Deploying Layer 4 to Layer 7 Services

- Overview, on page 1
- Example Use Cases, on page 13
- Example Use Cases for Service Graphs with Cloud Native and Third-Party Services, on page 29
- Guidelines and Limitations for Redirect, on page 48
- Adding a New CIDR to a Secondary VRF Using the Cloud APIC GUI, on page 50
- Deploying a Service Graph, on page 52

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. Beginning with release 5.1(2), Third Party Load Balancer deployments in Azure are supported.

Four types of Layer 4 to Layer 7 services are supported for deployments in Azure:

- ALB refers to Azure Application gateway or Application Load balancer
- NLB refers to Azure Load balancer or Network Load balancer
- Third Party Firewall
- Third Party Load Balancer

About Service Graphs

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

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 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.

Using Service Graphs with Cloud Native and Third-Party Services

Beginning with Release 5.1(2), you can now use service graphs with cloud native and third-party services. You can use service graphs in these situations either with or without redirect. See Example Use Cases for Service Graphs with Cloud Native and Third-Party Services, on page 29 for example use cases, with or without redirect.

You will use the cloud service endpoint group (service EPG), also introduced in Release 5.1(2), with this type of service graph. See Cloud Service Endpoint Groups for more information about the service EPG, and the deployment types and access types that are available for service EPGs.

The following deployment types and access types are supported with service graphs used with service EPGs for this purpose.

Table 1: Provider Service EPG Types

Deployment Types	Access Types
Cloud Native	Private
Cloud Native Managed	Public and Private
Third-Party	Private

Table 2: Consumer Service EPG Types

Deployment Types	Access Types
Cloud Native Managed	Public and Private

Guidelines and Limitations

- You must have the newer NSG-per-subnet configuration enabled in order to use service graphs with cloud native and third-party services, using the service EPGs. See Security Groups for more information on the NSG-per-subnet configuration.
- Any restrictions that apply for cloud EPG and service graph combinations also apply to service EPG and service graph combinations. For example, the cloud EPG/service graph restriction that a consumer and provider that is tag-based cannot be in the same VRF in the same region would also apply for service EPGs and service graphs.
- For two node graphs that don't perform redirect, SNAT and DNAT are enabled. It is assumed that the DNATed address is a device that is equivalent to a load balancer, which can take care of spraying traffic across different targets that may be in different subnets.

  Note that if those targets are in different subnets, the service graph doesn't provide route reachability rules for those targets. It is assumed that the service EPG will take care of the reachability in this case.
- For cases involving AKS and service graphs, the service graph will only establish route reachability to the load balancer's subnet of the AKS cluster.

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 Layer 4 to Layer 7 services 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 Layer 4 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.

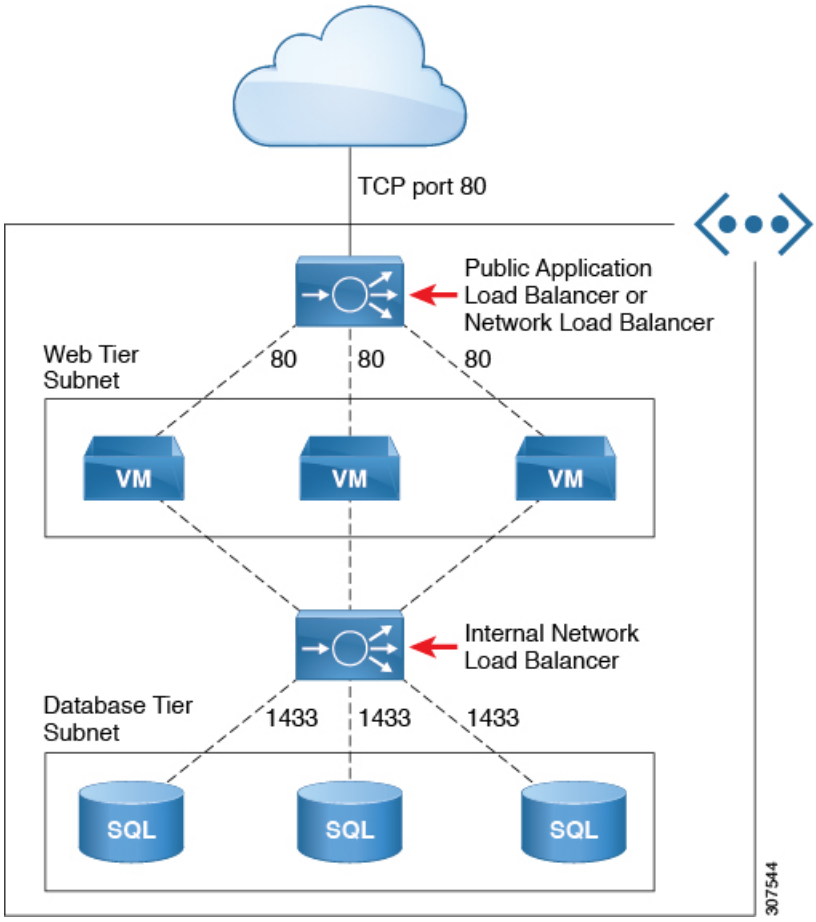
Listeners enable you to specify the ports and protocols (TCP or UDP) that the load balancer accepts and forwards traffic on. All listeners require you to configure at least one rule (a default rule, which does not have a condition). Rules enable you to specify the action that the load balancer takes 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



Understanding Configurations for Multiple Frontend IP Addresses on the Azure Network Load Balancer

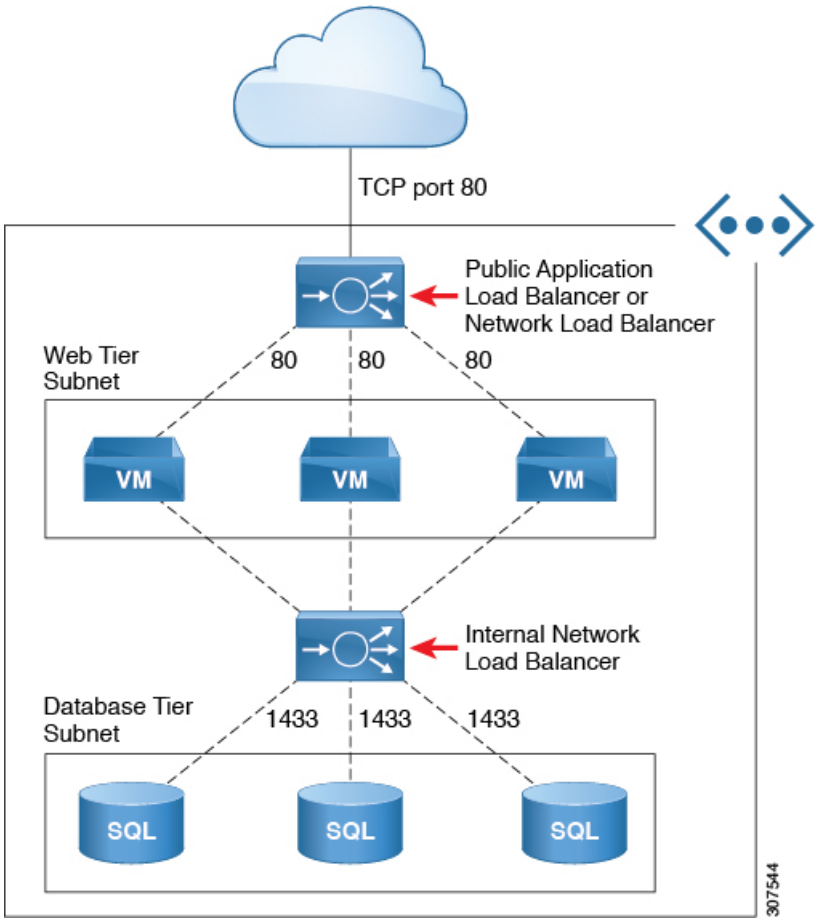
The following sections provide information on support for multiple frontend IP addresses on the Azure Network Load Balancer that is available beginning with Cisco Cloud APIC release 25.0(3).

- About Multiple Frontend IP Addresses on the Azure Network Load Balancer, on page 5
- Guidelines and Limitations, on page 7

About Multiple Frontend IP Addresses on the Azure Network Load Balancer

When configuring an internet-facing Network Load Balancer, the number of public IP addresses allowed to assign to frontend the internet traffic varies, depending on the release:

- Prior to Cisco Cloud APIC release 25.0(3), an internet-facing Network Load Balancer has a single public IP address assigned to frontend the internet traffic. The following graphic shows an example of a multi-node service graph configuration, where an internet-facing Network Load Balancer is shown at the top of the graphic, followed by VMs or a firewall, then an internal-facing Network Load Balancer as parts of this multi-node service graph.

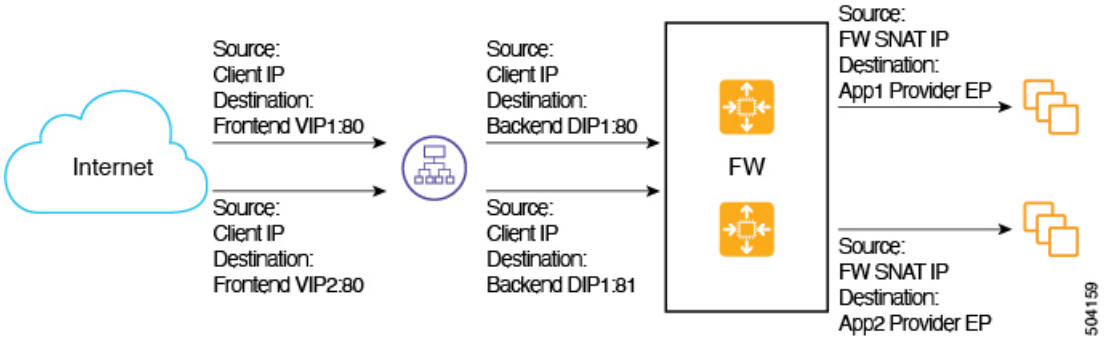


In this example, the internet-facing Network Load Balancer has a single public IP address assigned to frontend the internet traffic.

However, with this configuration, an issue might arise if you have a service graph and you need to expose multiple HTTPS services. Having the restriction of a single public IP address assigned to frontend the internet traffic for an internet-facing Network Load Balancer means that you cannot add more frontend IP addresses to that Network Load Balancer. In addition, you cannot add more Network Load Balancer in this situation due to a restriction from Azure, which does not allow multiple Network Load Balancers to share the same backend device (the firewalls in this example).

- Beginning with Cisco Cloud APIC release 25.0(3), support is now available for configuring multiple frontend IP addresses for an internet-facing Network Load Balancer. With this update, each frontend IP address is attached to one or more rules to a specific backend pool.

  The following graphic provides an example configuration where multiple frontend IP addresses are configured for an internet-facing Network Load Balancer.



This example configuration depicts the packet flow for the following listener rules:

	Listener Rule (Frontend Configuration)	Rule Action (Backend Configuration)
Rule1	• **IP**: VIP1 • **Port**: 80	**Port**: 80
Rule2	• **IP**: VIP2 • **Port**: 80	**Port**: 81

The service graph allows you to configure the settings for the listener rule and the rule action on services devices. When defined on a Network Load Balancer, the listener rule and rule action settings construct a mapping from a frontend configuration of the load balancer to a backend pool. Prior to Cisco Cloud APIC release 25.0(3), an internet-facing Network Load Balancer provided the ability to configure listeners with a single frontend IP address but with different port and protocol combinations. Beginning with Cisco Cloud APIC release 25.0(3), with the support for configuring multiple frontend IP addresses for an internet-facing Network Load Balancer, that ability is extended to configure listener rules with multiple frontends where each frontend is represented as a tuple combination of frontend IP addresses, port, and protocol.

Guidelines and Limitations

Following are the guidelines and limitations with the support for configuring multiple frontend IP addresses for an internet-facing Network Load Balancer:

- Support for multiple frontend IP addresses is available only for an internet-facing Network Load Balancer.
- Backend port reuse across multiple listener rules is not supported.

About Third-Party Load Balancers

Third-Party Load Balancer is a noncloud native Layer 4 to Layer 7 load balancer. Cloud APIC does not manage the configuration of the third-party load balancers. However, Cloud APIC automates the network stitching for connectivity to a third-party load balancer.

You can configure VIPs for a third-party load balancer from the external interface subnet. You can also configure additional VIPs for the third- party load balancers as secondary IP addresses on the external interface.

Cloud APIC supports third-party load balancers that are deployed in a two-arm mode (external and internal interfaces) with source NAT enabled.

Limitations for Third-Party Load Balancers:

- Cloud APIC does not support Direct Server Return (DSR) configurations on third-party load balancers.
- Third-party load balancers are not supported in active/standby high availability configurations.

  For details about third-party load balancer VMs in active/active mode, see Example Use Cases, on page 13.
- Alien VIP range is not supported for third-party load balancers.

About Allow All Traffic Option

Beginning with release 5.1(2g), the **Allow All Traffic** option is available for third-party firewalls and Azure network load balancers deployed as pass-through devices on a redirect-enabled service graph.

Note This option allows all inbound and outbound access to the subnet on which the interface belongs. Ensure that this does not present a security risk before enabling this option.

The following sections provide instructions for enabling the **Allow All Traffic** option.

- Third-Party Firewall, on page 8
- Azure Network Load Balancer, on page 9

Third-Party Firewall

- To enable this option when creating a new service graph type:
  1. From the **Application Management** list in the **Intent** menu, click **Services** > **Devices** > **Create Device**.
  2. Choose **Third party firewall** as the **Service Type**.
  3. Click **Add Interface**, then locate the **Allow All Traffic** area.
  4. Click the box next to the **Enabled** field in the **Allow All Traffic** area to allow all inbound and outbound access to the subnet on which the interface belongs.
  5. Click **Save** when finished.
- To enable this option when editing an existing service graph type:
  1. From the **Application Management** list in the **Intent** menu, click **Services**, then click on an existing service device with **Third-Party Firewall** shown as the **Device Type**.

     A panel showing details for this service device type slides in from the right side of the window.
  2. Click the Details icon ( ).

     Another window appears that provides more detailed information for this service device type.

3. Locate the **Interfaces** area in the window and click the necessary interface selector under the **Interface Selectors** column.

   A panel showing details for this interface slides in from the right side of the window.

4. Click the Details icon ( ).

   Another window appears that provides more detailed information for this interface.

5. Click the pencil icon to edit the configuration settings for this interface.
6. Locate the **Allow All Traffic** area, then click the box next to the **Enabled** field in the **Allow All Traffic** area to allow all inbound and outbound access to the subnet on which the interface belongs.
7. Click **Save** when finished.

Azure Network Load Balancer

- To enable this option when creating a new service graph type:
  1. From the **Application Management** list in the **Intent** menu, click **Services** > **Devices** > **Create Device**.
  2. Choose **Network Load Balancer** as the **Service Type**.
  3. In the **Settings** area, click the box next to the **Enabled** field in the **Allow All Traffic** area to allow all inbound and outbound access to the subnet on which the interface belongs.
  4. Click **Save** when finished.

- To enable this option when editing an existing service graph type:
  1. From the **Application Management** list in the **Intent** menu, click **Services**, then click on an existing service device with **Network Load Balancer** shown as the **Device Type**.

     A panel showing details for this service device type slides in from the right side of the window.

  2. Click the Details icon ( ).

     Another window appears that provides more detailed information for this service device type.

  3. Click the pencil icon to edit the configuration settings for this service device.
  4. In the **Settings** area, locate the **Allow All Traffic** area, then click the box next to the **Enabled** field in the **Allow All Traffic** area to allow all inbound and outbound access to the subnet on which the interface belongs.
  5. Click **Save** when finished.

Dynamic Server Attachment to Server Pool

Servers in a provider EPG or service devices such as third-party firewalls behind ALB/NLB 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 a listener rule on ALB/NLB that is the last node as part of service graph configuration, you can select provider EPG for a given rule. The endpoints from that EPG are dynamically added to the target group of the load balancer. If another node, such as a third-party firewall, exists between ALB/NLB and the provider EPG, the firewall endpoints are dynamically added to the target group of the load balancer. You do not need to specify the endpoints or FQDN for the targets.

Prior to Cisco Cloud APIC for Azure Release 25.0(2), VM scale sets were not supported as backend targets for load balancers. Cisco Cloud APIC for Azure Release 25.0(2) adds support for VM scale sets as backend targets.

Note When using a VM scale set for a firewall, use only a subnet-based EP selector for the firewall interfaces. Azure does not support per-NIC tagging for a VM scale set with multiple interfaces.

About Inter-VNet Services

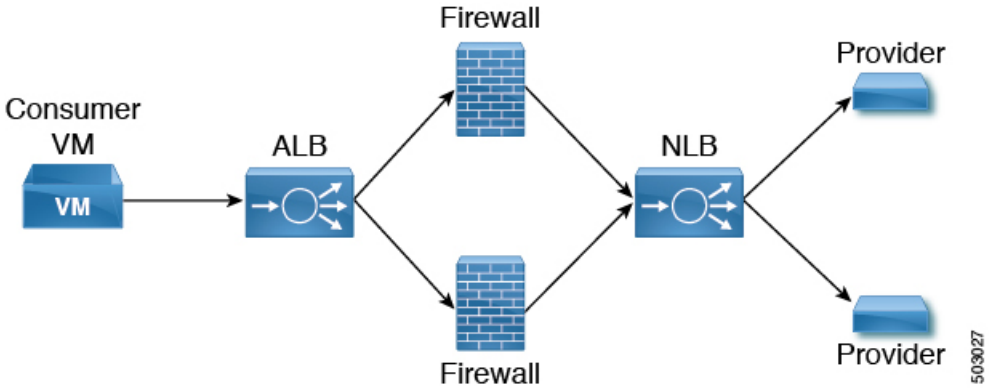
Beginning with Release 5.0(2), support is available for the deployment and automation of the inter-VNet services. This is both for the East-West and North-South use cases within the cloud.

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 load balancer or Network load balancer in the infra VNet and the provider in a non-infra VNet. The VNets should be peered together and the load balancer and the provider 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 16.

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.

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.

ConnType	Description
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:

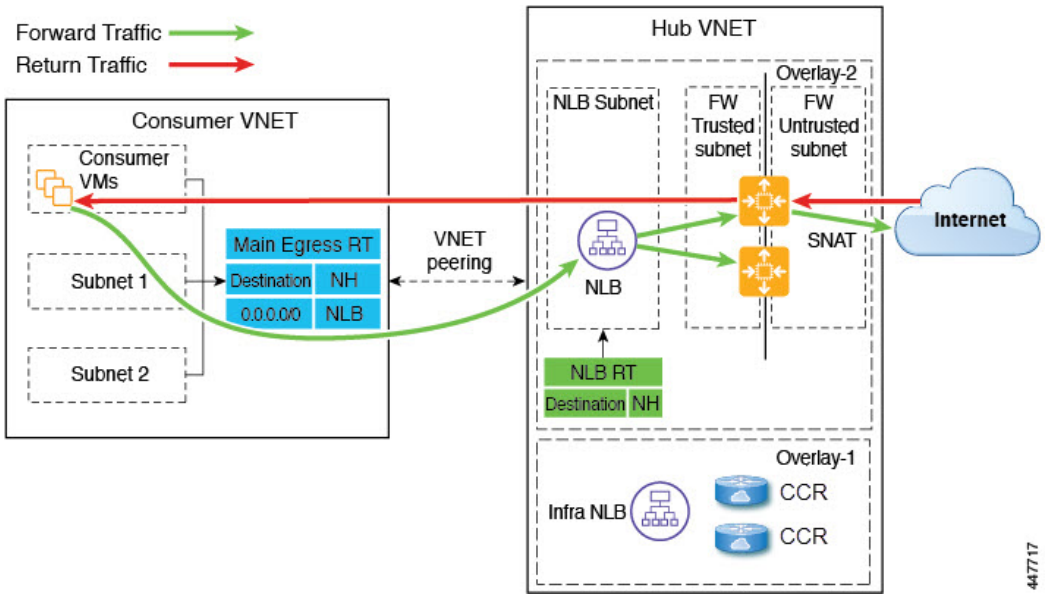
- Spoke to Internet, on page 14
- Spoke to Spoke, on page 16

- Inter-Region Spoke to Spoke, on page 18
- Internet to Spoke (Inter-VRF), on page 21
- High Availability Support for Third-Party Load Balancer, on page 23
- Consumer and Provider EPGs in Two Separate VNets, on page 25
- Hub VNet with Consumer and Provider EPGs in Two Separate VNets, on page 27

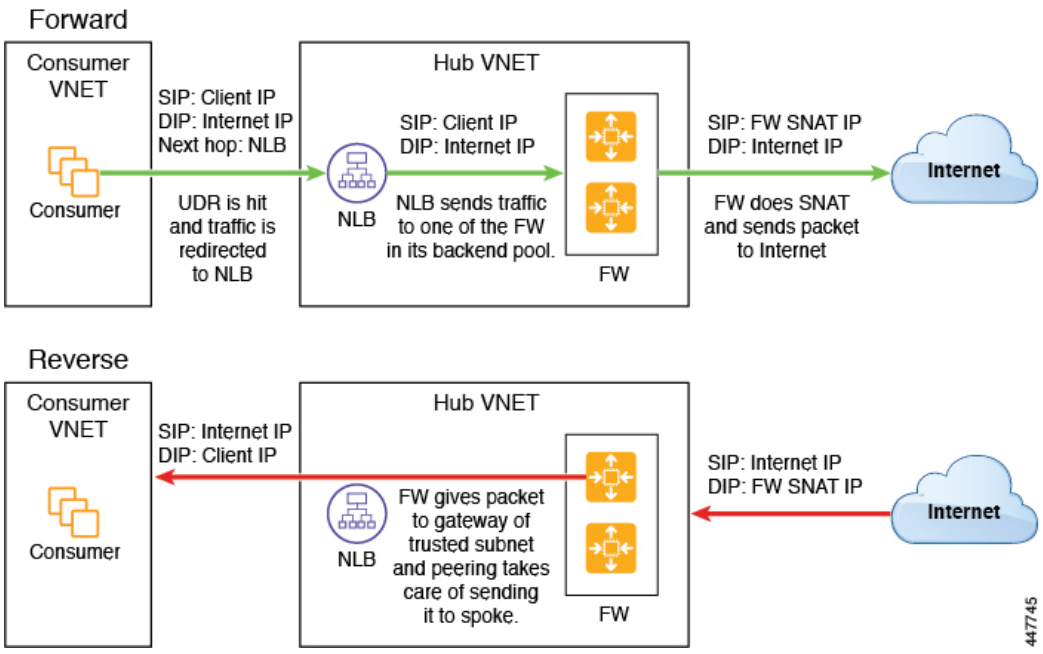
Spoke to Internet

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.

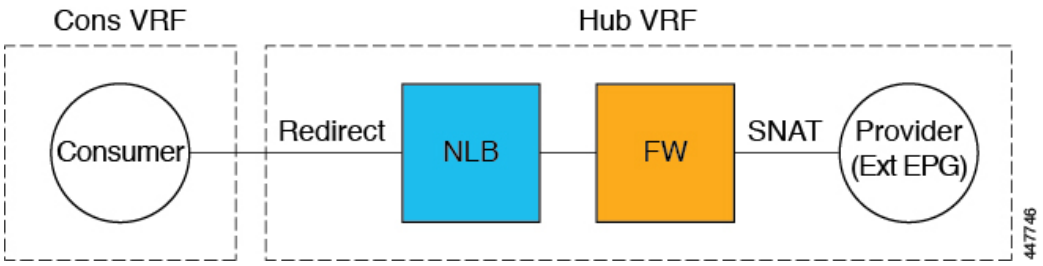
Ensure that all the Layer 4 to Layer 7 services devices used in this use case have dedicated subnets.



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 secondary VRF.
    - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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:

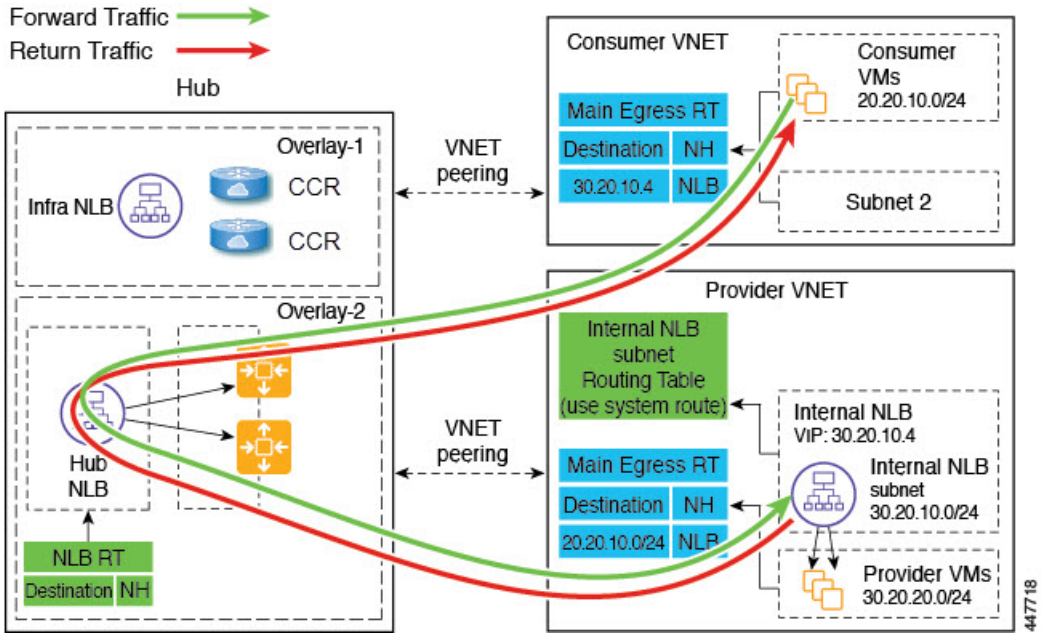
- In the **Consumer Connector Type** field, place a check in the box next to the **Redirect** option to enable the redirect function on the consumer side.
- In the **Provider Connector Type** field, leave the boxes unchecked.

- 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.

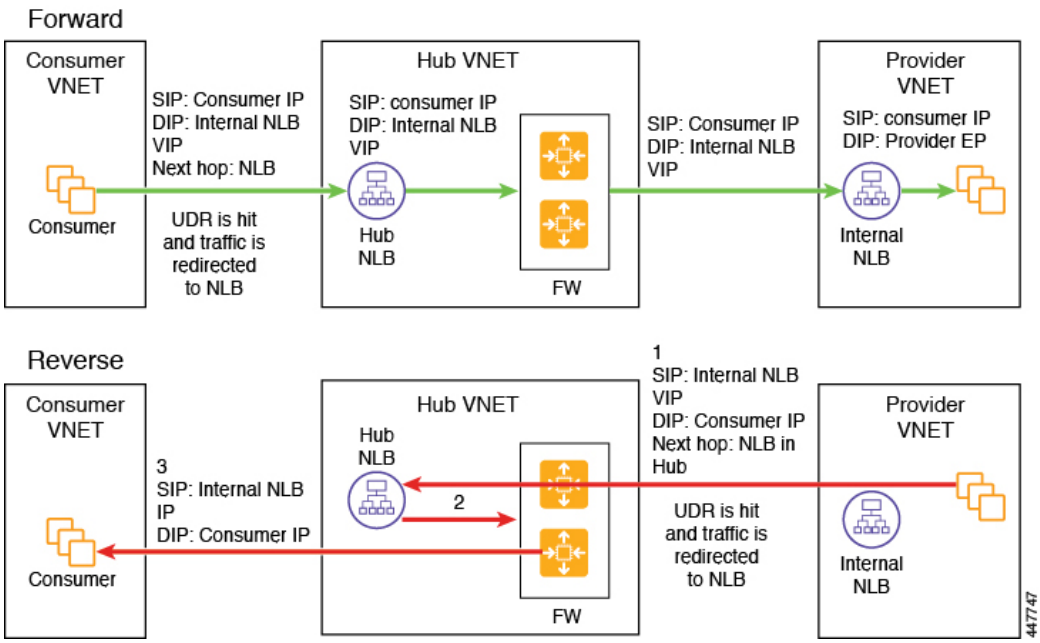
Spoke to Spoke

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 (or a third-party load balancer). 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.

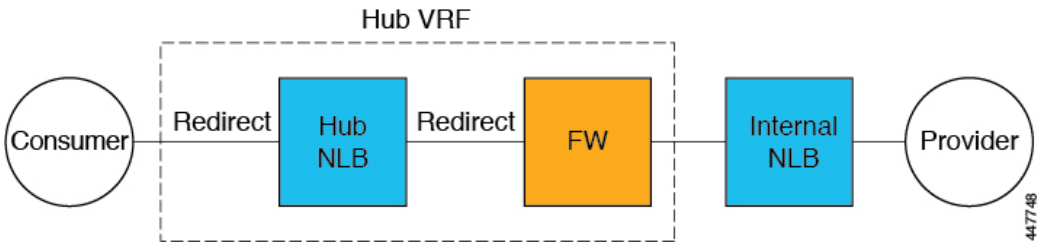
Ensure that all the Layer 4 to Layer 7 services devices used in this use case have dedicated subnets.



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 secondary VRF.
    - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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.

Note A third-party load balancer can be used in place of an internal NLB. Choose **Third-party load balancer** as the **Service Type**. Choose the **VRF** and set the interface(s) details by clicking **Add Interface**.

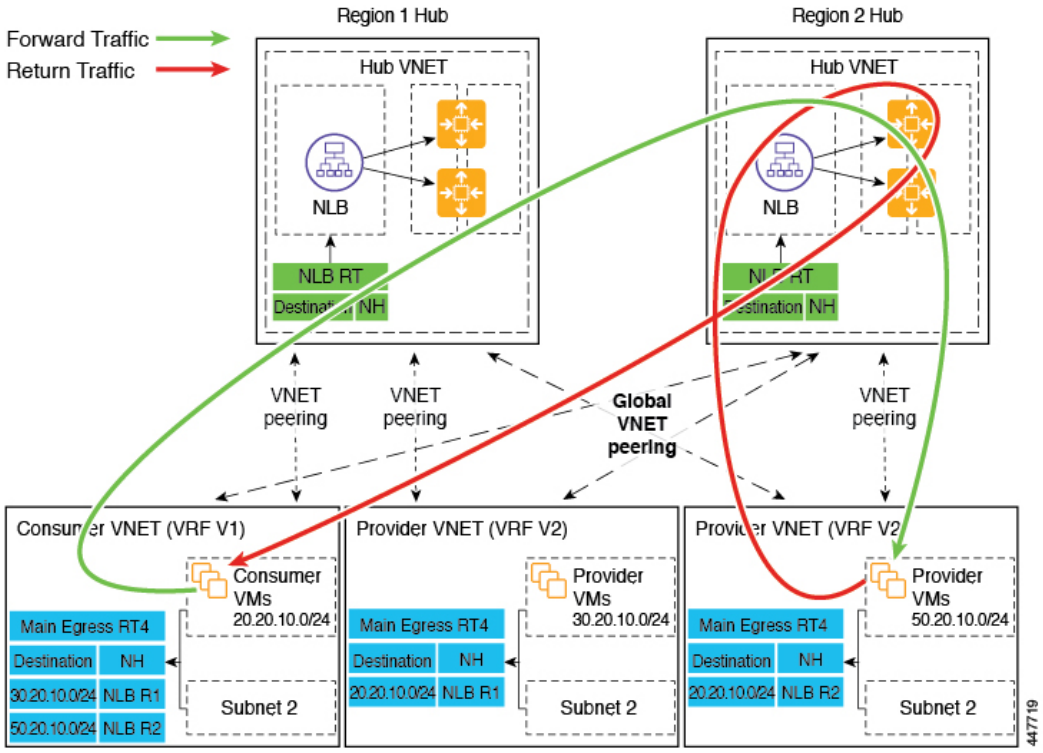
- In the **Create Service Graph** window, drag-and-drop the following service devices, in this order:
  - Network Load Balancer (for the hub VNet)
  - Third-Party Firewall (for the hub VNet)
  - Network Load Balancer or Third-Party Load Balancer (for the provider VNet)
- In the **Service Node** window 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**.

Note Ensure SNAT is configured on the third-party load balancers.

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.

Ensure that all the Layer 4 to Layer 7 services devices used in this use case have dedicated subnets.



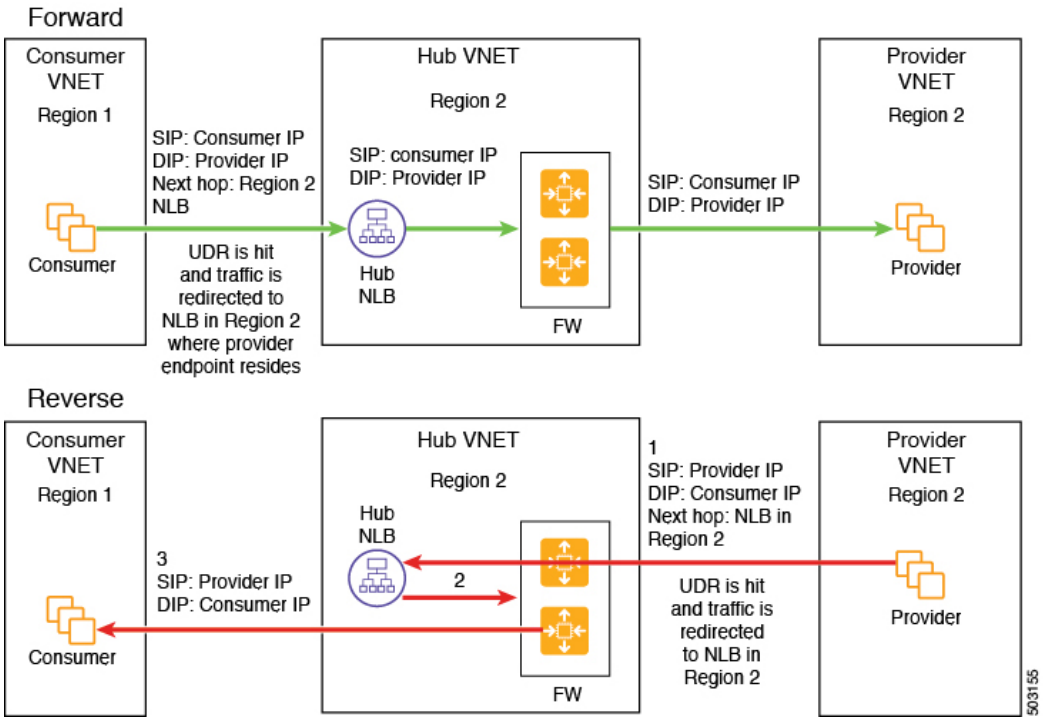
For example, consider the two subnets in the consumer VNet (VRF 1) egress route table (RT):

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

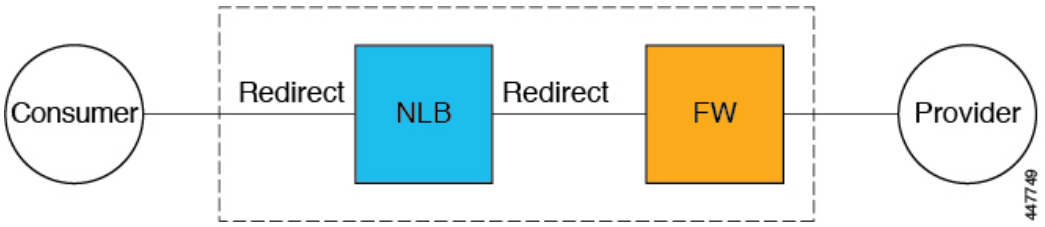
Assume the consumer wants to send traffic to the provider VMs 30.20.10.0/24, which are local to it. In that case, traffic will get redirected to the region 1 hub NLB and firewall, and will then go to the provider.

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 secondary VRF.
    - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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**.

In the above use case, the provider VMs can also be front-ended by a cloud native or third-party load balancer.

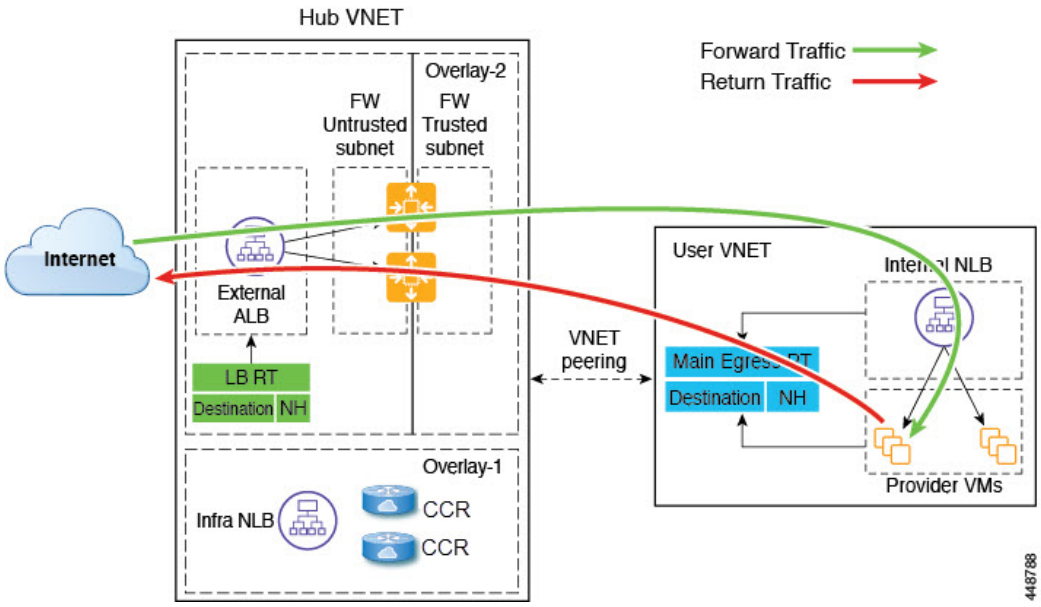
Internet to Spoke (Inter-VRF)

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.

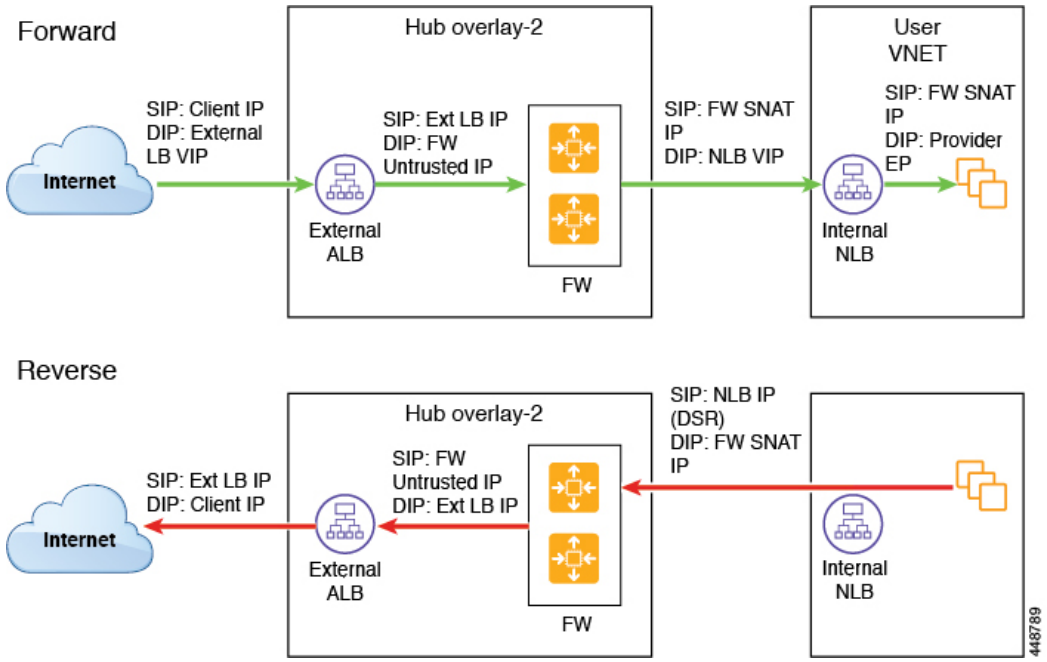
Note The general term "external load balancer" is used in this section because in this use case, the external load balancer could be either an NLB, ALB or a third-party load balancer. The following examples provide configurations using an ALB, but keep in mind that the external load balancer could be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

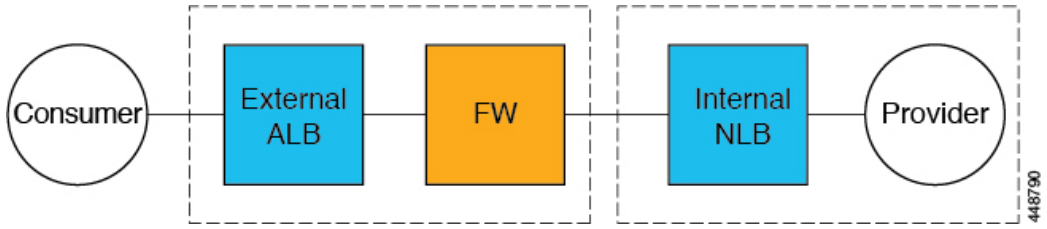
Ensure that all the Layer 4 to Layer 7 services devices used in this use case have dedicated subnets.



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 secondary VRF.
    - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary VRF.
    - Choose **Third-Party Load Balancer** as the **Service Type**, and choose the **VRF** and set the interface(s) details by clicking **Add Interface**.

- 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 or Third-Party 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**.

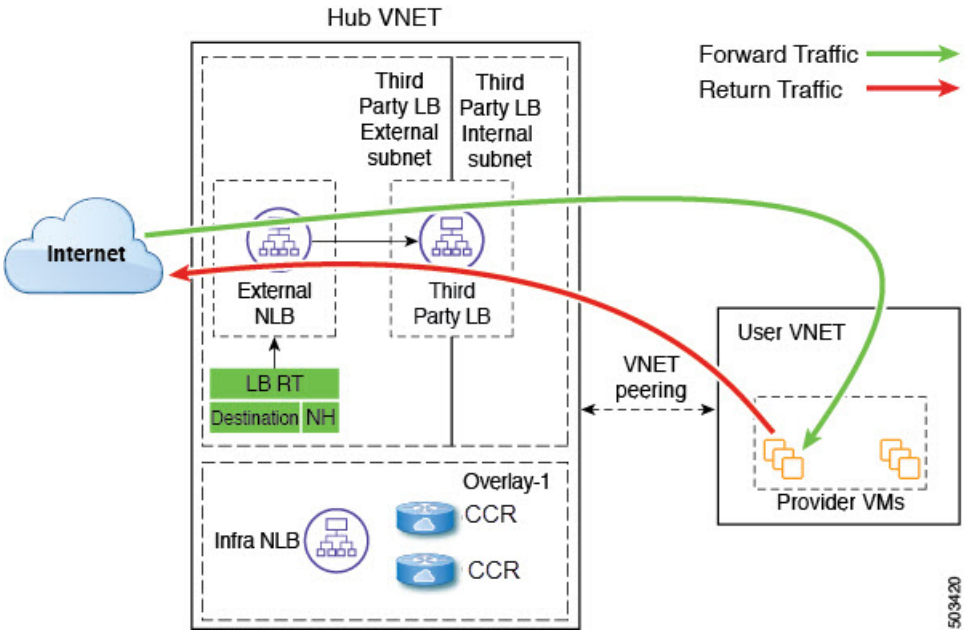
Note Ensure SNAT is configured on the third-party load balancers.

High Availability Support for Third-Party Load Balancer

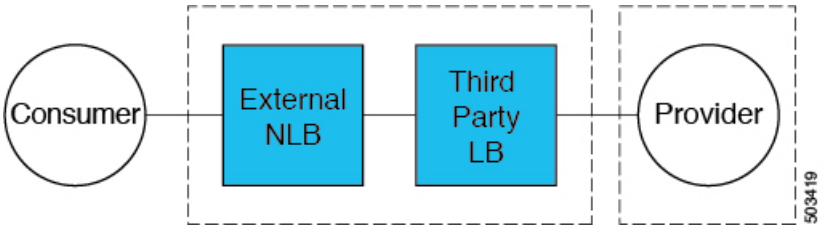
In this use case, traffic coming from the internet needs to go through the third-party load balancer before hitting the provider endpoints. Redirect is not used in this use case.

The third-party load balancer is configured as the backend pool of the NLB. Secondary IP addresses of the devices act as the target for the NLBs. You can choose to add either primary or secondary IP address (or both) as the target for the NLBs. The third-party load balancer VMs are deployed in active-active mode only. Third-party load balancers can not be used in active-standby high availability configuration.

Ensure that the third-party load balancers and the network load balancers have dedicated subnets.



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



As part of the 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 secondary VRF.
    - Choose **Third-Party Load Balancer** as the **Service Type**, and choose the **VRF** and set the interface(s) details by clicking **Add Interface**.
- In the **Create Service Graph** window, drag-and-drop the following service devices, in this order:
  - Network Load Balancer
  - Third-Party Load Balancer

Note Ensure that the Network Load Balancer and the Third-Party Load Balancer are in the same VNet.

- In the **Service Node** window for the Network Load Balancer for the hub VNet, leave the boxes unchecked for the **Consumer Connector Type** and the **Provider Connector Type**.

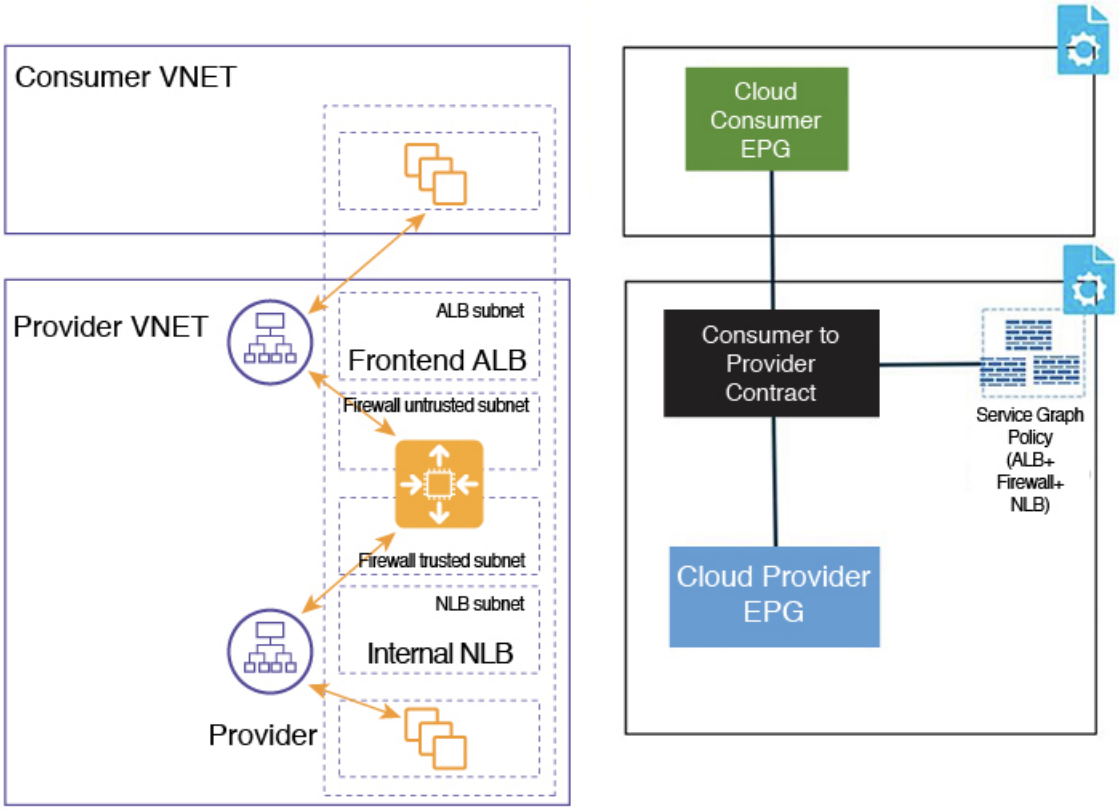
Note Ensure SNAT is configured on the third-party load balancers.

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.

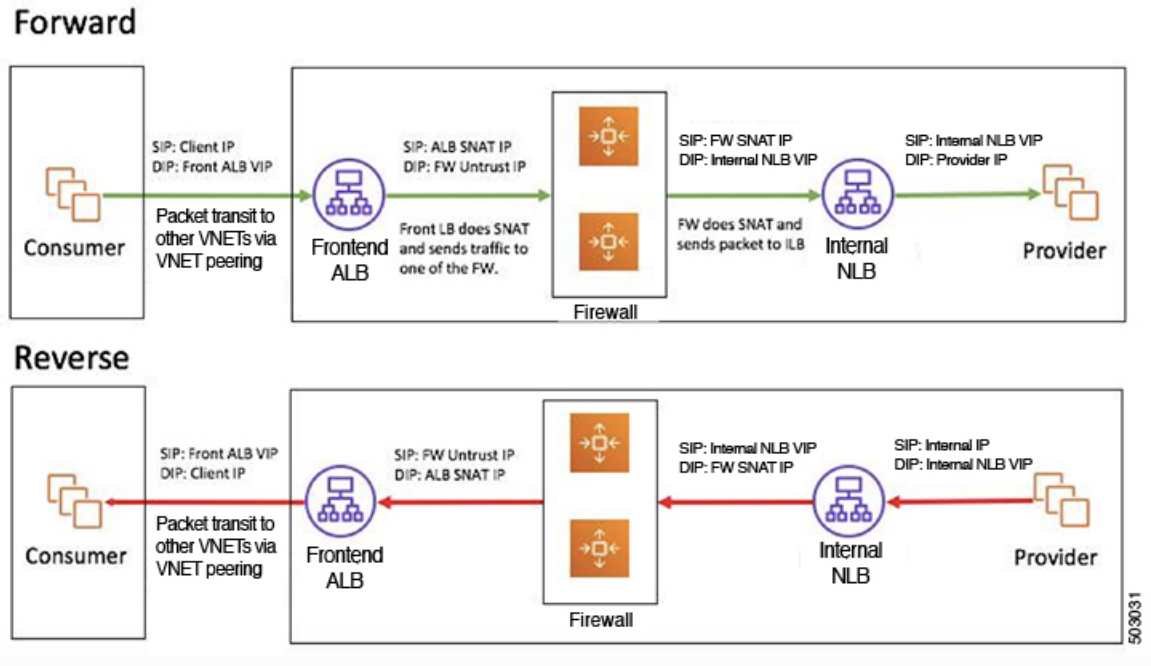
In this use case, a third-party load balancer can be used in place of the frontend ALB or an internal NLB. Ensure that all the Layer 4 to Layer 7 services devices used in this use case have dedicated subnets.



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 (or third-party 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:

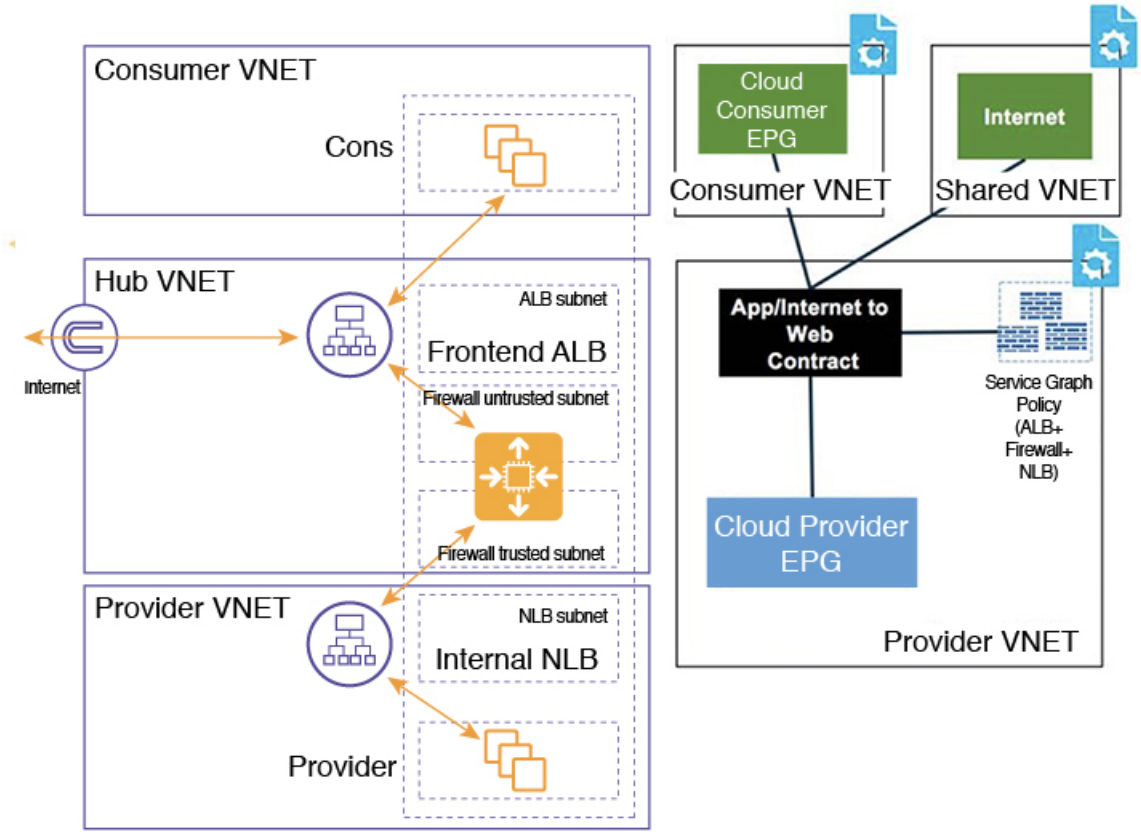


Hub VNet with Consumer and Provider EPGs in Two Separate VNets

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.

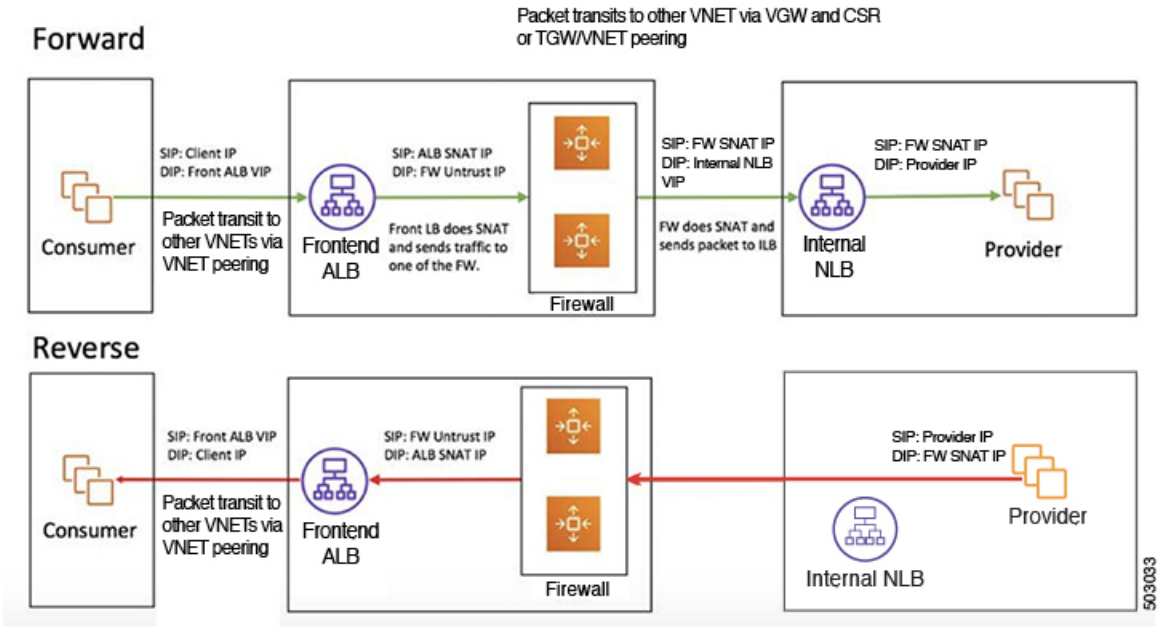
In this use case, a third-party load balancer can be used in place of the frontend ALB or an internal NLB. Ensure that all the Layer 4 to Layer 7 services devices used in this use case have dedicated subnets.



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 (or third-party 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:



Example Use Cases for Service Graphs with Cloud Native and Third-Party Services

Following are several example use case for service graphs with cloud native and third-party services, with and without redirect. Refer to Using Service Graphs with Cloud Native and Third-Party Services, on page 2 for more information and for guidelines and limitations.

Example Use Cases Without Redirect

Following are several example use case for service graphs with cloud native and third-party services without redirect.

You will be configuring cloud service EPGs as part of the process for each of these use cases. You must have the **NSG-per-subnet** configuration enabled if you are configuring cloud service EPGs. See Security Groups and Cloud Service Endpoint Groups for more information.

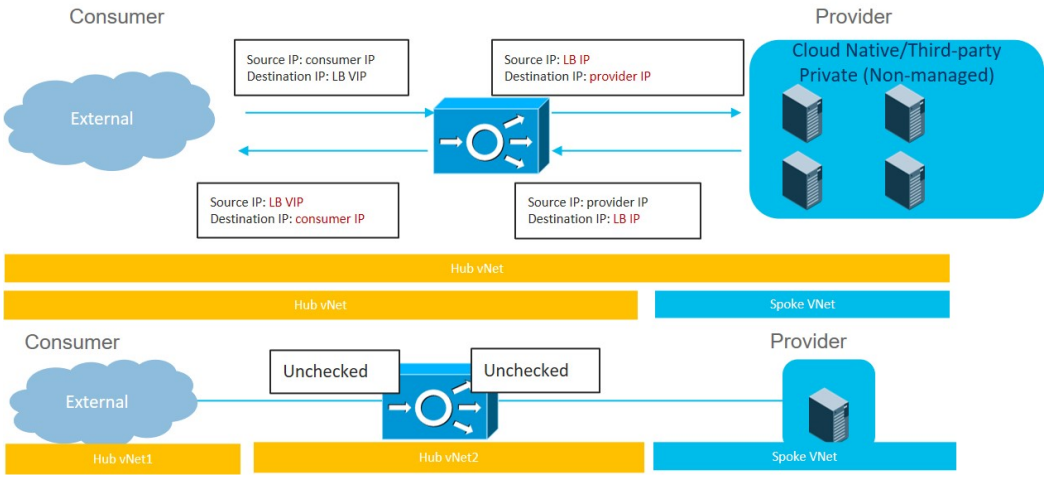
- Single-Node Service Graph for Internet Inbound Traffic: Non-Managed Service EPG as Provider, on page 30
- Single-Node Service Graph for Internet Inbound Traffic: Cloud Native Service EPG as Provider, on page 31
- Two-Node Service Graph for Internet Inbound Traffic: Cloud Native Managed Service EPG as Provider, on page 32
- Three-Node Service Graph for Internet Inbound Traffic: Cloud Native Managed Service EPG as Provider, on page 34

Note For each of the following use cases, a similar topology with a single node, two node and three node service graph with the service EPG as the provider can be supported for East-West traffic in the cloud. In these use cases, the consumer will be a cloud EPG and the load balancer used will be an internal load balancer.

Single-Node Service Graph for Internet Inbound Traffic: Non-Managed Service EPG as Provider

This use case has a single-node service graph, where the service node is a load balancer (application load balancer, network load balancer, or third-party load balancer).

In this use case, the service EPG is the provider, and an external EPG is configured on the consumer side. The service EPG can be in the hub or spoke VNets. The service endpoints are learned dynamically and are added to the application load balancer or network load balancer.



To configure this use case:

1. Create the external EPG on the consumer side.

   See Creating an External EPG Using the Cisco Cloud APIC GUI for those procedures. Select the `infra` tenant for this external EPG.

2. Create the service EPG on the provider side and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, using these settings:

   - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure Storage` would be a supported service type with a `Cloud Native` deployment type.
   - **Deployment type**: `Cloud Native` or `Third-Party`
   - **Access type**: `Private`

3. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   Make the following selections:

- In the **Create Device** window, create the service devices for the hub VNet:
  - In the **Tenant** field, choose the **infra** tenant.
  - 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 secondary VRF.
- In the **Create Service Graph** window, drag-and-drop the Application Load Balancer or Network Load Balancer.
- In the **Service Node** window for the Application Load Balancer or Network Load Balancer for the hub VNet, leave the boxes unchecked for the **Consumer Connector Type** and the **Provider Connector Type**.

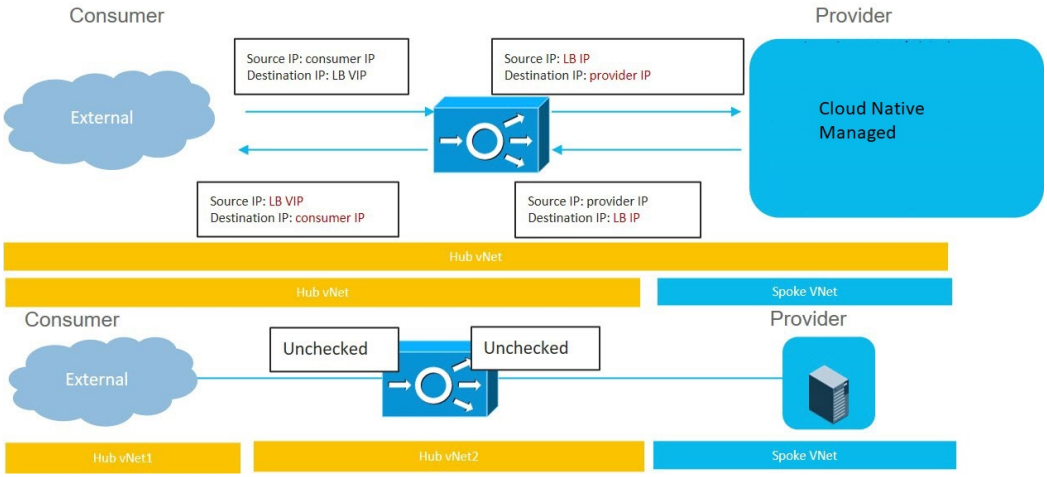
4. Deploy the Layer 4 to Layer 7 services.

   See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

Single-Node Service Graph for Internet Inbound Traffic: Cloud Native Service EPG as Provider

This use case has a single-node service graph, where the service node is a load balancer (application load balancer, network load balancer, or third-party load balancer).

In this use case, the service EPG is the provider, and an external EPG is configured on the consumer side. The service EPG can be in the hub or spoke VNets.



To configure this use case:

1. Create the external EPG on the consumer side.

   See Creating an External EPG Using the Cisco Cloud APIC GUI for those procedures. Select the `infra` tenant for this external EPG.

2. Create the service EPG on the provider side and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, using these settings:

- **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure ApiManagement Services` would be a supported service type with a `Cloud Native Managed` deployment type.
- **Deployment type**: `Cloud Native Managed`
- **Access type**: `Public and Private`

3. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   Make the following selections:

   - In the **Create Device** window, create the service devices for the hub VNet:
     - In the **Tenant** field, choose the **infra** tenant.
     - Choose **Application 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 secondary VRF.
   - In the **Create Service Graph** window, drag-and-drop the Application Load Balancer.
   - In the **Service Node** window for the Application Load Balancer for the hub VNet, leave the boxes unchecked for the **Consumer Connector Type** and the **Provider Connector Type**.

4. Deploy the Layer 4 to Layer 7 services.

   See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

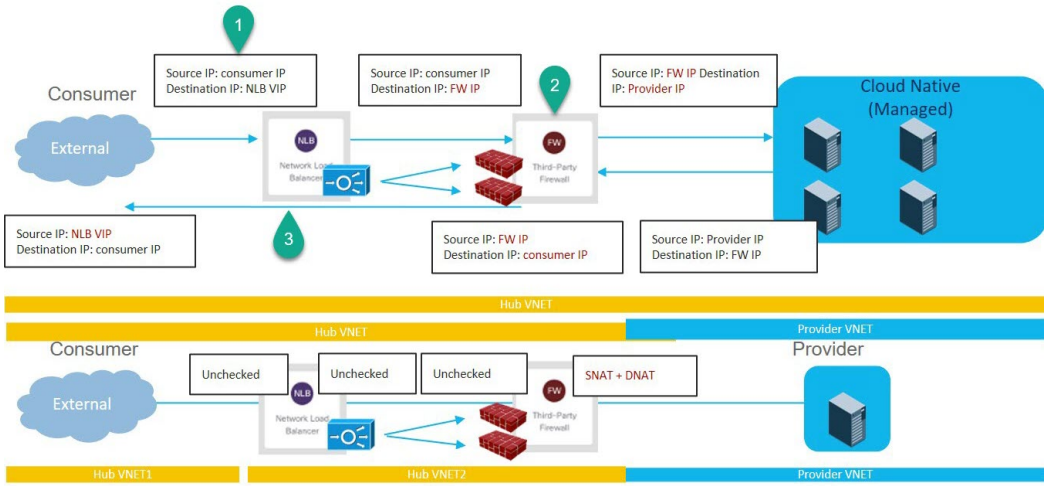
Two-Node Service Graph for Internet Inbound Traffic: Cloud Native Managed Service EPG as Provider

This use case has a two-node service graph, where the service nodes are a network load balancer and a firewall. Because this two-node service graph doesn't use redirect, SNAT+DNAT is performed on the firewall. The DNATed address is assumed to be a network load balancer or an equivalent service. For this use case, the service graph will only establish route reachability to the load balancer's subnet.

In this use case, the service EPG is the provider, and an external EPG is configured on the consumer side. The service EPG can be in the hub or spoke VNets.

These actions take place in this use case, as shown in the following figure:

1. Traffic is destined to the network load balancer public VIP, which then load balances the traffic to the firewall (DNAT).
2. SNAT+DNAT is performed on the firewall.
3. For the return traffic, Azure translates the source IP to the network load balancer public VIP.



To configure this use case:

1. Create the external EPG on the consumer side.

   See Creating an External EPG Using the Cisco Cloud APIC GUI for those procedures. Select the `infra` tenant for this external EPG.

2. Create the service EPG on the provider side and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, using these settings:

   - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure Kubernetes Services (AKS)` would be a supported service type with a `Cloud Native Managed` deployment type.
   - **Deployment type**: `Cloud Native Managed`
   - **Access type**: `Private`

3. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   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 secondary VRF.
       - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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, 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.

4. Deploy the Layer 4 to Layer 7 services.

   See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

Three-Node Service Graph for Internet Inbound Traffic: Cloud Native Managed Service EPG as Provider

This use case has a three-node service graph, where the service nodes are:

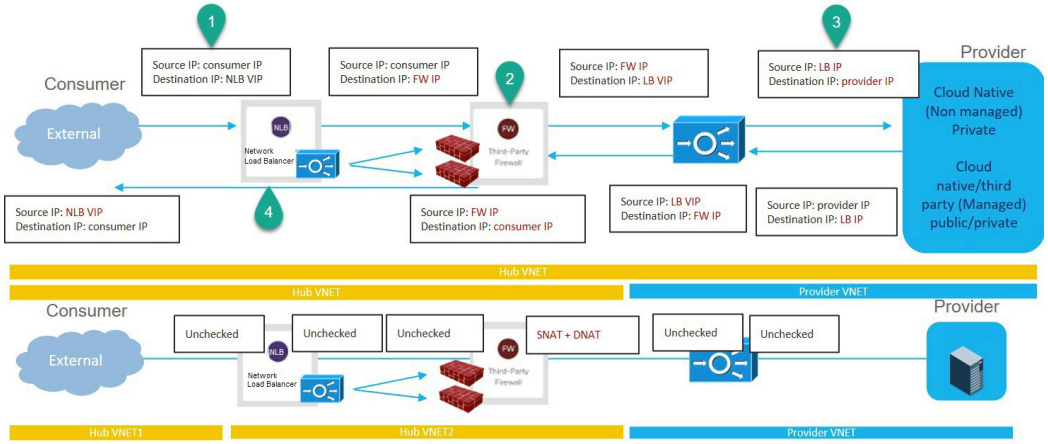
- First service device: Network load balancer in the hub VNet
- Second service device: Firewall in the hub VNet
- Third service device: Third-party load balancer in the hub VNet or spoke VNet

Because this three-node service graph doesn't use redirect, SNAT+DNAT is performed on the firewall. The DNATed address is assumed to be a load balancer or an equivalent service.

In this use case, the service EPG is the provider, and an external EPG is configured on the consumer side. The service EPG can be in the hub or spoke VNets.

These actions take place in this use case, as shown in the following figure:

1. Traffic is destined to the first service device, the network load balancer public VIP, which then load balances the traffic to the firewall (DNAT).
2. SNAT+DNAT is performed on the firewall, which is the second service device.
3. Traffic moves to the third service device, the third-party load balancer, which has SNAT configured.
4. For the return traffic, Azure translates the source IP to the network load balancer public VIP.



To configure this use case:

1. Create the external EPG on the consumer side.

   See Creating an External EPG Using the Cisco Cloud APIC GUI for those procedures. Select the `infra` tenant for this external EPG.

2. Create the service EPG on the provider side and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, with these settings:

   - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure ApiManagement Services` would be a supported service type with a `Cloud Native Managed` deployment type.
   - **Deployment type**: `Cloud Native Managed`
   - **Access type**: `Private`

3. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   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:
       - For the first service device, choose **Application 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 secondary VRF.
       - For the second service device, choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary VRF.
       - If the third service device is in the hub VNet, choose **Third-Party Load Balancer** as the **Service Type**, and choose the **VRF** and set the interface(s) details by clicking **Add Interface**.

- In the **Create Device** window, next create the service devices for the provider VNet, if necessary (if the third service device is in the provider VNet):
  - In the **Tenant** field, choose the provider tenant.
  - In the **Service Type** field, choose **Third-Party 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:
  - Application Load Balancer (for the hub VNet)
  - Third-Party Firewall (for the hub VNet)
  - Third-Party Load Balancer (for the hub or provider VNet)
- In the **Service Node** window for the 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.
- Ensure SNAT is configured on the third party load balancers.

4. Deploy the Layer 4 to Layer 7 services.

   See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

Example Use Cases With Redirect

Following are several example use case for service graphs with cloud native and third-party services with redirect.

You will be configuring cloud service EPGs as part of the process for each of these use cases. You must have the **NSG-per-subnet** configuration enabled if you are configuring cloud service EPGs. See Security Groups and Cloud Service Endpoint Groups for more information.

- Two-Node Service Graph for Internet Outbound, on page 37
- Two-Node Service Graph for East-West, on page 38
- Two-Node Service Graph for East-West with SNAT Option, on page 40
- Two-Node Service Graph for Inbound Traffic via Express Route Gateway, on page 42
- Two-Node Service Graph for Inbound Traffic via Express Route Gateway with SNAT Option, on page 44
- Three-Node Service Graph for Inbound Traffic via Express Route Gateway, on page 46

Two-Node Service Graph for Internet Outbound

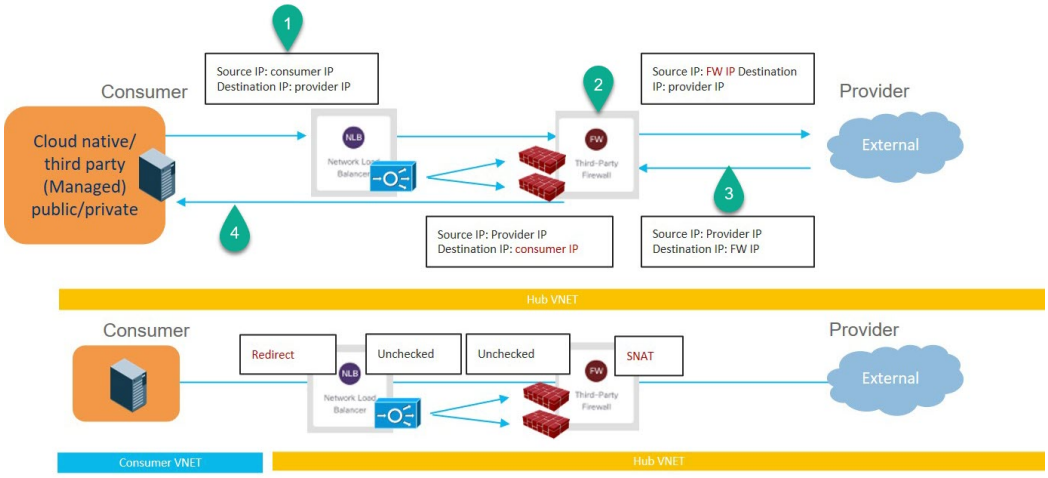
This use case has a two-node service graph, where the service nodes are a network load balancer and a firewall. Redirect is enabled on the consumer side in this use case, and SNAT is enabled on the firewall.

In this use case, the service EPG is the consumer, and an external EPG is configured on the provider side.

Note We recommend that you do not use 0.0.0.0/0 in an external EPG if the Layer 4 to Layer 7 service graph is used for PaaS that uses its own UDR for internet reachability.

These actions take place in this use case, as shown in the following figure:

1. Traffic is redirected to the network load balancer, which then load balances the traffic to the firewall.
2. SNAT is performed on the firewall.
3. The return traffic comes back to the firewall SNAT IP address.
4. At this point in the return direction, the return traffic doesn't go through the network load balancer.



To configure this use case:

1. Create the external EPG on the provider side.

   See Creating an External EPG Using the Cisco Cloud APIC GUI for those procedures.

   - Select the `infra` tenant for this external EPG.
   - Do not configure the external EPG with the 0.0.0.0/0 subnet.

2. Create the service EPG on the consumer side and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, with these settings:

   - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure Kubernetes Services (AKS)` would be a supported service type with a `Cloud Native Managed` deployment type.

- **Deployment type**: `Cloud Native Managed`
- **Access type**: `Private`

3. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   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 secondary VRF.
       - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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.

4. Deploy the Layer 4 to Layer 7 services.

   See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

Two-Node Service Graph for East-West

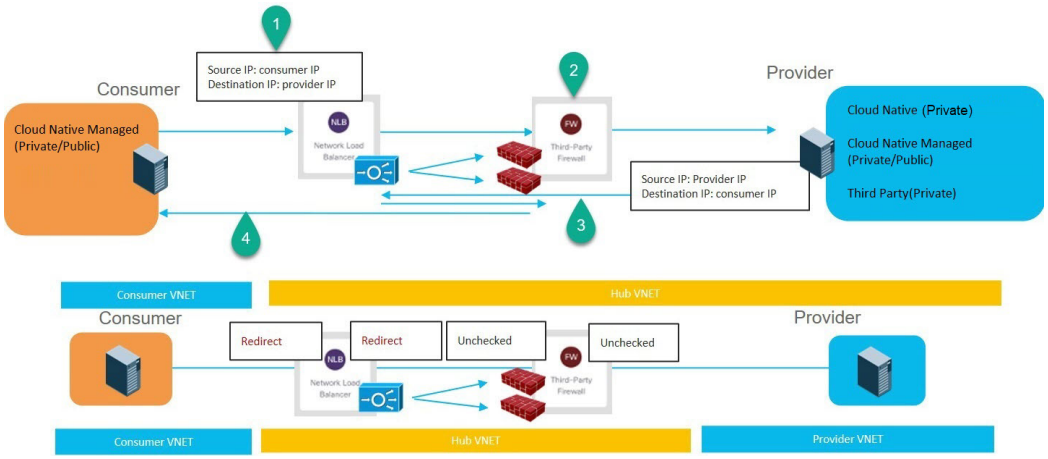
This use case has a two-node service graph, where the service nodes are a network load balancer and a firewall. Redirect is enabled on both the consumer and the provider side in this use case.

In this use case, the consumer and provider could be cloud EPGs or service EPGs.

These actions take place in this use case, as shown in the following figure:

1. Traffic is redirected to the network load balancer, which then load balances the traffic to the firewall.

2. SNAT is *not* performed on the firewall in this use case.
3. The return traffic is redirected to the network load balancer, which then load balances the traffic to the firewall.
4. At this point in the return direction, the return traffic comes back to the consumer.



To configure this use case:

1. If you are using service EPGs for the consumer or provider, create the service EPG and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, with these settings:

   - The service EPG as the consumer could have the following settings:
     - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure Kubernetes Services (AKS)` would be a supported service type with a `Cloud Native Managed` deployment type.
     - **Deployment type**: `Cloud Native Managed`
     - **Access type**: `Private`
   - The service EPG as the provider could have the following settings:
     - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure Storage File` would be a supported service type with a `Cloud Native` deployment type.
     - **Deployment type**: `Cloud Native`
     - **Access type**: `Private`

2. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   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 secondary VRF.
  - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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**.

3. Deploy the Layer 4 to Layer 7 services.

   See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

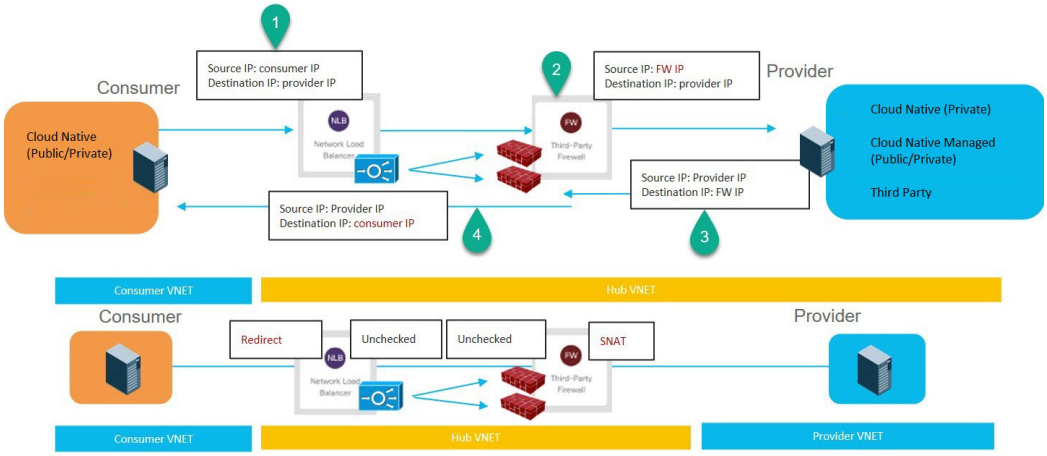
Two-Node Service Graph for East-West with SNAT Option

This use case has a two-node service graph, where the service nodes are a network load balancer and a firewall. Redirect is enabled only on the consumer side and SNAT is enabled on the firewall in this use case.

In this use case, the consumer and provider could be cloud EPGs or service EPGs.

These actions take place in this use case, as shown in the following figure:

1. Traffic is redirected to the network load balancer, which then load balances the traffic to the firewall.
2. SNAT is performed on the firewall.
3. The return traffic comes back to the firewall SNAT IP address.
4. At this point in the return direction, the return traffic doesn't go through the network load balancer.



To configure this use case:

1. If you are using service EPGs for the consumer or provider, create the service EPG and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, with these settings:

   - The service EPG as the consumer could have the following settings:
     - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure Active Directory Domain Services` would be a supported service type with a `Cloud Native Managed` deployment type.
     - **Deployment type**: `Cloud Native Managed`
     - **Access type**: `Private`
   - The service EPG as the provider could have the following settings:
     - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure Storage File` would be a supported service type with a `Cloud Native` deployment type.
     - **Deployment type**: `Cloud Native`
     - **Access type**: `Private`

2. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   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 secondary VRF.

- Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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.

3. Deploy the Layer 4 to Layer 7 services.

   See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

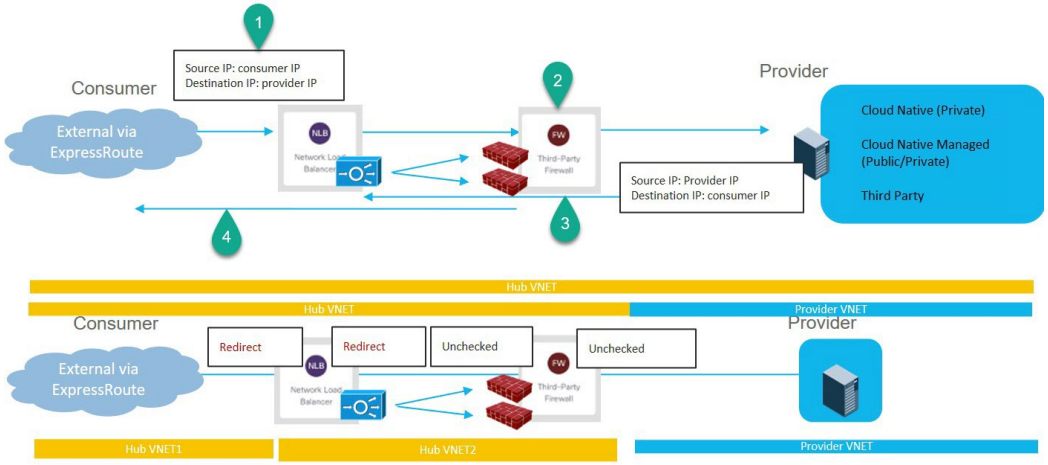
Two-Node Service Graph for Inbound Traffic via Express Route Gateway

This use case has a two-node service graph, where the service nodes are a network load balancer and a firewall. Redirect is enabled on both the consumer and the provider side in this use case.

In this use case, the service EPG is the provider, and the express route is on the consumer side.

These actions take place in this use case, as shown in the following figure:

1. Traffic is redirected to the network load balancer, which then load balances the traffic to the firewall.
2. SNAT is *not* performed on the firewall in this use case.
3. The return traffic is redirected to the network load balancer, which then load balances the traffic to the firewall.
4. At this point in the return direction, the return traffic comes back to the consumer.



To configure this use case:

1. Create the service EPG on the provider side and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, with these settings:

   - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure Active Directory Domain Services` would be a supported service type with a `Cloud Native Managed` deployment type.
   - **Deployment type**: `Cloud Native Managed`
   - **Access type**: `Private`

2. Deploy the express route gateway on the consumer side.

   See Deploying Express Route Gateway Using Redirect for those procedures.

3. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   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 secondary VRF.
       - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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.

4. Deploy the Layer 4 to Layer 7 services.

   See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

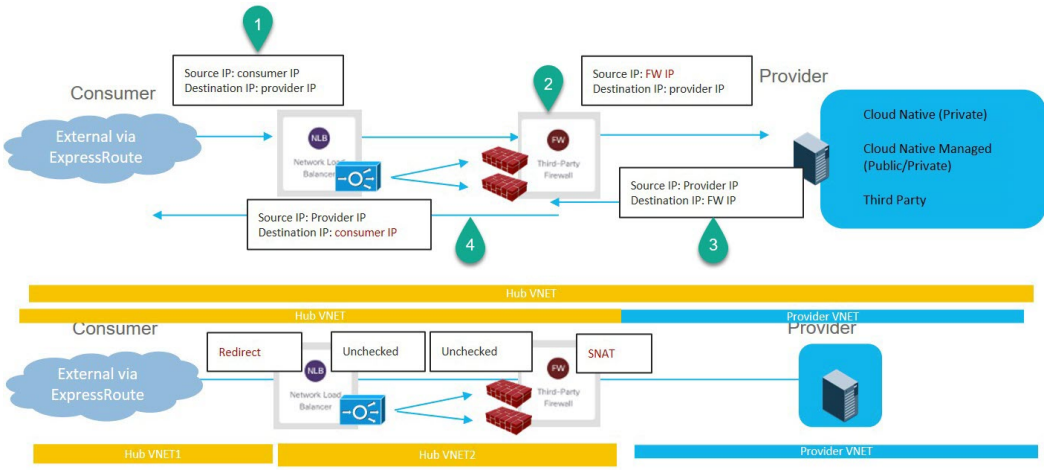
Two-Node Service Graph for Inbound Traffic via Express Route Gateway with SNAT Option

This use case has a two-node service graph, where the service nodes are a network load balancer and a firewall. Redirect is enabled only on the consumer side and SNAT is enabled on the firewall in this use case.

In this use case, the service EPG is the provider, the express route is on the consumer side.

These actions take place in this use case, as shown in the following figure:

1. Traffic is redirected to the network load balancer, which then load balances the traffic to the firewall.
2. SNAT is performed on the firewall.
3. The return traffic comes back to the firewall SNAT IP address.
4. At this point in the return direction, the return traffic doesn't go through the network load balancer.



To configure this use case:

1. Create the service EPG on the provider side and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, with these settings:

   - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Redis Cache` would be a supported service type with a `Cloud Native Managed` deployment type.
   - **Deployment type**: `Cloud Native Managed`
   - **Access type**: `Private`

2. Deploy the express route gateway on the consumer side.

   See Deploying Express Route Gateway Using Redirect for those procedures.

3. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   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 secondary VRF.
       - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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.

4. Deploy the Layer 4 to Layer 7 services.

See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

Three-Node Service Graph for Inbound Traffic via Express Route Gateway

This use case has a three-node service graph, where the service nodes are:

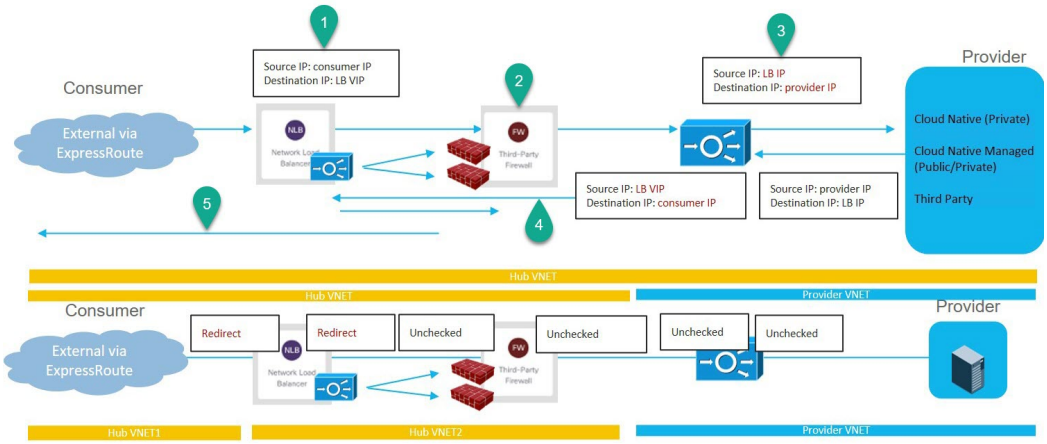
- First service device: Network load balancer in the hub VNet
- Second service device: Firewall in the hub VNet
- Third service device: Application load balancer in the hub or spoke VNet

Redirect is enabled on both the consumer and the provider side in this use case.

In this use case, the service EPG is the provider. The express route is on the consumer side, and the consumer can could be a cloud EPG or a service EPG.

These actions take place in this use case, as shown in the following figure:

1. Traffic is redirected to the network load balancer, which then load balances the traffic to the firewall.
2. SNAT is *not* performed on the firewall in this use case.
3. Traffic moves to the third service device, the application load balancer, which has SNAT configured.
4. The return traffic is redirected to the network load balancer, which then load balances the traffic to the firewall.
5. At this point in the return direction, the return traffic comes back to the consumer.



To configure this use case:

1. Create the service EPG on the provider side and assign the appropriate deployment type and access type to the service EPG.

   See Creating a Service EPG Using the Cisco Cloud APIC GUI for those procedures, with these settings:

   - **Service Type**: Any supported service type, depending on the deployment type (see Cloud Service Endpoint Groups for more information). For example, `Azure ApiManagement Services` would be a supported service type with a `Cloud Native Managed` deployment type.

- **Deployment type**: `Cloud Native Managed`
- **Access type**: `Private`

2. Deploy the express route gateway on the consumer side.

   See Deploying Express Route Gateway Using Redirect for those procedures.

3. Configure the service graph.

   See Creating Service Devices Using The Cloud APIC GUI, on page 53 for those procedures.

   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 secondary VRF.
       - Choose **Third-Party Firewall** as the **Service Type**, and in the **VRF** field, choose the secondary 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 **Application 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.

Note A third party load balancer can be used in place of an internal NLB. Choose **Third Party Load Balancer** as the **Service Type**. Choose the **VRF** and set the interface(s) details by clicking **Add Interface**.

   - 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)
     - Application 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**.

Note Ensure SNAT is configured on the third party load balancers.

4. Deploy the Layer 4 to Layer 7 services.

   See Deploying Layer 4 to Layer 7 Services Using the Cisco Cloud APIC GUI, on page 63 for those procedures. Attach the contract that exists between the consumer and provider to the service graph.

Guidelines and Limitations for Redirect

Following are the guidelines and limitations for redirect:

- All the Layer 4 to Layer 7 services devices should have their own dedicated subnet.
- Intra VRF Layer 4 to Layer 7 services redirection within a region:
  - Layer 4 to Layer 7 services redirect is not supported for east-west deployment when the consumer EPG and provider EPG are in the same VNet.
  - Layer 4 to Layer 7 services 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 to Layer 7 services redirection across regions:
  - Inter-Region Layer 4 to Layer 7 services 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 to Layer 7 services 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

Note Redirection to a third party load balancer is not supported.

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] LB(SNAT)[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 (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] • NLB[2]-FW(no SNAT)[1]-LB(SNAT)[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] NLB/ALB[1]-FW(ANT+DNAT)[6]-LB(SNAT)[1] (No redirection)	Supported	Supported	Not Supported	Not Supported	Supported	Supported
NLB[1]-LB(SNAT)[1] (No redirection)	Supported	Supported	Not Supported	Not 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 a Secondary VRF Using the Cloud APIC GUI

In some situations, you might have to disable VNet peering before adding new CIDRs or editing existing CIDRs in a secondary VRF. 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 52 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.

Note If you are adding new CIDRs to a secondary VRF and you have a multi-site deployment where you are running on the following releases:

- Release 5.2(1) or later on the Cloud APIC
- Release 3.3 or later on the Nexus Dashboard Orchestrator

After you have added the new CIDRs and re-enabled Hub Network Peering, wait at least five minutes for the CIDRs to come up before refreshing the site on Nexus Dashboard Orchestrator and deploying the infra configuration from the Nexus Dashboard Orchestrator. It will take time for the CIDRs to get deployed on Azure, so newly-added CIDRs might not get propagated to the remote site through Nexus Dashboard Orchestrator if you do not wait at least minutes before refreshing the site and deploying the infra configuration from the Nexus Dashboard Orchestrator.

If you see the following error message after you deploy the infra configuration from the Nexus Dashboard Orchestrator:

```
Invalid configuration CT_Remotectx_cidr: Remote Site CIDR
```

This means that you did not wait long enough before deploying the infra configuration from the Nexus Dashboard Orchestrator and the newly-added CIDRs did not get propagated to the remote site. If this happens:

1. Disable Hub Network Peering on the Cloud APIC
2. Refresh the site on Nexus Dashboard Orchestrator, then deploy the infra configuration from the Nexus Dashboard Orchestrator
3. Re-enable Hub Network Peering on the Cloud APIC
4. Wait at least five minutes (or a longer period than you waited for previously), then refresh the site and deploy the infra configuration from the Nexus Dashboard Orchestrator again

Procedure

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 VRF
6. A cloud context profile
7. 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.

Procedure

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.

Refer to the following tables for information specific to each type of service device.

- For an Application Load Balancer, see 4.a, on page 53.
- For a Network Load Balancer, see 4.b, on page 55.
- For a Third Party Load Balancer, see 4.c, on page 57.
- For a Third Party Firewall, see 4.d, on page 58.

a) Enter the necessary information for an Application Load Balancer:

Properties	Description
General	

Properties	Description
Name	Enter the name of the device.
Tenant	To choose a tenant: **1.** Click **Select Tenant**. The **Select Tenant** dialog appears. **2.** From the column on the left, click to choose a tenant. **3.** Click **Select**. You return to the **Create Device** dialog box.
Settings	
Service Type	Choose the device type: • Application Load Balancer
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.

Properties	Description
Subnet	To choose a subnet: **1.** 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**. **2.** Click **Select Cloud Context Profile**. The **Select Cloud Context Profile** dialog box appears. **3.** 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. **4.** To add additional subnets, repeat steps a-c.

b) Enter the necessary information for a Network Load Balancer:

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
Allow All Traffic	Determine if you want to enable the **Allow All Traffic** option. Enabling the **Allow All Traffic** option will allow all inbound and outbound access to the subnet on which the interface belongs. See About Allow All Traffic Option, on page 8 for more information. **Note** Ensure that this does not present a security risk before enabling this option. • If you want to allow all traffic, in the **Allow All Traffic** area, click the box next to the **Enabled** field. • If you do not want to allow all traffic, in the **Allow All Traffic** area, leave the box unchecked (unselected) next to the **Enabled** field.

Properties	Description

Scheme	Choose **Internet Facing** or **Internal**.
	• **Internet Facing**— This is used for configuring a public IP for the balancer. This is assigned by Azure.
	  • For releases prior to release 25.0(3), choosing the **Internet Facing** option is used to configure only a single default public frontend IP address.
	  • For release 25.0(3) and later, choosing the **Internet Facing** option can be used to configure a single default public frontend IP address or multiple public frontend IP addresses, depending on the selection that you make in the **Frontend IP Names** field later in this page.
	• **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.

Custom Resource Group	Enter a name for a custom resource group, if necessary.
Subnets	To choose a subnet: **1.** Click **+ Add Subnet**. **2.** 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**. **3.** Click **Select Cloud Context Profile**. The **Select Cloud Context Profile** dialog box appears. From the **Select Cloud Context Profile** dialog, click to choose a cloud context profile in the left column, then click **Select**. **4.** Click **Select Subnet**. The **Select Subnet** dialog box appears. From the **Select Subnet** dialog, click to choose a subnet in the left column, then click **Select**. **5.** Click the tick mark on the right to confirm. **6.** To add additional subnets, click **+ Add Subnet** again and repeat these steps.
Advanced Settings	Click the down arrow to expand the **Advanced Settings** area. The following entries are displayed.

Properties	Description
Frontend IP Names	Beginning with release 25.0(3), support is available for configuring multiple frontend IP addresses for an internet-facing Network Load Balancer. • By default, a single frontend IP address will automatically be created for the internet-facing Network Load Balancer. This is the existing behavior that is available prior to release 25.0(3). • If you want additional frontend IP addresses for the internet-facing Network Load Balancer, click **+ Add Frontend IP Name**. This is new behavior that is introduced in release 25.0(3). For more information, see Understanding Configurations for Multiple Frontend IP Addresses on the Azure Network Load Balancer, on page 5. Adding frontend IP names in this area tells Azure that you want multiple frontend IP addresses to be assigned to this internet-facing Network Load Balancer. Each frontend IP name that you enter in this area results in a single additional frontend IP address. The public frontend IP addresses in this area (the default frontend IP address and any additional frontend IP addresses) are then assigned by Azure. **1.** Click **+ Add Frontend IP Name** to add a name for an additional frontend IP address that you want Azure to assign for the Network Load Balancer. **2.** Enter a name for the additional frontend IP address, then click the tick mark on the right to confirm the new frontend IP name. **3.** Click **+ Add Frontend IP Name** again to add additional names for additional frontend IP addresses that you want Azure to assign for the Network Load Balancer. For example, assume that you want a total of three frontend IP addresses for the internet-facing Network Load Balancer: • The first of the three frontend IP addresses is automatically assigned by default, using existing behavior that is available prior to release 25.0(3). • You would then click **+ Add Frontend IP Name** twice, entering two separate frontend IP names (for example, `frontend2` and `frontend3`), to signal to Azure that you want Azure to assign a total of three frontend IP addresses for the internet-facing Network Load Balancer. To see the frontend IP addresses associated with the default and configured frontend IP names: **1.** Navigate to **Application Management** > **Services** > **Devices**. **2.** Double-click on the configured service device to bring up the **Overview** page for that service device. **3.** Click on **Cloud Resources** > **Frontend IP Names**. The default frontend IP address will be shown with the `Default` tag in this details page.

c) Enter the necessary information for a Third Party Load Balancer:

Table 4: Create Device Dialog Box Fields for Third Party Load Balancer

Properties	Description
General	
Name	Enter the name of the device.
Tenant	To choose a tenant: 1. Click **Select Tenant**. The **Select Tenant** dialog appears. 2. From the column on the left, click to choose a tenant. 3. Click **Select**. You return to the **Create Device** dialog box.
Settings	
Service Type	Choose the device type: • Third Party Load Balancer
Creation Mode	Select **Selectors**. **VRF** and **Interfaces** fields are displayed.
VRF	Click **Select VRF**. In the Select VRF dialog box that opens, click to choose a VRF in the left column. Click **Select**.
Interface	Click **Add Interface**. The **Interfaces** window is displayed. 1. Enter a name for the external interface in the **Interface Settings** field. 2. Click **Add Interface selector**. 3. In the **Interface Selector Settings** page, enter the name of the interface. 4. In the **Match Expressions** field, click **Match Expression** and select • **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 external or internal network of third party load balancer. 5. Click the tick mark to add the interface and then click **Save** (Interfaces window). 6. Click **Save** (Create Device window). Click **Add Interface** and repeat steps a - e to add more interfaces. **Note** Third party load balancer interfaces should be configured with subnet-based selectors when deployed in a multi-node service graph.

d) Enter the necessary information for a Third Party Firewall:

Table 5: 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: 1. Click **Select VRF**. The **Select VRF** dialog box appears. 2. From the **Select VRF** dialog, click to choose a VRF in the left column then click **Select**.

Properties	Description
Interfaces	Click **Add Interface**. The **Settings** page appears. **1.** In the **Name** field, enter the name of the interface. **2.** Determine if you want to enable the **Allow All Traffic** option. Enabling the **Allow All Traffic** option will allow all inbound and outbound access to the subnet on which the interface belongs. See About Allow All Traffic Option, on page 8 for more information. **Note** Ensure that this does not present a security risk before enabling this option. • If you want to allow all traffic, in the **Allow All Traffic** area, click the box next to the **Enabled** field. • If you do not want to allow all traffic, in the **Allow All Traffic** area, leave the box unchecked (unselected) next to the **Enabled** field. **3.** Click **Add Interface Selector**. **4.** Enter the name of the interface selector. **5.** Click on **Match Expressions** and select • **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. **6.** Click **Add**. **7.** Repeat steps a - f to add more interfaces.

Step 5 Click **Save** when finished.

Step 6 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.

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.

Procedure

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 6: 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 7: 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**.

Properties	Description
Third Party Load Balancer	**a.** Drag and drop the third party load balancer device into the box below. **b.** In the **Service node** dialog box, click **Select Third Party Load Balancer** and click to choose a third party load balancer in the left column. **c.** Click **Select Consumer Interface**. Select the interface marked as external. **d.** Click **Select Provider Interface**. Select the interface marked as internal. **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.

Procedure

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 8: 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 9: Add Cloud Load Balancer Listener Dialog Box Fields for Network Load Balancer

Properties	Description
Name	Enter the name of the listener.
Protocol	Click to choose **TCP** or **UDP**.
Port	Enter the port that the device will accept traffic on.
Frontend IP Name	Select the frontend IP address where you will be configuring the cloud load balancer listener. • **Use default IP**: Select this option to configure the cloud load balancer listener on the default frontend IP address. This is the existing behavior that is available prior to release 25.0(3). • **<frontend_ip_name>**: Select this option to configure the cloud load balancer listener on the additional frontend IP address associated with the frontend IP name that you configured when you created the service device for this internet-facing Network Load Balancer in Creating Service Devices Using The Cloud APIC GUI, on page 53. This is new behavior that is introduced in release 25.0(3). For more information, see Understanding Configurations for Multiple Frontend IP Addresses on the Azure Network Load Balancer, on page 5.

Properties	Description
Rule Settings	The **Rule Settings** pane contains the following options: • **Name**—Enter a name for the rule. • **Action Type**—Set to `Forward to` by default. The traffic is forwarded to the port for the EPG selected using the protocol chosen below. • **Port**—Enter the port on which the backend pool servers will accept traffic from the load balancer. • **Protocol**-Click to choose **TCP** or **UDP**. • **EPG**-The EPG with the web servers handling traffic.
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** 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.

Procedure

Step 1 To create an internal-facing load balancer for Application Gateway (Application Load Balancer):

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 (Network Load Balancer):

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>
```

Step 3 To create an internal-facing load balancer for Azure Load Balancing (Network Load Balancer) using the **Allow All Traffic** option described in About Allow All Traffic Option, on page 8:

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" allowAll="true" 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.

Procedure

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 Network Load Balancer:

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="">
            <cloudVip name="IP1"/>
            <cloudRsLDevToCloudSubnet
tDn="uni/tn-tn15/ctxprofile-cProfilewestus151/cidr-[15.151.0.0/16]/subnet-[15.151.2.0/24]" />
        </cloudLB>
    </fvTenant>
</polUni>
```

In this example:

- The `cloudLB` line is used to create an internet-facing Network Load Balancer with a single default IP address. This is the existing behavior that is available prior to release 25.0(3).
- The `cloudVip` line is used to create any additional frontend IP addresses for the internet-facing Network Load Balancer. This is new behavior that is introduced in release 25.0(3). For more information, see Understanding Configurations for Multiple Frontend IP Addresses on the Azure Network Load Balancer, on page 5.

Creating a Third-Party Firewall Using the REST API

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

Procedure

Step 1 To create a third-party firewall:

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>
```

Step 2 To create a third-party firewall using the **Allow All Traffic** option described in About Allow All Traffic Option, on page 8:

Example:

```
<cloudLDev name="HubFW" svcType="FW" status="">
    <cloudRsLDevToCtx tDn="uni/tn-infra/ctx-overlay-2"/>
    <cloudLIf name="provider"  allowAll="true" status="">
        <cloudEPSelector name="1" matchExpression="IP=='10.1.1.0/28'" status=""/>
    </cloudLIf>
    <cloudLIf name="consumer"  allowAll="true" status="">
        <cloudEPSelector name="east" matchExpression="IP=='10.1.2.0/28'" status=""/>
    </cloudLIf>
</cloudLDev>
```

Creating a Third Party Load Balancer Using the REST API

This example demonstrates how to create a third party load balancer using the REST API.

Procedure

This example demonstrates how to create a third party load balancer using the REST API:

Example:

```
<cloudLDev name="ThirdPartyLB" svcType="ADC" status="">
    <cloudRsLDevToCtx tDn="uni/tn-infra/ctx-overlay-2"/>
    <cloudLIf name="external">
        <cloudEPSelector name="ExtInterfaceSelector" matchExpression="IP=='{{ExtInterfaceSubnet}}'"
 status=""/>
    </cloudLIf>
    <cloudLIf name="internal">
        <cloudEPSelector name="IntInterfaceSelector" matchExpression="IP=='{{IntInterfaceSubnet}}'"
 status=""/>
    </cloudLIf>
</cloudLDev>
```

Creating a Service Graph Using the REST API for an Application Gateway

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

Procedure

To create a service graph for an 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>
```

Creating a Service Graph Using the REST API for Azure Load Balancer

To create a service graph for an Azure load balancer:

```
<?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 Service Graph Using the REST API for a Third Party Load Balancer

To create a service graph for a third party load balancer:

```
<polUni>
<fvTenant name="infra" >
<!-- Abs Graph Creation -->
<vnsAbsGraph name="{{graphName}}" uiTemplateType="UNSPECIFIED" type="cloud" status="">
<vnsAbsTermNodeProv name="T2">
<vnsOutTerm/>
<vnsInTerm />
<vnsAbsTermConn attNotify="no" name="1" />
</vnsAbsTermNodeProv>
<vnsAbsTermNodeCon name="T1" >
<vnsOutTerm/>
<vnsInTerm />
<vnsAbsTermConn attNotify="no" name="1" />
</vnsAbsTermNodeCon>
<vnsAbsNode funcTemplateType="ADC_TWO_ARM" name="{{F5Name}}" managed="no">
<vnsRsNodeToCloudLDev tDn="uni/tn-infra/cld-{{F5Name}}" />
<vnsAbsFuncConn attNotify="no" name="consumer" deviceLIfName="external"/>
<vnsAbsFuncConn attNotify="no" name="provider" deviceLIfName="internal"/>
</vnsAbsNode>
<vnsAbsConnection adjType="L3" connDir="provider" connType="external" directConnect="no"
name="ConsTermToF5">
<vnsRsAbsConnectionConns
tDn="uni/tn-infra/AbsGraph-{{graphName}}/AbsTermNodeCon-T1/AbsTConn"/>
<vnsRsAbsConnectionConns
tDn="uni/tn-infra/AbsGraph-{{graphName}}/AbsNode-{{F5Name}}/AbsFConn-consumer"/>
```

```
</vnsAbsConnection>
<vnsAbsConnection adjType="L3" connDir="provider" connType="external" directConnect="no"
name="F5ToProv">
<vnsRsAbsConnectionConns
tDn="uni/tn-infra/AbsGraph-{{graphName}}/AbsNode-{{F5Name}}/AbsFConn-provider" />
<vnsRsAbsConnectionConns
tDn="uni/tn-infra/AbsGraph-{{graphName}}/AbsTermNodeProv-T2/AbsTConn"/>
</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.

Procedure

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.

Procedure

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.

Procedure

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.

Procedure

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 a Network Load Balancer:

```
<?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="">
                            <cloudRsListenerToVip tDn="uni/tn-infra/clb-NLB/vip-IP1" 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="">
                            <cloudRsListenerToVip tDn="uni/tn-infra/clb-NLB/vip-IP1" status=""/>
                            <cloudRuleAction type="forward" port="55" protocol="udp" epgdn="uni/tn-
 tn15/cloudapp-ap/cloudepg-provEPG" />
                        </cloudListenerRule>
                    </cloudListener>
                </cloudSvcPolicy>
            </vnsAbsNode>
        </vnsAbsGraph>
    </fvTenant>
</polUni>
```

As described previously in this document, when defined on a Network Load Balancer, the listener rule and rule action settings construct a mapping from a frontend configuration of the load balancer to a backend pool. In this example:

- The `cloudListenerRule` lines are used to configure listeners with a single frontend IP address but with different port and protocol combinations for an internet-facing Network Load Balancer on Cisco Cloud APIC. This is the existing behavior that is available prior to release 25.0(3).
- The `cloudRsListenerToVip` lines are used to configure listener rules with multiple frontends for an internet-facing Network Load Balancer on Cisco Cloud APIC, where each frontend is represented as a tuple combination of frontend IP addresses, port, and protocol. This is new behavior that is introduced in release 25.0(3). For more information, see Understanding Configurations for Multiple Frontend IP Addresses on the Azure Network Load Balancer, on page 5.

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.

Procedure

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
cVcT6iCW1OAFJRw3c/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.

Procedure

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>
```