsZoneAttach status=""
tDn="uni/clouddomp/provp-azure/region-{{region}}/zone-default"/>
                </cloudSubnet>
                <cloudSubnet ip="{{HubFWSubnetExt}}" name="HubFWSubnetExt" status="">
                    <cloudRsZoneAttach status=""
tDn="uni/clouddomp/provp-azure/region-{{region}}/zone-default"/>
                </cloudSubnet>
                <cloudSubnet ip="{{HubFWMgmtSubnet}}" name="HubFWMgmtSubnet" status="">
                    <cloudRsZoneAttach status=""
tDn="uni/clouddomp/provp-azure/region-{{region}}/zone-default"/>
                </cloudSubnet>
                <cloudSubnet ip="{{ConsHubEPgSubnet}}" name="ConsHubEPgSubnet" status="">
                    <cloudRsZoneAttach status=""
tDn="uni/clouddomp/provp-azure/region-{{region}}/zone-default"/>
                </cloudSubnet>
             </cloudCidr>
        </cloudCtxProfile>
        <cloudLDev name="{{FWName}}" status="">
            <cloudRsLDevToCtx tDn="uni/tn-infra/ctx-{{ServicevVNetName}}"/>
            <cloudLIf name="external" >
                <cloudEPSelector matchExpression="custom:EPG=='FwExt'"  name="1"/>
            </cloudLIf>
            <cloudLIf name="internal" >
               <cloudEPSelector matchExpression="custom:EPG=='FwInt'"  name="1"/>
            </cloudLIf>
        </cloudLDev>
```

```
        <cloudLB name="{{NLBName}}" type="network" scheme="internal" size="small" instanceCount="2"
 status="">
            <cloudRsLDevToCloudSubnet
tDn="uni/tn-infra/ctxprofile-ct_ctxprofile_{{region}}/cidr-[{{HubCidrSvc}}]/subnet-[{{HubNLBSubnet}}]"
 status=""/>
        </cloudLB>
    </fvTenant>
</polUni>
```

Step 3 To configure a provider and the graph in a spoke:

```
<polUni>
    <fvTenant name="{{tnNameProv}}" status="" >
        <fvRsCloudAccount tDn="uni/tn-infra/act-[{{subscriptionId}}]-vendor-azure"/>
        <fvCtx name="{{ProviderVNetName}}"/>
        <cloudCtxProfile name="{{ProviderVNetName}}" status="">
            <cloudRsCtxProfileToGatewayRouterP tDn="uni/tn-infra/gwrouterp-default" status=""/>
           <cloudRsCtxProfileToRegion status="" tDn="uni/clouddomp/provp-azure/region-{{region}}"/>

            <cloudRsToCtx tnFvCtxName="{{ProviderVNetName}}"/>
            <cloudCidr name="cidr1" addr="{{VnetCidrProv}}" primary="yes" status="">
                <cloudSubnet ip="{{ProviderSubnet}}" name="ProviderSubnet" status="">
                    <cloudRsZoneAttach status=""
tDn="uni/clouddomp/provp-azure/region-{{region}}/zone-default"/>
                </cloudSubnet>
                <cloudSubnet ip="{{BackALBSubnet}}" name="BackALBSubnet" status="">
                    <cloudRsZoneAttach status=""
tDn="uni/clouddomp/provp-azure/region-{{region}}/zone-default"/>
                </cloudSubnet>
            </cloudCidr>
        </cloudCtxProfile>
        <!-- contract-->
        <vzFilter descr="" name="HttpsFilter" ownerKey="" ownerTag="">
            <vzEntry dFromPort="443" dToPort="443" etherT="ip" name="https" prot="tcp" status=""/>
            <vzEntry dFromPort="80" dToPort="80" etherT="ip" name="http" prot="tcp" status=""/>
            <vzEntry dFromPort="22" dToPort="22" etherT="ip" name="ssh" prot="tcp" status=""/>
        </vzFilter>
        <vzBrCP name="{{contractName}}" scope="global" status="">
            <vzSubj name="Sub1" revFltPorts="yes">
                <vzRsSubjGraphAtt directives="" tnVnsAbsGraphName="{{graphName}}"/>
                <vzRsSubjFiltAtt tnVzFilterName="HttpsFilter"/>
            </vzSubj>
        </vzBrCP>
        <!-- cloud App Profile-->
        <cloudApp name="provApp" status="">
            <cloudEPg name="App" status="">
                <cloudRsCloudEPgCtx tnFvCtxName="{{ProviderVNetName}}"/>
                <cloudEPSelector matchExpression="custom:EPG=='App'" name="1"/>
                <fvRsProv status="" tnVzBrCPName="{{contractName}}"/>
                <fvRsProv tnVzBrCPName="mgmt_common"/>
            </cloudEPg>
        </cloudApp>
        <!-- Abs Graph Creation -->
        <vnsAbsGraph name="{{graphName}}" uiTemplateType="UNSPECIFIED" type="cloud">
            <vnsAbsTermNodeProv name="T2">
                <vnsOutTerm/>
                <vnsInTerm />
                <vnsAbsTermConn attNotify="no" name="1" />
            </vnsAbsTermNodeProv>
            <vnsAbsTermNodeCon name="T1" >
                <vnsOutTerm/>
                <vnsInTerm />
                <vnsAbsTermConn attNotify="no" name="1" />
```

```
            </vnsAbsTermNodeCon>
            <vnsAbsNode  name="{{NLBName}}" managed="yes" >
                <vnsRsNodeToCloudLDev tDn="uni/tn-infra/clb-{{NLBName}}" status=""/>
                <cloudSvcPolicy tenantName="{{tnNameProv}}" contractName="{{contractName}}"
subjectName="Sub1" status="">
                  <cloudHealthProbe name="http_listener1-rule1" protocol="tcp" port=22 interval=15
 unhealthyThreshold=2/>
                   <cloudListener name="http_listener1" port="80" protocol="tcp" status="">
                       <cloudListenerRule name="rule1" default="true">
                           <cloudRuleAction type="haPort" port="80" protocol="tcp"
healthProbe="http_listener1-rule1"/>
                       </cloudListenerRule>
                   </cloudListener>
                </cloudSvcPolicy>
                <vnsAbsFuncConn attNotify="no" name="provider" connType="redir"/>
                <vnsAbsFuncConn attNotify="no" name="consumer" connType="redir"/>
            </vnsAbsNode>
            <vnsAbsNode funcTemplateType="FW_ROUTED" name="{{FWName}}" managed="no">
                <vnsRsNodeToCloudLDev tDn="uni/tn-infra/cld-{{FWName}}" />
                <vnsAbsFuncConn attNotify="no" name="consumer" deviceLIfName="internal"/>
                <vnsAbsFuncConn attNotify="no" name="provider" deviceLIfName="internal"/>
            </vnsAbsNode>
            <vnsAbsNode  name="{{BackALBName}}" managed="yes">
                <vnsRsNodeToCloudLDev tDn="uni/tn-{{tnNameProv}}/clb-{{BackALBName}}"/>
                <cloudSvcPolicy tenantName="{{tnNameProv}}" contractName="{{contractName}}"
subjectName="Sub1" status="">
                   <cloudListener name="http_listener1" port="80" protocol="http" status="">
                       <cloudListenerRule name="rule1" default="true">
                           <cloudRuleAction type="forward" port="80" protocol="http"
epgdn="uni/tn-{{tnNameProv}}/cloudapp-provApp/cloudepg-App"/>
                       </cloudListenerRule>
                   </cloudListener>
                </cloudSvcPolicy>
                <vnsAbsFuncConn attNotify="no" name="provider"/>
                <vnsAbsFuncConn attNotify="no" name="consumer"/>
            </vnsAbsNode>
           <vnsAbsConnection adjType="L3" connDir="provider" connType="external" directConnect="no"
 name="ConsTermToNLB">
                <vnsRsAbsConnectionConns
tDn="uni/tn-{{tnNameProv}}/AbsGraph-{{graphName}}/AbsTermNodeCon-T1/AbsTConn"/>
                <vnsRsAbsConnectionConns
tDn="uni/tn-{{tnNameProv}}/AbsGraph-{{graphName}}/AbsNode-{{NLBName}}/AbsFConn-consumer"/>
            </vnsAbsConnection>
           <vnsAbsConnection adjType="L3" connDir="provider" connType="external" directConnect="no"
 name="NLBToFW">
                <vnsRsAbsConnectionConns
tDn="uni/tn-{{tnNameProv}}/AbsGraph-{{graphName}}/AbsNode-{{NLBName}}/AbsFConn-provider" />
                <vnsRsAbsConnectionConns
tDn="uni/tn-{{tnNameProv}}/AbsGraph-{{graphName}}/AbsNode-{{FWName}}/AbsFConn-consumer"/>
            </vnsAbsConnection>
           <vnsAbsConnection adjType="L3" connDir="provider" connType="external" directConnect="no"
 name="FWToBackALB">
                <vnsRsAbsConnectionConns
tDn="uni/tn-{{tnNameProv}}/AbsGraph-{{graphName}}/AbsNode-{{FWName}}/AbsFConn-provider" />
                <vnsRsAbsConnectionConns
tDn="uni/tn-{{tnNameProv}}/AbsGraph-{{graphName}}/AbsNode-{{BackALBName}}/AbsFConn-consumer"/>
            </vnsAbsConnection>
           <vnsAbsConnection adjType="L3" connDir="provider" connType="external" directConnect="no"
 name="BackALBToProv">
                <vnsRsAbsConnectionConns
tDn="uni/tn-{{tnNameProv}}/AbsGraph-{{graphName}}/AbsNode-{{BackALBName}}/AbsFConn-provider" />
                <vnsRsAbsConnectionConns
tDn="uni/tn-{{tnNameProv}}/AbsGraph-{{graphName}}/AbsTermNodeProv-T2/AbsTConn"/>
            </vnsAbsConnection>
```

```
        </vnsAbsGraph>
        <cloudLB name="{{BackALBName}}" type="application" scheme="internal" size="small"
instanceCount="2">
            <cloudRsLDevToCloudSubnet
tDn="uni/tn-{{tnNameProv}}/ctxprofile-{{ProviderVNetName}}/cidr-[{{VnetCidrProv}}]/subnet-[{{BackALBSubnet}}]"
 status=""/>
        </cloudLB>
  </fvTenant>
</polUni>
```

Step 4 To configure the consumer and import the contract defined in the provider:

```
<polUni>
    <fvTenant name="{{tnNameCons}}" >
        <fvRsCloudAccount tDn="uni/tn-infra/act-[{{subscriptionId}}]-vendor-azure"/>
        <fvCtx name="{{ConsumerVNetName}}"/>
        <cloudCtxProfile name="{{ConsumerVNetName}}" status="">
            <cloudRsCtxProfileToGatewayRouterP tDn="uni/tn-infra/gwrouterp-default" status=""/>
           <cloudRsCtxProfileToRegion status="" tDn="uni/clouddomp/provp-azure/region-{{region}}"/>

            <cloudRsToCtx tnFvCtxName="{{ConsumerVNetName}}"/>
            <cloudCidr name="cidr1" addr="{{VnetCidrCons}}" primary="yes" status="">
                <cloudSubnet ip="{{ConsumerSubnet}}" name="ConsumerSubnet" status="">
                    <cloudRsZoneAttach status=""
tDn="uni/clouddomp/provp-azure/region-{{region}}/zone-default"/>
                </cloudSubnet>
            </cloudCidr>
        </cloudCtxProfile>
        <vzCPIf name="imported_{{contractName}}">
            <vzRsIf tDn="uni/tn-{{tnNameProv}}/brc-{{contractName}}" />
        </vzCPIf>
        <!-- cloud App Profile-->
        <cloudApp name="consApp" status="">
            <cloudEPg name="Web" status="">
                <cloudRsCloudEPgCtx tnFvCtxName="{{ConsumerVNetName}}"/>
                <cloudEPSelector matchExpression="custom:EPG=='Web'" name="1"/>
                <fvRsConsIf tnVzCPIfName="imported_{{contractName}}"/>
                <fvRsProv tnVzBrCPName="mgmt_common"/>
            </cloudEPg>
        </cloudApp>
  </fvTenant>
</polUni>
```

Attaching a Service Graph Using the REST API

This example demonstrates how to attach a service graph using the REST API.

Step 1 To attach a service graph for Application Gateways:

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- api/node/mo/uni/.xml -->
<polUni>
    <fvTenant name="tn15">

    <vzBrCP name="c1">
        <vzSubj name="c1">
            <vzRsSubjGraphAtt tnVnsAbsGraphName="c15_g1"/>
      </vzSubj>
```

```
    </vzBrCP>

  </fvTenant>
</polUni>
```

Step 2 To attach a service graph for Azure Load Balancing:

```
<?xml version="1.0" encoding="UTF-8"?>

<!-- api/node/mo/uni/.xml -->

<polUni>

<fvTenant name="tn15">

<vzBrCP name="c1">

<vzSubj name="c1">

<vzRsSubjGraphAtt tnVnsAbsGraphName="c15_g1" />

</vzSubj>

</vzBrCP>

</fvTenant>

</polUni>
```

Configuring an HTTP Service Policy Using the REST API

This example demonstrates how to create an HTTP service policy using the REST API.

Step 1 To create an HTTP service policy for Application Gateways:

```
<polUni>
  <fvTenant name="t2">
    <vnsAbsGraph name="CloudGraph" type="cloud" status="">
      <vnsAbsNode funcType="GoTo" name="N1" managed="yes">
        <cloudSvcPolicy tenantName="t2" contractName="httpFamily" subjectName="consubj">
          <cloudListener name="http_listener1" port="80" protocol="http" status="">
            <cloudListenerRule name="rule1" priority="10" default="yes" status="">
              <cloudRuleAction type="forward" port="80" protocol="http"
epgdn="uni/tn-t2/cloudapp-ap/cloudepg-provEPG"/>
            </cloudListenerRule>
            <cloudListenerRule name="redirectRule" priority="20">
              <cloudRuleCondition type="path" value="/img/*"/>
              <cloudRuleAction type="redirect" RedirectPort="8080"/>
            </cloudListenerRule>
            <cloudListenerRule name="FixedRspRule" priority="30">
              <cloudRuleCondition type="host" value="example.com"/>
              <cloudRuleAction type="fixedResponse" FixedResponseCode="200"/>
            </cloudListenerRule>
            <cloudListenerRule name="redirectHPRule" priority="40" status="">
              <cloudRuleCondition type="host" value="example.com"/>
              <cloudRuleCondition type="path" value="/img/*"/>
              <cloudRuleAction type="forward" port="80" protocol="http"
epgdn="uni/tn-t2/cloudapp-ap/cloudepg-provEPG"/>
            </cloudListenerRule>
```

```
          </cloudListener>
        </cloudSvcPolicy>
      </vnsAbsNode>
    </vnsAbsGraph>
  </fvTenant>
</polUni>
```

Step 2 To create an HTTP service policy for Azure Load Balancing:

```
<?xml version="1.0" encoding="UTF-8"?>

<polUni>

<fvTenant name="tn15">

<vnsAbsGraph name="CloudGraph" type="cloud" status="">

<vnsAbsNode funcType="GoTo" name="N1" managed="yes">

<cloudSvcPolicy tenantName=" tn15" contractName="httpFamily" subjectName="consubj">

<cloudListener name="tcp_listener" port="80" protocol="tcp" status="">

<cloudListenerRule name="rule1" priority="10" default="yes" status="">

<cloudRuleAction type="forward" port="80" protocol="tcp" epgdn="uni/tn-
tn15/cloudapp-ap/cloudepg-provEPG" />

</cloudListenerRule>

</cloudListener>

<cloudListener name="udp_listener" port="55" protocol="udp" status="">

<cloudListenerRule name="rule1" priority="10" default="yes" status="">

<cloudRuleAction type="forward" port="55" protocol="udp" epgdn="uni/tn-
tn15/cloudapp-ap/cloudepg-provEPG" />

</cloudListenerRule>

</cloudListener>

</cloudSvcPolicy>

</vnsAbsNode>

</vnsAbsGraph>

</fvTenant>

</polUni>
```

Configuring a Key Ring Using the REST API

This example demonstrates how to configure a key ring using the REST API. For more information about key ring configuration, see the *Cisco APIC Basic Configuration Guide*.

Note This procedure is applicable only for Application Gateways.

To configure a key ring:

```
<polUni>
     <fvTenant name="tn15" >
    <cloudCertStore>
    <pkiKeyRing status="" name="lbCert" tp="lbTP" key="-----BEGIN RSA PRIVATE KEY-----
MIIEpQIBAAKCAQEA4DGxaK+RHv/nToHLnmDBq2BfLimgX/zNJQC9bGuzr8Mj7dm0
XuHfQYGv0h1PtL4Pdxf5qjB0NbHjAVB1Gw8cDiErEgAXy9Km27ySo2foKryNqCRe
Ginn/CgF75QPIed568eScNDZPt/eMeHAuRX/PykKUatWWncGanjvHqc+SOLPF6TD
gQ5nwOHHFvyM2DY8bfdYWrWmGsO7JqZzbPMptA2QWblILsSoIrdkIIgf6ZfYy/EN
bH+nYN2rJT8lzYsxz0YmR0oRQHTiN2NiDY/ZV63yxCXfLg9qpNZCuD8KOfdCZPEq
8takiWBxiR5/HRPscWAdWQsoiKgG1k4NEbFA9QIDAQABAoIBAQDQqA9IslYrdtqN
q6mZ3s2BNfF/4kgb7gn0DWs+9EJJLCJNZVhFEo2ZxxyfPp6HRnjYS50W83/E1anD
+GD1bSucTuxqFWIQVh7r1ebYZIWk+NYSjr5yNVxux8U2hCNNV8WWVqkJjKcUqICB
Bm47FKj53LV46zE0gyCaibFrYxZJ9+farGneyBdnoV+3thmez7534KCi0t3J3Eri
lgSY3ql6hPXB2ZXAP4jdAoLgWDU4I1M6OqOiWopZM/QYIE/WtPYyJ0QzNCXObtc5
FboDcvedsgd4x5GlfV2A4xTBQMCTZUZJ9fYAcFogTZXD+UVqxorh47tf/mz+1fjq
f1XphEDlAoGBAPVlvKfGW46qqRnYovfryxxz4OMlsVSgcJpQTQtBQi2koJ8OwEZJ
2s+CX0r+oDqwP23go/QEVYVkcic9RGkJBNge1+dm/bTjzgMQYtqSCNtecTsZD5JN
y1jkciizznDkjcjReSZ2kh3dGXIbRiYk7ezp2z7EKfDrHe5x5ouGMgCnAoGBAOnh
buDEohv8KJaB+DiUfhtoa3aKNPBO+zWPCHp0HFGjPXshJcIYZc1GcycmuDKVNnDd
MxhE/yOnQHowi4T9FMLpz5yh5zuCUVqOBgB1P6MzbC5t5MtLrEYr/AqFN11CqyXQ
cVcT6iCWlOAFJRw3c/OiESwLMzchsl8RnbwOi6kDAoGBANVlzmPb07zB3eGTCU0t
KGiqwFLncUkVaDZZRFZYPpNwiRkoe73j9brkNbgCqxW+NLp5UjoeFry0N6y106q/
ZA4I7FnXryLBw2HYuw41Vixl+XOZ/HeO3RmFN1z717dGmaGbv43aKIB9x+X5n8wF
6z1NtBHmBk7yNwom1IRag1sbAoGAX0p4cJ/tJNXSe7AswHDQCL68uimJdDfZ5nKG
k83nE+Qc0qQozDJAmCiSFmuSNRnSep3FiafjBFXK0X4h+mdbJCc7bagRnI92Mh0X
mOwsp4P2GdywkZwdbuHQ6UBp1Ferf9aztzTn+as6xKOUATEezy9DK9zMWzQhhtaY
m9yZTp0CgYEA1UtcpWjAzQbXODJGmxGdAAakPpeiKw/Da3MccrTdGJt88ezM1Oej
Pdoab0G2PcfgJZoTSGk7N4XArVKeq7pgZ0kwcYAshO6A2Hal+D1z/bGoZP+kmD/x
Ny82phxYOXCnEc5Vv92lU59+j7e067UFLAYJe6fu+oFImvofRnP4DIQ=
-----END RSA PRIVATE KEY-----" cert="-----BEGIN CERTIFICATE-----
MIIElTCCA32gAwIBAgIJAKWNjp//arBsMA0GCSqGSIb3DQEBCwUAMIGNMQswCQYD
VQQGEwJVUzELMAkGA1UECBMCQ0ExETAPBgNVBAcTCFNhbiBKb3NlMRIwEAYDVQQK
EwlNeUNvbXBhbnkxDjAMBgNVBAsTBU15T3JnMRgwFgYDVQQDFA8qLmFtYXpvbmF3
cy5jb20xIDAeBgkqhkiG9w0BCQEWEXJhbXNoYWhAY2lzY28uY29tMB4XDTE4MTAw
MjIwNTMwNVoXDTE5MTAwMjIwNTMwNVowgY0xCzAJBgNVBAYTAlVTMQswCQYDVQQI
EwJDQTERMA8GA1UEBxMIU2FuIEpvc2UxEjAQBgNVBAoTCU15Q29tcGFueTEOMAwG
A1UECxMFTXlPcmcxGDAWBgNVBAMUDyouYW1hem9uYXdzLmNvbTEgMB4GCSqGSIb3
DQEJARYRcmFtc2hhaEBjaXNjby5jb20wggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAw
ggEKAoIBAQDgMbFor5Ee/+dOgcueYMGrYF8uKaBf/M0lAL1sa7OvwyPt2bRe4d9B
ga/SHU+0vg93F/mqMHQ1seMBUHUbDxwOISsSABfL0qbbvJKjZ+gqvI2oJF4aKef8
KAXvlA8h53nrx5Jw0Nk+394x4cC5Ff8/KQpRq1ZadwZqeO8epz5I4s8XpMOBDmfA
4ccW/IzYNjxt91hataYaw7smpnNs8ym0DZBZuUguxKgit2QgiB/pl9jL8Q1sf6dg
3aslPyXNizHPRiZHShFAdOI3Y2INj9lXrfLEJd8uD2qk1kK4Pwo590Jk8Sry1qSJ
YHGJHn8dE+xxYB1ZCyiIqAbWTg0RsUD1AgMBAAGjgfUwgfIwHQYDVR0OBBYEFBYq
K3b39+1oOr4IBSsePwcOpML7MIHCBgNVHSMEgbowgbeAFBYqK3b39+1oOr4IBSse
PwcOpML7oYGTpIGQMIGNMQswCQYDVQQGEwJVUzELMAkGA1UECBMCQ0ExETAPBgNV
BAcTCFNhbiBKb3NlMRIwEAYDVQQKEwlNeUNvbXBhbnkxDjAMBgNVBAsTBU15T3Jn
MRgwFgYDVQQDFA8qLmFtYXpvbmF3cy5jb20xIDAeBgkqhkiG9w0BCQEWEXJhbXNo
YWhAY2lzY28uY29tggkApY2On/9qsGwwDAYDVR0TBAUwAwEB/zANBgkqhkiG9w0B
AQsFAAOCAQEAe/RuzCheLIbHbrurGet6eaVx9DPYydNiKVBSAKO+5iuR84mQzhoT
nx5CN109xu5ml5baCYZZsSnn6D7usC092bPA/kRCGxt29gkjpWA74tJHqIhVWgbM
mOrLiSHoelewv+wRl0oVRChlTfKtXO68TUk6vrqpw76hKfOHIa7b2h1IIMdq6VA/
+A5FQ0xqYfqKdVd2RaINpzI8mqZiszqw+7E6j1PL5k4tftWEaYpfGPlVesFEyJEL
gHBUiPt8TIbaMYI8qUQmB/emnLXeKQ5PRxdRnleA3h8jfq3D1CQRTLjmDL3tpFwg
qopM6et5ZKqShX4T87BsgZIoiquzXqsuHg==
```

```
-----END CERTIFICATE-----">
    </pkiKeyRing>


    <pkiTP status="" name="lbTP" certChain="-----BEGIN CERTIFICATE-----
MIIElTCCA32gAwIBAgIJAKWNjp//arBsMA0GCSqGSIb3DQEBCwUAMIGNMQswCQYD
VQQGEwJVUzELMAkGA1UECBMCQ0ExETAPBgNVBAcTCFNhbiBKb3NlMRIwEAYDVQQK
EwlNeUNvbXBhbnkxDjAMBgNVBAsTBU15T3JnMRgwFgYDVQQDFA8qLmFtYXpvbmF3
cy5jb20xIDAeBgkqhkiG9w0BCQEWEXJhbXNoYWhAY2lzY28uY29tMB4XDTE4MTAw
MjIwNTMwNVoXDTE5MTAwMjIwNTMwNVowgY0xCzAJBgNVBAYTAlVTMQswCQYDVQQI
EwJDQTERMA8GA1UEBxMIU2FuIEpvc2UxEjAQBgNVBAoTCU15Q29tcGFueTEOMAwG
A1UECxMFTXlPcmcxGDAWBgNVBAMUDyouYW1hem9uYXdzLmNvbTEgMB4GCSqGSIb3
DQEJARYRcmFtc2hhaEBjaXNjby5jb20wggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAw
ggEKAoIBAQDgMbFor5Ee/+dOgcueYMGrYF8uKaBf/M0lAL1sa7OvwyPt2bRe4d9B
ga/SHU+0vg93F/mqMHQ1seMBUHUbDxwOISsSABfL0qbbvJKjZ+gqvI2oJF4aKef8
KAXvlA8h53nrx5Jw0Nk+394x4cC5Ff8/KQpRq1ZadwZqeO8epz5I4s8XpMOBDmfA
4ccW/IzYNjxt91hataYaw7smpnNs8ym0DZBZuUguxKgit2QgiB/pl9jL8Q1sf6dg
3aslPyXNizHPRiZHShFAdOI3Y2INj9lXrfLEJd8uD2qk1kK4Pwo590Jk8Sry1qSJ
YHGJHn8dE+xxYB1ZCyiIqAbWTg0RsUD1AgMBAAGjgfUwgfIwHQYDVR0OBBYEFBYq
K3b39+1oOr4IBSsePwcOpML7MIHCBgNVHSMEgbowgbeAFBYqK3b39+1oOr4IBSse
PwcOpML7oYGTpIGQMIGNMQswCQYDVQQGEwJVUzELMAkGA1UECBMCQ0ExETAPBgNV
BAcTCFNhbiBKb3NlMRIwEAYDVQQKEwlNeUNvbXBhbnkxDjAMBgNVBAsTBU15T3Jn
MRgwFgYDVQQDFA8qLmFtYXpvbmF3cy5jb20xIDAeBgkqhkiG9w0BCQEWEXJhbXNo
YWhAY2lzY28uY29tggkApY2On/9qsGwwDAYDVR0TBAUwAwEB/zANBgkqhkiG9w0B
AQsFAAOCAQEAe/RuzCheLIbHbrurGet6eaVx9DPYydNiKVBSAKO+5iuR84mQzhoT
nx5CN109xu5ml5baCYZZsSnn6D7usC092bPA/kRCGxt29gkjpWA74tJHqIhVWgbM
mOrLiSHoelewv+wRl0oVRChlTfKtXO68TUk6vrqpw76hKfOHIa7b2h1IIMdq6VA/
+A5FQ0xqYfqKdVd2RaINpzI8mqZiszqw+7E6j1PL5k4tftWEaYpfGPlVesFEyJEL
gHBUiPt8TIbaMYI8qUQmB/emnLXeKQ5PRxdRnleA3h8jfq3D1CQRTLjmDL3tpFwg
qopM6et5ZKqShX4T87BsgZIoiquzXqsuHg==
-----END CERTIFICATE-----">
    </pkiTP>
    </cloudCertStore>
     </fvTenant>
</polUni>
```

Creating an HTTPS Service Policy Using the REST API

This section demonstrates how to create an HTTPS service policy using the REST API.

Note A listener can have multiple certificates. The certificate options are:

- ELBSecurityPolicy-2016-08 – The default when no security policy is chosen.
- ELBSecurityPolicy-FS-2018-06
- ELBSecurityPolicy-TLS-1-2-2017-01
- ELBSecurityPolicy-TLS-1-2-Ext-2018-06
- ELBSecurityPolicy-TLS-1-1-2017-01
- ELBSecurityPolicy-2015-05
- ELBSecurityPolicy-TLS-1-0-2015-04

If you use multiple certificates, you must specify the default certificate. The default is specified using the **defaultCert** property in **cloudRsListenerToCert**.

Before you begin

You have already configured a key ring certificate.

Note This is applicable only for the Application Gateways.

To create an HTTPS service policy:

```
<polUni>
  <fvTenant name="t2">
    <vnsAbsGraph name="CloudGraph" type="cloud" status="">
      <vnsAbsNode funcType="GoTo" name="N1" managed="yes">
        <cloudSvcPolicy tenantName="t2" contractName="httpFamily" subjectName="consubj">
          <cloudListener name="https_listener" port="443" protocol="https"
secPolicy="eLBSecurityPolicy-2016-08" status="">
            <cloudRsListenerToCert defaultCert="yes" certStore="default"
tDn="uni/tn-t2/certstore/keyring-lbCert" status=""/>
            <cloudListenerRule name="defaultRule" default="yes" priority="100" status="">
              <cloudRuleAction type="forward" port="80" protocol="http"
epgdn="uni/tn-t1/cloudapp-ap/cloudepg-ep1">
                                                  </cloudRuleAction>
            </cloudListenerRule>
          </cloudListener>
        </cloudSvcPolicy>
      </vnsAbsNode>
    </vnsAbsGraph>
  </fvTenant>
</polUni>
```