Cisco UCS Director APIC Management Guide, Release 6.5

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Preface

Audience

This guide is intended primarily for data center administrators who use Cisco UCS Director and who have responsibilities and expertise in one or more of the following:

- Server administration
- Storage administration
- Network administration
- Network security
- Virtualization and virtual machines

Conventions

Text Type	Indication
GUI elements	GUI elements such as tab titles, area names, and field labels appear in **this font**. Main titles such as window, dialog box, and wizard titles appear in **this font**.
Document titles	Document titles appear in *this font*.
TUI elements	In a Text-based User Interface, text the system displays appears in `this font`.

Text Type	Indication
System output	Terminal sessions and information that the system displays appear in `this font`.
CLI commands	CLI command keywords appear in **this font**. Variables in a CLI command appear in *this font*.
[ ]	Elements in square brackets are optional.
{x | y | z}	Required alternative keywords are grouped in braces and separated by vertical bars.
[x | y | z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
< >	Nonprinting characters such as passwords are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the document.

Caution Means *reader be careful*. In this situation, you might perform an action that could result in equipment damage or loss of data.

Tip Means *the following information will help you solve a problem*. The tips information might not be troubleshooting or even an action, but could be useful information, similar to a Timesaver.

Timesaver Means *the described action saves time*. You can save time by performing the action described in the paragraph.

Warning

IMPORTANT SAFETY INSTRUCTIONS

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device.

SAVE THESE INSTRUCTIONS

Related Documentation

Cisco UCS Director Documentation Roadmap

For a complete list of Cisco UCS Director documentation, see the *Cisco UCS Director Documentation Roadmap* available at the following URL: http://www.cisco.com/en/US/docs/unified_computing/ucs/ucs-director/doc-roadmap/b_UCSDirectorDocRoadmap.html.

Cisco UCS Documentation Roadmaps

For a complete list of all B-Series documentation, see the *Cisco UCS B-Series Servers Documentation Roadmap* available at the following URL: http://www.cisco.com/go/unifiedcomputing/b-series-doc.

For a complete list of all C-Series documentation, see the *Cisco UCS C-Series Servers Documentation Roadmap* available at the following URL: http://www.cisco.com/go/unifiedcomputing/c-series-doc.

Note The *Cisco UCS B-Series Servers Documentation Roadmap* includes links to documentation for Cisco UCS Manager and Cisco UCS Central. The *Cisco UCS C-Series Servers Documentation Roadmap* includes links to documentation for Cisco Integrated Management Controller.

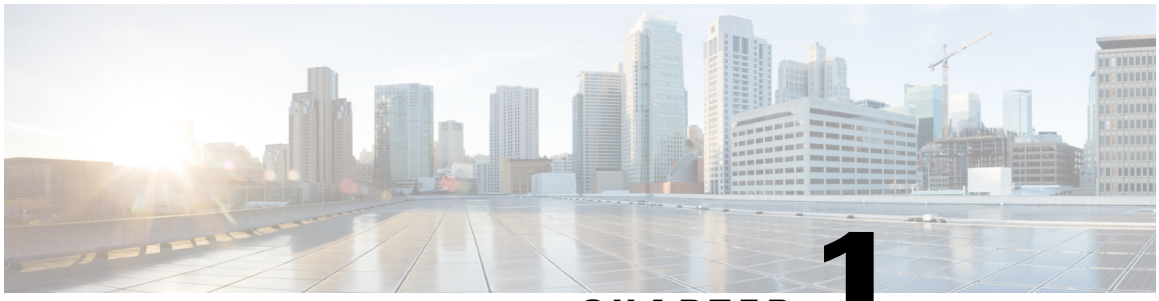
Documentation Feedback

To provide technical feedback on this document, or to report an error or omission, please send your comments to ucs-director-docfeedback@cisco.com. We appreciate your feedback.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see What's New in Cisco Product Documentation.

To receive new and revised Cisco technical content directly to your desktop, you can subscribe to the What's New in Cisco Product Documentation RSS feed. RSS feeds are a free service.



CHAPTER 1

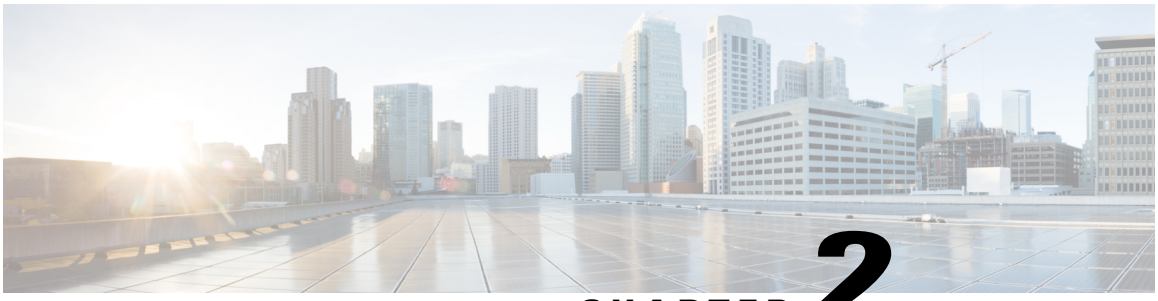
New and Changed Information for this Release

New and Changed Information

The following table provides an overview of the significant changes to this guide for the current release. The table does not provide an exhaustive list of all changes, or of all new features in this release.

Table 1: New Features and Changed Behavior in Cisco UCS Director, Release 6.5

Feature	Description	Where Documented
Reorganization and improvement of this guide.		
APIC authentication	APIC accounts can point to APIC user names that are authenticated through LDAP, RADIUS, or TACACS+.	Guidelines for APIC Accounts, on page 5
APIC accounts can have in-band or out-of-band Management	You can now add an APIC account to Cisco UCS Director with an in-band or out-of-band IP address.	Support for In-Band and Out-of-Band Management, on page 6
Unmanaged mode	Support for configuration of network devices in unmanaged mode.	Unmanaged Mode, on page 41
ASA/ASAv Configuration through APIC Function Profiles and Service Graphs	For systems that include network management through ACI, you can now configure NAT, static route, and IP address parameters in an APIC function profile. You can then add this function profile to an L4-L7 service graph.	APIC Function Profiles, on page 50



CHAPTER 2

Overview

Cisco UCS Director and Cisco Application Centric Infrastructure

Cisco UCS Director is a unified infrastructure management solution that provides management from a single interface for compute, network, storage, and virtualization layers. Cisco UCS Director uses a workflow orchestration engine with workflow tasks that support the compute, network, storage, and virtualization layers. Cisco UCS Director supports multitenancy, which enables policy-based and shared use of the infrastructure.

Cisco UCS Director also supports the ability to define contracts between different container tiers, enabling you to apply rules between tiers.

Cisco Application Centric Infrastructure (ACI) allows application requirements to define the network. This architecture simplifies, optimizes, and accelerates the entire application deployment cycle.

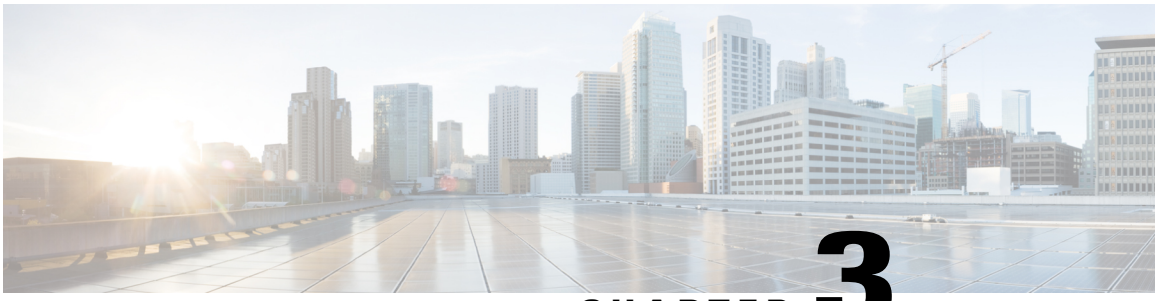
The combination of Cisco UCS Director and Cisco ACI enables automatic provisioning and delivery of an application-centric infrastructure.

Note To use ACI 1.1(1*), ensure that TLSv1 is enabled in Cisco Application Policy Infrastructure Controller (APIC). In APIC, choose **Fabric > Fabric Resources > Pod Polices > Communication > Default** and enable **TLSv1**.

Cisco Application Policy Infrastructure Controller

The Cisco Application Policy Infrastructure Controller (APIC) is the unified point of automation, management, monitoring, and programmability for the Cisco Application Centric Infrastructure (ACI). The APIC supports the deployment, management, and monitoring of any application anywhere, with a unified operations model for physical and virtual components of the infrastructure. It is the central control engine for the broader cloud network. The APIC programmatically automates network provisioning and control-based on user-defined application requirements and policies.

The Cisco UCS Director orchestration feature allows you to automate APIC configuration and management tasks through operational workflows. A complete list of the APIC orchestration tasks is available in the Workflow Designer, and in the Task Library. For more information about orchestration in Cisco UCS Director, see the Cisco UCS Director Orchestration Guide.



CHAPTER 3

Configuring APIC Accounts

Guidelines for APIC Accounts

Before you create an APIC account in Cisco UCS Director, consider the following guidelines and best practices.

Account Permissions on Cisco APIC

The Cisco APIC account username and password that you provide when you add the APIC account to Cisco UCS Director must have all the Cisco APIC privileges required to do the following:

- Access the supported features in Cisco APIC
- Perform actions in Cisco APIC, such as viewing and accessing reports
- Execute workflow tasks in Cisco UCS Director

Account Authentication on Cisco APIC

The Cisco APIC account username and password that you use for the APIC account in Cisco UCS Director is authenticated by Cisco APIC not by Cisco UCS Director. As a result, you can use one of the following types of accounts:

- Local authentication through a Cisco APIC account
- Remote authentication by Cisco APIC through one of the following:
  - LDAP
  - RADIUS

◦ TACACS+

If you use a Cisco APIC account with remote authentication, enter the username on the **Add Account** screen in the following format: apic:<Domain Name>\<Remote User Name>

Note Cisco UCS Director does not support authentication through RADIUS or TACACS+ for accounts used to log in to Cisco UCS Director. Support is only available for authentication of accounts that Cisco UCS Director uses to log in to Cisco APIC.

APIC Clusters

Each APIC account in Cisco UCS Director represents an APIC cluster. When you add an APIC cluster to an APIC account, Cisco UCS Director automatically discovers the controllers in that cluster.

To view details of the controllers, choose **Physical** > **Network**, choose the APIC account, and then click **View Details**.

ACI Fabric Integration

To integrate Cisco UCS Director with the ACI fabric, ensure that TLSv1 is enabled on the ACI fabric.

You must enable TLSv1 in Cisco APIC, as follows: **Fabric Policies** > **Pod Policies** > **Policies - Communication**.

APIC Accounts and Pods

Cisco APIC accounts are multi-domain manager accounts that are not tied to a specific pod. You can assign the account to a pod, but that is optional.

APIC Accounts and Resource Groups

If you add an APIC account to a resource group and that account is associated with a pod, you cannot edit the pod.

You cannot delete an account that is part of a resource group.

Support for In-Band and Out-of-Band Management

Cisco UCS Director supports in-band and out-of-band management of Cisco ACI. You can add a Cisco APIC account to Cisco UCS Director in the following scenarios:

- Out-of-Band—An out-of-band IP address is configured and the Cisco UCS Director VM is in a domain that is not managed by Cisco APIC.
- In-Band—An in-band IP address is configured and reachable, no out-of-band IP address is configured, and the Cisco UCS Director VM is in a domain managed by Cisco APIC.

Adding an APIC Account

Before You Begin

Review the guidelines and best practices in Guidelines for APIC Accounts, on page 5.

Step 1 Choose **Administration** > **Physical Accounts**.

Step 2 On the **Physical Accounts** page, click **Multi-Domain Managers**.

Step 3 Click **Add**.

Step 4 On the **Add Account** screen, choose **APIC** from the **Account Type** drop-down list and click **Submit**.

Step 5 On the **Add Account** screen, complete the fields, including the following:

a) Enter a unique account name and description.

b) From the **Pod** drop-down list, choose the pod where you want to add the APIC account.

c) In the **Server IP** field, enter the IP address of one of the APIC controllers in the APIC cluster.
Cisco UCS Director automatically discovers the IP address of the other APIC controllers in the APIC cluster.

If the IP address of the APIC controller is not reachable, Cisco UCS Director relies on the Out-of-Band IP address of another APIC controllers for managing Cisco APIC.

d) Check the **Use Credential Policy** box if you want to use a credential policy for this account rather than enter the username and password information manually.

e) If you checked the **Use Credential Policy** box, choose a policy from the **Credential Policy** drop-down list.
The APIC account in the credential policy must meet the criteria listed in Guidelines for APIC Accounts, on page 5.

Note You can only connect to Cisco APIC with HTTPS protocol. You cannot connect through SSH or Telnet protocol. If the credential policy specifies SSH or Telnet protocol, you are prompted to check the protocol defined in the credential policy.

f) If you did not check **Use Credential Policy**, enter the username and password that this account uses to access Cisco APIC.
This username must be a valid account with the required privileges in Cisco APIC. The account must also meet the criteria listed in Guidelines for APIC Accounts, on page 5.

Note For an account with remote authentication by Cisco APIC through LDAP, RADIUS, or TACACS+, enter the username in the following format: apic:<Domain Name>\<Remote User Name>.

g) If you did not check **Use Credential Policy**, do the following:

- From the **Protocol** drop-down list, choose **https**.
- In the **Port** field, enter the port used to access the APIC account. The default port is 443.

h) Enter the email address and location of the administrator or other person responsible for this account.

Step 6 Click **Submit**.

Cisco UCS Director tests the connection to the APIC server. If that test is successful, it adds the APIC account and discovers all controllers and other infrastructure elements in the APIC server. This discovery process and inventory collection takes a few minutes to complete.

Viewing APIC Resources

After creating an APIC account in Cisco UCS Director, you can view related resources of the APIC account.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click one of the following tabs to view the details of a specific component in the server:

- **Summary** tab—Displays the system overview and summary of the APIC controller.
- **Fabric Nodes** tab—Displays the list of fabric nodes with their details such as the node name, model, vendor, role, serial, and node ID with the status.

  To view more details about fabric nodes, choose a fabric node and click **View Details**. The following tabs appear:

  - **Fabric Chassis**—Displays the fabric name, ID, model, vendor, serial, revision, and operation status of the fabric chassis.
  - **Fan Slots**—Displays the fabric name, slot ID, type, operation status, and inserted-card details of the fan slots.
  - **Physical Interfaces**—Displays the interface details that include the speed, mode, CFG access VLAN, CFG native VLAN, bundle index, operational duplex mode, operational port state, and reason for the current operation state. The operational state of the port can be one of the following: Unknown, Down, Link-up, and Up.
  - **Fabric Routed Vlan Interfaces**—Displays the status and reason for the current operation status of the fabric-routed VLAN interfaces.
  - **Fabric Encapsulated Routed Interfaces**—Displays a list of the fabric-encapsulated routed interfaces.
  - **Fabric Routed Loopback Interfaces**—Displays a list of the fabric-routed loopback interfaces.
  - **Fabric Management Interfaces**—Displays a list of the fabric management interfaces.
  - **Tunnel Interfaces**—Displays the interface, operation state, reason for the current operation state, tunnel layer, tunnel type, and type of the tunnel interface.

- **System** tab—Displays the system details that include the node name, in-band management IP address, out-of-band management IP address, infrastructure IP address, fabric MAC address, ID, role, and serial number.
- **Fabric Memberships** tab—Displays the fabric membership details that include the node name, serial number, node ID, model, role, IP address, decommissioned status, and supported model.
- **Physical Domains** tab—Displays the physical domains in the APIC server. Click **Add** to add a domain.
- **Tenants Health** tab—Displays the health score of tenants.

  To view more details about a tenant's health, choose a tenant and click **View Details**. The following tabs appear:

  - **EPGs Health**—Displays the health score of endpoint groups (EPGs).
  - **Application Health**—Displays the health score of applications.

- **Nodes Health** tab—Displays the health score of nodes.

  To view more details about the health of the nodes, choose a node and click **View Details**. The following tabs appear:

  - **Access Ports Health**—Displays the health score of access ports.
  - **Fabric Ports Health**—Displays the health score of fabric ports.
  - **Line Cards Health**—Displays the health score of line cards.

- **Access Entity Profile** tab—Displays the names and descriptions of the access entity profiles.

  To view more details about the access entity profile, choose an entity profile and click **View Details**. The following tabs appear:

  - **Policy Groups**—Displays the policy groups of an entity profile.
  - **Domain Associated To Interfaces**—Displays a list of domains that are associated with the interfaces.

- **Link Level Policy** tab—Displays the name, automatic negotiation, speed, link debounce interval, and description of the link level policy.
- **VLAN Pool** tab—Displays the VLAN pools that are added in the APIC server. Click **Add** to add a VLAN pool.

  To view more details about a VLAN pool, choose a VLAN pool and click **View Details**. The following tab appears:

  - **VLAN Pool Range**—Displays the VLAN pool name, mode of allocation, and the pool range. Click **Add** to add a VLAN range to the VLAN pool.

- **CDP Interface Policy** tab—Displays the name and description of the Cisco Discovery Prototol (CDP) interface policy, with the administration status.
- **LLDP Interface Policy** tab—Displays the name and description of the Link Layer Discovery Protocol (LLDP) interface policy, with the receive status and transmit status.
- **Leaf Policy Group** tab—Displays the name and description of the leaf policy group.
- **Tenant(s)** tab—Displays the tenants in the APIC server. Click **Add** to add a tenant.

  To view more details about a tenant, choose a tenant and click **View Details**. The following tabs appear:

  - **Summary**—Displays the overview of the tenant.
  - **Application Profile**—Displays the name, tenant, description, and QoS Class of the tenant application profile. Click **Add** to add a tenant application profile. Choose an application profile and click **View Details** to view the EPGs of the application profile.

    Choose an EPG and click **View Details** to view the provided contracts, consumed contracts, Layer 4 to Layer 7 EPG parameters, consumed contract interface, static node, domain, static path, and subnet of the EPG. In the **Consumed Contract Interface** tab, click **Add** to add a consumed contract interface to EPG.
  - **Deployed Service Graph**—Displays the list of service graphs that are deployed in the tenant. Choose a service graph and click **View Details** to view the Layer 4 to Layer 7 deployed service graph parameters.
  - **Filters**—Displays the tenant, name, and description of the filters. To view the tenant filter rules, choose a filter and click **View Details**.

- **External Bridge Network—**Displays the tenant, name, and description of the external bridge network. Choose a network and click **View Details** to view the following tabs:
  - **External Network—**Choose an external network and click **View Details** to view the provided contracts, and consumed contracts details.
  - **Node Profile—**Choose a node profile and click **View Details** to view the interface profile details.
- **External Routed Networks—**Displays the tenant, name, and description of the external routed network. Choose a network and click **View Details** to view the following tabs:
  - **Route Profile—**Choose a route profile and click **View Details** to view the context details.
  - **Logical Node Profile—**Choose a logical node profile and click **View Details**. The following tabs appear:
    - **Logical Nodes** tab**—**Displays the logical nodes. Click **Add** to add a logical node to the logical node profile of the external routed network. Choose a logical node and click **View Details** to view the static routes to the logical node.
    - **Logical Interface Profile** tab**—**Choose a logical interface profile and click **View Details** to view the logical interface and logical OSPF interface. Click **Add** in the Logical OSPF Interface tab to create an interface profile with the OSPF profile data.
    - **BGP Peer Connectivity** tab**—**Displays the BGP peer connectivity of the logical node profile. Click **Add** to add a peer connection to a node profile.
  - **External Network—**Choose an external network and click **View Details** to view the subnet, provided contracts, and consumed contracts details. You can tag an external network and consumed contract using the **Add Tags** option. The tag is used to identify the network and contract that you want to use in the application container deployment.
- **Bridge Domains—**Displays the tenant, name, description, segment ID, unicast traffic, ARP flooding, multicast IP address, customer MAC address, unicast route, and Layer 2 unknown unicast value.

  To view more details about a bridge domain, choose a bridge domain and click **View Details**. The following tabs appear:
  - **DHCP Relay Label—**Displays the tenant, name, description, and scope of the DHCP relay.
  - **Subnet—**Displays the tenant, bridge domain, description, subnet control, and gateway address of the tenant.
- **Private Networks—**Displays the tenant name, name, description, policy control, and segment of the private networks. Click **Add** to add a private network.
- **BGP Timers—**Displays the tenant, name, graceful restart control, hold interval, keepalive interval, and stale interval of the Border Gateway Protocol (BGP) timer.
- **Contracts—**Displays the tenant, name, description, type, QoS, and scope of the contracts.

  To view more details about a contract, choose a contract and click **View Details**. The following tabs appear:
  - **Contract Subject—**Choose a contract subject and click **View Details** to view the filter chain, filter chain for consumer to provider, filter chain for provider to consumer, provided label, and consumed label. Each tab has the **Add** option to add a filter, in term filter, out term filter, provided label, and consumed label to a contract subject.

- **Exported Tenants—**Displays the contracts of the exported tenants.

- **Taboo Contracts—**Displays the tenant, name, description, and scope of the taboo contracts.
- **Relay Policy—**Displays a list of the relay policies.
- **Option Policy—**Displays a list of the option policies.
- **End Point Retention—**Displays the tenant, name, description, hold interval, bounce trigger, bounce entry aging interval, local endpoint aging interval, remote endpoint aging interval, and move frequency of the tenant.
- **OSPF Interface—**Displays the tenant, name, description, network type, priority, cost of interface, interface controls, hello interval, dead interval, retransmit interval, and transmit delay of the Open Shortest Path First (OSPF) interface. Click **Create** to create an OSPF interface policy.
- **EIGRP Interface—**Displays the EIGRP Interface details.
- **OSPF Timers—**Displays the OSPF timer details.
- **IGMP Snoop—**Displays the IGMP snoop details.
- **Custom QOS—**Displays the custom QoS details.
- **Action Rule Profile—**Displays the action rule profiles of the tenant. Click **Create** to create an action rule profile. In the **Create Action Rule Profile** dialog box, enter the name and description of the action rule profile. To set an action rule based on a route tag, check the **Set Rule Based On Route Tag** check box.
- **L4-L7 Service Graph—**Displays the Layer 4 to Layer 7 service graph details. Choose a service graph and click **View Details** to view the following tabs:
  - **Consumer EPG—**Displays the list of EPGs that are labeled as consumer in tenants. When an EPG consumes a contact, the endpoints in the consuming EPG may start communication with any endpoint in an EPG that is providing that contract.
  - **Provider EPG—**Displays the list of EPGs that are labeled as provider in tenants. When an EPG provides a contract, communication with that EPG can be initiated from other EPGs as long as the communication complies with the provided contract.
  - **Nodes—**Displays the list of nodes in the tenant. Choose a node and click **View Details** to view the node functions and connectors of the node. Choose a node function and click **View Details** to view the Layer 4 to Layer 7 function node parameters.
  - **Connections—**Displays the list of connections in the tenant. Choose a connection and click **View Details** to view the connection terminals in the tenant.

- **Function Profile Group——**Displays the function profile groups of tenants. Choose a function profile group and click **View Details** to view the function profiles of the group. Click **Add** to add a function profile. To view more details about a function profile, choose a function profile and click **View Details**. The following tabs appear:
  - **Function Profile Parameter—**Displays the function profile parameters. In the **Function Profile Parameter** tab, you can add an ACL, an interface, and add a bridge group interface to a function profile, and add a network object to a function profile. Choose a function profile parameter and click **View Details** to view the function profile parameter configuration and function profile parameter level-one folder.
  - **L4-L7 Function Profile Parameters—**Displays the list of Layer 4 to Layer 7 function profile parameters.

- **Function Profile Function Parameter—**Displays the list of function profile function parameters. Click **View Details** to view the function profile function parameter Rel details.

- **Device Clusters—**Displays the device cluster details. To view more details about a device cluster, choose a device cluster and click **View Details**. The following tabs appear:
  - **Device Cluster State—**Displays the cluster name, device state, and configured status of the device.
  - **Concrete Device—**Displays the list of concrete devices. Choose a concrete device and click **View Details** to view the virtual network interface card (vNIC) to concrete interface and the path to concrete interface.
  - **Logical Interface—**Displays the list of logical interfaces in the device cluster. Choose a logical interface and click **View Details** to view the logical interface details.

- **Deployed Device Cluster—**Displays the device clusters that are deployed in the tenant.
- **Imported Device Cluster—**Displays the device clusters that are imported in the tenant.
- **Router Configurations—**Displays the router configurations of the tenant. Click **Add** to add a router configuration.
- **Logical Device Context—**Displays the logical device context details. Choose the logical device context and click **View Details** to view the logical interface context.

- **L3 Domain** tab**—**Displays a list of Layer 3 domains in the APIC accounts. To create a Layer 3 domain, click **Create (+)**.

  On the **Create L3 Domain** screen, complete the following fields:
  - **L3 Domain** field**—**Name of the Layer 3 domain.
  - **Associated Attachable Entity Profile** field**—**Expand **Associated Attachable Entity Profile** and check an attachable access entry profile that you want to associate with the Layer 3 domain.
  - **VLAN Pool** field**—**Expand **VLAN Pool** and check a VLAN pool.
  - Click **Submit**.

- **L2 Domain** tab**—**Displays a list of Layer 2 domains in the APIC accounts. To create a Layer 2 domain, click **Create(+)**.

  On the **Create L2 Domain** screen, complete the following fields:
  - **L2 Domain** field**—**Name of the Layer 2 domain.
  - **Associated Attachable Entity Profile** field**—**Expand **Associated Attachable Entity Profile** and check an attachable access entry profile that you want to associate with the Layer 2 domain.
  - **VLAN Pool** field**—**Expand **VLAN Pool** and check a VLAN pool.
  - Click **Submit**.

- **VM Networking** tab**—**Displays the virtual machine (VM) networks with the vendor detail.

  To view more details about a VM network, choose a VM and click **View Details**. The following tab appears:

- **Domains—**Displays a list of VMware domains with the vendor details. Choose a VMware domain and click **View Details** to view the VMware domain controllers, vCenter credential, and vCenter/vShield. Choose a VMware domain controller and click **View Details** to view the distributed virtual switch (DVS), hypervisors, and virtual machine. Choose a DVS and click **View Details** to view the DVS port groups.

- **L4-L7 Service Device Types** tab**—**Displays the Layer 4 to Layer 7 service device types with their model, vendor, version, and capabilities.

  To view more details about the Layer 4 to Layer 7 service device type, choose a Layer 4 to Layer 7 service device type and click **View Details**. The following tabs appear:

  - **L4-L7 Service Device Properties—**Displays the vendor, package name, package version, and logging level of Layer 4 to Layer 7 service device types.
  - **L4-L7 Service Device Interface Labels—**Displays a list of interface labels.
  - **L4-L7 Service Functions—**Displays a list of service functions. Choose a service function and click **View Details** to view the details of the Layer 4 to Layer 7 service function connectors.

- **Fabric Nodes Topology** tab**—**Displays the topology details of fabric nodes.
- **L2 Neighbors** tab**—**Displays the Layer 2 neighbor details that include the protocol, fabric name, device ID, capability, port ID, local interface, hold time, and platform.
- **Deployed Service Graph** tab**—**Displays the tenant, contract, state, service graph, context name, node function, and description of the APIC account.
- **EPG to Contract Association** tab**—**Displays the details of the contract association with EPGs.
- **Access Port Policy Groups** tab**—**Displays the access port policy group name, link level policy, Cisco Discovery Protocol (CDP) policy, Link Aggregation Control Protocol (LACP) policy, Link Layer Discovery Protocol (LLDP) policy, link aggregation type, and attached entity profile of the accounts in the APIC server.
- **Fabric Interface Profiles** tab**—**Displays the fabric interface profiles of the APIC server.
- **Fabric Configured Switch Interfaces** tab**—**Displays the fabric configured switch interfaces of the APIC server.
- **Fabric Switch Profiles** tab**—**Displays the fabric switch profiles of the APIC server.

Assigning an APIC Account to a Pod

In the **Converged** menu of the user interface (UI), Cisco UCS Director displays the converged stack of devices for a data center. To display the APIC account in the converged UI, assign the APIC account to a pod.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account that you want to assign to a pod.

Step 4 From the **More Actions** drop-down list, choose **Assign to Pod**.

The **Assign to Pod** screen appears.

Step 5 Expand **Pod** and check a pod to which you want to assign the APIC account.

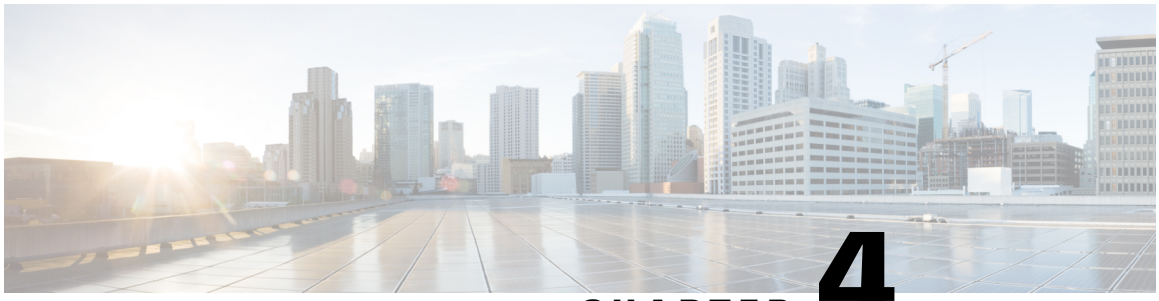
Step 6 Click **Submit**.
The APIC account appears in the converged UI.

Handling APIC Failover

APIC controllers are deployed in an APIC cluster. The recommendation is to have a minimum of three APIC controllers per cluster to ensure high availability. When you create an APIC account in Cisco UCS Director, provide the IP address of one of the APIC controllers in the APIC cluster. Cisco UCS Director discovers the other APIC controllers in the APIC cluster and their respective IP addresses.

If the IP address of the controller which was used to manage the APIC device goes down or is not reachable for 45 seconds, Cisco UCS Director tries to use any of the reachable controller IP addresses to interact with the APIC device.

If you have multiple ACI fabrics and each fabric with multiple controllers, one of the controllers of the ACI fabric is used to manage the APIC device. If the controller goes down or is not reachable for 45 seconds, Cisco UCS Director uses the next reachable controller within the ACI fabric.



CHAPTER 4

Managing Tenants

Tenants

A tenant is a logical container for application policies that enables you to exercise domain-based access control by isolating the resources such as applications, databases, web servers, network-attached storage, virtual machines, firewalls, Layer 4 to Layer 7 services, and so on. Tenants can represent a customer in a service provider setting, an organization or domain in an enterprise setting, or just a convenient grouping of policies.

A fabric can contain anywhere from one tenant, which may be useful for a small commercial environment, to 64,000+ tenants, for a cloud service provider in which case you assign each company their own tenant. Another use case would be to have a Dev tenant and a Production tenant. In this case, you create network constructs, EPGs, and policies in Dev tenant first and then simply copy it to the Production tenant. It ensures that the dev and prod are the exact same and takes away the human error that comes along with manual copying of these objects.

Note Configure a tenant before you can deploy any Layer 4 to Layer 7 services.

Tenant Types

The system provides the following four kinds of tenants:

- User tenant—Defined by the administrator according to the needs of users. It contains policies that govern the operation of resources such as applications, databases, web servers, network-attached storage, virtual machines, and so on.
- Common tenant—Provided by the system but can be configured by the fabric administrator. It contains policies that govern the operation of resources accessible to all tenants, such as firewalls, load balancers, Layer 4 to Layer 7 services, intrusion detection appliances, and so on.
- Infrastructure tenant—It contains policies that govern the operation of infrastructure resources such as the fabric VXLAN overlay.
- Management tenant—It contains policies that govern the operation of fabric management functions used for in-band and out-of-band configuration of fabric nodes.

Tenant Features

- Tenants can be isolated from one another or can share resources.
- Tenants do not represent a private network.
- Entities in the tenant inherit its policies.
- The primary elements that the tenant contains are filters, contracts, outside networks, bridge domains, Virtual Routing and Forwarding (VRF) instances, and application profiles that contain endpoint groups (EPGs).

Note In the APIC GUI under the tenant navigation path, a VRF (context) is called a private network.

Setting up a Tenant

This procedure provides an overview of how to set up a tenant for an APIC account in Cisco UCS Director.You can also use the workflows provided in Cisco UCS Director Orchestration to complete a guided setup of tenants for various use cases. For more information, see Cisco UCS Director Orchestration Guide.

This procedure assumes that you have already completed the following prior to creating tenants:

- The Day 0 setup of ACI fabric.
- The nodes in ACI fabric are connected and discovered.
- The APIC controller cluster has been configured.
- Cisco UCS Director is configured and the ACI pod has been set up.

Step 1 Create a Tenant.
See Creating a Tenant, on page 17.

Step 2 Create a Virtual Routing and Forwarding (VRF) (also known as Private Network).
See Creating a VRF, on page 20.

Step 3 Add Bridge Domain to the VRF.
See Adding a Bridge Domain to VRF, on page 21.

Step 4 Create Application Profiles.
See Creating an Application Profile for the Tenant, on page 25.

Step 5 Create EPGs.
See Adding an EPG, on page 26.

Step 6 Add domain to EPGs.
See Adding a Domain to an EPG, on page 27.

Step 7 Add Static path to EPGs.
See Adding a Static Path to EPG, on page 29.

Step 8 Create Contracts.
See Creating Contracts, on page 32.

Step 9 Add contracts to EPGs.
See Adding a Consumed Contract to an EPG, on page 35.

See Adding a Provided Contract to an EPG, on page 34.

Creating a Tenant

Before You Begin

Verify that Tags, monitoring policy, and security domains for the objects in the APIC account are configured before adding a tenant.

Create users in ACI and assign a security domain to the users or user groups. See User Access, Authentication, and Accounting chapter in Cisco APIC Basic Configuration Guide.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click **Add**.

Step 6 On the **Add APIC Tenant(s)** screen, complete the fields, including the following:

a) Add a unique name and description for the Tenant.

b) (Optional) Expand **Tag** and check the tag you want to use.
Tags are used to assign a descriptive name to a group of objects. For example, to enable easy searchable access to all web server EPGs, assign a web server tag to all such EPGs. Web server EPGs throughout the fabric can be located by referencing the web server tag.

c) (Optional) Expand **Monitoring Policy**, check the policy that you want to use, and then click **Validate**.
When you apply a monitoring policy, it overrides the default monitoring policy.

d) Expand **Security Domain**, check the security domain that you want to use, and then click **Validate**.
It is necessary to also assign the user to one or more security domains. By default, the ACI fabric includes two special pre-created domains:

- **All—**Allows access to the entire management information tree (MIT).
- **Infra—**Allows access to fabric infrastructure objects/subtrees, such as fabric access policies.

For example, if you have created a security domain for Production, given users roles, and attached them to that security domain, then choose the Production security domain instead of **All**.

e) Click **Submit**.

What to Do Next

After creating a tenant, create a VRF (also known as a private network) for the tenant.

Viewing Tenants

You can view a list of tenants that are onboarded in Cisco UCS Director and its details.

Step 1 Choose **Policies** > **Resource Groups**.

Step 2 On the **Resource Groups** page, click **Tenant**.

Step 3 Click the row with the tenant for which you want to view details.

Step 4 Click **View Details** to view the service offerings of the tenant.

Step 5 Click the row with the service offering and click **View details** to view the resource groups of a tenant.

Note If the disaster recovery support is enabled for the tenant, the resource groups of the primary site and the disaster recovery site are displayed.

Step 6 Click the row with the resource group and click **View details** to view the following information:

- **Resource Entity—**Displays a list of available resources, such as, VMWare cluster, resource pool, and data store, in a vPOD. During tenant onboarding, the resources matching the capacity, capability and tag of the tenant requirement are filtered from resource group and matched resources are added to the vPOD. With the capacity expansion support, the vPOD can store more than one resources for each resource type such as VMware cluster, resource pool, and storage pool. As multiple resources of same resource type is available in vPOD, the tenant expansion is possible after consumption of allocated resources.

  The tenant-specific and container-specific resource limits assist in provisioning VMs and BMs. During provisioning, all the available resources in vPOD are referred to find out the matching resources for resource allocation. After the resource filtration and selection, the matching resources from the same account are allocated for VM deployment.

  When a resource is no longer consumed by the container, you can delete the resource. To delete the resource, click the row with the resource and click **Delete**.

- **Tenant Details—**Displays more details of the tenant.
- **Tenant Resource Limits—**Displays availability of both virtual and physical resources in a tenant. The resources reserved during tenant onboarding are displayed along with the used and available resource values. The VDCs

Limit column specifies the maximum number of containers that are reserved for the tenant. The Available Number of VDCs column represents the number of containers that are available for provisioning. The physical resource limits display the blades that are reserved as part of tenant onboarding, along with the number of blades used for bare metal provisioning.

- **Container Resource Limits—**Displays availability of both virtual and physical resources in a container. The resource limits that are set during container creation are displayed along with the used and available resources.

  Note If a container is created without a resource limit, the value of the virtual resources is displayed as Not Set.

- **Private Network—**Displays the private networks created for the tenant. Click the row of a private network and click **View Details** to view the supernet and subnet pools of the private network. The **Supernets** screen lists the supernets available for the tiers. The **Subnets** screen displays the sub-network pool that is used for load balancer configuration during the container deployment.

Virtual Routing and Forwarding (VRF)

A Virtual Routing and Forwarding (VRF) is similar to a virtual router that defines a Layer 3 address domain. It is an IP technology that allows multiple instances of a routing table to coexist on the same router at the same time. Because the routing instances are independent, the same or overlapping IP addresses can be used without conflict. For example, a production VRF could be on the same network as the development VRF but the two have different default gateways.

A tenant can have multiple VRFs (also known as private network). One or more bridge domains are associated with a VRF. There are several policies you can associate with a private network, including OSPF and BGP timers, as well as how long end points should be retained.

Virtual Routing and Forwarding (VRF) Guidelines

The following guidelines and limitations apply for virtual routing and forwarding (VRF) instances:

- Within a single VRF instance, IP addresses must be unique. Between different VRF instances, you can have overlapping IP addresses.
- If shared services are used between VRF instances or tenants, make sure that there are no overlapping IP addresses.
- Any VRF instances that are created in common tenant is seen in other user-configured tenants.
- VRF supports enforced mode or unenforced mode. By default, a VRF instance is in enforced mode, which means all endpoint groups within the same VRF instance cannot communicate to each other unless there is a contract in place.
- Switching from enforced to unenforced mode (or the opposite way) is disruptive.

For more in-depth information, see the Cisco Application Centric Infrastructure Fundamentals Guide.

Creating a VRF

A Virtual Routing and Forwarding (VRF) object (also known as private layer 3 network in ACI) contains the Layer 2 and Layer 3 forwarding configuration, and IP address space isolation for tenants. Each tenant can have one or more VRFs, or share one default VRF with other tenants as long as there is no overlapping IP addressing being used in the ACI fabric.

Before You Begin

Verify that you have configured the BGP Timers Policies and OSPF Timers

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Private Networks**.

Step 7 Click **Add**.

Step 8 On the **Add Tenant Private Network** screen, complete the following fields:

a) Add a unique name for the private network.

b) From the **Policy Enforcement** drop-down list, choose from the following options:

- **Enforced—**Security rules (contracts) are enforced.
- **Unenforced—**Security rules (contracts) are not enforced.

The default is **enforced**.

c) Enter the description for the private network.

d) Expand **BGP Timers** and check the BGP timer that you want to use.
The Border Gateway Protocol (BGP) timer policy enables you to specify the intervals for the periodic activities and supplies two options for graceful restart control.

e) Expand **OSPF Timers** and check the OSPF timer that you want to use.
The context-level OSPF timer policy provides the Hello timer and Dead timer intervals configuration. OSPF timers control the behavior of protocol messages and shortest path first (SPF) calculations.

f) Expand **Monitoring Policy**, check the policy that you want to associate with the tenant.
When you apply a monitoring policy, it overrides the default monitoring policy.

g) Click **Submit**.

What to Do Next

After creating a private network, you create a bridge domain and link it to this VRF.

Bridge Domains

A bridge domain represents a Layer 2 forwarding construct within the fabric. It helps you to constrain broadcast and multicast traffic. It is a logical container for subnets.

A bridge domain must have at least one subnet associated with it but can contain multiple subnets. When you configure a bridge domain with multiple subnets, the first subnet added becomes the primary IP address on the SVI interface. Subsequent subnets are configured as secondary IP addresses. When the switch reloads, the primary IP address can change unless it is marked explicitly.

One or more EPGs can be associated with each bridge domain. EPGs within the same bridge domain may be configured to talk to each other, but they do not have layer 2 adjacency enabled by default.

Bridge domains in Cisco Application Centric Infrastructure (ACI) have several configuration options to allow the administrator to tune the operation in various ways. To learn more about the various options, see Cisco Application Centric Infrastructure Fundamentals Guide.

Note Once a bridge domain is configured, its mode cannot be switched.

A bridge domain must be linked to a Virtual Routing and Forwarding (VRF).

Subnets

A subnet defines the IP address range that can be used within the bridge domain. A bridge domain can contain multiple subnets, but a subnet is contained within a single bridge domain. The scope of a subnet can be public, private, or shared under a bridge domain or an EPG. See Adding a Subnet to a Bridge Domain, on page 23.

DHCP Relay Labels

DHCP Relay is required only when the DHCP server is in a different EPG or private network than the clients. DHCP label associates the provider DHCP server with the bridge domain. The DHCP label object also specifies the owner. If your infrastructure requires DHCP relay labels, see Adding a DHCP Relay Label to a Bridge Domain, on page 24.

Note The bridge domain DHCP label must match the DHCP Relay name. Label matching enables the bridge domain to consume the DHCP Relay.

Adding a Bridge Domain to VRF

A bridge domain is a unique Layer 2 forwarding domain that contains one or more subnets. Each bridge domain must be linked to a VRF.

Before You Begin

Create a Tenant for your customer, organization, or domain and configure your private network.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Bridge Domains**.

Step 7 Click **Add**.

Step 8 On the **Add Tenant Bridge Domain** screen, complete the following fields:

a) Add a unique name and description for the Bridge Domain.

b) Expand **Network**, check the network you want to use for the account, and click **Validate**.
This is the virtual routing and forwarding (VRF) object associated with the tenant for which this bridge domain is created. It is also known as context or private network.

c) From the **Forwarding** drop-down list, choose the forwarding parameter from the following options:
This sets the forwarding capacity between Layer 2 and Layer 3 networks. The values can be:

- **Optimize—**Automatically sets the Unicast and ARP parameters. Selects options: Hardware Proxy for L2 Unknown Unicast and Flood for Unknown Multicast Flooding with Unicast Routing enabled.
- **Custom—**Reveals the Unicast and ARP selections for custom configuration. If you choose custom forwarding, then complete the following additional parameters:

  1 From the **L2 Unknown Unicast** drop-down list, select the unicast parameter. The values can be **Flood** or **Hardware Proxy**.

    The default is Hardware Proxy. If enabled, unicast traffic flooding is blocked at a specific port, only permitting egress traffic with MAC addresses that are known to exist on the port. If you chose Flood, it floods the unicast traffic to all Layer 2 ports.

  2 From the **Unknown Multicast Flooding** drop-down list, select the multicast parameter. The values can be **Flood** or **Optimized Flood**.

  3 Check **ARP Flooding** to configure the flooding for the bridge domain.

    This enables ARP flooding, so that the Layer 2 broadcast domain maps IP addresses to the MAC addresses. If flooding is disabled, unicast routing is performed on the target IP address.

  4 Check **Unicast Routing** to configure the bridge domain routing. This forwarding method is based on predefined forwarding criteria (IP or MAC address). The default is layer 3 forwarding (IP address).

d) Check **Custom Mac Address** to configure the bridge domain Mac address and enter the address in **Mac Address** field.
By default, a bridge domain takes the fabric wide default MAC address of 00:22:BD:F8:19:FF. Configure this property to override the default address.

e) Expand **IGMP Snoop Policy**, check the snoop policy you want to use for this tenant, and then click **Validate**.

This policy inspects the IGMP membership report messages from interested hosts. It limits the multicast traffic to the subset of VLAN interfaces on which the hosts reside.

f) Expand **Associated L3 Out** and check the L3 out interface that you want to assign to this tenant.
This is the name of the Layer 3 outside interface associated with this object.

g) Expand **L3 Out for Route Profile**, check the route profile of L3 out network, and then click **Validate**.
L3 Out is the network outside the fabric, configured for the tenant consuming this bridge domain, that is reachable by a specific route to external networks of a tenant application. The route profile specifies policies for external networks.

h) Expand **Monitoring Policy**, check the policy associated with the tenant, and then click **Validate**.

Step 9 Click **Submit**.

Adding a Subnet to a Bridge Domain

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Bridge Domains**.

Step 7 On the **Bridge Domains** page, choose the row with the domain to which you want to add the subnet and click **View Details**.

Step 8 Click **Subnet**.

Step 9 On the **Subnet** page, click **Add**.

Step 10 On the **Add Subnet to Tenant Bridge Domain** screen, complete the following fields:

a) In the **Gateway IP (Address)** field, enter the IP address of the default gateway.

b) In the **Gateway IP (Prefix)** field, enter a prefix in the range of 1-30 that starts with "/x"

c) Check the **Shared Subnet** check box to share the subnet with multiple contexts (VRFs) in the same tenant or across tenants as part of a shared service.
Shared subnets must be unique across the contexts (VRF) involved in the communication. When a subnet under an EPG provides a Layer 3 external network shared service, such a subnet must be globally unique within the entire ACI fabric.

d) Check the **Public Subnet** check box to export it to a routed connection.

e) Check the **Private Subnet** check box to apply the subnet only within its tenant.

f) Check the **Subnet Control (Querier IP)** check box to apply specific protocol to the subnet. Querier IP enables IGMP Snooping on the subnet.

g) Expand **L3 Out for Route Profile**, check the L3 that you want to use for the bridge domain, and then click **Validate**.
This is the Layer 3 Outside Network (L3extOut) configured for the tenant consuming this bridge domain.

h) Expand **Route Profile** and check the route profile that you want to use for this bridge domain.

The route profile specifies policies for external networks.

i) Click **Submit**.

Adding a DHCP Relay Label to a Bridge Domain

DHCP Relay is required when the DHCP server is in a different EPG or private network than the clients. A DHCP relay label contains a name for the label, the scope, and a DHCP option policy. The scope is the owner of the relay server and the DHCP option policy supplies DHCP clients with configuration parameters such as domain, nameserver, and subnet router addresses.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Bridge Domains**.

Step 7 Click the row with the domain to which you want to add the DHCP label and click **View Details**.

Step 8 Click **DHCP Relay Label**.

Step 9 On the **DHCP Relay Label** page, click **Add**.

Step 10 On the **Add DHCP Label To Tenant Bridge Domain** screen, complete the following fields:

a) From the **Scope** drop-down list, choose the scope. Options are:

- **Infra—**The owner is the infrastructure.
- **Tenant—**The owner is the tenant.

The default is **Infra**.

b) Expand **DHCP Relay Name**, check the DHCP relay policy that you want to use for the tenant bridge domain, and then click **Validate**.

c) Expand **DHCP Option Policy**, check the option policy that you want to use, and click **Validate**.

d) Click **Submit**.

Application Profiles

Application profiles are logical containers that define the policies, services, and relationships between End Point Groups (EPGs). Each application profile contains one or more EPG that can communicate with the other EPGs in the same application profile, and with EPGs in other application profiles according to the contract rules. At minimum, associate one application profile with one EPG.

Modern applications contain multiple components. An application profile models the requirements of an application. For example, an e-commerce application could require a web server, a database server, data located in a storage area network, and access to outside resources that enable financial transactions. The application profile contains as many (or as few) EPGs as necessary that are logically related for the e-commerce application.

EPGs can be organized according to one of the following:

- The application they provide (such as sap in the example in Appendix A).
- The function they provide (such as infrastructure).
- Where they are in the structure of the data center (such as DMZ).
- Whatever organizing principle that a fabric or tenant administrator chooses to use.

Creating an Application Profile for the Tenant

The application profile is a set of requirements that an application instance has on the virtualized fabric. The policy regulates connectivity and visibility among endpoints within the scope of the policy.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Application Profile**.

Step 7 Click **Add**.

Step 8 On the **Add Tenant Application Profile** screen, complete the following fields:

a) Add a unique name, description, and an alias for the Application Profile.

b) Expand **Tag** and check the tag name that you want to use for the APIC account.

c) From the **QoS Class** drop-down list, choose from the following options for the priority class:

- **Unspecified—**This is the default value.
- **Level1—**Class 1 Differentiated Services Code Point (DSCP) value
- **Level2—**Class 2 DSCP value
- **Level3—**Class 3 DSCP value

d) Expand **Monitoring Policy**, check the policy associated with the tenant, and then click **Validate**. When you apply a monitoring policy, it overrides the default monitoring policy.

Step 9 Click **Submit**.

End Point Groups

An End Point Group (EPG) is a logical container of endpoints that have common policy requirements such as security, virtual machine mobility (VMM), QoS, or Layer 4 to Layer 7 services. They have an address (identity), a location, attributes (such as version or patch level), and can be physical or virtual. Knowing the address of an endpoint enables access to all its other identity details. Rather than configure and manage endpoints individually, they are placed in an EPG and are managed as a group.

The ACI fabric can contain the following types of EPGs:

- Application endpoint group
- Layer 2 external outside network instance
- Layer 3 external outside network instance
- Management endpoint groups for out-of-band or in-band access

By default, all endpoints in the same endpoint group can talk to each other without requiring a contract. Intra-endpoint group (intra-EPG) isolation prevents all endpoints in an EPG from talking to each other but inter-EPG communication is still permitted if there is a contract. This is similar to a private VLAN. For example, assume that you have three endpoints: two are in the client endpoint group, while the other endpoint is in the Web endpoint group. If there is a contract between endpoint groups, they can talk to each other.

Regardless of how an EPG is configured, EPG policies are applied only to the endpoints they contain. For example, to configure a WAN router connectivity to the fabric, you configure an EPG that includes any endpoints within the associated WAN subnet. The fabric learns of the endpoints through a discovery process and applies the policies accordingly.

After creating an EPG, add a static path to the EPG to determine the port and leaf/node for the traffic. See Adding a Static Path to EPG, on page 29.

You can also add static nodes (leaf, spine, or APIC), and domains (physical, VMM, L3, or L3 external - see examples) to EPGs and define how and when they are deployed. See Adding a Static Node to EPG, on page 30 and Adding a Domain to an EPG, on page 27.

Adding an EPG

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Application Profile**.
Step 7 Click the row with the profile that you want to update and click **View Details**.
Step 8 Click **EPG**.
Step 9 Click **Add**.
Step 10 On the **Add Tenant EPG** screen, complete the required fields including the following:

a) Add a unique name, description, and alias for the EPG.
b) (Optional) Expand **Tag** and check the tag you want to use.
c) From the **QoS Class** drop-down list, choose from the following options for the priority class:

- **Unspecified—**This is the default value.
- **Level1—**Class 1 Differentiated Services Code Point (DSCP) value
- **Level2—**Class 2 DSCP value
- **Level3—**Class 3 DSCP value
- **Custom—**Complete the additional parameter

d) If you chose custom QoS, expand **Custom QoS** and check the customized quality of service class that you want to use for the EPG.
e) Expand **Bridged Domain** and check the bridge domain for the EPG.
f) Expand **Monitoring Policy** and check the policy associated with the tenant.
When you apply a monitoring policy, it overrides the default monitoring policy.
g) Click **Submit**.

Adding a Domain to an EPG

An EPG is associated with domains by being linked to a domain profile, which can be a VMM, physical, Layer 2 external, or Layer 3 external domain.

Before You Begin

Create a physical, VMM, Layer 3, or Layer 2 domain for the APIC account.

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Application Profile**.
Step 7 Click the row with the profile that you want to update and click **View Details**.
Step 8 Click **EPG**.
Step 9 Click the row with the EPG that you want to update and click **View Details**.
Step 10 Click **Domain**.
Step 11 Click **Add**.
Step 12 On the **Add Domain To EPG** screen, complete the required fields, including the following:
a) Expand **Domain Profile**, check the domain profile that you want to add to the EPG, and click **Validate**.

b) From the **Deploy Immediacy** drop-down list, choose a path from the following options:

- **Immediate—**Specifies that the policy is programmed in the hardware policy CAM as soon as it is downloaded in the leaf software.
- **On Demand—**Specifies that the policy is programmed in the hardware policy CAM only when the first packet is received through the data path. This process helps to optimize the hardware space.

c) From the **Resolution Immediacy** drop-down list, choose a path from the following options:
It specifies whether policies are resolved immediately or when needed.

- **Immediate—**Specifies that EPG policies (including contracts and filters) are downloaded to the associated leaf switch software upon hypervisor attachment to VDS. LLDP or OpFlex permissions are used to resolve the hypervisor to leaf node attachments.
- **On Demand—**Specifies that a policy (for example, VLAN, VXLAN bindings, contracts, or filters) is pushed to the leaf node only when a hypervisor is attached to VDS and a VM is placed in the port group (EPG).
- **Pre-provision—**Specifies that a policy (for example, VLAN, VXLAN binding, contracts, or filters) is downloaded to a leaf switch even before a hypervisor is attached to the VDS. Therefore, this option pre-provisions the configuration on the switch.

d) From the **Allow Promiscuous** drop-down list, choose from the following options:
It enables all packets to pass to the VMM domain, which is often used to monitor network activity.

- **Reject—**Packets that do not include the network address are dropped.
- **Accept—**All traffic is received within the VMM domain.

e) From the **Forged Transmits** drop-down list, choose from the following options:

- **Reject—**All non-matching frames are dropped.
- **Accept—**Non-matching frames are received.

It specifies whether to allow forged transmits. A forged transmit occurs when a network adapter starts sending out traffic that identifies itself as something else. This security policy compares the effective address of the virtual network adapter and the source address inside an 802.3 Ethernet frame generated by the virtual machine to ensure that they match.

f) From the **MAC Changes** drop-down list, choose from the following options:

- **Reject—**Does not allow new MAC addresses.
- **Accept—**Allows new MAC addresses.

It enables you to define new MAC addresses for the network adapter within the virtual machine (VM).

g) Click **Submit**.

Adding a Static Path to EPG

Static path policies provide a summary of the configured properties of the policy, fault counts, and history for the static path. Configure the static path to the destination EPG.

Note When an EPG uses a static binding path, the encapsulation VLAN associated with this EPG must be part of a static VLAN pool.

Before You Begin

Contracts must be configured.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Application Profile**.

Step 7 Click the row with the profile that you want to update and click **View Details**.

Step 8 Click **EPG**.

Step 9 Click the row with the EPG that you want to update and click **View Details**.

Step 10 Click **Static Path**.

Step 11 Click **Add**.

Step 12 On the **Add Static Path To EPG** screen, complete the following fields:

a) From the **Path Type** drop-down list, choose from the following options:

- **Port—**Is the default value
- **Direct Port Channel—**Class 1 Differentiated Services Code Point (DSCP) value
- **Virtual Port Channel—**Class 2 DSCP value

b) Expand **Path**, check the static path that you want to add to the EPG, and click **Validate**.

c) In the **Encapsulation** field, enter a VLAN value that is part of one of the static VLAN blocks associated with the domain.

d) From the **Deployment Immediacy** drop-down list, choose from the following options:

- **Immediate—**Specifies that the policy is programmed in the hardware policy CAM as soon as it is downloaded in the leaf software.
- **On Demand—**Specifies that the policy is programmed in the hardware policy CAM only when the first packet is received through the data path. This process helps to optimize the hardware space.

Once EPG policies are downloaded to the leaf software, you can choose the deployment preferences to specify when a policy is pushed into leaf switches.

e) From the **Mode** drop-down list, choose the static association from the following options:
EPG tagging refers to configuring a static path under an EPG.

- **Tagged—**Select this mode if the traffic from the host is tagged with a VLAN ID.
- **Untagged—**Select this mode if the traffic from the host is untagged (without VLAN ID).

  When a leaf switch is configured for an EPG to be untagged, for every port this EPG uses, the packets exit the switch untagged.

  Note When an EPG is deployed as untagged, do not deploy that EPG as tagged on other ports of the same switch.

- **802.1P Untagged—**Select this mode if the traffic from the host is tagged with a 802.1P tag. When an access port is configured with a single EPG in native 802.1p mode, its packets exit that port untagged. When an access port is configured with multiple EPGs, one in native 802.1p mode, and some with VLAN tags, all packets exiting that access port are tagged VLAN 0 for EPG configured in native 802.1p mode and for all other EPGs packets exit with their respective VLAN tags.

  Note Only one native 802.1p EPG is allowed per access port.

f) Click **Submit**.

Adding a Static Node to EPG

Before You Begin

Create nodes in the APIC system.

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Application Profile**.
Step 7 Click the row with the profile that you want to update and click **View Details**.
Step 8 Click **EPG**.
Step 9 Click the row with the EPG that you want to update and click **View Details**.
Step 10 Click **Static Node**.
Step 11 Click **Add**.
Step 12 On the **Add Static Node To EPG** screen, complete the following fields:
a) Expand **Node**, check the node that you want to add to the EPG, and then click **Validate**.
b) In the **Encapsulation** field, enter a VLAN value that is part of one of the static VLAN blocks associated with the domain.

c) From the **Mode**drop-down list, choose the static association from the following options:

- **Native**
- **Regular**

d) From the **Deployment Immediacy** drop-down list, choose the policy from the following options:.

- **Immediate—**Specifies that the policy is programmed in the hardware policy CAM as soon as the policy is downloaded in the leaf software.
- **Lazy—**Specifies that the policy is programmed in the hardware policy CAM only when the first packet is received through the data path. This process helps to optimize the hardware space.

Once EPG policies are downloaded to the leaf software, you can choose the deployment preferences to specify when a policy is pushed into leaf switches.

e) Click **Submit**.

Contracts

EPGs can only communicate with other EPGs according to contract rules. Contracts determine the type of traffic that can pass between EPGs, including the protocols and ports allowed. If there is no contract, inter-EPG communication is disabled by default. There is no contract required for intra-EPG communication. A contract contains one or more subjects.

An EPG can both provide and consume the same contract. An EPG can also provide and consume multiple contracts simultaneously.

Contract Subjects

A subject is a sub-application running behind an endpoint group. A contract can encapsulate multiple subjects. An EPG associates with a subject and defines rules under the association for consuming, providing, or for peer-to-peer communications to that subject. Subjects contain filters and optional labels.

Export Contract feature enables you to export the XML or JSON code for later use with the REST API.

Provider and Consumer Contracts

Contracts can contain multiple communication rules and multiple endpoint groups. The relationship between an EPG and a contract can be either a provider or consumer. When an EPG provides a contract, communication with that EPG can be initiated from other EPGs as long as the communication complies with the provided contract. When an EPG consumes a contract, the endpoints in the consuming EPG may initiate communication with any endpoint in an EPG that is providing that contract.

Filters

Filters enable you to specify the protocols you want to permit for traffic management between two EPGs. For example, you may want to permit only `https` traffic. There are several types of filters.

- Permit—It allows traffic.

- Deny (Taboo)—For specific use cases. You may specify to allow all traffic in a contract, but set up taboos to deny certain traffic.
- Redirect—Useful to send traffic from an EPG to a layer 4-7 device such as a firewall, load balancer, or IPS/IDS.
- Mark—To mark traffic for Quality of Service reasons.

You can add filters to a contract by adding filter chains (consumer or provider) to contract subjects.

Contract Labels

Labels are optional advanced identifiers. When you use labels, you can specify more complex relationships between EPGs. Labels allow for control over which subjects and filters to apply when communicating between a specific pair of endpoint groups. Without labels, a contract applies every subject and filter between consumer and provider endpoint groups. You can use labels to represent a complex communication scenario, within the scope of a single contract, then reuse this contract while specifying only a subset of its policies across multiple endpoint groups.

Taboo Contracts

A Taboo contract provides a way for an EPG to specify the subjects on which communication is not allowed.

Creating Contracts

Without a contract, the default forwarding policy is to not allow any communication between EPGs but all communication within an EPG is allowed.

Note If two tenants are participating in same contract, ensure that they are not able to see each other and that their endpoint groups are not able to communicate.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Contracts**.

Step 7 Click **Add**.

Step 8 On the **Add Tenant Contract** page, complete the following fields:

a) Add a unique name and description for the contract.
If you create contracts under the common and user tenants, that are consumed by the same tenant, they must have different names.

b) From the **Scope** drop-down list, choose from the following options:

- **Application Profile**—The contract is applied to endpoint groups in the application profile.

- **Context—**The contract is applied to endpoint groups in the same Virtual Routing and Forwarding (VRF).
- **Global—**This contract is applied to endpoint groups throughout the fabric.
- **Tenant—**This contract is applied to endpoint groups within the same tenant.

c) From the **Priority** drop-down list, choose the priority level of the service contract from the following options:

- **Level1—**Class 1 Differentiated Services Code Point (DSCP) value
- **Level2—**Class 2 DSCP value
- **Level3—**Class 3 DSCP value
- **Unspecified—**This is the default value.

The default option is **Unspecified**.

Step 9 Click **Submit**.

What to Do Next

Create contract subjects to specify the information that can be communicated and the mechanism of communication.

Creating a Contract Subject

A subject is a sub-application running behind an endpoint group. A contract can encapsulate multiple subjects. An endpoint group always associates with a subject and defines rules under the association for consuming, providing, or for peer-to-peer communications to that subject.

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Contracts**.
Step 7 Click the row with the contract that you want to update and click **View Details**.
Step 8 Click **Contract Subjects**.
Step 9 Click **Add**.
Step 10 On the **Add Tenant Contract Subject** page, complete the required fields, including the following:

a) Add a unique name and description for the contract subject.
b) Check **Reverse Filter Ports** to apply the same subject rule to the reverse filter ports when the contract applies in both directions. If you choose this option, enter the following additional parameters:

- **In Term Service Graph**

- **In Term QoS**
- **Out Term Service Graph**
- **Out Term QoS**

c) Check **Apply Both Directions** to apply the contract to both inbound and outbound traffic. If the selected contract does not apply to both, then the filter chain must be configured for consumer to provider and provider to consumer separately.

d) Expand **Service Graphs**, check the box for the service graph that you want to add to the contract, and click **Validate**. The service graph is an image that shows the relationship between contracts and subjects.

e) From the **QoS** drop-down list, choose the traffic priority for the associated EPG from the following options: Each system class manages one lane of traffic.

- **Level1—**Class 1 Differentiated Services Code Point (DSCP) value
- **Level2—**Class 2 DSCP value
- **Level3—**Class 3 DSCP value
- **Unspecified—**This is the default value.

The default option is **Unspecified**.

Step 11 Click **Submit**.

What to Do Next

Create consumer and provider contracts.

Adding Contracts to EPGs

Provided Contracts

EPGs can only communicate with other EPGs according to contract rules. Contracts determine the types of traffic that can pass between EPGs, including the protocols and ports allowed.

The relationship between an EPG and a contract can be either a provider or consumer. When an EPG provides a contract, communication with that EPG can be initiated from other EPGs as long as the communication complies with the provided contract. When an EPG consumes a contract, the endpoints in the consuming EPG may initiate communication with any endpoint in an EPG that is providing that contract.

An EPG can both provide and consume the same contract. An EPG can also provide and consume multiple contracts simultaneously.

Adding a Provided Contract to an EPG

You can associate contracts that were created earlier to create policy relationships between the EPGs. A provided contract is a contract for which the EPG is a provider.

Note Verify that both provided and consumed contracts have the same name.

Before You Begin

Contracts must be configured.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Application Profile**.

Step 7 Click the row with the profile that you want to update and click **View Details**.

Step 8 Click **EPG**.

Step 9 Click the row with the EPG that you want to update and click **View Details**.

Step 10 Click **Consumed Contract**.

Step 11 Click **Add**.

Step 12 On the **Add Provided Contract To EPG** screen, complete the fields including the following:

a) Expand **Contract**, check the contract that you want to add to the EPG, and then click **Validate**.

b) From the **QoS** drop-down list, choose the traffic priority for the associated EPG from the following options: Each system class manages one lane of traffic.

- **Unspecified—**This is the default value.
- **Level1—**Class 1 Differentiated Services Code Point (DSCP) value
- **Level2—**Class 2 DSCP value
- **Level3—**Class 3 DSCP value

c) Click **Submit**.

Consumed Contracts

Also need to look into Taboo Contract and Filters.

Adding a Consumed Contract to an EPG

You can associate contracts that were created earlier to create policy relationships between the EPGs. A consumed contract is a contract for which the EPG is a consumer.

Note Verify that both provided and consumed contracts have the same name.

Before You Begin

Contracts must be configured.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Application Profile**.

Step 7 Click the row with the profile that you want to update and click **View Details**.

Step 8 Click **EPG**.

Step 9 Click the row with the EPG that you want to update and click **View Details**.

Step 10 Click **Consumed Contract**.

Step 11 Click **Add**.

Step 12 On the **Add Consumed Contract To EPG** screen, complete the fields including the following:

a) Expand **Contract**, check the contract that you want to add to the EPG, and then click **Validate**.

b) From the **QoS** drop-down list, choose the traffic priority for the associated EPG from the following options: Each system class manages one lane of traffic.

- **Unspecified—**This is the default value.
- **Level1—**Class 1 Differentiated Services Code Point (DSCP) value
- **Level2—**Class 2 DSCP value
- **Level3—**Class 3 DSCP value

c) Click **Submit**.

Adding a Consumed Contract Interface

Before You Begin

Contracts must be configured.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Application Profile**.

Step 7 Click the row with the profile that you want to update and click **View Details**.

Step 8 Click **EPG**.

Step 9 Click the row with the EPG that you want to update and click **View Details**.

Step 10 Click **Consumed Contract Interface**.

Step 11 Click **Add**.

Step 12 On the **Add Consumed Contract Interface To EPG** screen, complete the fields including the following:

a) Expand **Contract**, check the contract interface that you want to add to the EPG, and then click **Validate**.

b) From the **Priority** drop-down list, choose a priority for the selected EPG from the following options:

- **Level1—**Class 1 Differentiated Services Code Point (DSCP) value.
- **Level2—**Class 2 DSCP value
- **Level3—**Class 3 DSCP value
- **Unspecified—**Is the default value

c) Click **Submit**.

Contract Labels

Adding a Consumed Label to a Contract Subject

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Contracts**.

Step 7 Click the row with the contract that you want to update and click **View Details**.

Step 8 Click **Contract Subjects**.

Step 9 Click the row with the contract subject that you want to update and click **View Details**.

Step 10 Click **Consumed Label**.

Step 11 Click **Add**.

Step 12 On the **Add Consumed Label to Contract To Contract Subject** screen, complete the following fields:

a) From the **Match Type** drop-down list, choose the subject match criteria across providers, from the following options:

- **Atleast One**
- **Atmost One**
- **None**
- **All**

b) Enter a **Label Name**.
A subject label is used as classification criteria for subjects being consumed by the EPGs participating in the contract.

c) From the **Label Tag** drop-down list, choose a tag.
It is the search keyword or term that is assigned to the application profile. A tag allows you to group multiple objects by a descriptive name. You can assign the same tag name to multiple objects and you can assign one or more tag names to an object.

d) Check **Complement** for the contract to take effect if the labels do not match.

e) Click **Submit**.

Adding a Provided Label to a Contract Subject

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Contracts**.

Step 7 Click the row with the contract that you want to update and click **View Details**.

Step 8 Click **Contract Subjects**.

Step 9 Click the row with the contract subject that you want to update and click **View Details**.

Step 10 Click **Provided Label**.

Step 11 Click **Add**.

Step 12 On the **Add Provided Label to Contract To Contract Subject** screen, complete the following fields:

a) From the **Match Type** drop-down list, choose the subject match criteria across providers, from the following options:

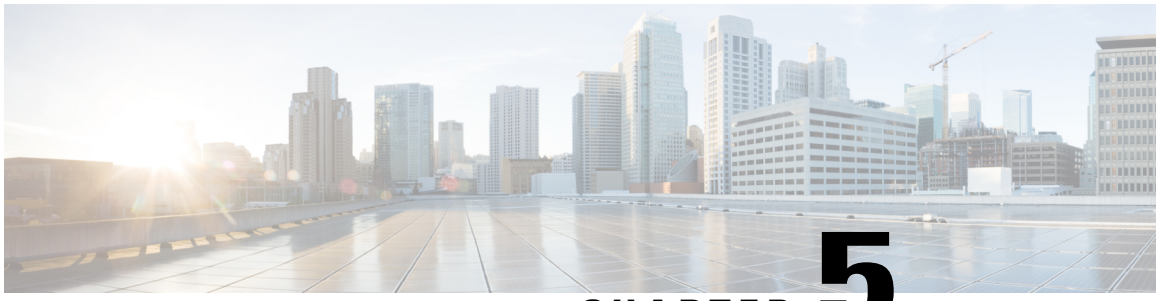
- **Atleast One**
- **Atmost One**
- **None**
- **All**

b) Enter a **Label Name**.
A subject label is used as classification criteria for subjects being consumed or provided by the EPGs participating in the contract.

c) From the **Label Tag** drop-down list, choose a tag.
It is the search keyword or term that is assigned to the application profile. A tag allows you to group multiple objects by a descriptive name. You can assign the same tag name to multiple objects and you can assign one or more tag names to an object.

d) Check **Complement** for the contract to take effect if the labels do not match.

e) Click **Submit**.



CHAPTER 5

Configuring L4-L7 Services

Unmanaged Mode

In unmanaged mode, Cisco APIC allocates only the network resources for the service graph and programs only the fabric side during graph instantiation. You must configure the unmanaged device in an external application or tool.

When you add an unmanaged network device, Cisco APIC does not require the device package for that device.

For more information about unmanaged mode, see the Cisco APIC Layer 4 to Layer 7 Services Deployment Guide.

Setting Up an Unmanaged Device

For unmanaged devices, the Application Policy Infrastructure Controller (APIC) allocates only the network resources for the service graph and programs only the fabric side during graph instantiation.You cannot configure an unmanaged device in the APIC.

Step 1 Add an unmanaged device cluster.
See Adding an Unmanaged Device Cluster, on page 43.

Step 2 Add at least one concrete device to the unmanaged device cluster.
See Adding a Concrete Device to an Unmanaged Device Cluster, on page 47.

Step 3 For a virtual concrete device, add at least one vNIC to the concrete interface on the device.
See Adding a vNIC to an Unmanaged Virtual Concrete Device, on page 48.

Step 4 For a physical concrete device, add at least one path to the concrete interface on the device.
See Adding a Path Interface to an Unmanaged Physical Concrete Device, on page 49.

Step 5 Add at least one logical interface to the unmanaged device cluster.
See Adding a Logical Interface to an Unmanaged Device Cluster, on page 45.

Step 6 Create an L4-L7 service graph template with the configuration parameters you want to use for the device cluster.
See Creating a Service Graph Template, on page 60.

Step 7 Apply the L4-L7 service graph template to configure the device cluster.
See Applying a Service Graph Template, on page 62.

Managed Mode

By default, when a device is registered with Cisco APIC, the device is set to be in managed mode. When a device is configured as managed, Cisco APIC manages the device and programs the device during graph instantiation.

Setting Up a Managed Device

Step 1 Add a managed device cluster.
See Adding a Managed Device Cluster, on page 44.

Step 2 Add at least one concrete device to the managed device cluster.
See Adding a Concrete Device to a Managed Device Cluster, on page 47.

Step 3 For a virtual concrete device, add at least one vNIC to the concrete interface on the device.
See Adding a vNIC to a Managed Virtual Concrete Device, on page 49.

Step 4 For a physical concrete device, add at least one path to the concrete interface on the device.
See Adding a Path Interface to a Managed Physical Concrete Device, on page 50.

Step 5 Add at least one logical interface to the managed device cluster.
See Adding a Logical Interface to a Managed Device Cluster, on page 46.

Step 6 Create an L4-L7 service graph template with the configuration parameters you want to use for the device cluster.
See Creating a Service Graph Template, on page 60.

Step 7 Apply the L4-L7 service graph template to configure the device cluster.
See Applying a Service Graph Template, on page 62.

Device Clusters

A device cluster, also known as a logical device, contains one or more concrete devices that act as a single device. A device cluster has cluster interfaces, also known as logical interfaces, which describe the interface information for the device cluster.

Device clusters can be managed or unmanaged.

When the Application Policy Infrastructure Controller (APIC) renders and instantiates service graph templates, it does the following:

- Associates function node connectors with the cluster interfaces.
- Allocates network resources for a function node connector, such as VLAN or Virtual Extensible Local Area Network (VXLAN) resources
- Programs those network resources onto the cluster logical interfaces

The service graph template uses a specific device that is based on a device selection policy, known as a logical device context.

Each device cluster can have a maximum of two concrete devices in active/standby mode.

Adding an Unmanaged Device Cluster

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Device Clusters**.

Step 7 Click **Add**.

Step 8 On the **Add Device Cluster** screen, complete the following fields:

a) Ensure that **Managed** is not checked.

b) In the **Device Cluster** field, enter a unique name for the cluster.

c) From the **Context Aware** drop-down list, choose one of the following:

- **Single—**The device cluster must be given to a specific tenant and cannot be shared across multiple tenants. This is the default value.
- **Multiple—**The device cluster can be shared across multiple tenants of a given type that you are hosting on a provider network.

d) From the **Function Type** drop-down list, choose one of the following:

- **Go To—**A GoTo device has a specific destination. This is the default value.
- **Go Through—**A GoThrough device is a transparent device. A packet goes through the device without being addressed to it, and the endpoints are not aware of the device.

e) From the **Service Type** drop-down list, choose one of the following:

- **ADC—**One-arm and two-arm deployment modes.
- **Firewall—**Routed and transparent deployment modes.
- **IDS/IPS—**IDS and IPS deployment modes.
- **Other—**Any other mode.

f) From the **Device Type** drop-down list, choose one of the following:

- **Physical**
- **Virtual**

g) Expand **Domain**, check the domain that you want to use, and then click **Validate**.
The domain must be a VMM domain if the device type is Virtual, and a physical domain if the device type is Physical.

Step 9 Click **Submit**.

Adding a Managed Device Cluster

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Device Clusters**.
Step 7 Click **Add**.
Step 8 On the **Add Device Cluster** screen, complete the following fields:

a) Ensure that **Managed** is checked.
b) In the **Device Cluster** field, enter a unique name for the cluster.
c) Expand **Device Package**, check the device package that you want to use, and click **Validate**.
d) From the **Context Aware** drop-down list, choose one of the following:

- **Single—**The device cluster must be given to a specific tenant and cannot be shared across multiple tenants. This is the default value.
- **Multiple—**The device cluster can be shared across multiple tenants of a given type that you are hosting on a provider network.

e) From the **Function Type** drop-down list, choose one of the following:

- **Go To—**A GoTo device has a specific destination. This is the default value.
- **Go Through—**A GoThrough device is a transparent device. A packet goes through the device without being addressed to it, and the endpoints are not aware of the device.

f) From the **Service Type** drop-down list, choose one of the following:

- **ADC—**One-arm and two-arm deployment modes.
- **Firewall—**Routed and transparent deployment modes.
- **IDS/IPS—**IDS and IPS deployment modes.
- **Other—**Any other mode.

g) From the **Device Type** drop-down list, choose one of the following:

- **Physical**
- **Virtual**

h) Expand **Domain**, check the domain that you want to use, and then click **Validate**.
The domain must be a VMM domain if the device type is Virtual, and a physical domain if the device type is Physical.

i) Expand **EPG**, check the EPG that you want to use, and then click **Validate**.

j) Enter the virtual IP address, port, user name, and password for the cluster management interface.

Step 9 Click **Submit**.

Logical Interfaces

Adding a Logical Interface to an Unmanaged Device Cluster

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Device Clusters**.

Step 7 Click the row with the unmanaged device cluster that you want to update and click **View Details**.
Check the **Managed** column to determine if the device cluster is managed or unmanaged.

Step 8 Click **Logical Interface**.

Step 9 Click **Add**.

Step 10 On the **Add Device Cluster Logical Interface** screen, complete the following fields:

a) Enter a unique name for the logical interface.

b) In the **Encapsulation** field, enter the traffic encapsulation identifiers for the logical interface. The valid VLAN range for encapsulation is between 1 and 4094.

Step 11 Click **Submit**.

Adding a Logical Interface to a Managed Device Cluster

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Device Clusters**.

Step 7 Click the row with the managed device cluster that you want to update and click **View Details**. Check the **Managed** column to determine if the device cluster is managed or unmanaged.

Step 8 Click **Logical Interface**.

Step 9 Click **Add**.

Step 10 On the **Add Device Cluster Logical Interface** screen, complete the following fields:

a) Enter a unique name for the logical interface.

b) Expand **Logical Interface Type**, check the interface type that you wnatto use for managed device cluster, and then click **Validate**.

Step 11 Click **Submit**.

Concrete Devices

A concrete device has concrete interfaces. When a concrete device is added to a logical device cluster, concrete interfaces are mapped to the logical interfaces. During service graph template instantiation, VLANs and VXLANs are programmed on concrete interfaces that are based on their association with logical interfaces.

You can create multiple cluster interfaces on a concrete device and then specify which cluster interface will be used for the connector in the device selection policy. This cluster interface can be shared by using multiple service graph instantiations.

Adding a Concrete Device to an Unmanaged Device Cluster

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Device Clusters**.

Step 7 Click the row with the unmanaged physical device cluster that you want to update and click **View Details**.

Step 8 Click **Concrete Device**.

Step 9 Click **Add**.

Step 10 On the **Add Device Cluster Concrete Device** screen, complete the following fields:

a) In the **Device Name** field, enter a unique name for the concrete device.
b) In the **Device Context Label** field, enter the label for the device cluster context.
c) For a virtual device cluster, in the **VM Name** field, enter the name of the VM where the device is hosted.
d) For a virtual device cluster, in the **vCenter Name** field, enter the name of the VMware vCenter where the VM is located.

Step 11 Click **Submit**.

Adding a Concrete Device to a Managed Device Cluster

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Device Clusters**.

Step 7 Click the row with the managed physical device cluster where you want to create the concrete device and click **View Details**.
Check the **Device Type** column to determine if the device cluster is physical or virtual.

Step 8 Click **Concrete Device**.

Step 9 Click **Add**.

Step 10 On the **Add Device Cluster Concrete Device** screen, complete the fields, including the following:

a) In the **Device Name** field, enter a unique name for the concrete device.
b) In the **Device Context Label** field, enter the label for the device cluster context.

c) For a virtual device cluster, in the **VM Name** field, enter the name of the VM where the device is hosted.
d) For a virtual device cluster, in the **vCenter Name** field, enter the name of the VMware vCenter where the VM is located.
e) Enter the virtual IP address, port, user name, and password for the cluster management interface.

Step 11 Click **Submit**.

Adding a vNIC to an Unmanaged Virtual Concrete Device

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Device Clusters**.
Step 7 Click the row with the device cluster that you want to update and click **View Details**.
Step 8 Click **Concrete Device**.
Step 9 Click the row with the concrete device that you want to update and click **View Details**.
Step 10 Click **vNIC to Concrete Interface**.
Step 11 Click **Add**.
Step 12 On the **Add Concrete Interface to Device** screen, complete the fields, including the following:
a) In the **Concrete Interface** field, enter a unique name for the interface.
b) Expand **Path**, check the path that you want to add to the interface, and click **Validate**.
c) In the **vNIC** field, enter the vNIC assigned to this interface.
d) Expand **Logical Interface Name** and check the interface where you want to add the path.
Step 13 Click **Submit**.

Adding a vNIC to a Managed Virtual Concrete Device

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Device Clusters**.

Step 7 Click the row with the managed device cluster that you want to update and click **View Details**.
Check the **Managed** column to determine if the device cluster is managed or unmanaged.

Step 8 Click **Concrete Device**.

Step 9 Click the row with the concrete device that you want to update and click **View Details**.

Step 10 Click **vNIC to Concrete Interface**.

Step 11 Click **Add**.

Step 12 On the **Add Concrete Interface to Device** screen, complete the following fields:

a) In the **Concrete Interface** field, enter a unique name for the interface.
b) Expand **Path**, check the path that you want to add to the interface, and click **Validate**.
c) In the **vNIC** field, enter the vNIC assigned to this interface.
d) Expand **Logical Interface Name** and check the interface where you want to add the path.

Adding a Path Interface to an Unmanaged Physical Concrete Device

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Device Clusters**.

Step 7 Click the row with the unmanaged device cluster that you want to update and click **View Details**.
Check the **Managed** column to determine if the device cluster is managed or unmanaged.

Step 8 Click **Concrete Device**.

Step 9 Click the row with the concrete device that you want to update and click **View Details**.

Step 10 Click **Path to Concrete Interface**.

Step 11 Click **Add**.

Step 12 On the **Add Concrete Interface to Device** screen, complete the fields, including the following:

a) In the **Concrete Interface** field, enter a unique name for the interface.
b) Expand **Path**, check the path that you want to add to the interface, and click **Validate**.
c) Expand **Logical Interface Name**, check the interface where you want to add the path, and click **Validate**.

Step 13 Click **Submit**.

Adding a Path Interface to a Managed Physical Concrete Device

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Device Clusters**.
Step 7 Click the row with the managed device cluster that you want to update and click **View Details**.
Check the **Managed** column to determine if the device cluster is managed or unmanaged.
Step 8 Click **Concrete Device**.
Step 9 Click the row with the concrete device that you want to update and click **View Details**.
Step 10 Click **Path to Concrete Interface**.
Step 11 Click **Add**.
Step 12 On the **Add Concrete Interface to Device** screen, complete the following fields:
a) In the **Concrete Interface** field, enter a unique name for the interface.
b) Expand **Path**, check the path that you want to add to the interface, and click **Validate**.
c) Expand **Logical Interface Name**, check the interface where you want to add the path, and click **Validate**.
Step 13 Click **Submit**.

APIC Function Profiles

An APIC function profile provides default values for the parameters of a particular function associated with a device package that is managed by Cisco APIC. You can then include one or more APIC function profiles in an L4-L7 service graph template. For example, you can create a function profile that provides default values for the Cisco ASA firewall function.

In Cisco UCS Director, you create APIC function profiles within function profile groups.

Function profile groups organize function profiles to make it easier to identify the profiles that you want to include in a specific service graph template.

Note Cisco UCS Director supports only the configuration of Cisco ASA devices through APIC function profiles and service graphs. You can create service graph template and function profile with load balancer service. But the parameters that are added for the function profile through individual workflow task, user interface action, and REST API in Cisco UCS Director, are supported for firewall service alone.

Creating an APIC Function Profile Group

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Function Profile Group**.
Step 7 Click **Add**.
Step 8 On the **Add Function Profile Group** screen, enter a name and description for the group and click **Submit**.

What to Do Next

Add one or more APIC function profiles to the function profile group.

Creating an APIC Function Profile

Note Cisco UCS Director supports only the configuration of Cisco ASA devices through APIC function profiles and service graphs.

Before You Begin

- Create an APIC function profile group.

- Create an APIC firewall policy.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Function Profile Group**.

Step 7 Click the row with the group where you want to add a function profile and click **View Details**.

Step 8 Click **Function Profile**.

Step 9 Click **Add**.

Step 10 On the **Create Function Profile** screen, complete the following fields:

a) Add a unique name and description for the function profile.

b) Expand **Function Name**, check the row with the APIC account, device, and function that you want to use, and then click **Validate**.
For example, to configure a firewall for a Cisco ASA 1.2, check a row that has a Device Package Name of CISCO-ASA-1.2 and a Function of Firewall. After you validate your selection, the function displays next to **Function Name**.

c) If you chose a load balancing function, in the **Load Balancer Parameters** area, complete the following fields:

- **External ID**
- **External Netmask**
- **Internal ID**
- **Internal Netmask**
- **Services—**Use a comma-separated list to include multiple services.
- **LB IPv4 IP**

d) Optional. If you chose a firewall function, expand **Firewall Policy** and check the APIC firewall policy that you want to assign to this function profile.
If the list does not include the firewall policy you need, click **Add** to create a new policy.

Alternately, navigate to **Policy** > **Resource Groups** > **APIC Firewall Policy**, and then click **Add** to create a firewall policy.

e) Click **Submit**.

What to Do Next

Click **View Details** and add one or more parameters to the function profile from **Function Profile Parameters**. After you add the parameters, they are displayed on either **L4L7 Function Profile Parameters** or **Function Profile Function Parameters**.

Adding ACL Parameters to an APIC Function Profile

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Function Profile Group**.

Step 7 Click the row with the group where you want to update the function profile and click **View Details**.

Step 8 Click **Function Profile**

Step 9 On the **Function Profiles** page, choose the profile where you want to add parameters and click **View Details**.

Step 10 Click **Function Profile Parameter**.

Step 11 Choose **Add ACL to Function Profile**.

Step 12 On the **Add ACL to Function Profile** screen, complete the following fields:

a) In the **ACL List Name** field, enter the name of the Access Control List.

b) In the **ACE Name** field, enter the name of the Access Control Entry in the ACL to specify the permit or deny rule for packets.

c) From the **Protocol** drop-down list, choose one of the following protocols:

- **ip**
- **tcp**
- **udp**
- **icmp**

d) Check **Source Any** if you want the ACL to apply to any source IP address.
If you do not check this box, enter a single IP address, an IP address range, or a network address or subnet address in the **Source Address** field.

e) Check **Destination Any** if you want the ACL to apply to any destination IP address.
If you do not check this box, you can enter a single IP address, an IP address range, or a network address or subnet address in the **Destination Address** field.

f) From the **Action** drop-down list, choose one of the following:

- **deny** if you want this ACL to drop the packet.
- **allow** if you want this ACL to forward the packet. The ACL denies all packets that you do not specifically allow.

g) In the **Order** field, enter the order of this entry in the ACL.

Step 13 Click **Submit**.

Adding an Interface to an APIC Function Profile

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Function Profile Group**.

Step 7 Click the row with the group where you want to update the function profile and click **View Details**.

Step 8 Click **Function Profile**

Step 9 On the **Function Profiles** page, choose the profile where you want to add parameters and click **View Details**.

Step 10 Click **Function Profile Parameters**.

Step 11 Choose **Add Interface to Function Profile**.

Step 12 On the **Add Interface to Function Profile** screen, complete the following fields:

a) Enter a unique name for the interface.

b) From the **Type** drop-down list, choose one of the following:

- **External**
- **Internal**

c) In the **IPv4 Address** field, enter the IPv4 address for the interface.

d) In the **Security Level** field, enter the security level for the interface.
The security level can be from 0 (lowest) to 100 (highest). The Cisco ASA uses the security level to determine the type of traffic allowed to and from the interface. For example, you can assign a higher security level to an interface that handles internal traffic and a lower security level to an interface that handles external traffic.

e) Expand **Bridge Group ID** and check the bridge group that you want to use for this interface.

f) Expand **Inbound ACL** and check the ACL that you want to use for inbound traffic.

g) Expand **Outbound ACL** and check the ACL that you want to use for outbound traffic.

Step 13 Click **Submit**.

Adding a Bridge Group Interface to an APIC Function Profile

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Function Profile Group**.

Step 7 On the **Function Profile Group** page, choose the row with the group where you want to update the function profile and click **View Details**.

Step 8 Click **Function Profile**

Step 9 On the **Function Profiles** page, choose the profile where you want to add parameters and click **View Details**.

Step 10 Click **Function Profile Parameters**.

Step 11 Choose **Add Bridge Group Interface to Function Profile**.

Step 12 On the **Add Bridge Group Interface to Function Profile** screen, complete the following fields:

- **Bridge Group ID—**Enter an integer between 1 and 100.
- **IPv4 Address Value—**Enter the IPv4 address for the bridge group interface.

Step 13 Click **Submit**.

Adding a Static Route to an Interface on an APIC Function Profile

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Function Profile Group**.

Step 7 Click the row with the group where you want to update the function profile and click **View Details**.

Step 8 Click **Function Profile**

Step 9 On the **Function Profiles** page, choose the profile where you want to add parameters and click **View Details**.

Step 10 Click **Function Profile Parameters**.

Step 11 Choose **Add Static Route to Interface on APIC Function Profile**.

Step 12 On the **Add Static Route to Interface on APIC Function Profile** screen, complete the following fields:

a) Expand **Interface Name**, check the interface you want to update, and click **Validate**.

b) From the **Type** drop-down list, choose either **IPv4** or **IPv6**.
c) If you chose **IPv4**, complete the following fields:

- **Gateway Address**
- **Network Mask**
- **Network**
- **Metric**

d) If you chose **IPv6**, complete the following fields:

- **Gateway Address**
- **Hop Count**
- **Prefix**
- **Tunneled**

Step 13 Click **Submit**.

Adding a Network Object to an APIC Function Profile

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Function Profile Group**.
Step 7 On the **Function Profile Group** page, choose the row with the group where you want to update the function profile and click **View Details**.
Step 8 Click **Function Profile**
Step 9 On the **Function Profiles** page, choose the profile where you want to add parameters and click **View Details**.
Step 10 Click **Function Profile Parameter**.
Step 11 Choose **Add Network Object to Function Profile**.
Step 12 On the **Add Network Object to Function Profile** screen, complete the following fields:
a) In the **Network Object Name** field, enter a unique name for the network object.
b) From the **Network Object Type** drop-down list, choose one of the following types:

- **FQDN**
- **Host IP Address**

- **IP Address Range**
- **Network IP Address**

c) If you chose **FQDN**, enter the fully qualified domain name for this network object.
d) If you chose **Host IP Address**, enter the IP address that you want to use for this network object.
e) If you chose **IP Address Range**, enter the range of IP addresses that you want to use for this network object.
f) If you chose **Network IP Address**, enter the IP address that you want to use for this network object.

Step 13 Click **Submit**.

Adding a Service Object to an APIC Function Profile

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Function Profile Group**.
Step 7 Click the row with the group where you want to update the function profile and click **View Details**.
Step 8 Click **Function Profile**
Step 9 On the **Function Profiles** page, choose the profile where you want to add parameters and click **View Details**.
Step 10 Click **Function Profile Parameters**.
Step 11 Choose **Add Service Object to Function Profile**.
Step 12 On the **Add Service Object to Function Profile** screen, complete the following fields:
a) In the **Service Object Name** field, enter a unique name for the service object.
b) Enter a description of the service object.
c) In the **Protocol Type** field, enter the IP protocol name or number for the service object.
d) From the **Service Object Type** drop-down list, choose one of the following types:

- **icmp**
- **icmp6**
- **tcp**
- **udp**

After you choose the type, you are prompted to enter additional parameters for that type.

e) If you chose **icmp**, enter the **Code** and **Type** for the service object.
f) If you chose **icmp6**, enter the **Code** and **Type** for the service object.
g) If you chose **tcp**, enter the **High Port**, **Low Port**, and **Operator** for the following fields:

- **TCP Destination**
- **TCP Source**

h) If you chose **udp**, enter the **High Port**, **Low Port**, and **Operator** for the following fields:

- **UDP Destination—**
- **UDP Source—**Enter the **High Port**, **Low Port**, and **Operator**.

Step 13 Click **Submit**.

Creating a NAT Rule for an APIC Function Profile

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Function Profile Group**.
Step 7 Click the row with the group where you want to update the function profile and click **View Details**.
Step 8 Click **Function Profile**.
Step 9 On the **Function Profiles** page, choose the profile where you want to add parameters and click **View Details**.
Step 10 Click **Function Profile Parameters**.
Step 11 Choose **Create NAT Rule**.
Step 12 On the **Create NAT Rule** screen, complete the following fields:

a) Enter a unique name for the NAT rule.
b) Expand **Source Real Object**, check the object that you want to use, and then click **Validate**.
c) Expand **Source Mapped Object**, check the object that you want to use, and then click **Validate**.
d) From the **Type** drop-down list, choose one of the following:

- **Static**
- **Dynamic**

e) Expand **Destination Real Object**, check the object that you want to use, and then click **Validate**.
f) Expand **Destination Mapped Object**, check the object that you want to use, and then click **Validate**.
g) Expand **Service Real Object**, check the object that you want to use, and then click **Validate**.
h) Expand **Service Mapped Object**, check the object that you want to use, and then click **Validate**.
i) In the **DNS** field, enter the IP address or the fully qualified domain name (FQDN) of the DNS server that you want to use.
j) In the **Order** field, enter the order of the rule in an access list.

The order of the rules in an access list determines how traffic is handled and which rule the Cisco ASA applies to the traffic. For an access list with multiple rules, the Cisco ASA goes through the rules in order and applies the first rule that matches the traffic.

k) In the **Uni-Direction** field, enter unidirectional so that the destination addresses cannot initiate traffic to the source addresses.
l) Expand **Source Interface**, check the interface that you want to use, and click **Validate**.
m) Expand **Destination Interface**, check the interface that you want to use, and click **Validate**.

Step 13 Click **Submit**.

Adding a Network Object Group to an APIC Function Profile

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Function Profile Group**.
Step 7 On the **Function Profile Group** page, choose the row with the group where you want to update the function profile and click **View Details**.
Step 8 Click **Function Profile**.
Step 9 On the **Function Profiles** page, choose the profile where you want to add parameters and click **View Details**.
Step 10 Click **Function Profile Parameters**.
Step 11 From **More Actoins** drop-down list, choose **Add Network Object Group to Function Profile**.
Step 12 On the **Add Network Object Group to Function Profile** screen, complete the following fields:

a) Enter a unique name and description for the network object group.
b) From the **Network Object Group Type** drop-down list, choose one of the following:

- **Host IP Address**
- **Network Address**
- **Network Object**

c) If you chose **Host IP Address**, enter an IPv4 or IPv6 address for the host.
d) If you chose **Network Address**, enter one of the following:

- An IPv4 address with netmask in the following format: 10.10.10.10/255.255.255.255
- An IPv6 address with prefix in the following format: X:X:X:X:X:X/<0-128>

e) If you chose **Network Object**, expand **Network Object Name**, check the network objects that you want to include, and click **Validate**.

Step 13 Click **Submit**.

Service Graph Templates

A service graph template contains configuration parameters, which you can specify through one or more of the following:

- Device package
- EPG
- Application profile
- Tenant context

You can apply a service graph template to multiple devices and ensure that all of those devices have the same configuration.

A function node within a service graph template can require one or more configuration parameters. You can lock the parameter values to prevent any additional changes.

The values of the configuration parameters in a service graph are passed to the device script within the device package. The device script converts the parameter data to the configuration that is downloaded onto the device.

Creating a Service Graph Template

Before You Begin

Create at least one function profile for the function and device.

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **L4-L7 Service Graph**.

Step 7 Click **Create L4 L7 Service Graph Template**.

Step 8 On the **Create L4 L7 Service Graph Template** screen, complete the following fields:

a) Enter a unique name and description for the service graph template.

b) From the **Type** drop-down list, choose the type of template you want to create.
The template type determines which configuration parameters you can include in the service graph template. The template type can be one of the following:

- **Single Node - Firewall in Transparent Mode—**A single node graph that inserts a firewall into the traffic path. The graph configures the firewall in transparent mode without routing. The bridge domain is used for traffic that is derived from the EPGs. You do not need to provide any additional bridge domains.
- **Single Node - Firewall in Routed Mode—**A single node graph that inserts a firewall into the traffic path. The graph configures the firewall in routed mode, which performs the routing. The bridge domain is used for traffic that is derived from the EPGs. You do not need to provide any additional bridge domains.
- **Single Node - ADC in One-Arm Mode—**A single node graph that inserts an ADC into the traffic path. The graph configures the ADC in 1-ARM mode. The bridge domain is used for traffic that is explicitly provided.
- **Single Node - ADC in Two-Arm Mode—**A single node graph that inserts an ADC into the traffic path. The graph configures the ADC in 2-ARM mode without routing. The bridge domain is used for traffic that is derived from the EPGs. You do not need to provide any additional bridge domains.
- **Two Nodes - Firewall in Transparent and ADC in One-Arm Mode—**A two node graph that inserts a firewall and an ADC into the traffic path. The graph configures the firewall in transparent mode without routing and the ADC in 1-ARM mode. The bridge domain that is used for the traffic from the firewall to the ADC and the ADC to the provider EPG is explicitly provided.
- **Two Nodes - Firewall in Routed and ADC in One-Arm Mode—**A two node graph that inserts a firewall and an ADC into the traffic path. The graph configures the firewall in routed mode and the ADC in 1-ARM mode. The bridge domain that is used for the traffic in to and out of the ADC is explicitly provided.
- **Two Nodes - Firewall in Routed and ADC in Two-Arm Mode—**A two node graph that inserts a firewall and an ADC into the traffic path. The graph configures the firewall in routed mode and the ADC in 2-ARM mode. The bridge domain that is used for the traffic from the firewall to the ADC and the firewall to the consumer EPG is explicitly provided.
- **Two Nodes - Firewall in Transparent and ADC in Two-Arm Mode—**A two node graph that inserts a firewall and an ADC into the traffic path. The graph configures the firewall in transparent mode and the ADC in 2-ARM mode. The bridge domain that is used for the traffic for Firewall to ADC is explicitly provided.

c) Complete the following fields to add the configurations to the service graph template.
If you chose a template type with a firewall, the firewall is always Node One, whether you choose a Single Node or Two Nodes template type. If you chose a template type with an ADC, the ADC is Node One for a Single Node template type and Node Two for a Two Nodes template type.

- **Managed—**Specifies whether the device is managed or unmanaged. An unmanaged device does not require further configuration. For a managed device, complete the following fields.
  - **Function Name—**Specifies the virtual function for a managed device. This is a single virtual function on a service device such as a firewall, a load balancer, or an SSL offloading device.
  - **Function Profile—**Specifies the function profile for a managed device. The profile includes the abstract device configuration, the abstract group configuration, and the abstract function configuration.

Step 9 Click **Submit**.

Applying a Service Graph Template

Before You Begin

Depending upon the configuration parameters you plan to use, create the following:

- Consumer EPG or external network
- Provider EPG or external network
- Contract
- Device clusters
- Cluster interfaces
- Bridge domains, if you plan to use a general connector type
- Router configuration, if you plan to use route peering

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **L4-L7 Service Graph**.

Step 7 Choose the service graph template with managed or unmanaged node that you want to apply.
Check the **Managed** column of the **Nodes** tab of service graph template to determine if the node is managed or unmanaged.

Step 8 Click **Apply L4 L7 Service Graph Template**.

Step 9 On the **Apply L4 L7 Service Graph Template** screen, complete the following fields:

a) From the **Consumer EPG/External Network** drop-down list, choose either **EPG** or **External Network** and then do one of the following:

- Expand **Consumer EPG**, check the EPG you want to use, and then click **Validate**.
- Expand **Consumer External Network**, check the external network you want to use, and then click **Validate**.

b) From the **Provider EPG/External Network** drop-down list, choose either **EPG** or **External Network** and then do one of the following:

- Expand **Provider EPG**, check the EPG you want to use, and then click **Validate**.
- Expand **Provider External Network**, check the external network you want to use, and then click **Validate**.

c) From the **Create a New Contract/Choose an Existing Contract Subject** drop-down list, choose one of the following:

- **Create a New Contract** and then complete the contract name and filters fields for that contract.
- **Choose an Existing Contract Subject** and then expand **Contract Subject** and check the contract subject that you want to use.

d) In the **Node One Consumer Connector** area, choose the device cluster, function profile, and the consumer connector type and then complete the appropriate fields.

Note The function profile is enabled only when the function profile is not provided as input while creating the service graph template.

- **General—**Choose the **Consumer Bridge Domain** and **Consumer Cluster Interface**.
- **Route Peering—**Choose the **Router Configuration**, **Consumer Cluster Interface**, and **Consumer External Network**.

e) In the **Node One Provider Connector** area, choose the provider connector type and then complete the appropriate fields.

- **General—**Choose the **Provider Bridge Domain** and **Consumer Cluster Interface**.
- **Route Peering—**Choose the **Router Configuration**, **Provider Cluster Interface**, and **Provider External Network**.

f) If your service graph or service graph template is a Two Node type, complete the **Node Two Connector** fields for that node.

Step 10 Click **Submit**.

Service Graphs

Service graphs identify the set of network or service functions that are needed by an application. You can instantiate service graphs on the ACI fabric through Cisco UCS Director.

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.

A service graph represents the network using the following elements:

- Function node—A function node represents a function that is applied to network 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 you configure a service graph, the network services are automatically configured according to the service function requirements in the service graph. This 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 them.

A service appliance (or 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.

For more information about the requirements of service graphs and their deployment, see the Cisco APIC Layer 4 to Layer 7 Services Deployment Guide.

Adding a Service Graph

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **L4-L7 Service Graph**.

Step 7 Click **Add**.

Step 8 On the **Add Service Graph** screen, complete the fields, including the following:

a) Enter a unique name and description for the service graph.

b) Expand **Nodes**, check the node that you want to use, and then click **Validate**.
If the node you want to use is not in the list, click **Add** to create the node.

Step 9 Click **Submit**.

Adding a Filter to a Service Graph Node

A filter policy is a group of resolvable filter entries. Each filter entry is a combination of network traffic classification properties.

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **L4-L7 Service Graph**.
Step 7 Click the service graph you want to update and click **View Details**.
Step 8 Click the node where you want to add a filter and click **View Details**.
Step 9 Click **Connectors**.
Step 10 Click **Add**.
Step 11 On the **Add Filter to Service Graph Node** screen, complete the following fields:
a) From the **Connector Mode** drop-down list, choose **internal** or **external**.
b) Expand **Filter Name**, check the filter that you want to use, and then click **Validate**.
Step 12 Click **Submit**.

Adding a Logical Device Context

The service graph uses a specific device based on a device selection policy, known as a logical device context.

Step 1 Choose **Physical** > **Network**.
Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.
Step 3 Click the row with the APIC account and click **View Details**.
Step 4 Click **Tenant(s)**.
Step 5 Click the row with the tenant that you want to update and click **View Details**.
Step 6 Click **Logical Device Context**.
Step 7 Click **Add**.
Step 8 On the **Add Tenant Logical Device Context** screen, complete the following fields:
a) Expand **Device Cluster**, check the device cluster that you want to use, and then click **Validate**.
b) Expand **Contract Name** and check the contract name that you want to use.
c) Expand **Graph Name** and check the graph name that you want to use.

d) Expand **Node Name** and check the node name that you want to use.

Step 9 Click **Submit**.

Adding a Logical Interface Context

Step 1 Choose **Physical** > **Network**.

Step 2 On the **Network** page, choose the account under **Multi-Domain Managers**.

Step 3 Click the row with the APIC account and click **View Details**.

Step 4 Click **Tenant(s)**.

Step 5 Click the row with the tenant that you want to update and click **View Details**.

Step 6 Click **Logical Device Context**.

Step 7 Click the row with the logical device context that you want to update and click **View Details**.

Step 8 Click **Logical Interface Context**.

Step 9 Click **Add**.

Step 10 On the **Add Tenant Logical Interface Context** screen, complete the following fields:

a) Expand **Logical Device Context**, check the logical device context to which you want to add an interface, and then click **Validate**.

b) Enter the connector name. By default, **any** is set as the connector name.

c) Expand **Logical Interface Name** and check the logical interface name that you want to add to the logical device context.

d) Expand **Bridge Domian Name** and check the bridge domain name that you want to add to the logical device context.

Step 11 Click **Submit**.