Configuring a Service Graph

About Service Graphs

The Cisco Application Centric Infrastructure (ACI) treats services as an integral part of an application. Any services that are required are treated as a service graph that is instantiated on the ACI fabric from the Cisco Application Policy Infrastructure Controller (APIC). Users define the service for the application, while service graphs identify the set of network or service functions that are needed by the application.

A service graph represents the network using the following elements:

- Function node—A function node represents a function that is applied to the traffic, such as a transform (SSL termination, VPN gateway), filter (firewalls), or terminal (intrusion detection systems). A function within the service graph might require one or more parameters and have one or more connectors.
- Terminal node—A terminal node enables input and output from the service graph.
- Connector—A connector enables input and output from a node.
- Connection—A connection determines how traffic is forwarded through the network.

After the graph is configured in the APIC, the APIC automatically configures the services according to the service function requirements that are specified in the service graph. The 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.

A service graph is represented as two or more tiers of an application with the appropriate service function inserted between.

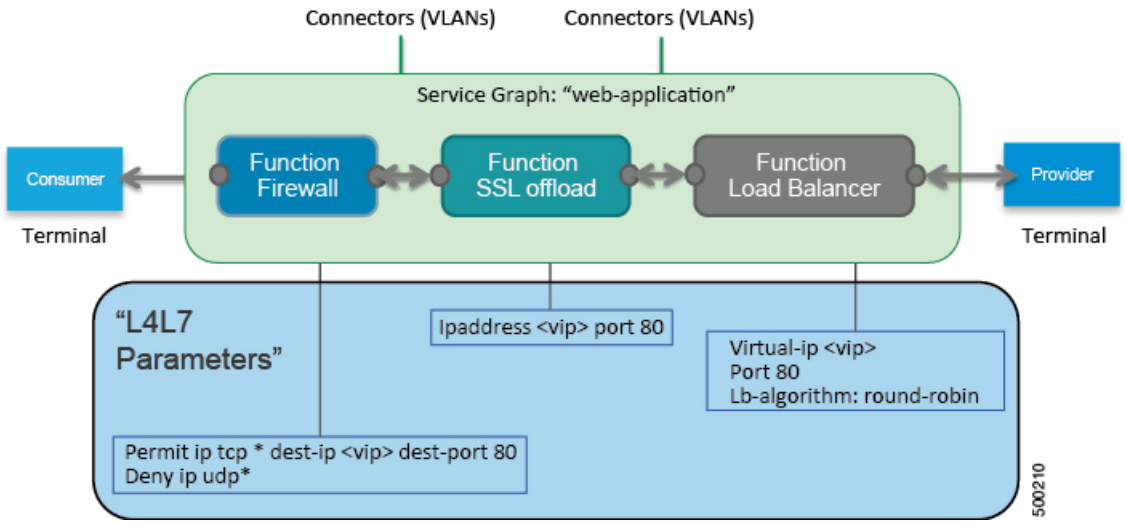
A service appliance (device) performs a service function within the graph. One or more service appliances might be required to render the services required by a graph. One or more service functions can be performed by a single-service device.

Service graphs and service functions have the following characteristics:

- Traffic sent or received by an endpoint group can be filtered based on a policy, and a subset of the traffic can be redirected to different edges in the graph.
- Service graph edges are directional.
- Taps (hardware-based packet copy service) can be attached to different points in the service graph.
- Logical functions can be rendered on the appropriate (physical or virtual) device, based on the policy.
- The service graph supports splits and joins of edges, and it does not restrict the administrator to linear service chains.
- Traffic can be reclassified again in the network after a service appliance emits it.
- Logical service functions can be scaled up or down or can be deployed in a cluster mode or 1:1 active-standby high-availability mode, depending on the requirements.

The following figure provides an example of a service graph deployment:

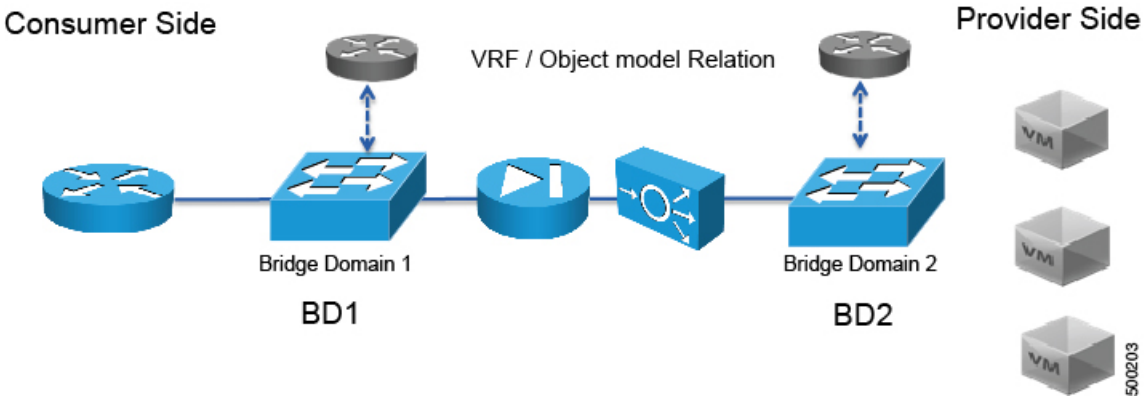
Figure 1: Example Service Graph Deployment



By using a service graph, you can install a service, such as an ASA firewall, once and deploy it multiple times in different logical topologies. Each time the graph is deployed, ACI takes care of changing the configuration on the firewall to enable the forwarding in the new logical topology.

Deploying a service graph requires bridge domains and VRFs, as shown in the following figure:

Figure 2: Bridge Domains and VRFs of a Service Graph



Note If you have some of the legs of a service graph that are attached to endpoint groups in other tenants, when you use the **Remove Related Objects of Graph Template** function in the GUI, the APIC does not remove contracts that were imported from tenants other than where the service graph is located. The APIC also does not clean endpoint group contracts that are located in a different tenant than the service graph. You must manually remove these objects that are in different tenants.

About Function Nodes

A function node represents a single service function. A function node has function node connectors, which represent the network requirement of a service function.

A function node within a service graph can require one or more parameters. The parameters can be specified by an endpoint group (EPG), an application profile, or a tenant VRF. Parameters can also be assigned at the time that you define a service graph. The parameter values can be locked to prevent any additional changes.

About Function Node Connectors

A function node connector connects a function node to the service graph and is associated with the appropriate bridge domain and connections based on the graph's connector's subset. Each connector is associated with a VLAN or Virtual Extensible LAN (VXLAN). Each side of a connector is treated as an endpoint group (EPG), and whitelists are downloaded to the switch to enable communication between the two function nodes.

About Service Graph Connections

A service graph connection connects one function node to another function node.

About Terminal Nodes

Terminal nodes connect a service graph with the contracts. You can insert a service graph for the traffic between two application endpoint groups (EPGs) by connecting the terminal node to a contract. Once connected, traffic between the consumer EPG and provider EPG of the contract is redirected to the service graph.

About Service Graph Template Configuration Parameters

A service graph template can have configuration parameters, which are specified by the device package. Configuration parameters can also be specified by an EPG, application profile, or tenant context. A function node within a service graph template can require one or more configuration parameters. The parameter values can be locked to prevent any additional changes.

When you configure a service graph template and specify the values of the configuration parameters, the Application Policy Infrastructure Controller (APIC) passes the parameters to the device script that is within the device package. The device script converts the parameter data to the configuration that is downloaded onto the device.

Configuring Service Graph Templates Using the GUI

You can configure the service graph templates using the GUI.

See Using the GUI for the procedure for configuring the service graph templates.

Creating a Service Graph Template Using the REST APIs

You can create a service graph template using the following REST API:

```
<polUni>
  <fvTenant name="acme">
    <vnsAbsGraph name="G1">
      <vnsAbsTermNodeCon name="Input1">
        <vnsAbsTermConn name="C1">
                </vnsAbsTermConn>
      </vnsAbsTermNodeCon>
      <vnsAbsNode name="Node" funcType="GoTo">
        <vnsRsDefaultScopeToTerm
          tDn="uni/tn-acme/AbsGraph-G1/AbsTermNodeProv-Output1/outtmnl"/>
        <vnsAbsFuncConn name="inside">
          <vnsRsMConnAtt
            tDn="uni/infra/mDev-Insieme-Generic-1.0/mFunc-SubnetFunc/mConn-external"/>
        </vnsAbsFuncConn>
        <vnsAbsFuncConn name="outside">
          <vnsRsMConnAtt
            tDn="uni/infra/mDev-Insieme-Generic-1.0/mFunc-SubnetFunc/mConn-internal"/>
        </vnsAbsFuncConn>
        <vnsAbsDevCfg>
          <vnsAbsFolder key="oneFolder" name="f1">
            <vnsAbsParam key="oneParam" name="p1" value="v1"/>
          </vnsAbsFolder>
        </vnsAbsDevCfg>
        <vnsAbsFuncCfg>
          <vnsAbsFolder key="folder" name="folder1" devCtxLbl="C1">
            <vnsAbsParam key="param" name="param" value="value"/>
          </vnsAbsFolder>
```

```
            <vnsAbsFolder key="folder" name="folder2" devCtxLbl="C2">
              <vnsAbsParam key="param" name="param" value="value"/>
            </vnsAbsFolder>
          </vnsAbsFuncCfg>
          <vnsRsNodeToMFunc tDn="uni/infra/mDev-Insieme-Generic-1.0/mFunc-SubnetFunc"/>
        </vnsAbsNode>
        <vnsAbsTermNodeProv name="Output1">
          <vnsAbsTermConn name="C6">
                  </vnsAbsTermConn>
        </vnsAbsTermNodeProv>
        <vnsAbsConnection name="CON1">
          <vnsRsAbsConnectionConns
            tDn="uni/tn-acme/AbsGraph-G1/AbsTermNodeCon-Input1/AbsTConn"/>
         <vnsRsAbsConnectionConns tDn="uni/tn-acme/AbsGraph-G1/AbsNode-Node/AbsFConn-inside"/>

        </vnsAbsConnection>
        <vnsAbsConnection name="CON3">
         <vnsRsAbsConnectionConns tDn="uni/tn-acme/AbsGraph-G1/AbsNode-Node/AbsFConn-outside"/>

          <vnsRsAbsConnectionConns
            tDn="uni/tn-acme/AbsGraph-G1/AbsTermNodeProv-Output1/AbsTConn"/>
        </vnsAbsConnection>
      </vnsAbsGraph>
    </fvTenant>
  </polUni>
```

Configuring a Service Graph Using the NX-OS-Style CLI

You can configure a service graph using the NX-OS-style CLI.

Step 1 Enter the configure mode.

Example:

```
apic1# configure
```

Step 2 Enter the configure mode for a tenant.

```
tenant tenant_name
```

Example:

```
apic1(config)# tenant t1
```

Step 3 Add a service graph.

```
l4l7 graph graph_name [contract contract_name]
```

Parameter	Description
graph	Name of the service graph.
contract	Name of the contract that is associated with this service graph instance. Specify the contract only if you want to create the service graph instance. You can simply configure a service graph (equivalent to the service graph template) without instantiating it.

Example:

```
apic1(config-tenant)# l4l7 graph G2 contract C2
```

Step 4 Add a node (service) in the service graph.

```
service node_name [device-cluster-tenant tenant_name] [device-cluster device_name] [mode
deployment_mode]
```

Parameter	Description
service	The name of the service node to add.
device-cluster-tenant	The tenant from which to import the device cluster. Specify this only if the device-cluster is not in the same tenant in which the graph is being configured.
device-cluster	Name of the device cluster to use for this service node.
mode	The deployment mode. Possible values are: • ADC_ONE_ARM—Specifies one-arm mode. • ADC_TWO_ARM—Specifies two-arm mode. • FW_ROUTED—Specifies routed (GoTo) mode. • FW_TRANS—Specifies transparent (GoThrough) mode. • OTHERS—Specifies any other deployment mode. If the mode is not specified, then a deployment mode is not used.

Example:

The following example adds node `N1` to the device cluster `D4`, which is from tenant `t1`:

```
apic1(config-graph)# service N1 device-cluster-tenant t1 device-cluster D4
```

The following example adds node `N1` to the device cluster `D4`, which is from tenant `t1`, and uses the routed deployment mode:

```
apic1(config-graph)# service N1 device-cluster-tenant t1 device-cluster D4 mode FW_ROUTED
```

Step 5 Add the consumer connector.

```
connector connector_type [cluster-interface interface_type]
```

Parameter	Description
connector	The type of the connector in the service graph. Possible values are: • provider • consumer

Parameter	Description
cluster-interface	The type of the device cluster interface. Possible values are: • provider • consumer Do not specify this parameter if you are a service graph template in tenant `Common`.

Example:
```
apic1(config-service)# connector consumer cluster-interface consumer
```

Step 6 Configure the bridge domain for the connectors by specifying the bridge domain information and tenant where the bridge domain is present.

```
bridge-domain tenant tenant_name name bridge_domain_name
```

Parameter	Description
tenant	Tenant that owns the bridge domain. You can only specify a bridge domain from same tenant or tenant `Common`. For example if you are in tenant `t1`, then you cannot specify the bridge domain from tenant `t2`.
name	Name of the bridge domain.

Example:
```
apic1(config-connector)# bridge-domain tenant t1 name bd2
```

Step 7 (Optional) Configure the direct server return (DSR) virtual IP address (VIP) for the connector.

```
dsr-vip ip_address
```

If you specify the DSR VIP, the Application Policy Infrastructure Controller (APIC) does not learn the VIP.

Parameter	Description
dsr-vip	The virtual IP address of the DSR for the connector.

Example:
```
apic1(config-connector)# dsr-vip 192.168.10.100
```

Step 8 Configure connections for the consumer and provider and exit the service graph configuration mode.

```
connection connection_name {terminal terminal_type service node_name connector connector_type} |
  {intra_service service1 node_name connector1 connector_type service2 node_name connector2
connector_type}
exit
```

Parameter	Description
connection	The name of the connection.
terminal	Connects a service node to the terminal. Specifies the type of the terminal. Possible values are: • provider • consumer
service service1 service2	The name of the service node to add. service is used only with terminal. service1 and service2 are used only with intra_service.
connector connector1 connector2	The type of the connector. Possible values are: • provider • consumer connector is used only with terminal. connector1 and connector2 are used only with intra_service.
intra_service	Connects a service node to another node.

Example:
The following example configures the connections of a single node graph:

```
apic1(config-graph)# connection CON1 terminal consumer service N1 connector consumer
apic1(config-graph)# connection CON2 terminal provider service N2 connector provider
apic1(config-graph)# exit
```

The following example configures the connections of a two node graph:

```
apic1(config-graph)# connection CON1 terminal consumer service N1 connector consumer
apic1(config-graph)# connection CON2 intra_service service1 N1 connector1 provider service2 N2
connector2 consumer
apic1(config-graph)# connection CON3  terminal provider service N2 connector provider
apic1(config-graph)# exit
```

Step 9 Exit the configuration mode.

Example:

```
apic1(config-tenant)# exit
apic1(config)# exit
```