Cisco Cloud APIC for AWS User Guide, Release 5.0(x)

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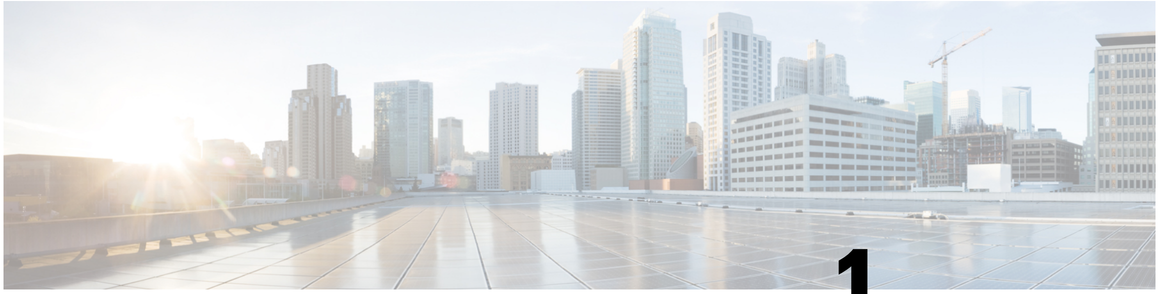


CHAPTER 1

New and Changed Information

New and Changed Information

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

Table 1: New Features and Changed Behavior in Cisco APIC for Cisco APIC Release 5.0(2)

Feature or Change	Description	Where Documented
Naming convention support for more than 32 characters for the tenant and VRF name combination	All VRFs are assigned a VrfEncoded value. If the tenant and VRF name combination has more than 32 characters, then a VRF name (which also contains the tenant name) is identified in the cloud router using the VrfEncoded value.	Configuring Cisco Cloud APIC Components, on page 29

Table 2: New Features and Changed Behavior in Cisco APIC for Cisco APIC Release 5.0(1x) and Later

Release	Feature or Change	Description	Where Documented
5.0(1)	Support for AWS Transit Gateway on Cisco Cloud APIC	You can use Amazon Web Services (AWS) Transit Gateway with Cisco Cloud APIC to automate connectivity between virtual private clouds.	See the chapter AWS Transit Gateway on Cisco Cloud APIC, on page 137 in this guide and *Increasing Bandwidth Between VPCs by Using AWS Transit Gateway*.

Release	Feature or Change	Description	Where Documented
5.0(1)	Support for using filters to see specific information in AWS flow logs	You can use filters to see specific information derived by processing AWS flow logs. You can filter for a combination of source or destination IP address, port and protocol.	See the chapter Cisco Cloud APIC Statistics, on page 117 in this guide.
5.0(1)	Support for statistics collection for AWS Transit Gateway traffic	You can collect statistics for traffic to and from AWS Transit Gateways in Cisco Cloud APIC. You need to enable collection when you set up Cloud APIC for AWS Transit Gateway, and you need to create flow logs.	See the chapter Cisco Cloud APIC Statistics, on page 117 in this guide.

CHAPTER 2

About Cisco Cloud APIC

Overview

Cisco Application Policy Infrastructure Controller (APIC) Release 4.1(1) introduces Cisco Cloud APIC, which is a software deployment of Cisco APIC that you deploy on a cloud-based virtual machine (VM). When deployed, Cisco Cloud APIC:

- Provides an interface that is similar to the existing Cisco APIC to interact with the AWS public cloud
- Automates the deployment and configuration of cloud constructs
- Configures the cloud router control plane
- Configures the data path between the on-premises Cisco ACI fabric and the cloud site
- Translates Cisco ACI policies to cloud native construct
- Discovers endpoints
- Provides a consistent policy, security, and analytics for workloads deployed either on or across on-premises data centers and the public cloud

Note

- Cisco Multi-Site pushes the MP-BGP EVPN configuration to the on-premises spine switches
- On-premises VPN routers require a manual configuration for IPsec

- Provides an automated connection between on-premises data centers and the public cloud with easy provisioning and monitoring
- Policies are pushed by Cisco Multi-Site Orchestrator to the on-premises and cloud sites, and Cisco Cloud APIC translates the policies to the cloud to keep the policies consistent with the on-premises site

For more information about extending Cisco ACI to the public cloud, see the *Cisco Cloud APIC Installation Guide*.

When the Cisco Cloud APIC is up and running, you can begin adding and configuring Cisco Cloud APIC components. This document describes the Cisco Cloud APIC policy model and explains how to manage (add, configure, view, and delete) the Cisco Cloud APIC components using the GUI and the REST API.

Guidelines and Limitations

This section contains the guidelines and limitations for Cisco Cloud APIC.

- You cannot stretch more than one VRF between on-prem and the cloud while using inter-VRF route leaking in the cloud CSRs (cloud routers). For example, in a situation where VRF1 with EPG1 is stretched and VRF2 with EPG2 is also stretched, EPG1 cannot have a contract with EPG2. However, you can have multiple VRFs in the cloud, sharing one or more contracts with one on-premises VRF.
- Set the BD subnet for on-premises sites as advertised externally to advertise to the CSR1kv on the cloud.
- The default AWS security group (SG) rules limit only permits 2 CSRs per region and only 2 regions can deploy CSRs (a total maximum of 4 CSRs). To deploy more CSRs, increase the AWS SG rule limit to 120 or more. We recommend increasing the rule limit to 500.
- When configuring an object for a tenant, first check for any stale cloud resources in AWS. A stale configuration might be present if it was not cleaned properly from the previous Cisco Cloud APIC instances that managed the account.

  Note It takes some time for Cisco Cloud APIC to detect the stale cloud resources after adding the tenant account ID.

  To check for and clean up stale cloud resources:

  1. Click the **Navigation menu** > **Application Management** > **Tenants**. The **Tenants** summary table appears in the work pane with a list of tenants as rows in a summary table.
  2. Double click the tenant you are creating objects for. The **Overview**, **Cloud Resources**, **Application Management**, **Statistics**, and **Event Analytics** tabs appear.
  3. Click the **Cloud Resources** > **Actions** > **View Stale Cloud Objects**. The **Stale Cloud Objects** dialog box appears.
  4. If you see any stale objects, click to place a check mark in the **Automatically Clean Up Stale Cloud Objects** check box.
  5. Click **Save**. The Cisco Cloud APIC automatically cleans up stale cloud objects.

     Note To disable the automatic cleanup, follow steps 1 - 4 and click the **Automatically Clean Up Stale Cloud Objects** check box to remove the check mark.

- Cisco Cloud APIC tries to manage the AWS resources that it created. It does not attempt to manage resources created by other applications, other than listing existing resources as inventory. At the same time, it is also expected that AWS IAM users in the AWS infra tenant account, and the other tenant accounts, do not disturb the resources that Cisco Cloud APIC creates. For this purpose, all resources Cisco Cloud APIC creates on AWS has at least one of these two tags:
  - AciDnTag
  - AciOwnerTag

  Cisco Cloud APIC must prevent AWS IAM users who have access to create, delete, or update EC2, or any other resources, from accessing or modifying the resources that Cisco Cloud APIC created and manages. Such restrictions should apply on both the infra tenant and other user tenant accounts. AWS account administrators should utilize the above two tags to prevent their unintentional access and modifications. For example, you can have an access policy like the following to prevent access to resources managed by Cloud APIC:

  ```
  {
    "Effect": "Deny",
    "Action": [
      "ec2:*"
    ],
    "Resource": "*",
    "Condition": {
      "StringLike": {"ec2:ResourceTag/AciDnTag": "*"}
    }
  }
  ```

- When configuring shared L3Out:
  - An on-premises L3Out and cloud EPGs cannot be in tenant common.
  - If an on-premises L3Out and a cloud EPG are in different tenants, define a contract in tenant common. The contract cannot be in the on-premises site or the cloud tenant.
  - Specify the CIDR for the cloud EPG in the on-premises L3Out external EPGs (l3extInstP).
  - When an on-premises L3Out has a contract with a cloud EPG in a different VRF, the VRF in which the cloud EPG resides cannot be stretched to the on-premises site and cannot have a contract with any other VRF in the on-premises site.
  - When configuring an external subnet in an on-premises external EPG:
    - Specify the external subnet as a non-zero subnet.
    - The external subnet cannot overlap with another external subnet.
    - Mark the external subnet with a shared route-control flag to have a contract with a cloud EPG.
  - The external subnet that is marked in the on-premises external EPG should have been learned through the routing protocol in the L3Out or created as a static route.

- When mapping availability zones, choose only a or b in Cisco Cloud APIC. Internally, the zone-mapping function maps this to actual availability zones in AWS.

Note The mapping works in alphabetical order. The availability zones are sorted alphabetically and then the function picks the first two and associates them to a zone a and b in Cisco Cloud APIC.

- Configuring ASN 64512 for cloud routers causes BGP sessions to not work between cloud routers and AWS virtual private gateways.
- For the total supported scale, see the following *Scale Supported* table:

Note With the scale that is specified in the *Scale Supported* table:

- You can have only 4 total managed regions.
- You can have only CSRs in 2 regions, 2 * 2 CSRs. This is irrespective of AWS SG rule limit.

Table 3: Scale Supported

Component	Number Supported
Tenants	20
Applications	500
EPGs	500
Cloud Endpoints	1000
VRFs	20
Cloud Context Profiles	40
Contracts	1000
Service Graphs	200
Service Devices	100

About the Cisco Cloud APIC GUI

The Cisco Cloud APIC GUI is categorized into groups of related windows. Each window enables you to access and manage a particular component. You move between the windows using the **Navigation** menu that is located on the left side of the GUI. When you hover your mouse over any part of the menu, the following list of tab names appear: **Dashboard**, **Topology**, **Application Management**, **Cloud Resources**, **Operations**, **Infrastructure**, and **Administrative**.

Each tab contains a different list of subtabs, and each subtab provides access to a different component-specific window. For example, to view the tenant-specific window, hover your mouse over the **Navigation** menu and click **Application Management** > **Tenants**. From there, you can use the **Navigation** menu to view the details of another component. For example, you can navigate to the **Availability Zones** window from **Tenants** by clicking **Cloud Resources** > **Availability Zones**.

The **Intent** menu bar icon enables you to create a component from anywhere in the GUI. For example, to create a tenant while viewing the **Availability Zones** window, click the **Intent** icon. A dialog appears with a search box and a drop-down list. When you click the drop-down list and choose **Application Management**, a list of options, including the **Tenant** option, appears. When you click the **Tenant** option, the **Create Tenant** dialog appears displaying a group of fields that are required for creating the tenant.

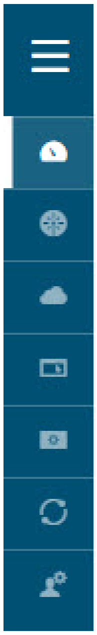
For more information about the GUI icons, see Understanding the Cisco Cloud APIC GUI Icons, on page 7

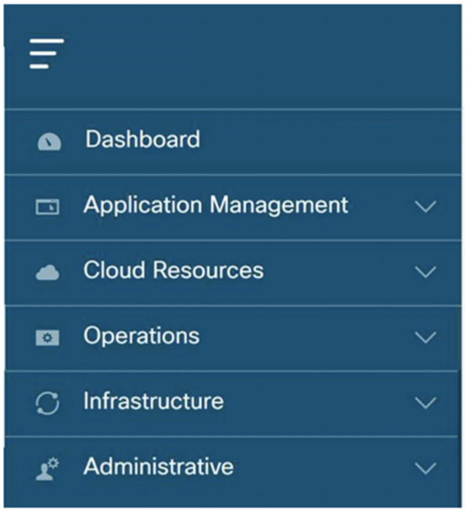
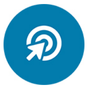
For more information about configuring Cisco Cloud APIC components, see Configuring Cisco Cloud APIC Components, on page 29

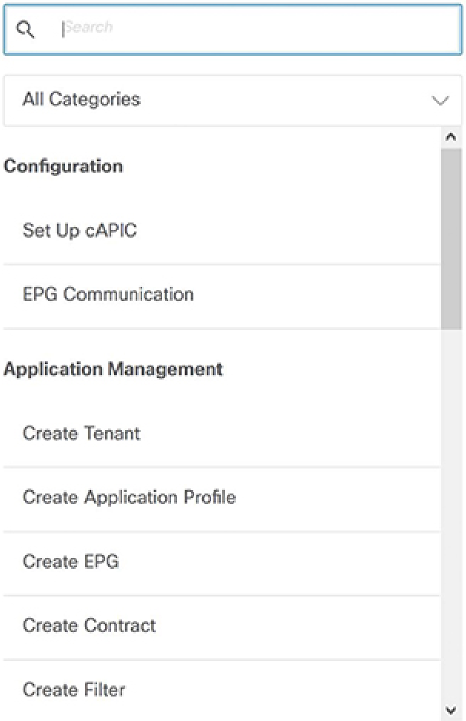
Understanding the Cisco Cloud APIC GUI Icons

This section provides a brief overview of the commonly used icons in the Cisco Cloud APIC GUI.

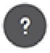
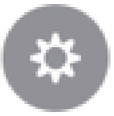
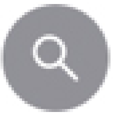
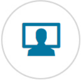
Table 4: Cisco Cloud APIC GUI Icons

Icon	Description
Figure 1: Navigation Pane (Collapsed) 	The left side of the GUI contains the **Navigation** pane, which collapses and expands. To expand the pane, hover your mouse icon over it or click the menu icon at the top. When you click the menu icon, the **Navigation** pane locks in the open position. To collapse it, click the menu icon again. When you expand the **Navigation** pane by hovering the mouse icon over the menu icon, you collapse the **Navigation** pane by moving the mouse icon away from it. When expanded, the **Navigation** pane displays a list of tabs. When clicked, each tab displays a set of subtabs that enable you to navigate between the Cisco Cloud APIC component windows.

Icon	Description
Figure 2: Navigation Pane (Expanded)  Dashboard Application Management Cloud Resources Operations Infrastructure Administrative	The Cisco Cloud APIC component windows are organized in the **Navigation** pane as follows: • **Dashboard** Tab—Displays summary information about the Cisco Cloud APIC components. • **Topology** Tab—Displays a topographical map of managed regions. • **Application Management** Tab—Displays information about tenants, application profiles, EPGs, contracts, filters, VRFs, service graphs, devices, and cloud context profiles. • **Cloud Resources** Tab—Displays information about regions, availability zones, VPCs, routers, security groups, endpoints, instances, and cloud services (and target groups). • **Operations** Tab—Displays information about event analytics, active sessions, backup & restore policies, tech support policies, firmware management, schedulers, and remote locations. • **Infrastructure** Tab—Displays information about the system configuration, inter-region connectivity, and on-premises connectivity. • **Administrative** Tab—Displays information about authentication, event analytics, security, local and remote users, and smart licensing. **Note** For more information about the contents of these tabs, see Viewing System Details, on page 89
Figure 3: Intent Menu-Bar Icon 	The **Intent** icon appears in the menu bar between the **search** and the **help** icons. When clicked, the **Intent** dialog appears (see below). The **Intent** dialog enables you to create a component from any window in the Cisco Cloud APIC GUI. When you create or view a component, a dialog box opens and hides the **Intent** icon. Close the dialog box to access the **Intent** icon again. For more information about creating a component, see Configuring Cisco Cloud APIC Components, on page 29.

Icon	Description
Figure 4: Intent (What do you want to do?) Dialog Box  Search All Categories Configuration Set Up cAPIC EPG Communication Application Management Create Tenant Create Application Profile Create EPG Create Contract Create Filter	

Icon	Description
	The **Intent** (What do you want to do?) dialog box contains a search box and a drop-down list. The drop-down list enables you to apply a filter for displaying specific options. The search box enables you to enter text for searching through the filtered list. • **All Categories** • **Configuration**—Displays the following options: • **Set Up cAPIC** • **EPG Communication** • **Application Management**—Displays the following options: • **Create Tenant** • **Create Application Profile** • **Create EPG** • **Create Contract** • **Create Filter** • **Create VRF** • **Create Device** • **Create Service Graph** • **Create Cloud Context Profile** • **Operations**—Displays the following options: • **Create Backup Configuration** • **Create Tech Support** • **Create Scheduler** • **Create Remote Location** • **Administrative**—Displays the following options: • **Create Login Domain** • **Create Provider** • **Create Security Domain** • **Create Role** • **Create RBAC Rule** • **Create Certificate Authority**

Icon	Description
	- **Create Key Ring** - **Create Local User**
Figure 5: Help Menu-Bar Icon 	The **help** menu-bar icon opens the *Cisco Cloud APIC Quick Start Guide* .
Figure 6: System Tools Menu-Bar Icon 	The **system tools** menu-bar icon provides the following options: - **About**—Display the Cisco Cloud APIC version. - **ObjectStore Browser**—Open the Managed Object Browser, or Visore, which is a utility that is built into Cisco Cloud APIC that provides a graphical view of the managed objects (MOs) using a browser.
Figure 7: Search Menu-Bar Icon 	The **search** menu-bar icon displays the search field, which enables you to to search for any object by name or any other distinctive fields.
Figure 8: User Profile Menu-Bar Icon 	The **user profile** menu-bar icon provides the following options: - **Change Password**—Enables you to change the password. - **Logout**—Enables you to log out of the GUI.

CHAPTER 3

Cisco Cloud APIC Policy Model

About the ACI Policy Model

The ACI policy model enables the specification of application requirements policies. The Cisco Cloud APIC automatically renders policies in the cloud infrastructure. When you or a process initiates an administrative change to an object in the cloud infrastructure, the Cisco Cloud APIC first applies that change to the policy model. This policy model change then triggers a change to the actual managed item. This approach is called a model-driven framework.

Policy Model Key Characteristics

Key characteristics of the policy model include the following:

- As a model-driven architecture, the software maintains a complete representation of the administrative and operational state of the system (the model). The model applies uniformly to cloud infrastructure, cloud infrastructure, services, system behaviors, and virtual devices attached to the network.
- The logical and concrete domains are separated; the logical configurations are rendered into concrete configurations by applying the policies in relation to the available resources. No configuration is carried out against concrete entities. Concrete entities are configured implicitly as a side effect of the changes to the Cisco Cloud policy model.

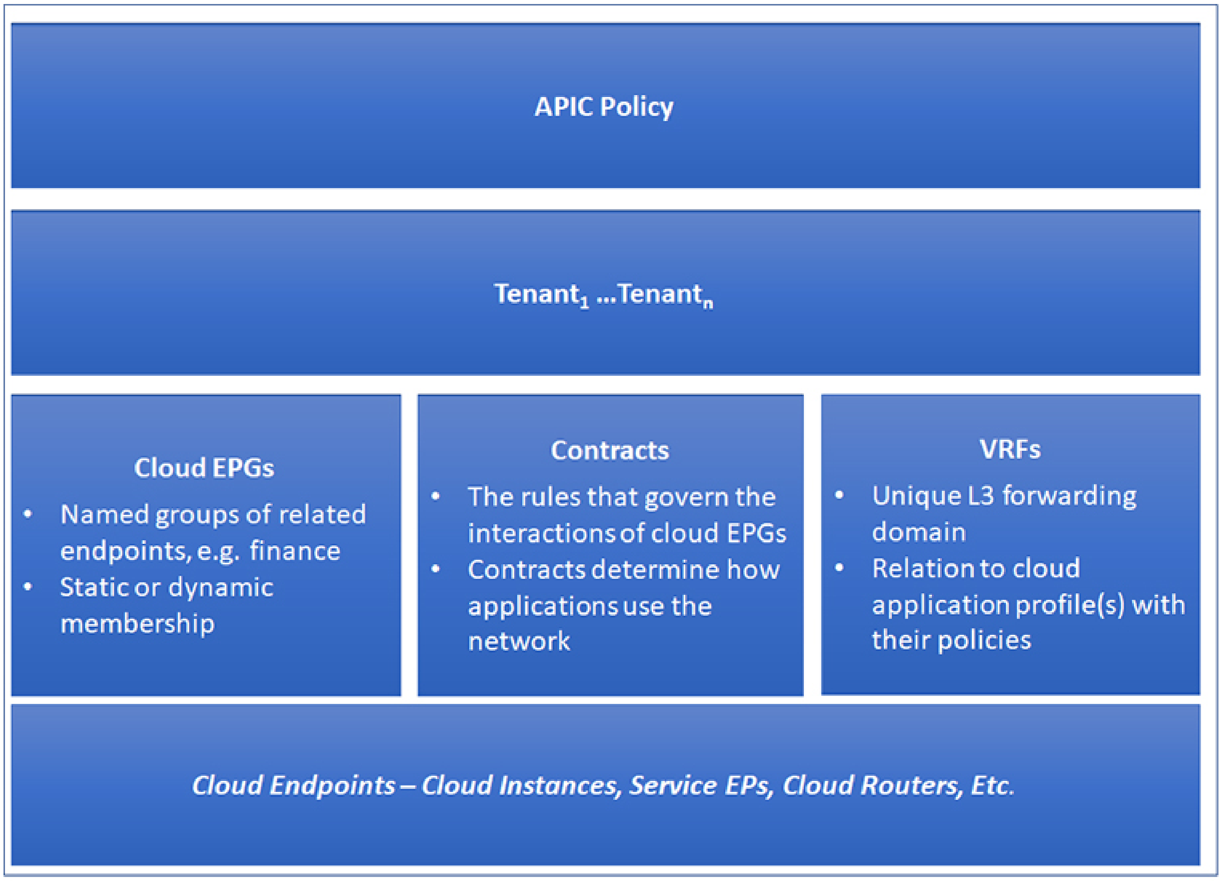
- The system prohibits communications with newly connected endpoints until the policy model is updated to include the new endpoint.
- Network administrators do not configure logical system resources directly. Instead, they define logical (hardware-independent) configurations and the Cisco Cloud APIC policies that control different aspects of the system behavior.

Managed object manipulation in the model relieves engineers from the task of administering isolated, individual component configurations. These characteristics enable automation and flexible workload provisioning that can locate any workload anywhere in the infrastructure. Network-attached services can be easily deployed, and the Cisco Cloud APIC provides an automation framework to manage the lifecycle of those network-attached services.

Logical Constructs

The policy model manages the entire cloud infrastructure, including the infrastructure, authentication, security, services, applications, cloud infrastructure, and diagnostics. Logical constructs in the policy model define how the cloud infrastructure meets the needs of any of the functions of the cloud infrastructure. The following figure provides an overview of the ACI policy model logical constructs.

Figure 9: ACI Policy Model Logical Constructs Overview


APIC Policy
Tenant_1 ...Tenant_n
Cloud EPGs
• Named groups of related endpoints, e.g. finance
• Static or dynamic membership
Contracts
• The rules that govern the interactions of cloud EPGs
• Contracts determine how applications use the network
VRFs
• Unique L3 forwarding domain
• Relation to cloud application profile(s) with their policies
Cloud Endpoints – Cloud Instances, Service EPs, Cloud Routers, Etc.

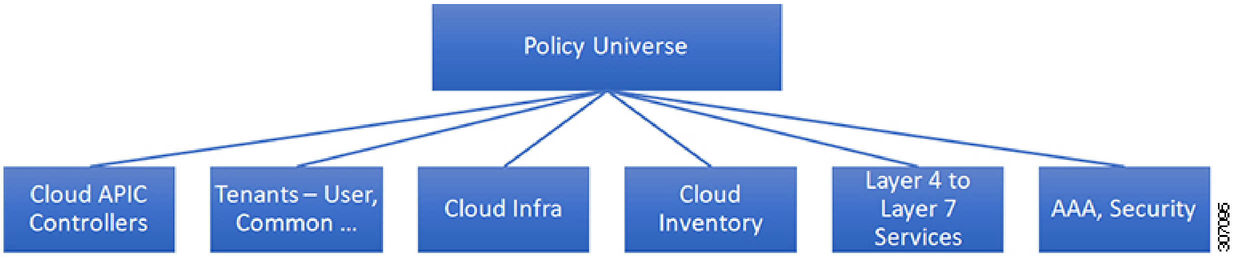
cloud infrastructure-wide or tenant administrators create predefined policies that contain application or shared resource requirements. These policies automate the provisioning of applications, network-attached services, security policies, and tenant subnets, which puts administrators in the position of approaching the resource pool in terms of applications rather than infrastructure building blocks. The application needs to drive the networking behavior, not the other way around.

The Cisco ACI Policy Management Information Model

The cloud infrastructure comprises the logical components as recorded in the Management Information Model (MIM), which can be represented in a hierarchical management information tree (MIT). The Cisco Cloud APIC runs processes that store and manage the information model. Similar to the OSI Common Management Information Protocol (CMIP) and other X.500 variants, the Cisco Cloud APIC enables the control of managed resources by presenting their manageable characteristics as object properties that can be inherited according to the location of the object within the hierarchical structure of the MIT.

Each node in the tree represents a managed object (MO) or group of objects. MOs are abstractions of cloud infrastructure resources. An MO can represent a concrete object, such as a cloud router, adapter, or a logical object, such as an application profile, cloud endpoint group, or fault. The following figure provides an overview of the MIT.

Figure 10: Cisco ACI Policy Management Information Model Overview



The hierarchical structure starts with the policy universe at the top (Root) and contains parent and child nodes. Each node in the tree is an MO and each object in the cloud infrastructure has a unique distinguished name (DN) that describes the object and locates its place in the tree.

The following managed objects contain the policies that govern the operation of the system:

- A tenant is a container for policies that enable an administrator to exercise role-based access control. The system provides the following four kinds of tenants:
  - The administrator defines user tenants according to the needs of users. They contain policies that govern the operation of resources such as applications, databases, web servers, network-attached storage, virtual machines, and so on.
  - Although the system provides the common tenant, it can be configured by the cloud infrastructure 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.

Note As of the Cisco Application Policy Infrastructure Controller (APIC) Release 4.1(1), the Cisco Cloud APIC only supports load balancers as a Layer 4 to Layer 7 service.

- The infrastructure tenant is provided by the system but can be configured by the cloud infrastructure administrator. It contains policies that govern the operation of infrastructure resources. It also enables a cloud infrastructure provider to selectively deploy resources to one or more user tenants. Infrastructure tenant policies are configurable by the cloud infrastructure administrator.

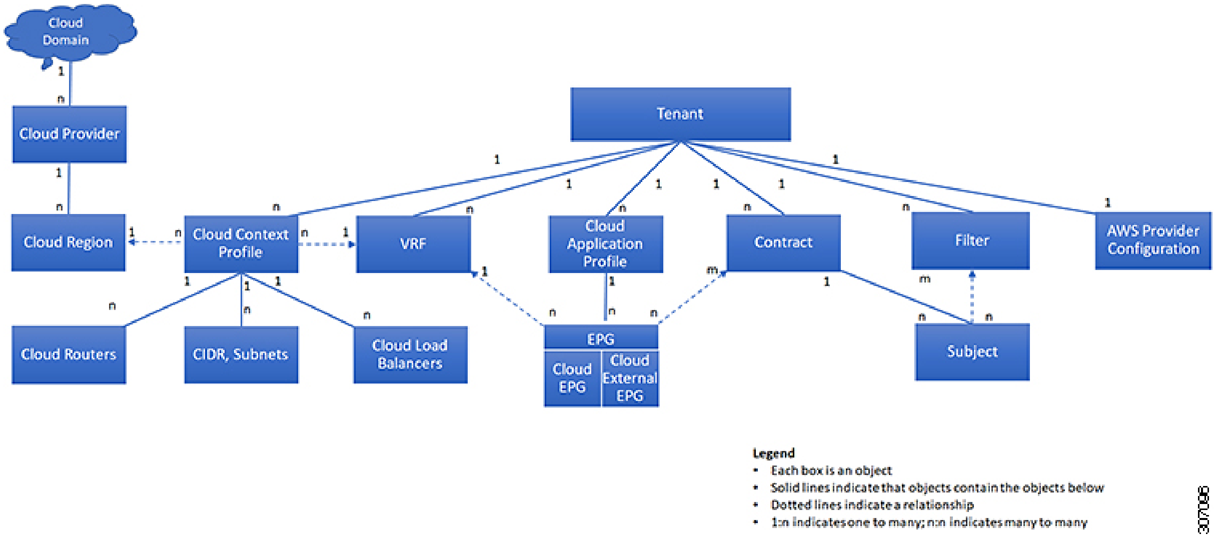
- The cloud infra policies enable you to manage on-premises and inter-region connectivity when setting up the Cisco Cloud APIC. For more information, see the *Cisco Cloud APIC Installation Guide*.
- Cloud inventory is a service that enables you to view different aspects of the system using the GUI. For example, you can view the regions that are deployed from the aspect of an application or the applications that are deployed from the aspect of a region. You can use this information for cloud resource planning and troubleshooting.
- Layer 4 to Layer 7 service integration lifecycle automation framework enables the system to dynamically respond when a service comes online or goes offline. For more information, see Deploying Layer 4 to Layer 7 Services, on page 99
- Access, authentication, and accounting (AAA) policies govern user privileges, roles, and security domains of the Cisco Cloud ACI cloud infrastructure. For more information, see Cisco Cloud APIC Security, on page 125

The hierarchical policy model fits well with the REST API interface. When invoked, the API reads from or writes to objects in the MIT. URLs map directly into distinguished names that identify objects in the MIT. Any data in the MIT can be described as a self-contained structured tree text document encoded in XML or JSON.

Tenants

A tenant (`fvTenant`) is a logical container for application policies that enable an administrator to exercise domain-based access control. A tenant represents a unit of isolation from a policy perspective, but it does not represent a private network. 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. The following figure provides an overview of the tenant portion of the management information tree (MIT).

Figure 11: Tenants



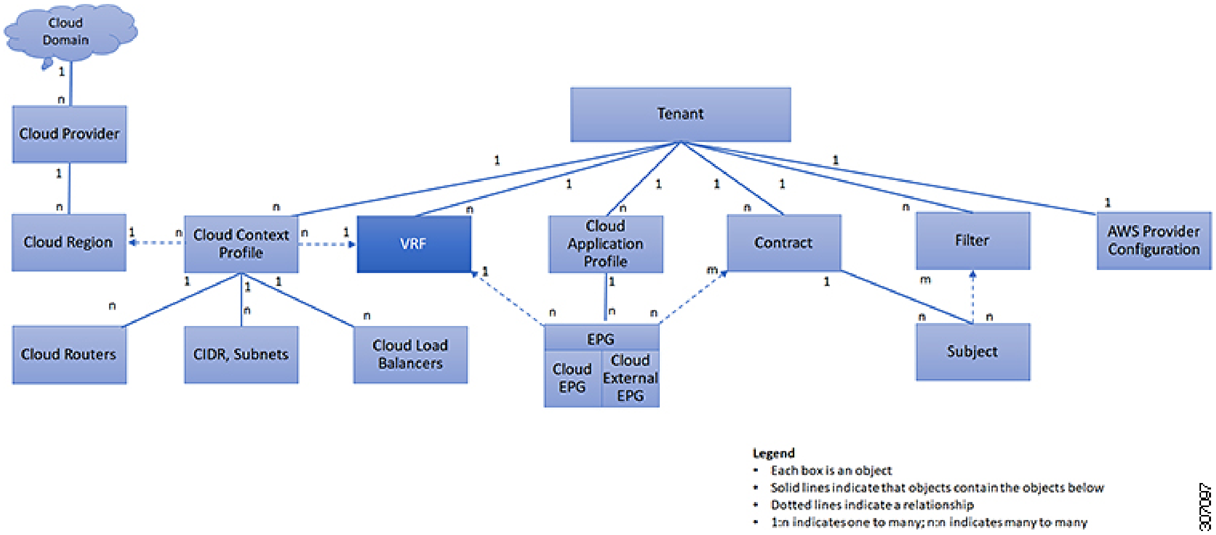
Tenants can be isolated from one another or can share resources. The primary elements that the tenant contains are filters, contracts, Virtual Routing and Forwarding (VRF) instances, cloud context profiles, AWS provider configurations, and cloud application profiles that contain cloud endpoint groups (cloud EPGs). Entities in the tenant inherit its policies. VRFs are also known as contexts; each VRF can be associated with multiple cloud context profiles. A cloud context profile in conjunction with a VRF and a region represents the AWS VPC in that region.

Tenants are logical containers for application policies. The cloud infrastructure can contain multiple tenants. You must configure a tenant before you can deploy any Layer 4 to Layer 7 services. The ACI cloud infrastructure supports IPv4 and dual-stack configurations for tenant networking.

VRFs

A Virtual Routing and Forwarding (VRF) object (`fvCtx`) or context is a tenant network (called a private network in the Cisco Cloud APIC GUI. A tenant can have multiple VRFs. A VRF is a unique Layer 3 forwarding and application policy domain. The following figure shows the location of VRFs in the management information tree (MIT) and their relation to other objects in the tenant.

Figure 12: VRFs

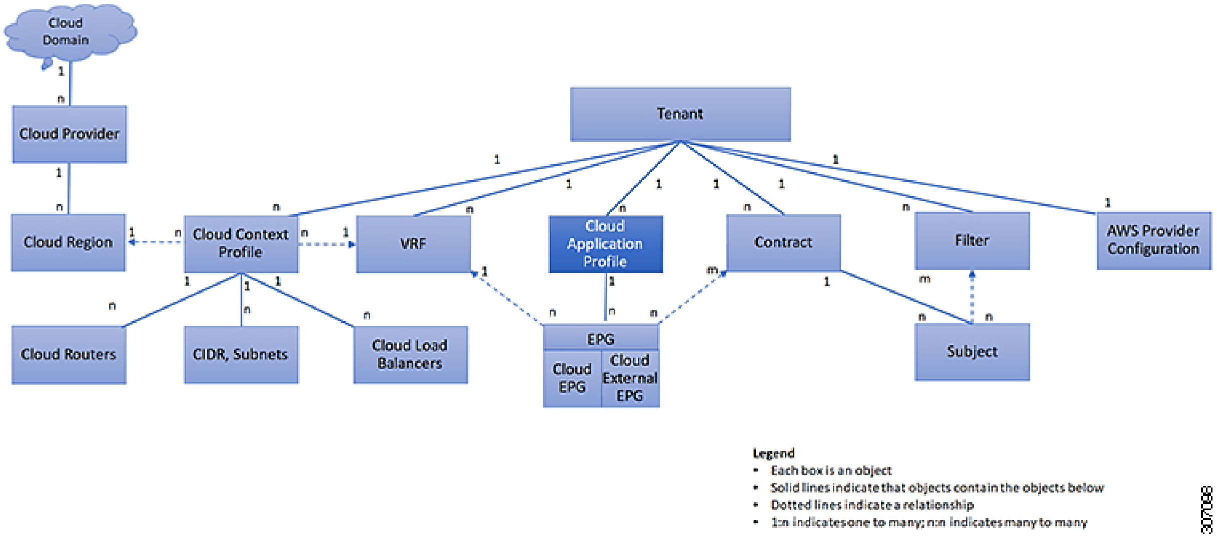


A VRF defines a Layer 3 address domain. One or more cloud context profiles are associated with a VRF. You can only associate one cloud context profile with a VRF in a given region. All the endpoints within the Layer 3 domain must have unique IP addresses because it is possible to forward packets directly between these devices if the policy allows it. A tenant can contain multiple VRFs. After an administrator creates a logical device, the administrator can create a VRF for the logical device, which provides a selection criteria policy for a device cluster. A logical device can be selected based on a contract name, a graph name, or the function node name inside the graph.

Cloud Application Profiles

A cloud application profile (`cloudAp`) defines the policies, services and relationships between cloud EPGs. The following figure shows the location of cloud application profiles in the management information tree (MIT) and their relation to other objects in the tenant.

Figure 13: Cloud Application Profiles



Legend
- Each box is an object
- Solid lines indicate that objects contain the objects below
- Dotted lines indicate a relationship
- 1:n indicates one to many; n:n indicates many to many

Cloud application profiles contain one or more cloud EPGs. Modern applications contain multiple components. For example, an e-commerce application could require a web server, a database server, data located in a storage service, and access to outside resources that enable financial transactions. The cloud application profile contains as many (or as few) cloud EPGs as necessary that are logically related to providing the capabilities of an application.

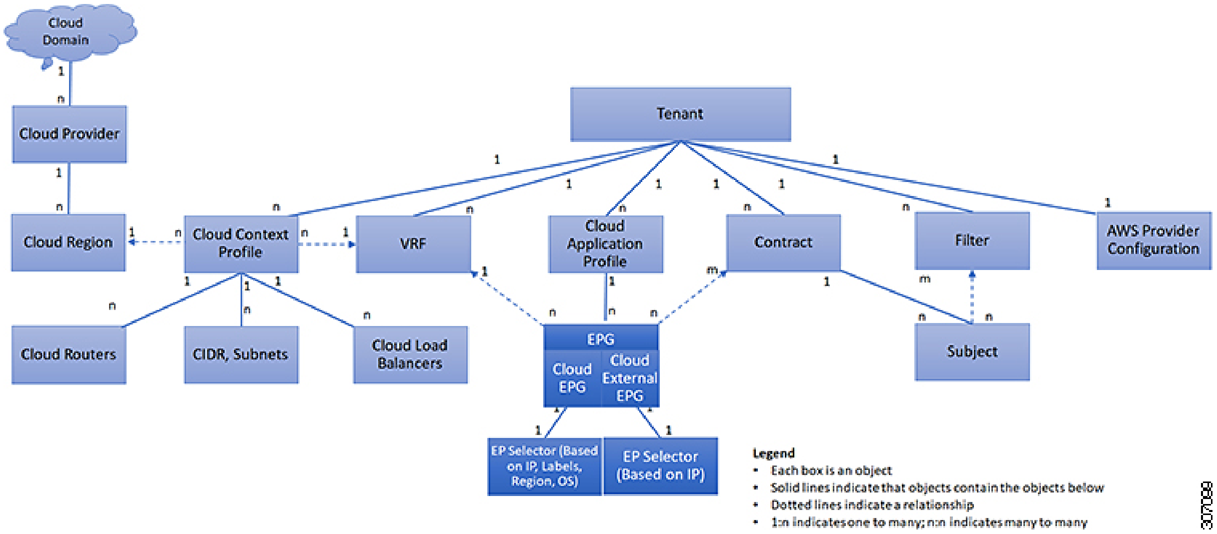
Cloud EPGs can be organized according to one of the following:

- The application they provide, such as a DNS server or SAP application (see *Tenant Policy Example* in *Cisco APIC REST API Configuration Guide*).
- 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 cloud infrastructure or tenant administrator chooses to use

Cloud Endpoint Groups

The cloud endpoint group (cloud EPG) is the most important object in the policy model. The following figure shows where application cloud EPGs are located in the management information tree (MIT) and their relation to other objects in the tenant.

Figure 14: Cloud Endpoint Groups


Cloud Domain
Cloud Provider
Tenant
Cloud Region
Cloud Context Profile
VRF
Cloud Application Profile
Contract
Filter
AWS Provider Configuration
Cloud Routers
CIDR, Subnets
Cloud Load Balancers
EPG
Cloud EPG
Cloud External EPG
Subject
EP Selector (Based on IP, Labels, Region, OS)
EP Selector (Based on IP)
Legend
• Each box is an object
• Solid lines indicate that objects contain the objects below
• Dotted lines indicate a relationship
• 1:n indicates one to many; n:n indicates many to many
307098

A cloud EPG is a managed object that is a named logical entity that contains a collection of endpoints. Endpoints are devices that are connected to the network directly or indirectly. They have an address (identity), a location, attributes (such as version or patch level), and are virtual. Knowing the address of an endpoint also enables access to all its other identity details. Cloud EPGs are fully decoupled from the physical and logical topology. Endpoint examples include servers, virtual machines, storage services, or clients on the Internet. Endpoint membership in a cloud EPG can be dynamic or static.

The ACI cloud infrastructure can contain the following types of cloud EPGs:

- Cloud endpoint group (`cloudEPg`)
- Cloud external endpoint group (`cloudExtEPg`)

Cloud EPGs contain endpoints that have common policy requirements such as security or Layer 4 to Layer 7 services. Rather than configure and manage endpoints individually, they are placed in a cloud EPG and are managed as a group.

Policies apply to cloud EPGs, never to individual endpoints.

Regardless of how a cloud EPG is configured, cloud EPG policies are applied to the endpoints they contain.

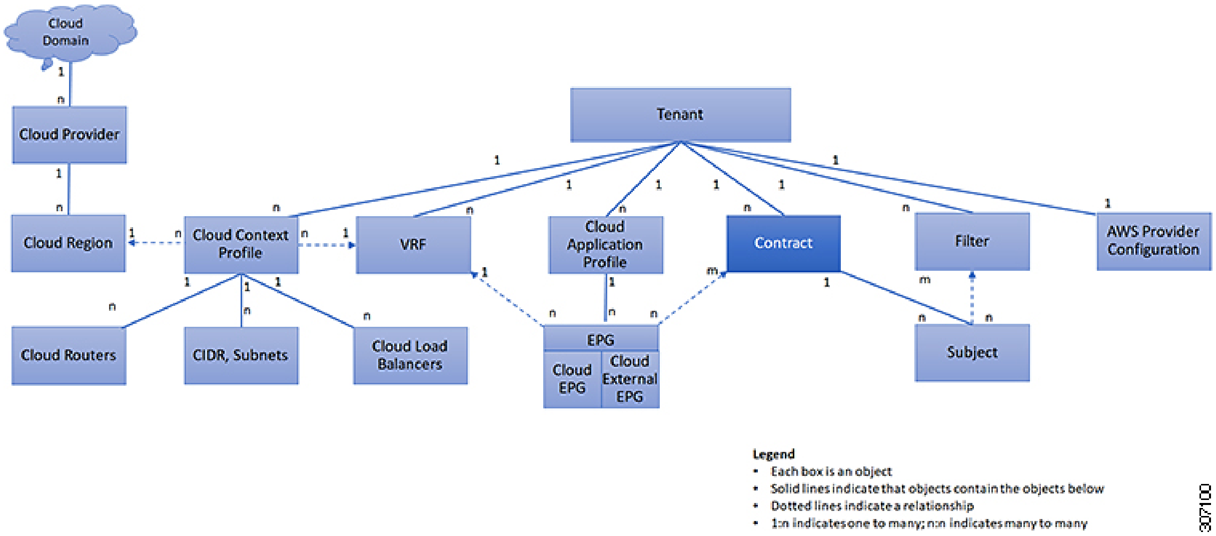
WAN router connectivity to the cloud infrastructure is an example of a configuration that uses a static cloud EPG. To configure WAN router connectivity to the cloud infrastructure, an administrator configures a `cloudExtEPg` cloud EPG that includes any endpoints within an associated WAN subnet. The cloud infrastructure learns of the cloud EPG endpoints through a discovery process as the endpoints progress through their connectivity life cycle. Upon learning of the endpoint, the cloud infrastructure applies the `cloudExtEPg` cloud EPG policies accordingly. For example, when a WAN connected client initiates a TCP session with a server within an application (`cloudEPg`) cloud EPG, the `cloudExtEPg` cloud EPG applies its policies to that client endpoint before the communication with the (`cloudExtEPg`) cloud EPG web server begins. When the client server TCP session ends, and communication between the client and server terminates, the WAN endpoint no longer exists in the cloud infrastructure.

The Cisco Cloud APIC uses endpoint selectors to assign endpoints to Cloud EPGs. The endpoint selector is essentially a set of rules that are run against the cloud instances that are assigned to the AWS VPC managed by Cisco ACI. Any endpoint selector rules that match endpoint instances assign that endpoint to the Cloud EPG. The endpoint selector is similar to the attribute-based microsegmentation available in Cisco ACI.

Contracts

In addition to cloud EPGs, contracts (`vzBrCP`) are key objects in the policy model. Cloud EPGs can only communicate with other cloud EPGs according to contract rules. The following figure shows the location of contracts in the management information tree (MIT) and their relation to other objects in the tenant.

Figure 15: Contracts



An administrator uses a contract to select one or more types of traffic that can pass between cloud 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; intra-EPG communication is always implicitly allowed.

Contracts govern the following types of cloud EPG communications:

- Between cloud EPGs (`cloudEPg`), both intra-tenant and inter-tenant

  Note In the case of a shared service mode, a contract is required for inter-tenant communication. A contract is used to specify static routes across VRFs, although the tenant VRF does not enforce a policy.

- Between cloud EPGs and cloud external EPGs (`cloudExtEPg`)

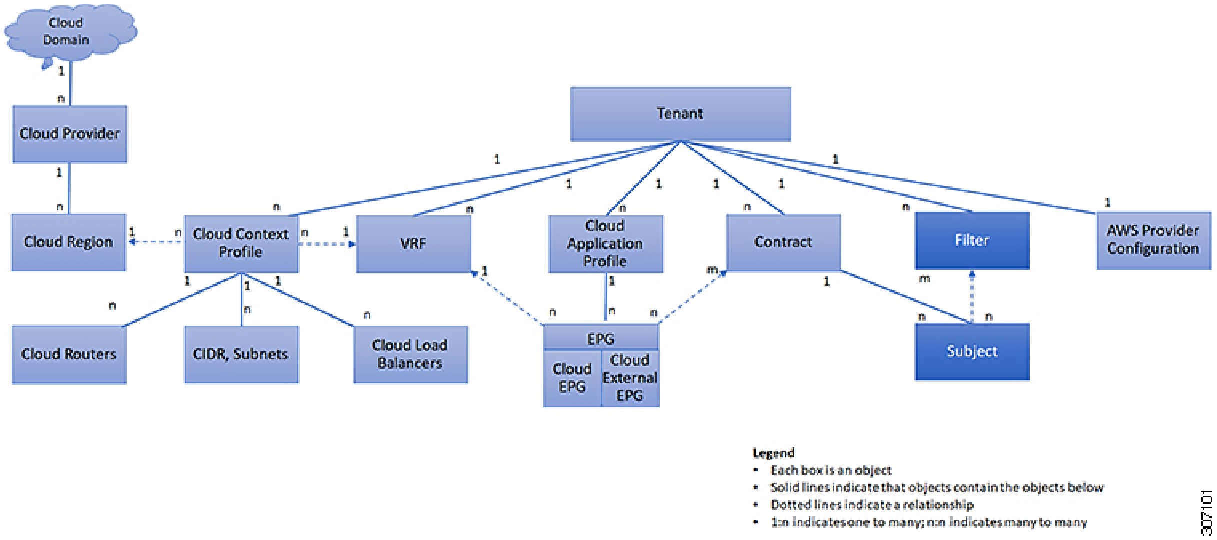
Contracts govern the communication between cloud EPGs that are labeled providers, consumers, or both. The relationship between a cloud EPG and a contract can be either a provider or consumer. When a cloud EPG provides a contract, communication with that cloud EPG can be initiated from other cloud EPGs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

Note A cloud EPG can both provide and consume the same contract. A cloud EPG can also provide and consume multiple contracts simultaneously.

Filters and Subjects Govern Cloud EPG Communications

Subject and filter managed-objects enable mixing and matching among cloud EPGs and contracts so as to satisfy various applications or service delivery requirements. The following figure shows the location of application subjects and filters in the management information tree (MIT) and their relation to other objects in the tenant.

Figure 16: Subjects and Filters



Contracts can contain multiple communication rules and multiple cloud EPGs can both consume and provide multiple contracts. A policy designer can compactly represent complex communication policies and re-use these policies across multiple instances of an application.

Note Subjects are hidden in Cisco Cloud APIC and not configurable. For rules installed in AWS, source port provided in the filter entry s not taken into account.

Subjects and filters define cloud EPG communications according to the following options:

- Filters are Layer 2 to Layer 4 fields, TCP/IP header fields such as Layer 3 protocol type, Layer 4 ports, and so forth. According to its related contract, a cloud EPG provider dictates the protocols and ports in both the in and out directions. Contract subjects contain associations to the filters (and their directions) that are applied between cloud EPGs that produce and consume the contract.

Note When a contract filter match type is `All`, best practice is to use the VRF unenforced mode. Under certain circumstances, failure to follow these guidelines results in the contract not allowing traffic among cloud EPGs in the VRF.

- Subjects are contained in contracts. One or more subjects within a contract use filters to specify the type of traffic that can be communicated and how it occurs. For example, for HTTPS messages, the subject specifies the direction and the filters that specify the IP address type (for example, IPv4), the HTTP protocol, and the ports allowed. Subjects determine if filters are unidirectional or bidirectional. A unidirectional filter is used in one direction. Unidirectional filters define in or out communications but not the same for both. Bidirectional filters are the same for both; they define both in and out communications.

Note For rules that are installed in AWS, the source port provided in the filter entry is not taken into account.

- ACI contracts rendered in AWS constructs are always stateful, allowing return traffic.

About the Cloud Template

The cloud template provides a template that configures and manages the Cisco Cloud APIC infra network. The template requires only the most essential elements for the configuration. From these elements, the cloud template generates a detailed configuration necessary for setting up the Cisco Cloud APIC infra network. However, it is not a one-time configuration generation—it is possible to add, modify, or remove elements of the template input. The cloud template updates the resulting configuration accordingly.

One of the central things in the AWS network configuration is the Virtual Private Cloud (VPC). AWS supports many regions worldwide and one VPC is specific to one region.

The cloud template accepts one or more region names and generates the entire configuration for the infra VPCs in those regions. They are the infra VPCs. The Cisco Cloud APIC-managed object (MO) corresponding to the AWS VPC is `cloudCtxProfile`. For every region specified in the cloud template, it generates the `cloudCtxProfile` configuration. A `cloudCtxProfile` is the topmost MO for all the configuration corresponding to a region. Underneath, it has many of other MOs organized as a tree to capture a specific configuration. A `cloudCtxProfile` MO generated by the cloud template carries `ctxProfileOwner == SYSTEM`. For the non-infra network, it is possible to configure `cloudCtxProfile` directly; in this case, `cloudCtxProfile` carries `ctxProfileOwner == USER`.

A primary property of an AWS VPC is the CIDR. Every region needs a unique CIDR. In Cisco Cloud APIC, you can provide the CIDRs for the infra VPCs. The CIDRs for the first two regions come from the Cloud Formation Template (CFT) that deploys the Cisco Cloud APIC AMI on the AWS. The `cloudApicSubnetPool` MO provides CIDRs for the additional regions directly to the Cisco Cloud APIC. In the Cisco Cloud APIC configuration, the `cloudCidr` MO, which is a child of `cloudCtxProfile`, models the CIDR.

The cloud template generates and manages a huge number of MOs in the `cloudCtxProfile` subtree including, but not limited to, the following:

- Subnets
- Association of subnets to AWS availability zones
- Cloud routers
- IP address allocation for the cloud router interfaces
- IP address allocation and configuration for tunnels
- IP address allocation and configuration for loopbacks

Without the cloud template, you would be responsible for configuring and managing these.

The *Cisco Cloud Template MO* table contains a brief summary of the inputs (MOs) to the cloud template.

Table 5: Cloud Template MOs

MO	Purpose
`cloudtemplateInfraNetwork`	The root of the cloud template configuration. Attributes include: `numRoutersPerRegion`—The number of cloud routers for each `cloudRegionName` specified under `cloudtemplateIntNetwork`.
`cloudtemplateProfile`	Configuration profile for all the cloud routers. Attributes include: • `routerUsername` • `routerPassword` • `routerThroughput`
`cloudtemplateIntNetwork`	Contains a list of regions, which specify where you deploy the cloud routers. Each region is captured through a `cloudRegionName` child MO
`cloudtemplateExtNetwork`	Contains infra network configuration input that is external of the cloud. Contains a list of regions where cloud routers are configured for external networking. Each region is captured through a `cloudRegionName` child MO
`cloudtemplateVpnNetwork`	Contains information for setting up a VPN with an ACI on-premises site or another Cisco Cloud APIC site.
`cloudtemplateIpSecTunnel`	Captures the IP address of the IPSec peer in the ACI on-premises site.
`cloudtemplateOspf`	Captures the OSPF area to be used for the VPN connections.

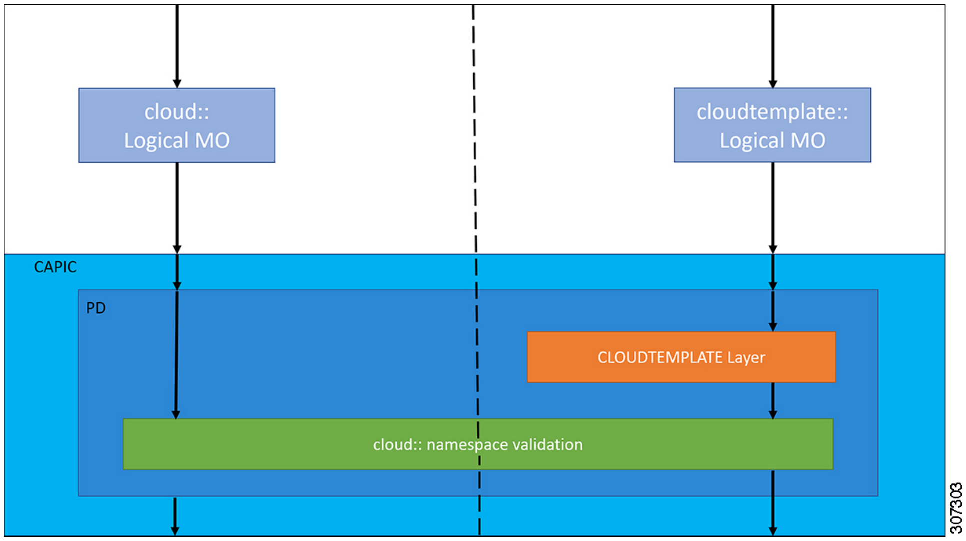
MO	Purpose
`cloudtemplateBgpEvpn`	Captures the peer IP address, ASN, and so forth, for setting up the BGP session with the on-premises site.

In Cisco Cloud APIC, the layering of MOs is slightly different from a regular Cisco APIC due to the cloud template. In a regular Cisco APIC, you post logical MOs that go through two layers of translation:

1. Logical MO to resolved MO
2. Resolved MO to concrete MO

In Cisco Cloud APIC, there is an additional layer of translation for the infra network. This additional layer is where the cloud template translates logical MOs in the `cloudtemplate` namespace to logical MOs in the cloud namespace. For configurations outside of the infra network, you post logical MOs in the cloud namespace. In this case, the MOs go through the usual two-layer translation as in the regular Cisco APIC.

Figure 17: Cloud and Cloud Template MO Conversion



Note For information about configuring the cloud template, see Configuring Cisco Cloud APIC Components, on page 29

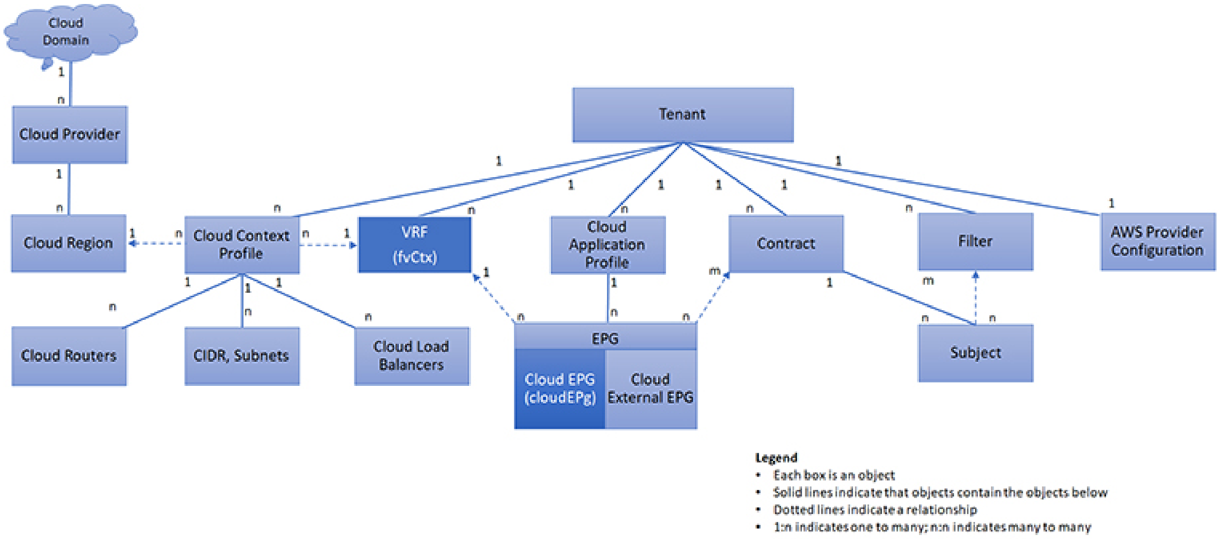
Managed Object Relations and Policy Resolution

Relationship-managed objects express the relation between managed object instances that do not share containment (parent-child) relations. MO relations are established between the source MO and a target MO in one of the following two ways:

- An explicit relation, such as with `cloudRsZoneAttach` and `cloudRsCloudEPgCtx`, defines a relationship that is based on the target MO distinguished name (DN).
- A named relation defines a relationship that is based on the target MO name.

The dotted lines in the following figure show several common MO relations.

Figure 18: MO Relations



For example, the dotted line between the cloud EPG and the VRF defines the relation between those two MOs. In this figure, the cloud EPG (`cloudEPg`) contains a relationship MO (`cloudRsCloudEPgCtx`) that is named with the name of the target VRF MO (`fvCtx`). For example, if production is the VRF name (`fvCtx.name=production`), then the relation name is production (`cloudRsCloudEPgCtx.tnFvCtxName=production`).

In the case of policy resolution based on named relations, if a target MO with a matching name is not found in the current tenant, the ACI cloud infrastructure tries to resolve in the common tenant. For example, if the user tenant cloud EPG contained a relationship MO targeted to a VRF that did not exist in the tenant, the system tries to resolve the relationship in the common tenant. If a named relation cannot be resolved in either the current tenant or the common tenant, the ACI cloud infrastructure attempts to resolve to a default policy. If a default policy exists in the current tenant, it is used. If it does not exist, the ACI cloud infrastructure looks for a default policy in the common tenant. Cloud context profile, VRF, and contract (security policy) named relations do not resolve to a default.

Default Policies

Warning Default policies can be modified or deleted. Deleting a default policy can result in a policy resolution process to complete abnormally.

The ACI cloud infrastructure includes default policies for many of its core functions. Examples of default policies include the following:

- Cloud AWS provider (for the infra tenant)
- Monitoring and statistics

Note To avoid confusion when implementing configurations that use default policies, document changes made to default policies. Be sure that there are no current or future configurations that rely on a default policy before deleting a default policy. For example, deleting a default firmware update policy could result in a problematic future firmware update.

A default policy serves multiple purposes:

- Allows a cloud infrastructure administrator to override the default values in the model.
- If an administrator does not provide an explicit policy, the Cisco CloudAPIC applies the default policy. An administrator can create a default policy and the Cisco Cloud APIC uses that unless the administrator provides any explicit policy.

The following scenarios describe common policy resolution behavior:

- A configuration explicitly refers to the default policy: if a default policy exists in the current tenant, it is used. Otherwise, the default policy in tenant **common** is used.
- A configuration refers to a named policy (not default) that does not exist in the current tenant or in tenant common: if the current tenant has a default policy, it is used. Otherwise, the default policy in tenant **common** is used.

  Note The scenario above does not apply to a VRF in a tenant.

- A configuration does not refer to any policy name: if a default policy exists in the current tenant, it is used. Otherwise, the default policy in tenant **common** is used.

The policy model specifies that an object is using another policy by having a relation-managed object (MO) under that object and that relation MO refers to the target policy by name. If this relation does not explicitly refer to a policy by name, then the system tries to resolve a policy that is called default. Cloud context profiles and VRFs are exceptions to this rule.

Shared Services

Cloud EPGs in one tenant can communicate with cloud EPGs in another tenant through a contract interface that is contained in a shared tenant. Within the same tenant, a cloud EPG in one VRF can communicate with another cloud EPG in another VRF through a contract defined in the tenant. The contract interface is an MO that can be used as a contract consumption interface by the cloud EPGs that are contained in different tenants. By associating to an interface, a cloud EPG consumes the subjects that are represented by the interface to a contract contained in the shared tenant. Tenants can participate in a single contract, which is defined at some third place. More strict security requirements can be satisfied by defining the tenants, contract, subjects, and filter directions so that tenants remain isolated from one another.

Follow these guidelines when configuring shared services contracts:

- A shared service is supported only with non-overlapping and non-duplicate CIDR subnets. When configuring CIDR subnets for shared services, follow these guidelines:
  - CIDR subnets leaked from one VRF to another must be disjointed and must not overlap.

- CIDR subnets advertised from multiple consumer networks into a VRF or vice versa must be disjointed and must not overlap.

CHAPTER 4

Configuring Cisco Cloud APIC Components

About Configuring the Cisco Cloud APIC

You create the Cisco Cloud APIC components using either the Cisco Cloud APIC GUI or the REST API. This section explains how to create configuration, application management, operations, and administrative components.

Note

- For information about configuring a load balancer and service graph, see Deploying Layer 4 to Layer 7 Services, on page 99.
- For information about the GUI, such as navigation and a list of configurable components, see About the Cisco Cloud APIC GUI, on page 6.

Configuring the Cisco Cloud APIC Using the GUI

Creating a Tenant Using the Cisco Cloud APIC GUI For Release 4.2(2) and Earlier

This section explains how to create a tenant using the Cisco Cloud APIC GUI.

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

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

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

Step 3 From the **Application Management** list in the **Intent** menu, click **Create Tenant**. The **Create Tenant** dialog box appears.

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

Table 6: Create Tenant Dialog Box Fields

Properties	Description
Name	Enter the name of the tenant.
Description	Enter a description of the tenant.
Settings	
Add Security Domain	To add a security domain: **a.** Click **Add Security Domain**. The **Select Security Domains** dialog appears with a list of security domains in the left pane. **b.** Click to choose a security domain. **c.** Click **Select** to add the security domain to the tenant.
Trusted Tenant	Click to check (default) or uncheck the **Enabled** check box. **Trusted Tenant** is enabled when checked.
Cloud Account ID	Enter the cloud account ID.

Step 5 Click **Save** when finished.

Creating a Tenant Using the Cisco Cloud APIC GUI For Release 4.2(3) and Later

This section explains how to create a tenant using the Cisco Cloud APIC GUI.

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

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

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

Step 3 From the **Application Management** list in the **Intent** menu, click **Create Tenant**. The **Create Tenant** dialog box appears.

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

Table 7: Create Tenant Dialog Box Fields

Properties	Description
Name	Enter the name of the tenant.
Description	Enter a description of the tenant.
Settings	

Properties	Description
Add Security Domain	To add a security domain: **a.** Click **Add Security Domain**. The **Select Security Domains** dialog appears with a list of security domains in the left pane. **b.** Click to choose a security domain. **c.** Click **Select** to add the security domain to the tenant.
AWS Account ID	Enter the cloud account ID.
Access Type	Click to enable the tenant type: • **Untrusted** • **Trusted** • **Organization**

Step 5 Click **Save** when finished.

Configure a Tenant AWS Provider For Release 4.2(2) and Earlier

Before you begin

- AWS Provider is auto-configured for Infra tenant. You do not need to do anything to configure the AWS provider for the infra tenant.
- For all non-infra tenants, the AWS provider is configured either as a trusted tenant or as untrusted tenant. Our recommendation is to use trusted tenants because managing credentials is not easy. Also, each tenant must be in a separate AWS account. Sharing the same AWS account for multiple tenants is not allowed.

  For a trusted tenant, establish the trust relationship first with the account in which Cisco Cloud APIC is deployed (the account for the infra tenant). To establish the trust relation and give all the required permissions to the Cisco Cloud APIC for accessing the tenant account, run the tenant role cloud-formation template in the tenant account. This template is available as a tenant-cft.json object in the S3 bucket that is named capic-common-[capicAccountId]-data in the infra tenant’s AWS account. For security reasons, public access to this S3 bucket is not allowed, so the S3 bucket owner needs to download this file and use it in the tenant account.
- Untrusted tenants - use the account access and secret keys. The access and secret keys being used must be for an IAM user having these permissions at a minimum. The IAM role created must be named `ApicTenantRole`.

  Note Cloud APIC does not disturb AWS resources created by other applications or users. It only manages the AWS resources created by itself.

```
{
    "Version": "2012-10-17",
    "Statement": [
       {
            "Action": [
                "ec2:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "s3:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "events:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "logs:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "cloudtrail:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "cloudwatch:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "resource-groups:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "sqs:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": "elasticloadbalancing:*",
            "Resource": "*",
           "Effect": "Allow"
        }, {
            "Action": [
                "config:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": "iam:PassRole",
            "Resource": "arn:aws:iam::<account-id>:role/ApicTenantRole",
            "Effect": "Allow"
        }
    ]
}
```

- Add trust relationship:

```
 {
    "Version": "2012-10-17",
    "Statement": [
       {
            "Effect": "Allow",
            "Principal": {
                "Service": "vpc-flow-logs.amazonaws.com",
                "AWS": "arn:aws:iam::<account-d>:root"
            },
            "Action": "sts:AssumeRole"
       }
    ]
}
```

- Cloud APIC enforces ownership checks to prevent deployment of policies in the same tenant-region combination done either intentionally or by mistake. For example, assume that Cloud APIC is deployed in AWS account IA1 in region R1. Now you want to deploy a tenant TA1 in region R2. This tenant deployment i.e. account-region combination TA1-R2 is now owned by IA1-R1. If another Cloud APIC attempts to manage the same tenant-region combination later (say Capic2 in AWS account IA2 deployed in region R3), this will not be allowed because the current owner for the deployment TA1-R2 is IA1-R1. In other words, only one account in one region can be managed by one Cloud APIC. Example below shows some valid and wrong deployment combinations.

```
Capic1:
IA1-R1: TA1-R1 - ok
        TA1-R2 - ok

Capic2:
IA1-R2: TA1-R1 - not allowed
        TA1-R3 - ok

Capic3:
IA2-R1: TA1-R1 - not allowed
        TA1-R4 - ok
        TA2-R4 - ok
```

- Ownership enforcement is done using AWS Resource Groups. When a new tenant in account TA1 in region R2 is managed by Cloud APIC, a Resource Group CAPIC_TA1_R2 (e.g. CAPIC_123456789012_us-east-2) is created in the tenant account. This Resource Group has a resource tag AciOwnerTag with value IA1_R1_TA1_R2, assuming it was managed by Cloud APIC in account IA1 and deployed in region R1. If the AciOwnerTag mismatch happens, tenant-region management is aborted.

  Here is a summary of AciOwnerTag mismatch cases:

  - Initially Cloud APIC is installed in an account, and then taken down and Cloud APIC is installed in a different account. All existing tenant-region deployment will fail.

  - Another Cloud APIC is managing the same tenant-region.

  In ownership mismatch cases, **retry** (to setup tenant-region again) is not currently supported. As a workaround, if you are certain that no other Cloud APIC is managing the same tenant-region combination, logon to the tenant's AWS account and manually remove the affected Resource Group (e.g. CAPIC_123456789012_us-east-2). Next, reload Cloud APIC or delete and add the tenant again.

Step 1 In the Cloud APIC, configure the AWS Provider.

a) On the **Intent** menu, choose **Tenants** > ***tenant_name*** from the drop-down.

b) In the **Intent** pane, choose **Application Management** > ***tenant_name*** .

Step 2 Perform the following actions:

a) Confirm there is a check in the **Trusted** Tenant checkbox.

The AWS account must be a Trusted account for the user tenant using the cloud.

b) In the **Cloud Account ID** field, provide the Cloud account ID.

c) Run the tenant role cloud-formation template available at the URL https://capic-common-<infraAccountId>-data.s3.amazonaws.com/tenant-cft.json which is in a s3 bucket in the infra tenant’s AWS account.

Note Alternatively, keep the trusted flag unchecked and provide the access and secret keys as done normally for any tenant.

Step 3 Click **Save**.

Configuring a Tenant AWS Provider For Release 4.2(3) and Later

Before you begin

- AWS Provider is auto-configured for Infra tenant. You do not need to do anything to configure the AWS provider for the infra tenant.
- For all non-infra tenants, the AWS provider is configured either as a trusted tenant, untrusted tenant, or organization tenant. Our recommendation is to use trusted tenants because managing credentials is not easy. Also, each tenant must be in a separate AWS account. Sharing the same AWS account for multiple tenants is not allowed.

  For a trusted tenant, establish the trust relationship first with the account in which Cisco Cloud APIC is deployed (the account for the infra tenant). To establish the trust relation and give all the required permissions to the Cisco Cloud APIC for accessing the tenant account, first create a tenant and assign the Trusted tag to that tenant as the Access Type. Then, bring up that new trusted tenant again by clicking on the tenant name in the Tenants page, and in the AWS Account area in the tenant window, click the Run the CloudFormation template link.
- Organization tenants are for adding tenant accounts that are part of the organization. This requires deploying the Cisco Cloud APIC in the master account of the organization.
- Untrusted tenants use the account access and secret keys. The access and secret keys being used must be for an IAM user having these permissions at a minimum. The IAM role created must be named `ApicTenantRole`.

  Note Cloud APIC does not disturb AWS resources created by other applications or users. It only manages the AWS resources created by itself.

```
{
    "Version": "2012-10-17",
    "Statement": [
       {
            "Action": [
                "ec2:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "s3:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "events:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "logs:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "cloudtrail:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "cloudwatch:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "resource-groups:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "sqs:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": "elasticloadbalancing:*",
            "Resource": "*",
           "Effect": "Allow"
        }, {
            "Action": [
                "config:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": "iam:PassRole",
            "Resource": "arn:aws:iam::<account-id>:role/ApicTenantRole",
            "Effect": "Allow"
        }
    ]
}
```

- Add trust relationship:

```
 {
    "Version": "2012-10-17",
    "Statement": [
       {
            "Effect": "Allow",
            "Principal": {
                "Service": "vpc-flow-logs.amazonaws.com",
                "AWS": "arn:aws:iam::<infra-account-id>:root"
            },
            "Action": "sts:AssumeRole"
       }
    ]
}
```

- The Cloud APIC uses the OrganizationAccountAccessRole IAM role to manage policies for AWS Organization tenants.
    - If you created an AWS account within the existing organization in the master account, the OrganizationAccountAccessRole IAM role is automatically assigned to that created AWS account. You do not have to manually configure the OrganizationAccountAccessRole IAM role in AWS in this case.
    - If the master account invited an existing AWS account to join the organization, then you must manually configure the OrganizationAccountAccessRole IAM role in AWS. Configure the OrganizationAccountAccessRole IAM role in AWS for the organization tenant and verify that it has Cloud APIC-related permissions available.

      The OrganizationAccountAccessRole IAM role, together with the SCP (Service Control Policy) used for the organization or the account, must have the minimum permissions that are required by the Cloud APIC to manage policies for the tenants. The access policy requirement is the same as the requirement for the trusted or untrusted tenants.

```
{
    "Version": "2012-10-17",
    "Statement": [
       {
            "Action": [
                "ec2:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "s3:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "events:*"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }, {
            "Action": [
                "logs:*"
                ],
                "Resource": "*",
                "Effect": "Allow"
            }, {
                "Action": [
                    "cloudtrail:*"
                ],
                "Resource": "*",
                "Effect": "Allow"
            }, {
                "Action": [
                    "cloudwatch:*"
                ],
                "Resource": "*",
                "Effect": "Allow"
            }, {
                "Action": [
                    "resource-groups:*"
                ],
                "Resource": "*",
                "Effect": "Allow"
            }, {
                "Action": [
                    "sqs:*"
                ],
                "Resource": "*",
                "Effect": "Allow"
            }, {
                "Action": "elasticloadbalancing:*",
                "Resource": "*",
               "Effect": "Allow"
            }, {
                "Action": [
                    "config:*"
                ],
                "Resource": "*",
                "Effect": "Allow"
            }, {
               "Action": "iam:PassRole",
               "Resource": "*",
               "Effect": "Allow"
              }

        ]
    }
```

To add a trust relationship for an Organization tenant:

```
{
   "Version": "2012-10-17",
   "Statement": [
      {
           "Effect": "Allow",
           "Principal": {
               "Service": "vpc-flow-logs.amazonaws.com",
               "AWS": "arn:aws:iam::<infra-account-id>:root"
           },
           "Action": "sts:AssumeRole"
      }
   ]
}
```

- Cloud APIC enforces ownership checks to prevent deployment of policies in the same tenant-region combination done either intentionally or by mistake. For example, assume that Cloud APIC is deployed in AWS account IA1 in region R1. Now you want to deploy a tenant TA1 in region R2. This tenant deployment i.e. account-region combination TA1-R2 is now owned by IA1-R1. If another Cloud APIC attempts to manage the same tenant-region combination later (say Capic2 in AWS account IA2 deployed in region R3), this will not be allowed because the current owner for the deployment TA1-R2 is IA1-R1. In other words, only one account in one region can be managed by one Cloud APIC. Example below shows some valid and wrong deployment combinations.

```
Capic1:
IA1-R1: TA1-R1 - ok
        TA1-R2 - ok

Capic2:
IA1-R2: TA1-R1 - not allowed
        TA1-R3 - ok

Capic3:
IA2-R1: TA1-R1 - not allowed
        TA1-R4 - ok
        TA2-R4 - ok
```

- Ownership enforcement is done using AWS Resource Groups. When a new tenant in account TA1 in region R2 is managed by Cloud APIC, a Resource Group CAPIC_TA1_R2 (e.g. CAPIC_123456789012_us-east-2) is created in the tenant account. This Resource Group has a resource tag AciOwnerTag with value IA1_R1_TA1_R2, assuming it was managed by Cloud APIC in account IA1 and deployed in region R1. If the AciOwnerTag mismatch happens, tenant-region management is aborted.

  Here is a summary of AciOwnerTag mismatch cases:

  - Initially Cloud APIC is installed in an account, and then taken down and Cloud APIC is installed in a different account. All existing tenant-region deployment will fail.
  - Another Cloud APIC is managing the same tenant-region.

  In ownership mismatch cases, **retry** (to setup tenant-region again) is not currently supported. As a workaround, if you are certain that no other Cloud APIC is managing the same tenant-region combination, logon to the tenant's AWS account and manually remove the affected Resource Group (e.g. CAPIC_123456789012_us-east-2). Next, reload Cloud APIC or delete and add the tenant again.

Step 1 In the Cloud APIC, configure the AWS Provider.

a) On the **Intent** menu, choose **Tenants** > ***tenant_name*** from the drop-down.
b) In the **Intent** pane, choose **Application Management** > ***tenant_name*** .

Step 2 Perform the following actions:

a) In the **AWS Account ID** field, provide the cloud account ID.
b) In the **Access Type** area, choose **Trusted**.

   The AWS account must be a Trusted account for the user tenant that is using the cloud.

c) Click **Save**.
d) Bring up the new trusted tenant again by clicking on the tenant name in the **Tenants** page.

   In the **AWS Account** area in the tenant **Overview** page, you will see the following message: "In order to deploy any configuration from this tenant, you must create a trusted role in the tenant AWS account which will establish trust with the AWS infra account. To do so, open the link below to run the CloudFormation template."

e) Click the **Run the CloudFormation** template link.

This returns you to the AWS sign in page, which should be pre-populated with the necessary AWS account information that you entered earlier in these procedures in the Cloud APIC GUI.

f) Click **Next** in the AWS sign in page after verifying that the sign-in information is correct.

g) Run the tenant role cloud-formation template in the tenant account.

Note Alternatively, keep the trusted flag unchecked and provide the access and secret keys as done normally for any tenant.

Step 3 Click **Save**.

Creating an Application Profile Using the Cisco Cloud APIC GUI

This section explains how to create an application profile using the Cisco Cloud APIC GUI.

Before you begin

Create a tenant.

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

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

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

Step 3 From the **Application Management** list in the **Intent** menu, click **Create Application Profile**. The **Create Application Profile** dialog box appears.

Step 4 Enter a name in the **Name** field.

Step 5 Choose a tenant:

a) Click **Select Tenant**.

The **Select Tenant** dialog box appears.

b) From the **Select Tenant** dialog, click to choose a tenant in the left column then click **Select**.

You return to the **Create Application Profile** dialog box.

Step 6 Enter a description in the **Description** field.

Step 7 Click **Save** when finished.

Creating a VRF Using the Cisco Cloud APIC GUI

This section explains how to create a VRF using the Cisco Cloud APIC GUI.

Before you begin

Create a tenant.

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

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

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

Step 3 From the **Application Management** list in the **Intent** menu, click **Create VRF**. The **Create VRF** dialog box appears.

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

Table 8: Create VRF Dialog Box Fields

Properties	Description
General	
Name	Enter a name for the VRF in the **Name** field.
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog box appears. **b.** From the **Select Tenant** dialog, click to choose a tenant in the left column then click **Select**. You return to the **Create VRF** dialog box.
Description	Enter a description of the VRF.
Settings > IPv4 unicast address family BGP targets	
Add Filter	**a.** Click the **Add Route Target** option for the unicast address family BGP target you want to configure. **b.** Click to choose the following options for the **Type** field: • **Export**—The route target can be exported to other VRFs • **Import**—The route target is imported from other VRFs • Enter the route target that can be exported from the current VRF or imported into the current VRF in the **Route Target** text box.

Step 5 When finished, click **Save**.

Creating an EPG Using the Cisco Cloud APIC GUI

This section explains how to create an EPG using the Cisco Cloud APIC GUI. Each service needs at least one consumer EPG and one provider EPG.

Before you begin

Create an application profile and a VRF.

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

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

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

Step 3 From the **Application Management** list in the **Intent** menu, click **Create EPG**. The **Create EPG** dialog box appears.

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

Table 9: Create EPG Dialog Box Fields

Properties	Description
Name	Enter the name of the EPG.
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog box appears. **b.** From the **Select Tenant** dialog, click to choose a tenant in the left column then click **Select**. You return to the **Create EPG** dialog box.
Application Profile	To choose an application profile: **a.** Click **Select Application Profile**. The **Select Application Profile** dialog box appears. **b.** From the **Select Application Profile** dialog, click to choose an application profile in the left column then click **Select**. You return to the **Create EPG** dialog box.
Description	Enter a description of the EPG.
Settings	
Type	Choose the EPG type: • **Cloud** - Click to create the EPG in the cloud. • **External** - Click to create an external EPG.
Route Reachability	(Visible when creating an external EPG) Click the **Route Reachability** drop-down list and choose: • **On Premises** • **Internet** • **Unspecified**

Properties	Description
VRF	To choose a VRF: **a.** Click **Select VRF**. The **Select VRF** dialog box appears. **b.** From the **Select VRF** dialog, click to choose a VRF in the left column then click **Select**. You return to the **Create EPG** dialog box.

Properties	Description
Endpoint Selectors	

Properties	Description
	Note See Configuring Instances in AWS, on page 52 for instructions on configuring instances in AWS as part of the endpoint selector configuration process. To add an endpoint selector: **a.** Click **Add Endpoint Selector** to open the **Add Endpoint Selector** dialog. **b.** In the **Add Endpoint Selector** dialog, enter a name in the **Name** field. **c.** Click **Selector Expression**. The **Key**, **Operator**, and **Value** fields are enabled. **d.** Click the **Key** drop-down list to choose a key. The options are: • Choose **IP** if you want to use an IP address or subnet for the endpoint selector. • Choose **Zone** if you want to use an availability zone for the endpoint selector. • Choose **Region** if you want to use the Amazon Web Services region for the endpoint selector. • Choose **Custom** if you want to create a custom key for the endpoint selector. **Note** When choosing the **Custom** option, the drop-down list becomes a text box. You need to enter a name for the key in the spaces after **custom:** (for example, **custom: Location**). **e.** Click the **Operator** drop-down list to choose an operator. The options are: • **equals**: Used when you have a single value in the Value field. • **not equals**: Used when you have a single value in the Value field. • **in**: Used when you have multiple comma-separated values in the Value field. • **not in**: Used when you have multiple comma-separated values in the Value field. • **has key**: Used if the expression contains only a key.

Properties	Description
	• **does not have key**: Used if the expression contains only a key. **f.** Enter a value in the **Value** field then click the check mark to validate the entries. The value you enter depends on the choices you made for the **Key** and **Operator** fields. For example, if the **Key** field is set to **IP** and the **Operator** field is set to **equals**, the **Value** field must be an IP address or subnet. However, if the **Operator** field is set to **has key**, the **Value** field is disabled. **g.** When finished, click the check mark to validate the selector expression. **h.** Determine if you want to create additional endpoint selector expressions to the endpoint selector. If you create more than one expression under a single endpoint selector, a logical AND exists between those expressions. For example, assume you created two sets of expressions under a single endpoint selector: • Endpoint selector 1, expression 1: • **Key:** Zone • **Operator:** equals • **Value:** us-west-1a • Endpoint selector 1, expression 2: • **Key:** IP • **Operator:** equals • **Value:** 192.0.2.1/24 In this case, if *both* of these expressions are true (if the availability zone is us-west-1a AND if the IP address belongs to subnet 192.0.2.1/24), then that endpoint is assigned to the Cloud EPG.

Properties	Description
	i. Click the check mark after every additional expression that you want to create under this endpoint selector then click **Add** when finished. If you create more than one endpoint selector under an EPG, a logical OR exists between those endpoint selectors. For example, assume you had created endpoint selector 1 as described in the previous step, and then you created a second endpoint selector as described below: • Endpoint selector 2, expression 1: • **Key:** Region • **Operator:** in • **Value:** us-east-1, us-east-2 In this case: • If the availability zone is us-west-1a AND the IP address belongs to the 192.0.2.1/24 subnet (endpoint selector 1 expressions) OR • If the region is either us-east-1 or us-east-2 (endpoint selector 2 expression) Then that end point is assigned to the Cloud EPG.

Step 5 Click **Save** when finished.

Creating a Contract Using the Cisco Cloud APIC GUI

This section explains how to create a contract using the Cisco Cloud APIC GUI.

Before you begin

Create filters.

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

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

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

Step 3 From the **Application Management** list in the **Intent** menu, click **Create Contract**. The **Create Contract** dialog box appears.

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

Table 10: Create Contract Dialog Box Fields

Properties	Description
Name	Enter the name of the contract.
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog box appears. **b.** From the **Select Tenant** dialog, click to choose a tenant in the left column then click **Select**. You return to the **Create Contract** dialog box.
Description	Enter a description of the contract.
Settings	
Scope	The scope limits the contract to any endpoint groups within the same application profile, within the same VRF instance, throughout the fabric (globally), or within the same tenant. **Note** Shared services enables communication between EPGs in different tenants and between EPGs in different VRFs. To enable EPGs in one tenant to communicate with EPGs in another tenant, choose **Global** scope. To enable an EPG in one VRF to communicate with another EPG in a different VRF, choose **Global** or **Tenant** scope. For more information about shared services, see Shared Services, on page 27 Click the drop-down arrow to choose from the following scope options: • **Application Profile** • **VRF** • **Global** • **Tenant**
Apply Filter in Both Directions	Put a check in the box to apply the same filters to traffic from consumer-to-provider and provider-to-consumer. Do not put a check in the box if you want to apply different filters for each direction of traffic. The check box is enabled by default.

Properties	Description
Add Filter	To choose a filter: **a.** Click **Add Filter**. The filter row appears with a **Select Filter** option. **b.** Click **Select Filter**. The **Select Filter** dialog box appears. **c.** From the **Select Filter** dialog, click to choose a filter in the left column then click **Select**. You return to the **Create Contract** dialog box.

Step 5 Click **Save** when finished.

Specifying Consumer and Provider EPGs Using the Cisco Cloud APIC

This section explains how to specify an EPG as a consumer or a provider.

Before you begin

- You have configured a contract.
- You have configured an EPG.

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

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

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

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

Step 4 To choose a contract:

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

Step 5 To add a consumer EPG:

a) Click **Add Consumer EPGs**. The **Select Consumer EPGs** dialog appears.
b) In the pane on the left side of the **Select Consumer EPGs** dialog, click to place a check in a check box to choose an EPG.

Step 6 To add a provider EPG:

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

c) When finished, click **Select**. The **Select Provider EPGs** dialog box closes.

Creating a Filter Using the Cisco Cloud APIC GUI

This section explains how to create a filter using the Cisco Cloud APIC GUI.

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

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

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

Step 3 From the **Application Management** list in the **Intent** menu, click **Create Filter**. The **Create Filter** dialog box appears.

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

Table 11: Create Filter Dialog Box Fields

Properties	Description
Name	Enter a name for the filter in the **Name** field.
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog box appears. **b.** From the **Select Tenant** dialog, click to choose a tenant in the left column then click **Select**. You return to the **Create Filter** dialog box.
Description	Enter a description of the filter.

Properties	Description
Add Filter	To add a filter: **a.** Click **Add Filter Entry**. The **Create Filter Entry** dialog box appears. **b.** Enter a name for the filter entry in the **Name** field. **c.** From the **Select Filter** dialog, click to choose a filter in the left column then click **Select**. You return to the **Create Contract** dialog box. **d.** Click the **Ethernet Type** drop-down list to choose an ethernet type. The options are: • **IP** • **Unspecified** **Note** When **Unspecified** is chosen, the remaining fields are disabled. **e.** Click the **IP Protocol** drop-down menu to choose a protocol. The options are: • **icmp** • **tcp** • **udp** • **Unspecified** **Note** The remaining fields are enabled only when **tcp** or **udp** is chosen. **f.** Enter the appropriate port information in the **Origin Port from** and **to** fields. **g.** Enter the appropriate port information in the **Destination Port from** and **to** fields. **h.** When finished entering filter entry information, click **Add**. You return to the **Create Filter** dialog box where you can repeat the steps to add another filter entry.

Step 5 When finished, click **Save**.

Creating a Cloud Context Profile Using the Cisco Cloud APIC GUI

This section explains how to create a cloud context profile using the Cisco Cloud APIC GUI.

Before you begin

Create a VRF.

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

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

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

Step 3 From the **Application Management** list in the **Intent** menu, click **Create Cloud Context Profile**. The **Create Cloud Context Profile** dialog box appears.

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

Table 12: Create Cloud Context Profile Dialog Box Fields

Properties	Description
Name	Enter the name of the cloud context profile.
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog box appears. **b.** From the **Select Tenant** dialog, click to choose a tenant in the left column then click **Select**. You return to the **Create Cloud Context Profile** dialog box.
Description	Enter a description of the cloud context profile.
Settings	
Select Region	To choose a region: **a.** Click **Select Region**. The **Select Region** dialog box appears. **b.** From the **Select Region** dialog, click to choose a region in the left column then click **Select**. You return to the **Create Cloud Context Profile** dialog box.
Select VRF	To choose a VRF: **a.** Click **Select VRF**. The **Select VRF** dialog box appears. **b.** From the **Select VRF** dialog box, click to choose a VRF in the left column then click **Select**. You return to the **Create Cloud Context Profile** dialog box.
VPN Gateway Router	Click to check (enabled) or uncheck (disabled) in the **VPN Gateway Router** check box.

Properties	Description
Add CIDR	**Note** The following subnets are reserved and should not be used in this Add CIDR field: • 169.254.0.0/16 (reserved for VPN tunnel to the transit gateway) • 192.168.100.0/24 (reserved by the CCR for the bridge domain interface) To add a CIDR: **a.** Click **Add CIDR**. The **Add CIDR** dialog box appears. **b.** Enter the address in the **Address** field. **c.** Click **Add Subnet** and enter the subnet address in the **Address** field. **d.** To add availability zones: **1.** Click **Select Availability Zone**. The **Select Availability Zone** dialog box appears. **2.** From the **Select Availability Zone** dialog box, click to choose an availability zone in the left column then click **Select**. You return to the **Create Cloud Context Profile** dialog box. **e.** Click to check (enabled) or uncheck (disabled) the **Primary** check box. **f.** When finished, click **Add**.

Step 5 Click **Save** when finished.

Configuring Instances in AWS

When you configure endpoint selectors for Cisco Cloud APIC, you will also need to configure the instances that you will need in AWS that will correspond with the endpoint selectors that you configure for Cisco Cloud APIC.

This topic provides the instructions for configuring the instances in AWS. You can use these procedures to configure the instances in AWS either before you configure the endpoint selectors for Cisco Cloud APIC or afterward. For example, you might go to your account in AWS and create a custom tag or label in AWS first, then create an endpoint selector using a custom tag or label in Cisco Cloud APIC afterward. Or you might create an endpoint selector using a custom tag or label in Cisco Cloud APIC first, then go to your account in AWS and create a custom tag or label in AWS afterward.

Step 1 Review your cloud context profile configuration settings and determine which settings you will use with your AWS instance.

You must configure a cloud context profile as part of the AWS instance configuration process. When you configure a cloud context profile, the configurations, such as the VRF and region settings, are pushed out to AWS afterward.

a) From the **Navigation** menu, choose the **Application Management** tab.

When the **Application Management** tab expands, a list of subtab options appear.

b) Choose the **Cloud Context Profiles** subtab option.

A list of the cloud context profiles that you have created for your Cisco Cloud APIC are displayed.

c) Select the cloud context profile that you will use as part of this AWS instance configuration process.

Various configuration parameters are displayed for this cloud context profile, such as the region, VRF, IP address and subnets. Use the information displayed in this window when you configure the AWS instance.

Step 2 Log in to the Amazon Web Services account for the Cisco Cloud APIC user tenant, if you are not logged in already.

Step 3 Go to **Services** > **EC2** > **Instances** > **Launch Instance**.

Step 4 In the **Choose an Amazon Machine Image (AMI)** page, select an Amazon Machine Image (AMI).

Step 5 In the **Choose an Instance Type** page, select an instance type, then click **Configure Instance Details**.

Step 6 In the **Configure Instance Details** page, enter the necessary information in the appropriate fields.

- In the **Network** field, select your Cisco Cloud APIC VRF.

  This would be the VRF that is associated with the cloud context profile that you are using as part of this AWS instance configuration process.

- In the **Subnet** field, select the subnet.

- In the **Auto-assign Public IP** field, if you want to have a public IP, select **Enable** from the scroll-down menu.

Step 7 When you have finished entering the necessary information into the **Configure Instance Details** page, click **Add Storage**.

Step 8 In the **Add Storage** page, accept the default values or configure the storage in this page, if necessary, and click **Add Tags**.

Step 9 In the **Add Tags** page, click **Add Tag** and enter the necessary information in the appropriate fields in this page.

Note If you will be using IP Address, Region or Zone for the type of endpoint selector later in these procedures, you do not have to enter any information in this page. In those situations, when you start the instance in AWS, the IP address, region or zone will be discovered by the Cisco Cloud APIC and the endpoint will be assigned to the EPG.

- **Key:** Enter the key that you will use when you create a custom tag for the type of endpoint selector that you are adding later in these procedures.

- **Value:** Enter the value that you will be using for this key.

- **Instances:** Check the box for this field.

- **Volumes:** Check the box for this field.

For example, if you are planning on creating a custom tag for a specific building for your endpoint selector later in these procedures (such as building6), you might enter the following values in these fields on this page:

- **Key:** Location
- **Value:** building6

Step 10 Click **Review and Launch**.

The **Select an existing key pair or create a new key pair** page appears. Use the information in this page if you want to ssh to the instance later on.

Creating a Backup Configuration Using the Cisco Cloud APIC GUI

This section explains how to create a backup configuration.

Before you begin

Create a remote location and a scheduler, if needed.

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

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

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

Step 3 From the **Operations** list in the **Intent** menu, click **Create Backup Configuration**. The **Create Backup Configuration** dialog box appears.

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

Table 13: Create Backup Configuration Dialog Box Fields

Properties	Description
General	
Name	Enter the name of the backup configuration.
Description	Enter a description of the backup configuration.
Settings	
Backup Destination	Choose a backup destination. • **Local** • **Remote**

Properties	Description
Backup Object	

Properties	Description
	Choose the root hierarchical content to consider for the backup • **Policy Universe** • **Selector Object**—When chosen, this option adds the **Object Type** drop-down list and **Object DN** field. **a.** From the **Object Type** drop-down list, choose from the following options: • **Tenant**—When chosen the **Select Tenant** option appears. • **Application Profile**—When chosen the **Select Application Profile** option appears. • **EPG**—When chosen the **Select EPG** option appears. • **Contract**—When chosen the **Select Contract** option appears. • **Filter**—When chosen the **Select Filter** option appears. • **VRF**—When chosen the **Select VRF**option appears. • **Device**—When chosen the **Select fvcloudLBCtx**option appears. • **Service Graph**—When chosen the **Select Service Graph** option appears. • **Cloud Context Profile**—When chosen the **Select Cloud Context Profile** option appears. **b.** Click the **Select <object_name>**. The **Select <object_name>** dialog appears. **c.** From the **Select <object_name>** dialog, click to choose from the options in the left column then click **Select**. You return to the **Create Backup Configuration** dialog box. **Note** The **Object DN** field is automatically populated with the DN of the object it will use as root of the object tree to backup • **Enter DN**—When chosen, this option displays the **Object DN** field. **a.** From the **Object DN** field, enter the DN of a

Properties	Description
	specific object to use as the root of the object tree to backup.
Scheduler	**a.** Click **Select Scheduler** to open the **Select Scheduler** dialog and choose a scheduler from the left-side column. **b.** Click the **Select** button at the bottom-right corner when finished.
Trigger Backup After Creation	Choose one of the following: - **Yes**—(Default) Trigger a backup after creating the backup configuration. - **No**—Do not trigger a backup after creating the backup configuration.

Step 5 Click **Save** when finished.

Creating a Tech Support Policy Using the Cisco Cloud APIC GUI

This section explains how to create a tech support policy.

Before you begin

When creating a tech support policy for a remote location, you must first create the remote location.

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

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

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

Step 3 From the **Operations** list in the **Intent** menu, click **Create Tech Support**. The **Create Tech Support** dialog box appears.

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

Table 14: Create Tech Support Dialog Box Fields

Properties	Description
General	
Name	Enter the name of the tech support policy.
Description	Enter a description of the tech support.
Settings	

Properties	Description
Export Destination	Choose an export destination. • **Controller** • **Remote Location**—When chosen the **Select Remote Location** option appears. **a.** Click **Select Remote Location**. The **Select Remote Location** dialog box appears. **b.** From the **Select Remote Location** dialog, click to choose a remote location in the left column then click **Select**. You return to the **Create Tech Suport** dialog box.
Include Pre-Upgrade Logs	Click to place a check in the **Enabled** check box if you want to include pre-upgrade logs in the tech support policy.
Trigger After Creation	Click to place a check in the **Enabled** (the default) check box if you want to create the tech support policy after the policy creation. To disable, click the check box to uncheck.

Step 5 Click **Save** when finished.

Creating a Trigger Scheduler Using the Cisco Cloud APIC GUI

This section explains how to create a trigger scheduler.

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

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

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

Step 3 From the **Operations** list in the **Intent** menu, click **Create Scheduler**. The **Create Trigger Scheduler** dialog box appears.

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

Table 15: Create Trigger Scheduler Dialog Box Fields

Properties	Description
General	
Name	Enter the name of the trigger scheduler policy.
Description	Enter a description of the trigger scheduler.
Settings	

Properties	Description
Recurring Windows	Click **Add Recurring Window**. The **Add Recurring Window** dialog appears. **a.** From the **Schedule** drop-down list, choose from the following. • **every-day** • **Monday** • **Tuesday** • **Wednesday** • **Thursday** • **Friday** • **Saturday** • **Sunday** • **odd-day** • **even-day** **b.** From the **Start Time** field, enter a time. **c.** From the **Maximum Concurrent Tasks** field, enter a number or leave the field empty to specify unlimited. **d.** From the **Maximum Running Time**, click to choose **Unlimited** or **Custom**. **e.** Click **Add** when finished.
Add One Time Window	Click **Add One Time Window**. The **Add One Time Window** dialog appears. **a.** From the **Start Time** field, enter a date and time. **b.** From the **Maximum Concurrent Tasks** field, enter a number or leave the field blank to specify unlimited. **c.** From the **Maximum Running Time**, click to choose **Unlimited** or **Custom**. **d.** Click **Add** when finished.

Step 5 Click **Save** when finished.

Creating a Remote Location Using the Cisco Cloud APIC GUI

This section explains how to create a remote location using the Cisco Cloud APIC.

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

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

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

Step 3 From the **Operations** list in the **Intent** menu, click **Create Remote Location**. The **Create Remote Location** dialog box appears.

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

Table 16: Create Remote Location Dialog Box Fields

Properties	Description
General	
Name	Enter the name of the remote location policy.
Description	Enter a description of the remote location policy.
Settings	
Hostname/IP Address	Enter the hostname or IP address of the remote location
Protocol	Choose a protocol: • **FTP** • **SFTP** • **SCP**
Path	Enter the path for the remote location.
Port	Enter the port for the remote location.
Username	Enter a username for the remote location.
Authentication Type	When using SFTP or SCP, choose the authentication type: • **Password** • **SSH Key**
SSH Key Content	Enter the SSH key content.
SSH Key Passphrase	SSH key passphrase.
Password	Enter a password for accessing the remote location.
Confirm Password	Reenter the password for accessing the remote location.

Properties	Description
Management EPG	**a.** Click **Select Management EPG**. The **Select Management EPG** dialog appears. **b.** From the column on the left, click to choose a management EPG. **c.** Click **Select**.

Step 5 Click **Save** when finished.

Creating a Login Domain Using the Cisco Cloud APIC GUI

This section explains how to create a login domain using the Cisco Cloud APIC GUI.

Before you begin

Create a provider before creating a non-local domain.

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

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

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

Step 3 From the **Administrative** list in the **Intent** menu, click **Create Login Domain**. The **Create Login Domain** dialog box appears.

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

Table 17: Create Login Domain Dialog Box Fields

Properties	Description
Name	Enter the name of the login domain.
Description	Enter a description of the login domain.
Realm	Choose a realm: • **Local** • **LDAP**—Requires adding providers and choosing an authenication type. • **RADIUS**—Requires adding providers. • **TACACS+**—Requires adding providers. • **SAML**—Requires adding providers.

Properties	Description
Providers	To add a provider: **a.** Click **Add Providers**. The **Select Providers** dialog appears with a list of providers in the left pane. **b.** Click to choose a provider. **c.** Click **Select** to add the provider.
Advanced Settings	Displays the **Authentication Type** and **LDAP Group Map Rules** fields.
Authentication Type	When LDAP is chosen for realm option, choose one of the following authentication types: • **Cisco AV Pairs**—(Default) • **LDAP Group Map Rules**—Requires adding LDAP group map rules.

Properties	Description
LDAP Group Map Rules	To add an LDAP group map rule: **a.** Click **Add LDAP Group Map Rule**. The **Add LDAP Group Map Rule** dialog appears with a list of providers in the left pane. **b.** Enter a name for the rule in the **Name** field. **c.** Enter a description for the rule in the **Description** field. **d.** Enter a group DN for the rule in the **Group DN** field. **e.** Add security domains: **1.** Click **Add Security Domain**. The **Add Security Domain** dialog box appears. **2.** Click **Select Security Domain**. The **Select Security Domain** dialog box appears with a list of security domains in the left pane. **3.** Click to choose a security domain. **4.** Click **Select** to add the security domain. You return to the **Add Security Domain** dialog box. **5.** Add a user role: **a.** From the **Add Security Domain** dialog box, click **Select Role**. The **Select Role** dialog box appears with a list of roles in the left pane. **b.** Click to choose a role. **c.** Click **Select** to add the role. You retun to the **Add Security Domain** dialog box. **d.** From the **Add Security Domain** dialog box, click the **Privilege Type** drop-down list and choose **Read Privilege** or **Write Privilege**. **e.** Click the check mark on the right side of the **Privilege Type** drop-down list to confirm. **f.** Click **Add** when finished. You return to the **Add LDAP Group Map Rule** dialog box where you can add another security domain.

Step 5 Click **Save** when finished.

Creating a Provider Using the Cisco Cloud APIC GUI

This section explains how to create a provider using the Cisco Cloud APIC GUI.

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

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

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

Step 3 From the **Administrative** list in the **Intent** menu, click **Create Provider**. The **Create Provider** dialog box appears.

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

Table 18: Create Provider Dialog Box Fields

Properties	Description
Hostname/IP Address	Enter the hostname or IP address of the provider.
Description	Enter a description of the provider.
Type	Click the **Type** drop-down list and choose one of the following types: • **LDAP** • **RADIUS** • **TACACS+** • **SAML** **Note** A set of fields will appear based on the type that you choose.
[LDAP] Settings	
Bind DN	Enter the LDAP bind DN.
Base DN	Enter the LDAP base DN.
Password	Enter a password for the LDAP settings.
Confirm Password	Reenter the password for the LDAP settings.
Port	Enter the port number for the provider type.
Advanced Settings	Displays additional fields in the **Settings** section of the provider dialog box.
Timeout (sec)	Enter the number of seconds allowed before a timeout occurs. The default is 30.
Retries	Enter the number of allowed retries. The default is 1.

Properties	Description
SSL	To enable SSL, click to place a check in the **SSL** check box. To disable SSL, click to remove the check from the **SSL** check box. The default is enabled.
SSL Certificate Validation Level	Choose one of the following: • **Permissive** • **Strict**
Attribute	Enter an LDAP attribute in the **Attribute** text box.
Filter Type	Choose a filter type: • **Default** • **Microsoft AD** • **Custom**
Filter	Enter an LDAP filter in the text box. This option only appears when the **Custom** filter type is chosen.
Select Management EPG	To add a management EPG: **a.** Click **Select Management EPG**. The **Select Management EPG** dialog appears with a list of EPGs in the left pane. **b.** Click to choose an EPG. **c.** Click **Select** to add the management EPG to the LDAP.
Server Monitoring	To enable server monitoring, click to place a check in the **Enabled** check box. To disable server monitoring, click to remove the check from the **Enabled** check box. The default is disabled.
[RADIUS] Settings	
Key	Enter the RADIUS key.
Confirm Key	Reenter the RADIUS key.
Advanced Settings	Displays additional fields in the **Settings** section of the provider dialog box.
Port	Enter the port number for the RADIUS settings. The default is 1812.

Properties	Description
Authentication Protocol	Choose from the following: • **PAP**—(Default) • **CHAP** • **MS-CHAP**
Timeout (sec)	Enter the number of seconds allowed before a timeout occurs. The default is 5.
Retries	Enter the number of allowed retries. The default is 1.
Select Management EPG	To add a management EPG: **a.** Click **Select Management EPG**. The **Select Management EPG** dialog appears with a list of EPGs in the left pane. **b.** Click to choose an EPG. **c.** Click **Select** to add the management EPG to the RADIUS.
Server Monitoring	To enable server monitoring, click to place a check in the **Enabled** check box. To disable server monitoring, click to remove the check from the **Enabled** check box. The default is disabled.
[TACACS+] Settings	
Key	Enter the TACACS+ key.
Confirm Key	Reenter the TACACS+ key.
Advanced Settings	Displays additional fields in the **Settings** section of the provider dialog box.
Port	Enter the port number for the TACACS+ settings. The default is 1812.
Authentication Protocol	Choose from the following: • **CHAP** • **MS-CHAP** • **PAP**—(Default)
Timeout (sec)	Enter the number of seconds allowed before a timeout occurs. The default is 5.
Retries	Enter the number of allowed retries. The default is 1.

Properties	Description
Select Management EPG	To add a management EPG: **a.** Click **Select Management EPG**. The **Select Management EPG** dialog appears with a list of EPGs in the left pane. **b.** Click to choose an EPG. **c.** Click **Select** to add the management EPG to the TACACS+.
Server Monitoring	To enable server monitoring, click to place a check in the **Enabled** check box. To disable server monitoring, click to remove the check from the **Enabled** check box. The default is disabled.
[SAML] Settings	
Identity Provider	Choose from the following identity providers: • **ADFS**—(default) • **OKTA** • **PING IDENTITY**
Identity Provider Metadata URL	Enter the metatdata URL provided by the identity provider.
Entity ID	Enter a unique ID as the SAML entity identifier.
HTTPS Proxy for Metadata URL	Enter the HTTPS proxy used to reach the identity provider's metadata URL.
Advanced Settings	Displays additional fields in the **Settings** section of the provider dialog box.
GUI Redirect Banner Message (URL)	Enter the GUI redirect banner message.
Certificate Authority	To choose a certificate authority: **a.** Click **Select Certificate Authoriy**. The **Select Certificate Authoriy** dialog appears with a list of certificates in the left pane. **b.** Click to choose a certificate. **c.** Click **Select** to add the certificate. You return to the **Create Provider** dialog box.
Timeout (sec)	Enter the number of seconds allowed before a timeout occurs. The default is 5.
Retries	Enter the number of allowed retries. The default is 1.

Properties	Description
Signature Algorithm Authentication User Requests*	Click the **Signature Algorithm for Requests** drop-down list and choose one of the following: • **RSA SHA1** • **RSA SHA224** • **RSA SHA256** (Default) • **RSA SHA384** • **RSA SHA512**
Sign SAML Authentication Requests	To enable, click to place a check in the check box. To disable, click to remove the check from the check box. The default is enabled.
Sign SAML Response Message	To enable, click to place a check in the check box. To disable, click to remove the check from the check box. The default is enabled.
Sign Assertions in SAML Response	To enable, click to place a check in the check box. To disable, click to remove the check from the check box. The default is enabled.
Encrypt SAML Assertions	To enable, click to place a check in the check box. To disable, click to remove the check from the check box. The default is enabled.

Step 5 Click **Save** when finished.

Creating a Security Domain Using the Cisco Cloud APIC GUI

A security domain restricts the tenant to the security domains that you add. If you do not add a security domain, all security domains will have access to this tenant. This section explains how to create a security domain using the GUI.

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

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

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

Step 3 From the **Administrative** list in the **Intent** menu, click **Create Security Domain**. The **Create Security Domain** dialog box appears.

Step 4 In the **Name** field, enter the name of the security domain.

Step 5 In the **Description** field, enter a description of the security domain.

Step 6 Click **Save** when finished.

Creating a Role Using the Cisco Cloud APIC GUI

This section explains how to create a role using the Cisco Cloud APIC GUI.

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

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

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

Step 3 From the **Administrative** list in the **Intent** menu, click **Create Role**. The **Create Role** dialog box appears.

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

Table 19: Create Role Dialog Box Fields

Properties	Description
General	
Name	Enter a name for the role in the **Name** field.
Description	Enter a description of the role.
Settings	

Properties	Description
Privilege	

Properties	Description
	Click to place a check mark in the check boxes of the privileges you want to assign the user. The privileges are: • **aaa**—Used for configuring authentication, authorization, accouting and import/export policies. • **access-connectivity-l1**Used for Layer 1 configuration under infra. Example: selectors and port Layer 1 policy configurations. • **access-connectivity-l2**—Used for Layer 2 configuration under infra. Example: Encap configurations on selectors, and attachable entity. • **access-connectivity-l3**—Used for Layer 3 configuration under infra and static route configurations under a tenant's L3Out. • **access-connectivity-mgmt**—Used for management infra policies. • **access-connectivity-util**—Used for tenant ERSPAN policies. • **access-equipment**—Used for access port configuration. • **access-protocol-l1**—Used for Layer 1 protocol configurations under infra. • **access-protocol-l2**—Used for Layer 2 protocol configurations under infra. • **access-protocol-l3**—Used for Layer 3 protocol configurations under infra. • **access-protocol-mgmt**—Used for fabric-wide policies for NTP, SNMP, DNS, and image management. • **access-protocol-ops**—Used for operations-related access policies such as cluster policy and firmware policies. • **access-protocol-util**—Used for tenant ERSPAN policies. • **access-qos**—Used for changing CoPP and QoS-related policies. • **admin**—Complete access to everything (combine ALL roles) • **fabric-connectivity-l1**—Used for Layer 1 configuration under the fabric. Example: selectors and port Layer 1 policy and vPC protection.

Properties	Description
	• **fabric-connectivity-l2**—Used in firmware and deployment policies for raising warnings for estimating policy deployment impact. • **fabric-connectivity-l3**—Used for Layer 3 configuration under the fabric. Example: Fabric IPv4 and MAC protection groups. • **fabric-connectivity-mgmt**—Used for atomic counter and diagnostic policies on leaf switches and spine switches. • **fabric-connectivity-util**—Used for atomic counter, diagnostic, and image management policies on leaf switches and spine switches. • **fabric-equipment**—Used for atomic counter, diagnostic, and image management policies on leaf switches and spine switches. • **fabric-protocol-l1**—Used for Layer 1 protocol configurations under the fabric. • **fabric-protocol-l2**—Used for Layer 2 protocol configurations under the fabric. • **fabric-protocol-l3**—Used for Layer 3 protocol configurations under the fabric. • **fabric-protocol-mgmt**—Used for fabric-wide policies for NTP, SNMP, DNS, and image management. • **fabric-protocol-ops**—Used for ERSPAN and health score policies. • **fabric-protocol-util**—Used for firmware management traceroute and endpoint tracking policies. • **none**—No privilege. • **nw-svc-device**—Used for managing Layer 4 to Layer 7 service devices. • **nw-svc-devshare**—Used for managing shared Layer 4 to Layer 7 service devices. • **nw-svc-params**—Used for managing Layer 4 to Layer 7 service policies. • **nw-svc-policy**—Used for managing Layer 4 to Layer 7 network service orchestration.

Properties	Description
	- **ops**—Used for operational policies including monitoring and troubleshooting policies such as atomic counter, SPAN, TSW, tech support, traceroute, analytics, and core policies. - **tenant-connectivity-l1**—Used for Layer 1 connectivity changes, including bridge domains and subnets. - **tenant-connectivity-l2**—Used for Layer 2 connectivity changes, including bridge domains and subnets. - **tenant-connectivity-l3**—Used for Layer 3 connectivity changes, including VRFs. - **tenant-connectivity-mgmt**—Used for tenant in-band and out-of-band management connectivity configurations and for debugging/monitoring policies such as atomic counters and health score. - **tenant-connectivity-util**—Used for atomic counter, diagnostic, and image management policies on leaf switches and spine switches. - **tenant-epg**—Used for managing tenant configurations such as deleting/creating endpoint groups, VRFs, and bridge domains. - **tenant-ext-connectivity-l2**—Used for managing tenant L2Out configurations. - **tenant-ext-connectivity-l3**—Used for managing tenant L3Out configurations. - **tenant-ext-connectivity-mgmt**—Used as write access for firmware policies. - **tenant-ext-connectivity-util**—Used for debugging/monitoring/observer policies such as traceroute, ping, oam, and eptrk. - **tenant-ext-protocol-l1**—Used for managing tenant external Layer 1 protocols. Generally only used for write access for firmware policies. - **tenant-ext-protocol-l2**—Used for managing tenant external Layer 2 protocols. Generally only used for write access for firmware policies. - **tenant-ext-protocol-l3**—Used for managing tenant external Layer 3 protocols such as BGP, OSPF, PIM, and IGMP. - **tenant-ext-protocol-mgmt**—Used as write access for firmware policies.

Properties	Description
	• **tenant-ext-protocol-util**—Used for debugging/monitoring/observer policies such as traceroute, ping, oam, and eptrk. • **tenant-network-profile**—Used for managing tenant configurations, such as deleting and creating network profiles, and deleting and creating endpoint groups. • **tenant-protocol-l1**—Used for managing configurations for Layer 1 protocols under a tenant. • **tenant-protocol-l2**—Used for managing configurations for Layer 2 protocols under a tenant. • **tenant-protocol-l3**—Used for managing configurations for Layer 3 protocols under a tenant. • **tenant-protocol-mgmt**—Only used as write access for firmware policies. • **tenant-protocol-ops**—Used for tenant traceroute policies. • **tenant-protocol-util**—Used for debugging/monitoring/observer policies such as traceroute, ping, oam, and eptrk. • **tenant-qos**—Only used as Write access for firmware policies. • **tenant-security**—Used for Contract related configurations for a tenant. • **vmm-connectivity**—Used to read all the objects in APIC's VMM inventory required for VM connectivity. • **vmm-ep**—Used to read VM and Hypervisor endpoints in the APIC's VMM inventory. • **vmm-policy**—Used for managing policies for VM networking. • **vmm-protocol-ops**—Not used by VMM policies. • **vmm-security**—Used for Contract related configurations for a tenant.

Step 5 Click **Save** when finished.

Creating an RBAC Rule Using the Cisco Cloud APIC GUI

This section explains how to create an RBAC rule using the GUI.

Before you begin

Create a security domain.

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

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

A list of **Administrative** options appears in the **Intent** menu.

Step 3 From the **Administrative** list in the **Intent** menu, click **Create RBAC Rule**. The **Create RBAC Rule** dialog box appears.

Step 4 In the **DN** field, enter the DN for the rule.

Step 5 Choose a security domain:

a) Click **Select Security Domain**. The **Select Security Domain** dialog box appears.

b) From the **Select Security Domain** dialog box, click to choose a security domain from the column on the left then click **Select**. You return to the **Create RBAC Rule** dialog box.

Step 6 From the **Allow Writes** field, click **Yes** to allow writes or **No** to not allow writes.

Step 7 Click **Save** when finished.

Creating a Certificate Authority Using the Cisco Cloud APIC GUI

This section explains how to create a certificate authority using the GUI.

Before you begin

- Have the certificate chain.
- If the certificate authority is for a tenant, create the tenant.

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

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

A list of **Administrative** options appears in the **Intent** menu.

Step 3 From the **Administrative** list in the **Intent** menu, click **Create Certificate Authority**. The **Create Certificate Authority** dialog box appears.

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

Table 20: Create Certificate Authority Dialog Box Fields

Properties	Description
Name	Enter the name of the certificate authority.
Description	Enter a description of the certificate authority.

Properties	Description
Used for	Choose from the following options: • **Tenant**—Choose if the certificate authority is for a specific tenant. When chosen, the **Select Tenant** option appears in the GUI. • **System**—Choose if the certificate authority is for the system.
Select Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog box appears. **b.** From the **Select Tenant** dialog, click to choose a tenant in the left column then click **Select**. You return to the **Create Certificate Authority** dialog box.
Certificate Chain	Enter the certificate chain in the **Certificate Chain** text box. **Note** Add the certificates for a chain in the following order: **a.** CA **b.** Sub-CA **c.** Subsub-CA **d.** Server

Step 5 Click **Save** when finished.

Creating a Key Ring Using the Cisco Cloud APIC GUI

This section explains how to create a key ring using the Cisco Cloud APIC GUI.

Before you begin

- Create a certificate authority.
- Have a certificate.
- If the key ring is for a specific tenant, create the tenant.

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

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

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

Step 3 From the **Administrative** list in the **Intent** menu, click **Create Key Ring**. The **Create Key Ring** dialog box appears.

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

Table 21: Create Key Ring Dialog Box Fields

Properties	Description
Name	Enter the name of the key ring.
Description	Enter a description of the key ring.
Used for	• **System**—The key ring is for the system. • **Tenant**—The key ring is for a specific tenant. Displays a **Tenant** field for specifying the tenant.
Select Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog box appears. **b.** From the **Select Tenant** dialog, click to choose a tenant in the left column then click **Select**. You return to the **Create Key Ring** dialog box.
Settings	
Certificate Authority	To choose a certificate authority: **a.** Click **Select Certificate Authority**. The **Select Certificate Authority** dialog appears. **b.** Click to choose a certificate authority in the column on the left. **c.** Click **Select**. You return to the **Create Key Ring** dialog box.
Private Key	Choose one of the following: • **Generate New Key**—Generates a new key. • **Import Existing Key**—Displays the **Private Key** text box and enables you to use an existing key.
Private Key	Enter an existing key in the **Private Key** text box (for the **Import Existing Key** option).

Properties	Description
Modulus	Click the **Modulus** drop-down list to choose from the following: • **MOD 512** • **MOD 1024** • **MOD 1536** • **MOD 2048**—(Default)
Certificate	Enter the certificate information in the **Certificate** text box.

Step 5 Click **Save** when finished.

Creating a Local User Using the Cisco Cloud APIC GUI

This section explains how to create a local user using the Cisco Cloud APIC GUI.

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

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

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

Step 3 From the **Administrative** list in the **Intent** menu, click **Create Local User**. The **Create Local User** dialog box appears.

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

Table 22: Create Local User Dialog Box Fields

Properties	Description
Name	Enter the username of the local user.
Password	Enter the password for the local user.
Confirm Password	Reenter the password for the local user.
Description	Enter a description of the local user.
Settings	
Account Status	To choose the account status: • **Active**—Activates the local user account. • **Inactive**—Deactivates the local user account.
First Name	Enter the first name of the local user.

Properties	Description
Last Name	Enter the last name of the local user.
Email Address	Enter the email address of the local user.
Phone Number	Enter the phone number of the local user.
Security Domains	To add a security domain: **a.** Click **Add Security Domain**. The **Add Security Domain** dialog box appears. **b.** Click **Select Security Domain**. The **Select Security Domain** dialog box appears with a list of security domains in the left pane. **c.** Click to choose a security domain. **d.** Click **Select** to add the security domain. You return to the **Add Security Domain** dialog box. **e.** Add a user role: **1.** From the **Add Security Domain** dialog box, click **Select Role**. The **Select Role** dialog box appears with a list of roles in the left pane. **2.** Click to choose a role. **3.** Click **Select** to add the the role. You retun to the **Add Security Domain** dialog box. **4.** From the **Add Security Domain** dialog box, click the **Privilege Type** drop-down list and choose **Read Privilege** or **Write Privilege**. **5.** Click the check mark on the right side of the **Privilege Type** drop-down list to confirm. **6.** Click **Add** when finished. You return to the **Create Local User** dialog box where you can add another security domain.

Step 5 Click **Advanced Settings** and enter the appropriate values in each field as listed in the following *Create Local User Dialog Box Fields: Advanced Settings* table then continue.

Table 23: Create Local User Dialog Box Fields: Advanced Settings

Property	Description
Account Expires	If you choose **Yes**, the account is set to expire at the time that you choose.
Password Update Required	If you choose **Yes**, the user must change the password upon the next login.

Property	Description
OTP	Put a check in the box to enable the one-time password feature for the user.
User Certificates	To add a user certificate: **a.** Click **Add X509 Certificate**. The **Add X509 Certificate** dialog box appears. **b.** Enter a name in the **Name** field. **c.** Enter the X509 certificate in the **User X509 Certificate** text box. **d.** Click **Add**. The **X509 certificate in the User X509 Certificate** dialog box closes. You return to the **Local User** dialog box.
SSH Keys	To add a an SSH key: **a.** Click **Add SSH Key**. The **Add SSH Key** dialog box appears. **b.** Enter a name in the **Name** field. **c.** Enter the SSH key in the **Key** text box. **d.** Click **Add**. The **Add SSH Key** dialog box closes. You return to the **Local User** dialog box.

Step 6 Click **Save** when finished.

Managing Regions (Configuring a Cloud Template) Using the Cisco Cloud APIC GUI

Regions are configured during the first-time setup. When configured, you specify the regions that are managed by Cisco Cloud APIC and the region's inter-site and inter-region connectivity. This section explains how to manage regions with the cloud template using the Cisco Cloud APIC GUI after the initial installation.

For more information about cloud templates, see About the Cloud Template, on page 23.

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

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

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

Step 3 From the **Configuration** list in the **Intent** menu, click **Set Up cAPIC**. The **Set up - Overview** dialog box appears with options for **DNS Servers**, **Region Management**, and **Smart Licensing**.

Step 4 For **Region Management**, click **Edit Configuration**. The **Set Up - Region Management** dialog box appears with a list of managed regions.

Step 5 To choose a region that you want to be managed by the Cisco Cloud APIC, click to place a check mark in check box of that region. The **Cloud Routers** and **On-Premises Connectivity** check boxes are enabled.

Step 6 To deploy cloud routers locally to this region, click to place a check mark in the **Cloud Routers** check box.

Step 7 To enable the cloud routers in the region to connect to on-premises AC sites, click to place a check mark in the **On-Premises Connectivity** check box. The **Cloud Routers** check box is automatically checked.

Step 8 To configure the fabric infra connectivity for the cloud site, click **Next**.

Step 9 To specify the subnet, click **Add Subnet for Cloud Router** and enter the subnet in the text box.

Step 10 To chose the number of routers per region, click the **Number of Routers Per Region** drop-down list and click **2**, **3**, or **4**.

Step 11 Enter a username in the **Username** text box.

Step 12 Enter a password in the **Password** and **Confirm Password** text boxes.

Step 13 To choose the troughput value, click the **Throughput of the routers** drop-down list.

Note Cloud routers should be undeployed from all regions before changing the throughput or login credentials.

Step 14 To specify the license token, enter the product instance registration token in the **License Token** text box.

Step 15 To configure inter-site connectivity, click **Next**.

Step 16 To enter a peer public IP in the text box, click **Add Template for IPsec**.

Step 17 Enter the OSPF area ID in the **OSPF Area Id** text box.

Step 18 To add an external subnet pool, click **Add External Subnet Pool for Infra Network** and enter a subnet pool in the text box.

Step 19 Click **Save and Continue** when finished.

Configuring Cisco Cloud APIC Using the REST API

Creating a Tenant Using the REST API

This section demonstrates how to create a tenant and assigns using the REST API.

To create a tenant:

```
<polUni>
  <fvTenant name="infra">
    <cloudAwsProvider region="us-east-1" accessKeyId="123" secretAccessKey="ABCDE" providerId="admin"
 status=""/>
  </fvTenant>
</polUni>
```

Creating a Contract Using the REST API

This example demonstrates how to create a contract for the Cisco Cloud APIC using the REST API.

Before you begin

Create filters.

To create a contract:

Example:

```
<polUni>
  <fvTenant name="t2" status="">
    <vzFilter descr="" name="http-family-destination" ownerKey="" ownerTag="">
      <vzEntry name="http" prot="tcp" etherT="ip" dFromPort="http" dToPort="http"/>
      <vzEntry name="https" prot="tcp" etherT="ip" dFromPort="https" dToPort="https"/>
    </vzFilter>
    <vzBrCP name="httpFamily">
      <vzSubj name="default" revFltPorts="yes" targetDscp="unspecified">
        <vzRsSubjFiltAtt action="permit" directives="" tnVzFilterName="http-family-destination"/>
      </vzSubj>
    </vzBrCP>
  </fvTenant>
</polUni>
```

Creating a Cloud Context Profile Using the REST API

This section demonstrates how to create a cloud context profile.

Before you begin

Create a VRF.

To create a cloud context profile:

Example:

```
<polUni>
<fvTenant name="Corp1" status="">
 <cloudAwsProvider accessKeyId="" secretAccessKey="" providerId="aws" status="" accountId=""/>

   <fvCtx name="prod-1" status="">
    <bgpRtTargetP af="ipv4-ucast">
      <bgpRtTarget rt="route-target:as4-nn2:400:400" type="export"/>
      <bgpRtTarget rt="route-target:as4-nn2:400:400" type="import"/>
    </bgpRtTargetP>
  </fvCtx>

   <fvCtx name="prod-2" status="">
    <bgpRtTargetP af="ipv4-ucast">
      <bgpRtTarget rt="route-target:as4-nn2:500:500" type="export"/>
      <bgpRtTarget rt="route-target:as4-nn2:500:500" type="import"/>
    </bgpRtTargetP>
  </fvCtx>
  <cloudVpnGwPol name="VgwPol" status=""/>

  <cloudApp name="payment" status="">
    <cloudEPg  name="web" status="">
      <cloudRsCloudEPgCtx tnFvCtxName="prod-1" />
    </cloudEPg>
  </cloudApp>
  <cloudApp name="billing">
    <cloudEPg  name="app">
      <cloudRsCloudEPgCtx tnFvCtxName="prod-2" />
    </cloudEPg>
  </cloudApp>

  <cloudCtxProfile name="prod-web-east-1">
    <cloudRsCtxProfileToRegion tDn="uni/clouddomp/provp-aws/region-us-east-1"/>
    <cloudRsToCtx tnFvCtxName="prod-1"/>
    <cloudRouterP name="RouterP1" type="vpn-gw">
     <cloudRsToVpnGwPol tnCloudVpnGwPolName="VgwPol"/>
       <cloudIntNetworkP name="IntNetworkP1"/>
    </cloudRouterP>

    <cloudCidr addr="60.10.10.1/16" primary="true">
        <cloudSubnet ip="60.10.10.1/24">
            <cloudRsZoneAttach tDn="uni/clouddomp/provp-aws/region-us-east-1/zone-us-east-1a"/>
        </cloudSubnet>
    </cloudCidr>
  </cloudCtxProfile>

  <cloudCtxProfile name="prod-payment-east-1" status="">
    <cloudRsCtxProfileToRegion tDn="uni/clouddomp/provp-aws/region-us-east-1"/>
    <cloudRsToCtx tnFvCtxName="prod-2" status=""/>
    <cloudRouterP name="RouterP1" type="vpn-gw">
     <cloudRsToVpnGwPol tnCloudVpnGwPolName="VgwPol"/>
       <cloudIntNetworkP name="IntNetworkP1" status=""/>
    </cloudRouterP>

    <cloudCidr addr="70.10.10.1/16" primary="true" status="">
       <cloudSubnet ip="70.10.10.1/24" status="">
           <cloudRsZoneAttach tDn="uni/clouddomp/provp-aws/region-us-east-1/zone-us-east-1a"/>
       </cloudSubnet>
    </cloudCidr>
  </cloudCtxProfile>

</fvTenant>
</polUni>
```

Managing a Cloud Region Using the REST API

This section demonstrates how to manage a cloud region using the REST API.

To create a cloud region:

```
<polUni>
  <cloudDomP name="dom-us-east-2">
    <cloudBgpAsP asn="64513"/>
    <cloudProvP vendor="aws">
      <cloudRegion name="us-east-2" adminSt="managed">
```

```
        <cloudZone name="us-east-2a"/>
        <cloudZone name="us-east-2b"/>
      </cloudRegion>
    </cloudProvP>
  </cloudDomP>
</polUni>
```

Creating a Filter Using the REST API

This section demonstrates how to create a filter using the REST API.

To create a filter:

```
https://<IP_Address>/api/node/mo/.xml
<polUni>
<fvTenant name="intervpc" >
<fvCtx name="VRF1"/>
    <cloudApp name="CloudAP1" >
    <cloudEPg name="CloudEPG1" >
        <cloudRsCloudEPgCtx tnFvCtxName="VRF1"/>
        <fvRsProv tnVzBrCPName="Contract2” > </fvRsProv>
        <cloudEPSelector name="sel1" matchExpression="custom:epgtag=='cloudepg1'" />
      </cloudEPg>
     </cloudApp>

      <vzFilter name="http" annotation="orchestrator:msc" >
      <vzEntry name="Entry3" prot="tcp" etherT="ipv4" arpOpc="unspecified" stateful="no"
applyToFrag="no" sFromPort="unspecified" sToPort="unspecified" dFromPort="80" dToPort="80" > </vzEntry>

    </vzFilter>

   <vzBrCP name="Contract2" scope="global">
      <vzSubj name="test-subj" >


        <vzRsSubjFiltAtt action="permit" tnVzFilterName="http" directives="none" />


      </vzSubj>
    </vzBrCP>
   </fvTenant>
</polUni>
```

Creating an Application Profile Using the REST API

This section demonstrates how to create an application profile using the REST API.

Before you begin

Create a tenant.

To create an application profile:

```
https://<IP_Address>/api/node/mo/.xml
<polUni>
<fvTenant name="intervpc" >
<fvCtx name="VRF1"/>
    <cloudApp name="CloudAP1" >

    <cloudEPg name="CloudEPG1" >
        <cloudRsCloudEPgCtx tnFvCtxName="VRF1"/>
        <fvRsProv tnVzBrCPName="Contract2” > </fvRsProv>
        <cloudEPSelector name="sel1" matchExpression="custom:epgtag=='cloudepg1'" />
      </cloudEPg>

     </cloudApp>

      <vzFilter name="http" annotation="orchestrator:msc" >
      <vzEntry name="Entry3" prot="tcp" etherT="ipv4" arpOpc="unspecified" stateful="no"
applyToFrag="no" sFromPort="unspecified" sToPort="unspecified" dFromPort="80" dToPort="80" > </vzEntry>

    </vzFilter>
   <vzBrCP name="Contract2" scope="global">
      <vzSubj name="test-subj" >
        <vzRsSubjFiltAtt action="permit" tnVzFilterName="http" directives="none" />
        </vzSubj>
    </vzBrCP>
   </fvTenant>
</polUni>
```

Creating a Cloud EPG Using the REST API

This example demonstrates how to create a cloud EPG using the REST API.

Before you begin

Create an application profile and a VRF.

To create a cloud EPG:

Example:

```
<polUni>
  <fvTenant name="t2" status="">
    <!-- Tenant provide AWS credentials -->
   <cloudAwsProvider region="us-east-2" accessKeyId="123" secretAccessKey="ABCDE" providerId="admin"/>

    <fvCtx name="v1" status=""/>
    <cloudApp name="ap">
      <cloudEPg name="provEPG" status="">
        <cloudRsCloudEPgCtx tnFvCtxName="v1"/>
        <cloudEPSelector name="1" matchExpression="custom:tag=='provfoo'"/>
        <cloudEPSelector name="2" matchExpression="custom:tag=='provbaz'"/>
        <fvRsProv tnVzBrCPName="httpFamily"/>
      </cloudEPg>
      <cloudEPg name="consEPG">
```

```
        <cloudRsCloudEPgCtx tnFvCtxName="v1"/>
        <cloudEPSelector name="1" matchExpression="custom:tag=='consfoo'"/>
        <cloudEPSelector name="2" matchExpression="custom:tag=='consbaz'"/>
        <fvRsCons tnVzBrCPName="httpFamily"/>
      </cloudEPg>
    </cloudApp>
  </fvTenant>
</polUni>
```

Creating an External Cloud EPG Using the REST API

This example demonstrates how to create an external cloud EPG using the REST API.

Before you begin

Create an application profile and a VRF.

To create an external cloud EPG:

Example:

```
<polUni>
  <fvTenant name="t2" status="">
    <!-- Tenant provide AWS credentials -->
   <cloudAwsProvider region="us-east-2" accessKeyId="123" secretAccessKey="ABCDE" providerId="admin"/>

    <fvCtx name="v1" status=""/>
    <cloudApp name="ap">
      <cloudEPg name="provEPGInternet" status="">
        <cloudRsCloudEPgCtx tnFvCtxName="v1"/>
        <cloudEPSelector name="1" matchExpression="custom:tag=='provfoo'"/>
        <cloudEPSelector name="2" matchExpression="custom:tag=='provbaz'"/>
        <fvRsProv tnVzBrCPName="httpFamily"/>
      </cloudEPg>
      <cloudExtEPg name="consInternetEPG">
        <cloudRsCloudEPgCtx tnFvCtxName="v1"/>
        <cloudExtEPSelector name="1" subnet="0.0.0.0/0"/>
        <fvRsCons tnVzBrCPName="httpFamily"/>
      </cloudExtEPg>
    </cloudApp>
  </fvTenant>
</polUni>
```

Creating a Cloud Template Using the REST API

This section demonstrates how to create a cloud template using the REST API. For more information about cloud templates, see About the Cloud Template, on page 23.

Before you begin

To create a cloud template:

```
<polUni>
  <fvTenant name="infra">
    <cloudtemplateInfraNetwork name="default" vrfName="overlay-1">
         <cloudtemplateProfile name="defaultxyz" routerUsername="SomeFirstName"
routerPassword="SomePass" >
              </cloudtemplateProfile>
      <cloudtemplateExtSubnetPool subnetpool="10.20.0.0/16"/>

      <cloudtemplateIntNetwork name="default">
        <cloudRegionName provider="aws" region="us-west-1"/>
        <cloudRegionName provider="aws" region="us-west-2"/>
      </cloudtemplateIntNetwork>

      <cloudtemplateExtNetwork name="default">
        <cloudRegionName provider="aws" region="us-west-2"/>

        <cloudtemplateVpnNetwork name="default">

          <cloudtemplateIpSecTunnel peeraddr="23.2.1.1/32" />
          <cloudtemplateIpSecTunnel peeraddr="23.0.1.1/32" />
          <cloudtemplateIpSecTunnel peeraddr="23.1.1.1/32" />

          <cloudtemplateOspf area="0.0.0.1"/>

        </cloudtemplateVpnNetwork>

        <cloudtemplateBgpEvpn peeraddr="34.1.1.1/32" asn="63000" siteId="123" password="abcd1234" />


      </cloudtemplateExtNetwork>
</cloudtemplateInfraNetwork>
  </fvTenant>
</polUni>
```

CHAPTER 5

Viewing System Details

Viewing Application Management Details

This section explains how to view application management details using the Cisco Cloud APIC GUI. The application management details include the information of a specific tenant, application profile, EPG, contract, filter, VRF, service, or cloud context profile.

Step 1 From the **Navigation** menu, choose the **Application Management** tab.

When the **Application Management** tab expands, a list of subtab options appear. See the *Application Management Options* table for more information.

Table 24: Application Management Subtabs

Subtab Name	Description
Tenants	Displays tenants as rows in a summary table.
Application Profiles	Displays application profiles as rows in a summary table.
EPGs	Displays an EPGs as rows in a summary table.
Contracts	Displays a contracts as rows in a summary table.
Filters	Displays filters as rows in a summary table.
VRFs	Displays VRFs as rows in a summary table.

Subtab Name	Description
Services	Contains the following two subtabs and information: • **Devices**—Displays the devices as rows in a summary table. • **Service Graphs**—Displays service graphs as rows in a summary table.
Cloud Context Profiles	Displays cloud context profiles as rows in a summary table.

Step 2 Click the tab that represents the component with the details you want to view.

A summary table appears with items as rows in the table. For example, if you chose the **Tenants** subtab, a list of tenants appear as rows in a summary table

Note You can filter the rows by entering an attribute in the *Filter by Attributes* bar.

Step 3 To view a summary pane, click the row that represents the specific component you want to view.

Step 4 For more information, double-click the summary table row that represents the specific component you want to view.

A new dialog box appears over the **work** pane with any of the following tabs:

Note The tabs that appear differ between components and configurations.

- **Overview**—Provides a general overview of cloud resources, configuration relationships, and settings of the component.
- **Cloud Resources**—Contains a list of subtabs that display the cloud resource information related to the component.
- **Configuration**—Contains one or more subtabs that display the configuration information related to the component.
- **Statistics**—Enables you to view statistics based on a chosen sampling interval and statistics type. The **Statistics** tab may contain subtabs, depending on the component you are viewing.
- **Event Analytics**—Contains a list of subtabs that display faults, events, and audit logs.

Note The dialog box that appears over the **work** pane contains an **edit** button in the top-right corner between the **refresh** button and the **Actions** button. When clicked, the **edit** button enables you to edit the chosen component.

Viewing Cloud Resource Details

This section explains how to view cloud resource details using the Cisco Cloud APIC GUI. The cloud resource details include the information about a specific region, availability zone, VPC, router, security group, endpoint, instance, and cloud service.

Step 1 From the **Navigation** menu, choose the **Cloud Resources** tab.

When the **Cloud Resources** tab expands, a list of subtab options appear. See the *Cloud Resource Options* table for more information.

Table 25: Cloud Resource Subtabs

Subtab Name	Description
Regions	Displays regions as rows in a summary table.
Availability Zones	Displays the availability zones as rows in a summary table.
VPCs	Displays VPCs as rows in a summary table.
Routers	Displays routers as rows in a summary table.
Security Groups	Displays security groups as rows in a summary table.
Endpoints	Displays endpoints as rows in a summary table.
Instances	Displays the instances as rows in a summary table.
Cloud Services	Contains the following subtabs: • **Cloud Services** Tab—Displays cloud services as rows in a summary table. • **Target Groups** Tab—Displays target groups as rows in a summary table.

Step 2 Click the tab that represents the component with the details you want to view.

A summary table appears with items as rows in the table. For example, if you chose the **Security Groups** subtab, a list of security groups appear as rows in a summary table

Note You can filter the rows by entering an attribute in the *Filter by Attributes* bar.

Step 3 To view a summary pane, click the row that represents the specific component you want to view.

Step 4 For more information, double-click the summary table row that represents the specific component you want to view.

A new dialog box appears over the **work** pane with any of the following tabs:

Note The tabs that appear differ between components and configurations.

- **Overview**—Provides a general overview of cloud resources, configuration relationships, and settings of the component.
- **Cloud Resources**—Contains a list of subtabs that display the cloud resource information related to the component.
- **Application Management**—Contains a list of subtabs that display the ACI relation information related to the component.
- **Statistics**—Enables you to view statistics based on a chosen sampling interval and statistics type. The **Statistics** tab may contain subtabs, depending on the component you are viewing.
- **Event Analytics**—Contains a list of subtabs that display faults, events, and audit logs.

Viewing Operations Details

This section explains how to view operations details using the Cisco Cloud APIC GUI. The operations details include the information of a specific fault, event, audit log, active sessions, backup and restore policies, tech support policies, firmware management, scheduler policies, and remote locations.

Step 1 From the **Navigation** menu, choose the **Operations** tab.

When the **Operations** tab expands, a list of subtab options appear. See the *Operations Options* table for more information.

Table 26: Operations Subtabs

Subtab Name	Description
Event Analytics	Contains the following subtabs: • **Faults** Tab—Displays faults as rows in a summary table. • **Events** Tab—Displays events as rows in a summary table. • **Audit Logs** Tab—Displays audit logs as rows in a summary table.
Active Sessions	Displays a list of active users as rows in a summary table.
Backup & Restore	Contains the following subtabs: • **Backups** Tab—Displays backups as rows in a summary table. • **Backup Policies** Tab—Displays backups as rows in a summary table. • **Job Status** Tab—Displays the job status as rows in a summary table. • **Event Analytics** Tab—Contains the following subtabs: • **Faults** Tab—Displays faults as rows in a summary table. • **Events** Tab—Displays events as rows in a summary table. • **Audit Logs** Tab—Displays audit logs as rows in a summary table.

Subtab Name	Description
Tech Support	Contains the following subtabs: • **Tech Support**Tab—Displays tech support policies as rows in a summary table. • **Core Logs** Tab—Displays core logs as rows in a summary table. • **Per-Feature Containers** Tab—Displays the per-feature containers as rows in a summary table.
Firmware Management	Contains the following subtabs: • **General** Tab—Displays general firmware management information. • **Images** Tab—Displays a list of images. • **Event Analytics** Tab—Contains the following subtabs: • **Faults** Tab—Displays faults as rows in a summary table. • **Events** Tab—Displays events as rows in a summary table. • **Audit Logs** Tab—Displays audit logs as rows in a summary table.
Schedulers	Displays scheduler policies as rows in a summary table.
Remote Locations	Displays remote locations as rows in a summary table.

Step 2 Click the tab that represents the component you want to view.

A summary table appears with items as rows in the table. For example, if you chose the **Active Sessions** subtab, a list of active sessions appear as rows in a summary table.

Note You can filter the rows by entering an attribute in the *Filter by Attributes* bar.

Step 3 To view a summary pane, click the row that represents the specific component you want to view.

Step 4 For more information, double-click the summary table row that represents the specific item you want to view.

A new dialog box appears over the **work** pane that displays additional information about the item you chose from the summary table.

Viewing Infrastructure Details

This section explains how to view infrastructure details using the Cisco Cloud APIC GUI. The infrastructure details include information about system configuration, inter-region connectivity, and external connectivity.

Step 1 From the **Navigation** menu, choose the **Infrastructure** tab.

When the **Infrastructure** tab expands, a list of subtab options appear. See the *Infrastructure Options* table for more information.

Table 27: Infrastructure Subtabs

Subtab Name	Description
System Configuration	Displays **General** system configuration information, **Management Access** information, **Controllers**, and **Event Analytics**.
Inter-Region Connectivity	Displays one pane with a map that contains the inter-site connectivity view and additional panes for each region.
On-Premises Connectivity	Displays one pane with a map that contains the inter-region connectivity view and additional panes for each region.

Step 2 Click the tab that represents the component with the details you want to view.

Viewing Administrative Details

This section explains how to view administrative details using the Cisco Cloud APIC GUI. The administrative details include the information about authentication, security, users, and smart licensing..

Step 1 From the **Navigation** menu, choose the **Administrative** tab.

When the **Administrative** tab expands, a list of subtab options appear. See the *Administrative Options* table for more information.

Table 28: Administrative Subtabs

Subtab Name	Description
Authentication	Displays the **Authentication Default Settings**, **Login Domains**, and **Providers** subtabs, which contain the information described below: • **Authentication Default Settings** Tab—Displays settings information. • **Login Domains** Tab—Displays the login domains as rows in a summary table. • **Providers** Tab—Displays the providers as rows in a summary table. • **Event Analytics** Tab—Displays the **Faults**, **Events**, and **Audit Logs** subtabs, each with the corresponding information displayed as rows in a summary table.
Security	Contains the following list of subtabs: • **Security Default Settings** Tab—Enables you to view the default security settings information. • **Security Domains** Tab—Enables you to view security domain information in a summary table. • Roles Tab—Enables you to view the role information in a summary table. • **RBAC Rules** Tab—Enables you to view RBAC rule information in a summary table. • Certificate Authorities Tab—Enables you to view the certificate authority information in a summary table. • **Key Ring** Tab—Enables you to view key ring information in a summary table.
Users	Contains the following subtabs: • **Local** Tab—Displays local users as rows in a summary table. • **Remote** Tab—Displays remote users as rows in a summary table.
Smart Licensing	Contains the following subtabs: • **General** Tab—Displays the licenses as rows in a summary table. • **Faults** Tab—Displays faults as rows in a summary table.

Step 2 Click the tab that represents the component you want to view.

For some options, a summary table appears with items as rows in the table (For example, if you choose the **Users** tab, a list of users appear as rows in a summary table). To view a summary pane, click the row that represents the specific component you want to view. To view more information, double-click the summary table row that represents the specific item you want to view. A new dialog box appears over the **work** pane that displays additional information about the item you chose from the summary table.

Note You can filter the rows by entering an attribute in the *Filter by Attributes* bar.

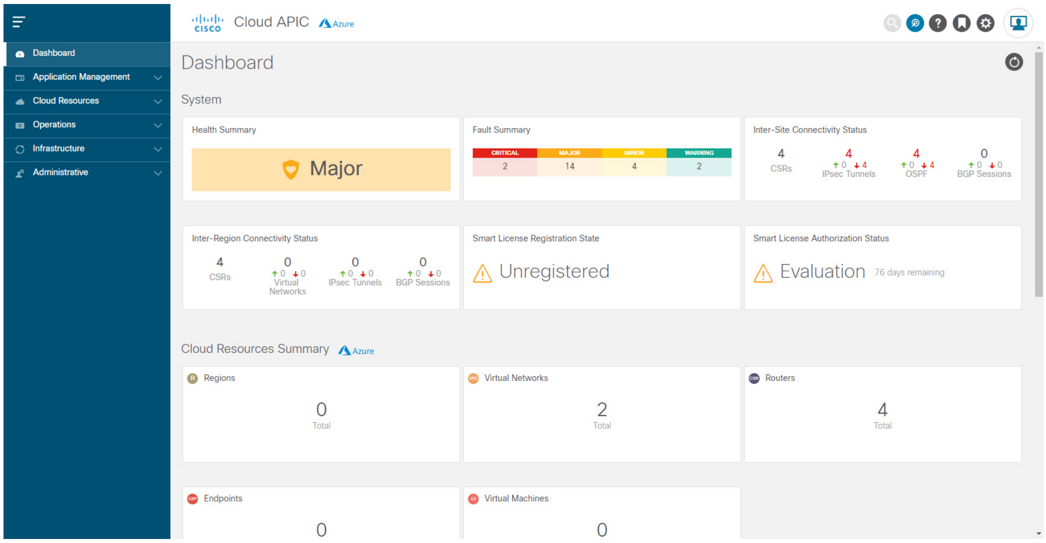
Viewing Health Details Using the Cisco Cloud APIC GUI

This section explains how to view health details using the Cisco Cloud APIC GUI. You can view health details for any object that you can see in the Cloud Resources area in the Cisco Cloud APIC GUI, such as the following:

- Regions
- Availability Zones (for AWS cloud sites)
- VPCs (for AWS cloud sites)
- VNETs (for Azure cloud sites)
- Routers
- Security Groups
- Endpoints
- Instances
- Cloud Services

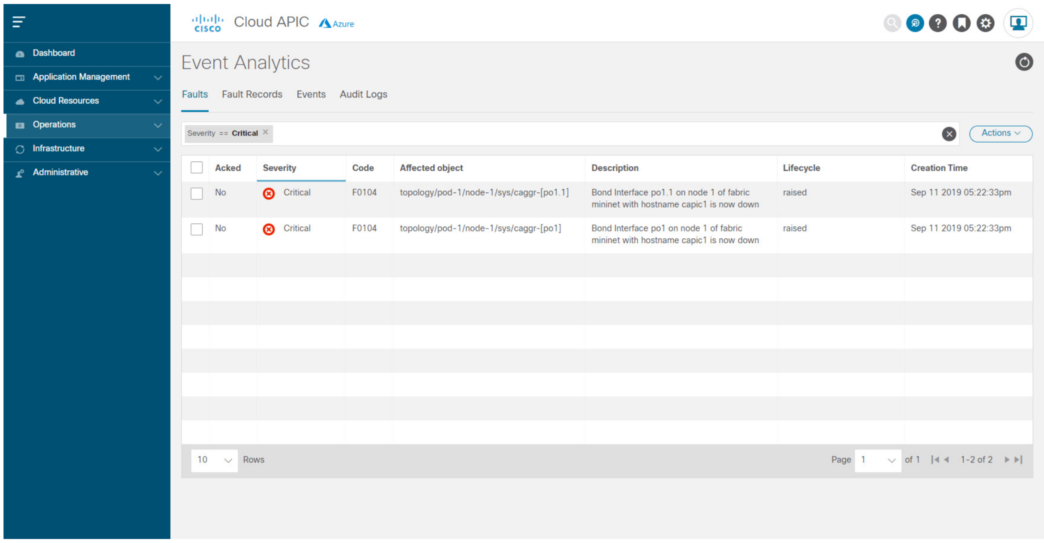
Step 1 From the **Navigation** menu, choose the **Dashboard** tab.

The **Dashboard** window for the Cisco Cloud APIC system appears. From this window, you can view the overall health status of your system.



Step 2 Click within the Fault Summary area in the **Dashboard** window.

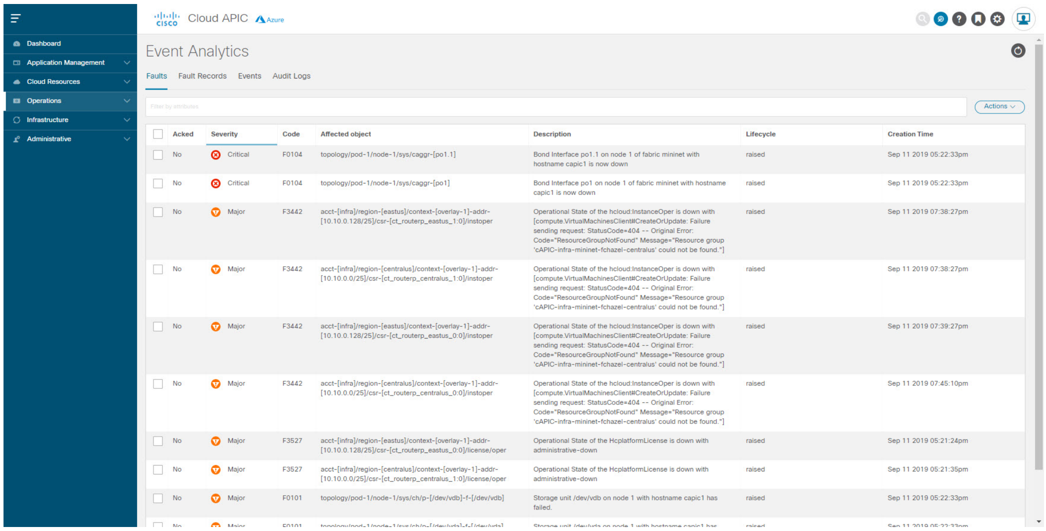
The **Event Analytics** window appears, showing more detailed information for the specific fault level that you clicked. The following screen shows an example **Event Analytics** window for the faults listed with critical severity.



□	Acked	Severity	Code	Affected object	Description	Lifecycle	Creation Time
□	No	⊗ Critical	F0104	topology/pod-1/node-1/sys/caggr-[po1.1]	Bond Interface po1.1 on node 1 of fabric mininet with hostname capic1 is now down	raised	Sep 11 2019 05:22:33pm
□	No	⊗ Critical	F0104	topology/pod-1/node-1/sys/caggr-[po1]	Bond Interface po1 on node 1 of fabric mininet with hostname capic1 is now down	raised	Sep 11 2019 05:22:33pm

Step 3 Click the **X** next to the Severity level to display Event Analytics information for all faults.

The information provided in the **Event Analytics** window changes to show the events with critical, major, and warning levels of severity.



Event Analytics

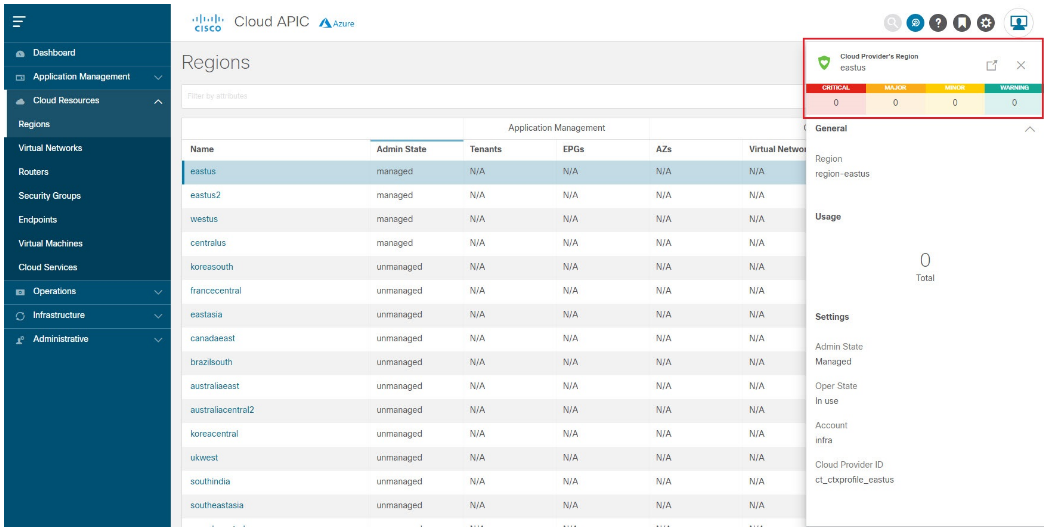
□	Acked	Severity	Code	Affected object	Description	Lifecycle	Creation Time
□	No	Critical	F0104	topology/pod-1/node-1/sys/caggr-[po1.1]	Bond Interface po1.1 on node 1 of fabric mininet with hostname capic1 is now down	raised	Sep 11 2019 05:22:33pm
□	No	Critical	F0104	topology/pod-1/node-1/sys/caggr-[po1]	Bond Interface po1 on node 1 of fabric mininet with hostname capic1 is now down	raised	Sep 11 2019 05:22:33pm
□	No	Major	F3442	acct-[infra]/region-[eastus]/context-[overlay-1]-addr-[10.10.0.128/25]/csr-[ct_routerp_eastus_1:0]/instoper	Operational State of the hcloud:InstanceOper is down with [compute.VirtualMachinesClient#CreateOrUpdate: Failure sending request: StatusCode=404 -- Original Error: Code="ResourceGroupNotFound" Message="Resource group 'cAPIC-infra-mininet-fchazel-centralus' could not be found."]	raised	Sep 11 2019 07:38:27pm
□	No	Major	F3442	acct-[infra]/region-[centralus]/context-[overlay-1]-addr-[10.10.0.0/25]/csr-[ct_routerp_centralus_1:0]/instoper	Operational State of the hcloud:InstanceOper is down with [compute.VirtualMachinesClient#CreateOrUpdate: Failure sending request: StatusCode=404 -- Original Error: Code="ResourceGroupNotFound" Message="Resource group 'cAPIC-infra-mininet-fchazel-centralus' could not be found."]	raised	Sep 11 2019 07:38:27pm
□	No	Major	F3442	acct-[infra]/region-[eastus]/context-[overlay-1]-addr-[10.10.0.128/25]/csr-[ct_routerp_eastus_0:0]/instoper	Operational State of the hcloud:InstanceOper is down with [compute.VirtualMachinesClient#CreateOrUpdate: Failure sending request: StatusCode=404 -- Original Error: Code="ResourceGroupNotFound" Message="Resource group 'cAPIC-infra-mininet-fchazel-centralus' could not be found."]	raised	Sep 11 2019 07:39:27pm
□	No	Major	F3442	acct-[infra]/region-[centralus]/context-[overlay-1]-addr-[10.10.0.0/25]/csr-[ct_routerp_centralus_0:0]/instoper	Operational State of the hcloud:InstanceOper is down with [compute.VirtualMachinesClient#CreateOrUpdate: Failure sending request: StatusCode=404 -- Original Error: Code="ResourceGroupNotFound" Message="Resource group 'cAPIC-infra-mininet-fchazel-centralus' could not be found."]	raised	Sep 11 2019 07:45:10pm
□	No	Major	F3527	acct-[infra]/region-[eastus]/context-[overlay-1]-addr-[10.10.0.128/25]/csr-[ct_routerp_eastus_0:0]/license/oper	Operational State of the HcplatformLicense is down with administrative-down	raised	Sep 11 2019 05:21:24pm
□	No	Major	F3527	acct-[infra]/region-[centralus]/context-[overlay-1]-addr-[10.10.0.0/25]/csr-[ct_routerp_centralus_1:0]/license/oper	Operational State of the HcplatformLicense is down with administrative-down	raised	Sep 11 2019 05:21:35pm
□	No	Major	F0101	topology/pod-1/node-1/sys/ch/p-[/dev/vdb]-f-[/dev/vdb]	Storage unit /dev/vdb on node 1 with hostname capic1 has failed.	raised	Sep 11 2019 05:22:33pm
□	No	Major	F0101	topology/pod-1/node-1/sys/ch/p-[/dev/vda]-f-[/dev/vda]	Storage unit /dev/vda on node 1 with hostname capic1 has	raised	Sep 11 2019 05:22:33pm

Step 4 From the **Navigation** menu, choose the **Cloud Resources** tab.

When the **Cloud Resources** tab expands, a list of subtab options appear. See the *Administrative Options* table for more information.

Step 5 Choose any item under the **Cloud Resources** tab to display health information for that component.

For example, the following figure shows health information that might be displayed when you click on **Cloud Resources** > **Regions**, then you select a specific region.



Regions

		Application Management			
Name	Admin State	Tenants	EPGs	AZs	Virtual Networ
eastus	managed	N/A	N/A	N/A	N/A
eastus2	managed	N/A	N/A	N/A	N/A
westus	managed	N/A	N/A	N/A	N/A
centralus	managed	N/A	N/A	N/A	N/A
koreasouth	unmanaged	N/A	N/A	N/A	N/A
francecentral	unmanaged	N/A	N/A	N/A	N/A
eastasia	unmanaged	N/A	N/A	N/A	N/A
canadaeast	unmanaged	N/A	N/A	N/A	N/A
brazilsouth	unmanaged	N/A	N/A	N/A	N/A
australiaeast	unmanaged	N/A	N/A	N/A	N/A
australiacentral2	unmanaged	N/A	N/A	N/A	N/A
koreacentral	unmanaged	N/A	N/A	N/A	N/A
ukwest	unmanaged	N/A	N/A	N/A	N/A
southindia	unmanaged	N/A	N/A	N/A	N/A
southeastasia	unmanaged	N/A	N/A	N/A	N/A

Cloud Provider's Region
eastus

CRITICAL	MAJOR	MINOR	WARNING
0	0	0	0

General

Region
region-eastus

Usage

0
Total

Settings

Admin State
Managed

Oper State
In use

Account
infra

Cloud Provider ID
ct_ctxprofile_eastus

CHAPTER 6

Deploying Layer 4 to Layer 7 Services

Overview

The Cisco Cloud APIC enables you to deploy Layer 4 to Layer 7 service devices to the public cloud. This initial release supports application load balancer (ALB) deployments in Amazon Web Services (AWS).

About Application Load Balancers

An application load balancer (ALB) is a Layer 7 load balancer that inspects packets and creates access points to HTTP and HTTPS headers. It also identifies the load and spreads it out to the targets with higher efficiency. You deploy an ALB using a service graph, which enables you to define how you want traffic to come into the network, the devices that the traffic passes through, and how the traffic leaves the network. You specify these actions by configuring one or more listeners.

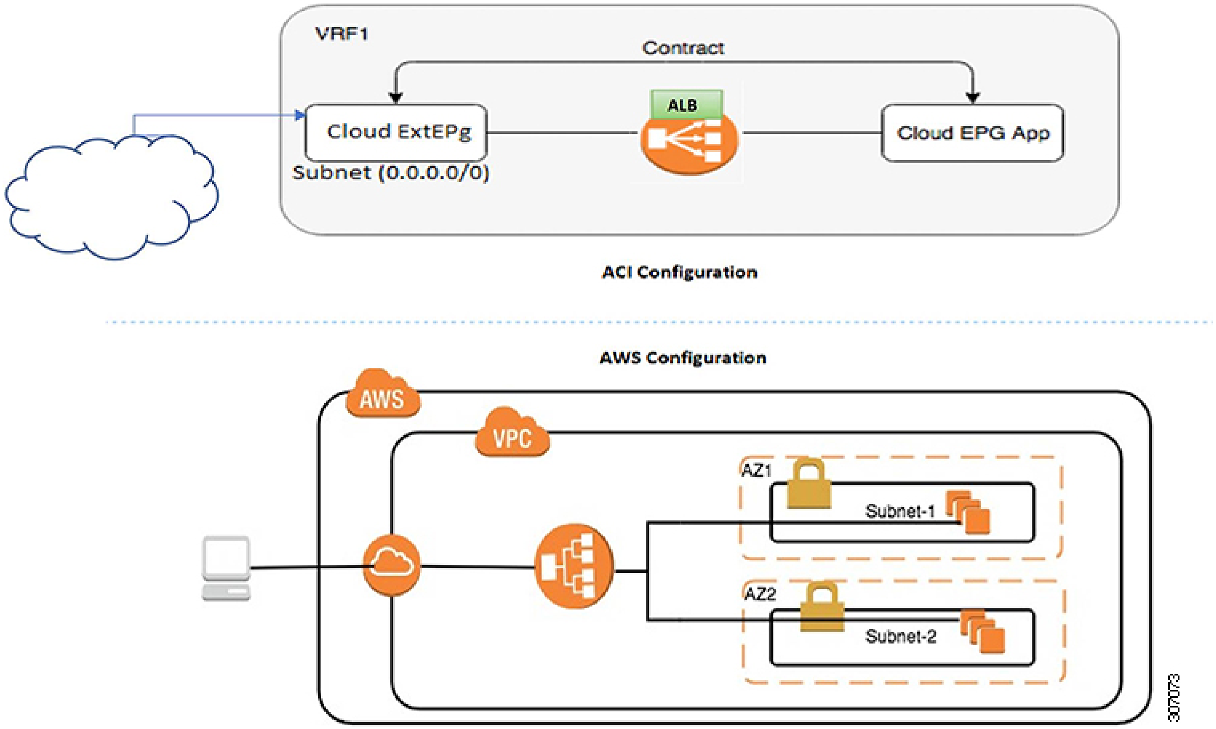
Listeners enable you to specify the ports and protocols (HTTP or HTTPS) that the ALB accepts traffic on. When specifying HTTPS, you also choose a security policy and an SSL certificate.

Note A listener can have multiple certificates.

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

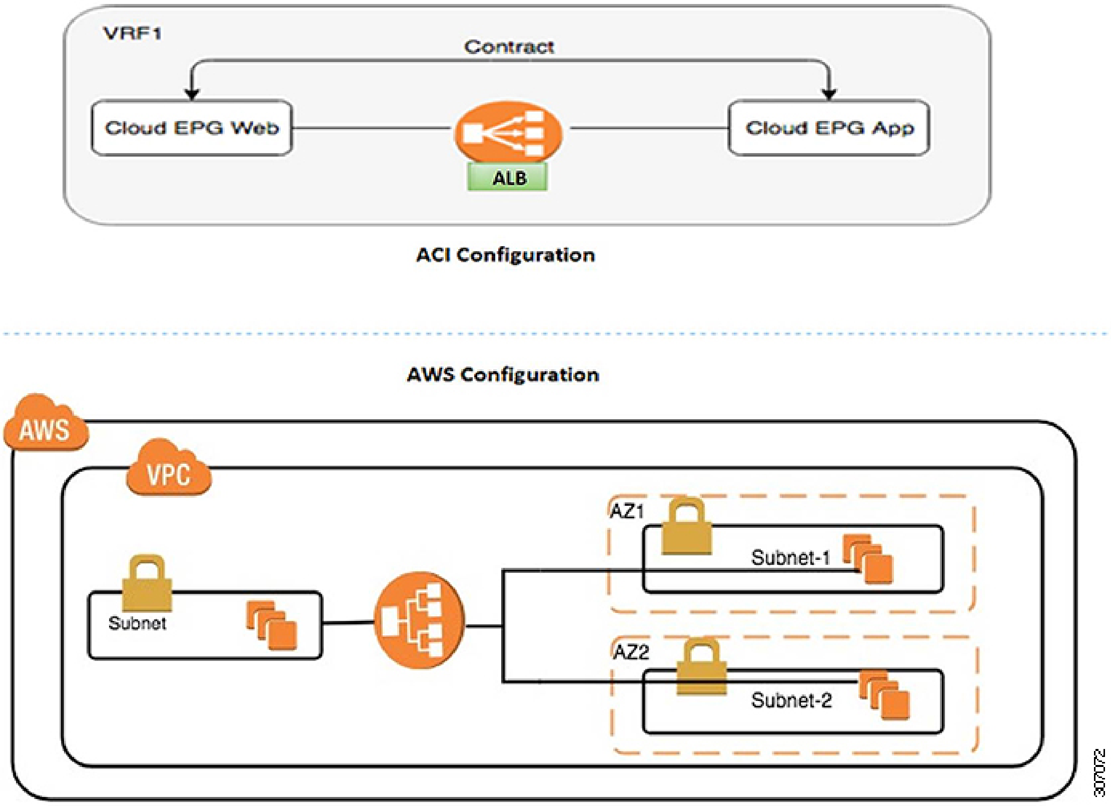
There are two deployment types: internet-facing and internal-facing. An internet-facing deployment inserts the ALB as a service between the consumer external EPG and the provider cloud EPG. The following figure shows the contract configuration within the VRF and the ALB as a service inserted between the consumer external EPG and the provider cloud EPG.

Figure 19: Internet-Facing Deployment



An internal-facing deployment inserts the ALB as a service between the consumer cloud EPG and the provider cloud EPG. The following figure shows the contract configuration within the VRF and the ALB as a service inserted between the consumer cloud EPG and provider cloud EPG.

Figure 20: Internal-Facing Deployment



Note You can find more information about ALBs in the documentation on the AWS website.

Dynamic Server Attachment to Server Pool

Servers in the server pool or target group are dynamically added. You do not need to specify the IP addresses or instance Ids for the targets. The relation from a listener rule to a provider cloud EPG is used for the dynamic selection of endpoints. The relation is also used for adding the endpoints to the target group. By default, the endpoints are registered with the port number 80.

Based on the target group-to-security group association that is provided in the ALB, and the EPG (security group) of the endpoint, the EC2 instance (server) is associated to the target group dynamically on the target group's default port. Alternatively, instead of registering the EC2 instance on the target group port, you can attach the custom port by specifying the ports in the following table:

Table 29: Custom Port-Based Attachment

Provider EPG	Ports
EPGMap:<Epg1DN>	9090

Provider EPG	Ports
EPGMap:<Epg2DN>	9091, 9099

You can specify EPGMap:<EpgDN> as the tag and the list of ports to be registered on the target group as a list separated by commas.

About Service Graphs

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

A service graph represents the network using the following elements:

- Function node—A function node represents a function that is applied to the traffic, such as a load balancer. 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.

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

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

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

Service graphs and service functions have the following characteristics:

- Traffic sent from specific endpoint groups can be redirected based on a policy.
- Service graph redirection is directional. In other words, redirection can be applied to both traffic directions or either one of them.
- Logical functions can be rendered on the appropriate 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.

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

About Function Nodes

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

A function node within a service graph requires the following parameters:

- A tenant
- A cloud context profile with subnets in two availability zones

Function parameters can be specified when the service graph is rendered. For example, if the function node is a load balancer, the listener and its rule can be specified for the function node at the time the graph is rendered.

About Terminal Nodes

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

Deploying a Service Graph

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

Before you can configure a service graph, you must first configure the following:

1. A tenant
2. A cloud context profile
3. Subnets
4. An application profile
5. A consumer EPG
6. A provider EPG
7. A contract

Deploying the Service Graph Using the Cloud APIC GUI

Creating a Load Balancer Using the Cisco Cloud APIC GUI

This section explains how to create a load balancer using the Cisco Cloud APIC GUI.

Step 1 Click **Application Management** > **Services**.

The **Services** page appears.

Step 2 Click the Devices tab, then click **Actions** > **Create Device**.

The **Create Device** page appears.

Step 3 Enter the appropriate values in each field as listed in the following *Create Device Dialog Box Fields* table then continue.

Table 30: Create Device Dialog Box Fields

Properties	Description
General	
Name	Enter the name of the load balancer.
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog appears. **b.** From the column on the left, click to choose a tenant. **c.** Click **Select**. You return to the **Create Device** dialog box.
Settings	
Service Type	Choose **Application Load Balancer**.
Scheme	Choose **Internal** or **Internet Facing**.
Add Availability Zone	You can specify only one subnet per availabilty zone. You must specifiy subnets from at least two availability zones to increase the availability of your load balancer. To choose an availability zone: **a.** Click **Add Availability Zone**. The **Add Availability Zone** dialog box appears. **b.** Click **Select Availability Zone**. The **Select Availability Zone** dialog box appears. **c.** From the column on the left, click to choose an availability zone. **d.** Click **Select**. You return to the **Add Availability Zone** dialog box.

Properties	Description
Subnet	For Cisco Cloud APIC deployed in AWS, two subnets are required (one subnet per availability zone). To choose a subnet: **a.** From the **Add Availability Zone** dialog box, click **Select Subnet**. The **Select Subnet** dialog box appears. **b.** From the column on the left, click to choose a subnet. **c.** Click **Select**. You return to the **Add Availability Zone** dialog box. **d.** Click **Add** to add the availability zone and subnet.

Step 4 Click **Save** when finished.

Creating a Service Graph Template Using the Cisco Cloud APIC GUI

This section explains how to configure a service graph template using the Cisco Cloud APIC GUI.

Before you begin

You have already created a device.

Step 1 Click **Application Management** > **Services**.

The **Services** page appears.

Step 2 Click the **Service Graphs** tab, then click **Actions** > **Create Service Graph**.

The **Create Service Graph** page appears.

Step 3 Enter the appropriate values in each field as listed in the following *Create Service Graph Dialog Box Fields* table then continue.

Table 31: Create Service Graph Dialog Box Fields

Properties	Description
General	
Name	Enter the name of service graph template.
Tenant	To choose a tenant: **a.** Click **Select Tenant**. The **Select Tenant** dialog appears. **b.** From the column on the left, click to choose a tenant. **c.** Click **Select**. You return to the **Create Service Graph** dialog box.

Properties	Description
Description	Enter a description of the service graph template.
Settings	
Select a Device	To choose a device: **a.** Drag and drop the Application Load Balancer icon to the **Drop Device** area in the service graph. The **Service Node** dialog box appears. **b.** Click **Select Application Load Balancer**. The **Select Application Load Balancer** dialog appears. **c.** From the column on the left, click to choose a device. **d.** Click **Select**. You return to the **Service Node** dialog box. **e.** Click **Add**. You return to the **Create Service Graph** window.

Step 4 Click **Save** when finished.

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

This section explains how to deploy Layer 4 to Layer 7 services.

Before you begin

- You have configured a device.
- You have configured a service graph.

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

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

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

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

Step 4 To choose a contract:

a) Click **Select Contract**. The **Select Contract** dialog appears.

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

Step 5 To add a consumer EPG:

a) Click **Add Consumer EPGs**. The **Select Consumer EPGs** dialog appears.

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

Step 6 To add a provider EPG:

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

Step 7 To choose a service graph:

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

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

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

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

Table 32: Add Cloud Load Balancer Listener Dialog Box Fields

Properties	Description
Name	Enter the name of the listener.
Port	Enter the port that the device will accept traffic on.
Protocol	Click to choose **HTTP** or **HTTPS**.
Security Policy	Click the drop-down list and choose a security policy (only available when **HTTPS** is chosen).

Properties	Description
SSL Certificate	To choose an SSL certificate(only available when **HTTPS** is chosen): **a.** Click **Add SSL Certificates**. **b.** Click to place a check mark in the check box of the certificates you want to add. **c.** Choose a key ring: **1.** Click **Select Key Ring**. The **Select Key Ring** dialog appears. **2.** From the **Select Key Ring** dialog, click to choose a key ring in the left column then click **Select**. The **Select Key Ring** dialog box closes. **d.** Click the **Certificate Store** drop-down list and choose a certificate. **Note** A listener can have multiple certificates.
Add Rule	To add rule settings to the device listener, click **Add Rule**. A new row appears in the **Rules** list an the **Rules Settings** fields are enabled.

Properties	Description
Rule Settings	

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

Properties	Description
	- **Redirect Hostname**—Enter a hostname for the redirect. - **Redirect Path**—Enter a redirect path. - **Redirect Port**—Enter the port that the device will accept traffic on. - **Redirect Protocol**—Click to the **Redirect Protocol** drop-down list and choose **HTTP**, **HTTPS**, or **Inherit**. - **Redirect Query**—Enter a redirect query. Click **Add Rule** when finished.

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

Deploying a Service Graph Using the REST API

Creating an Internal-Facing Load Balancer Using the REST API

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

To create an internal-facing load balancer:

Example:

```
<polUni>
  <fvTenant name="t2" status="">
    <cloudLB name="ALB1" type="application" scheme="internal" status="">
      <cloudRsLDevToCloudSubnet tDn="uni/tn-t2/ctxprofile-c1/cidr-[10.33.0.0/16]/subnet-[10.33.7.0/24]"
 status=""/>
      <cloudRsLDevToCloudSubnet tDn="uni/tn-t2/ctxprofile-c1/cidr-[10.33.0.0/16]/subnet-[10.33.8.0/24]"
 status=""/>
    </cloudLB>
  </fvTenant>
</polUni>
```

Configuring an Internet-Facing Load Balancer Using the REST API

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

To create an internet-facing load balancer:

Example:

```
<polUni>
  <fvTenant name="t2" status="">
    <cloudLB name="ALB1" type="application" scheme="internet" status="">
      <cloudRsLDevToCloudSubnet tDn="uni/tn-t2/ctxprofile-c1/cidr-[10.33.0.0/16]/subnet-[10.33.5.0/24]"
 status=""/>
      <cloudRsLDevToCloudSubnet tDn="uni/tn-t2/ctxprofile-c1/cidr-[10.33.0.0/16]/subnet-[10.33.6.0/24]"
 status=""/>
    </cloudLB>
  </fvTenant>
</polUni>
```

Creating a Service Graph Using the REST API

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

To create a service graph:

```
<polUni>
  <fvTenant name="t2">
    <vnsAbsGraph name="CloudGraph" type="cloud" status="">
      <vnsAbsTermNodeProv name="Input1">
        <vnsAbsTermConn name="C1"/>
      </vnsAbsTermNodeProv>
      <vnsAbsTermNodeCon name="Output1">
        <vnsAbsTermConn name="C2"/>
      </vnsAbsTermNodeCon>
      <vnsAbsNode funcType="GoTo" name="N1" managed="yes">
        <vnsRsNodeToCloudLDev tDn="uni/tn-t2/clb-ALB1" status=""/>
        <vnsAbsFuncConn name="provider"/>
        <vnsAbsFuncConn name="consumer"/>
      </vnsAbsNode>
      <vnsAbsConnection connDir="consumer" connType="external" name="CON2">
       <vnsRsAbsConnectionConns tDn="uni/tn-t2/AbsGraph-CloudGraph/AbsTermNodeCon-Output1/AbsTConn"/>

        <vnsRsAbsConnectionConns tDn="uni/tn-t2/AbsGraph-CloudGraph/AbsNode-N1/AbsFConn-consumer"/>
      </vnsAbsConnection>
      <vnsAbsConnection connDir="provider" connType="internal" name="CON1">
       <vnsRsAbsConnectionConns tDn="uni/tn-t2/AbsGraph-CloudGraph/AbsTermNodeProv-Input1/AbsTConn"/>

        <vnsRsAbsConnectionConns tDn="uni/tn-t2/AbsGraph-CloudGraph/AbsNode-N1/AbsFConn-provider"/>
      </vnsAbsConnection>
    </vnsAbsGraph>
  </fvTenant>
</polUni>
```

Attaching a Service Graph Using the REST API

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

To attach a service graph:

```
<polUni>
  <fvTenant name="t2">
    <vzBrCP name="httpFamily">
      <vzSubj name="default" revFltPorts="yes" targetDscp="unspecified">
        <vzRsSubjGraphAtt tnVnsAbsGraphName="CloudGraph"/>
      </vzSubj>
    </vzBrCP>
  </fvTenant>
</polUni>
```

Configuring an HTTP Service Policy Using the REST API

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

To create an HTTP service policy:

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

Configuring a Key Ring Using the REST API

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

To configure a key ring:

```
<polUni>
  <fvTenant name="t2">
    <cloudCertStore>
      <pkiKeyRing status="" name="lbCert" tp="lbTP" key="-----BEGIN RSA PRIVATE KEY-----
MIIEpQIBAAKCAQEA4DGxaK+RHv/nToHLnmDBq2BfLimgX/zNJQC9bGuzr8Mj7dm0
XuHfQYGv0h1PtL4Pdxf5qjB0NbHjAVB1Gw8cDiErEgAXy9Km27ySo2foKryNqCRe
Ginn/CgF75QPIed568eScNDZPt/eMeHAuRX/PykKUatWWncGanjvHqc+SOLPF6TD
gQ5nwOHHFvyM2DY8bfdYWrWmGsO7JqZzbPMptA2QWblILsSoIrdkIIgf6ZfYy/EN
bH+nYN2rJT8lzYsxz0YmR0oRQHTiN2NiDY/ZV63yxCXfLg9qpNZCuD8KOfdCZPEq
8takiWBxiR5/HRPscWAdWQsoiKgG1k4NEbFA9QIDAQABAoIBAQDQqA9IslYrdtqN
q6mZ3s2BNfF/4kgb7gn0DWs+9EJJLCJNZVhFEo2ZxxyfPp6HRnjYS50W83/E1anD
+GD1bSucTuxqFWIQVh7r1ebYZIWk+NYSjr5yNVxux8U2hCNNV8WWVqkJjKcUqICB
Bm47FKj53LV46zE0gyCaibFrYxZJ9+farGneyBdnoV+3thmez7534KCi0t3J3Eri
lgSY3ql6hPXB2ZXAP4jdAoLgWDU4I1M6OqOiWopZM/QYIE/WtPYyJ0QzNCXObtc5
FboDcvedsgd4x5GlfV2A4xTBQMCTZUZJ9fYAcFogTZXD+UVqxorh47tf/mz+1fjq
f1XphEDlAoGBAPVlvKfGW46qqRnYovfryxxz4OMlsVSgcJpQTQtBQi2koJ8OwEZJ
2s+CX0r+oDqwP23go/QEVYVkcic9RGkJBNge1+dm/bTjzgMQYtqSCNtecTsZD5JN
y1jkciizznDkjcjReSZ2kh3dGXIbRiYk7ezp2z7EKfDrHe5x5ouGMgCnAoGBAOnh
buDEohv8KJaB+DiUfhtoa3aKNPBO+zWPCHp0HFGjPXshJcIYZc1GcycmuDKVNnDd
MxhE/yOnQHowi4T9FMLpz5yh5zuCUVqOBgB1P6MzbC5t5MtLrEYr/AqFN11CqyXQ
cVcT6iCW1OAFJRw3c/OiESwLMzchsl8RnbwOi6kDAoGBANVlzmPb07zB3eGTCU0t
KGiqwFLncUkVaDZZRFZYPpNwiRkoe73j9brkNbgCqxW+NLp5UjoeFry0N6y106q/
ZA4I7FnXryLBw2HYuw41Vixl+XOZ/HeO3RmFN1z717dGmaGbv43aKIB9x+X5n8wF
6z1NtBHmBk7yNwom1IRag1sbAoGAX0p4cJ/tJNXSe7AswHDQCL68uimJdDfZ5nKG
k83nE+Qc0qQozDJAmCiSFmuSNRnSep3FiafjBFXK0X4h+mdbJCc7bagRnI92Mh0X
mOwsp4P2GdywkZwdbuHQ6UBp1Ferf9aztzTn+as6xKOUATEezy9DK9zMWzQhhtaY
m9yZTp0CgYEA1UtcpWjAzQbXODJGmxGdAAakPpeiKw/Da3MccrTdGJt88ezM1Oej
Pdoab0G2PcfgJZoTSGk7N4XArVKeq7pgZ0kwcYAshO6A2Hal+D1z/bGoZP+kmD/x
Ny82phxYOXCnEc5Vv92lU59+j7e067UFLAYJe6fu+oFImvofRnP4DIQ= -----END RSA PRIVATE KEY-----" cert="-----BEGIN
 CERTIFICATE----- MIIElTCCA32gAwIBAgIJAKWNjp//arBsMA0GCSqGSIb3DQEBCwUAMIGNMQswCQYD
VQQGEwJVUzELMAkGA1UECBMCQ0ExETAPBgNVBAcTCFNhbiBKb3NlMRIwEAYDVQQK
EwlNeUNvbXBhbnkxDjAMBgNVBAsTBU15T3JnMRgwFgYDVQQDFA8qLmFtYXpvbmF3
cy5jb20xIDAeBgkqhkiG9w0BCQEWEXJhbXNoYWhAY2lzY28uY29tMB4XDTE4MTAw
MjIwNTMwNVoXDTE5MTAwMjIwNTMwNVowgY0xCzAJBgNVBAYTAlVTMQswCQYDVQQI
EwJDQTERMA8GA1UEBxMIU2FuIEpvc2UxEjAQBgNVBAoTCU15Q29tcGFueTEOMAwG
A1UECxMFTXlPcmcxGDAWBgNVBAMUDyouYW1hem9uYXdzLmNvbTEgMB4GCSqGSIb3
DQEJARYRcmFtc2hhaEBjaXNjby5jb20wggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAw
ggEKAoIBAQDgMbFor5Ee/+dOgcueYMGrYF8uKaBf/M0lAL1sa7OvwyPt2bRe4d9B
ga/SHU+0vg93F/mqMHQ1seMBUHUbDxwOISsSABfL0qbbvJKjZ+gqvI2oJF4aKef8
KAXvlA8h53nrx5Jw0Nk+394x4cC5Ff8/KQpRq1ZadwZqeO8epz5I4s8XpMOBDmfA
4ccW/IzYNjxt91hataYaw7smpnNs8ym0DZBZuUguxKgit2QgiB/pl9jL8Q1sf6dg
3aslPyXNizHPRiZHShFAdOI3Y2INj9lXrfLEJd8uD2qk1kK4Pwo590Jk8Sry1qSJ
YHGJHn8dE+xxYB1ZCyiIqAbWTg0RsUD1AgMBAAGjgfUwgfIwHQYDVR0OBBYEFBYq
K3b39+1oOr4IBSsePwcOpML7MIHCBgNVHSMEgbowgbeAFBYqK3b39+1oOr4IBSse
PwcOpML7oYGTpIGQMIGNMQswCQYDVQQGEwJVUzELMAkGA1UECBMCQ0ExETAPBgNV
BAcTCFNhbiBKb3NlMRIwEAYDVQQKEwlNeUNvbXBhbnkxDjAMBgNVBAsTBU15T3Jn
MRgwFgYDVQQDFA8qLmFtYXpvbmF3cy5jb20xIDAeBgkqhkiG9w0BCQEWEXJhbXNo
YWhAY2lzY28uY29tggkApY2On/9qsGwwDAYDVR0TBAUwAwEB/zANBgkqhkiG9w0B
AQsFAAOCAQEAe/RuzCheLIbHbrurGet6eaVx9DPYydNiKVBSAKO+5iuR84mQzhoT
nx5CN109xu5ml5baCYZZsSnn6D7usC092bPA/kRCGxt29gkjpWA74tJHqIhVWgbM
mOrLiSHoelewv+wRl0oVRChlTfKtXO68TUk6vrqpw76hKfOHIa7b2h1IIMdq6VA/
+A5FQ0xqYfqKdVd2RaINpzI8mqZiszqw+7E6j1PL5k4tftWEaYpfGPlVesFEyJEL
gHBUiPt8TIbaMYI8qUQmB/emnLXeKQ5PRxdRnleA3h8jfq3D1CQRTLjmDL3tpFwg qopM6et5ZKqShX4T87BsgZIoiquzXqsuHg==
 -----END CERTIFICATE-----">
      </pkiKeyRing>
      <pkiTP status="" name="lbTP" certChain="-----BEGIN CERTIFICATE-----
MIIElTCCA32gAwIBAgIJAKWNjp//arBsMA0GCSqGSIb3DQEBCwUAMIGNMQswCQYD
VQQGEwJVUzELMAkGA1UECBMCQ0ExETAPBgNVBAcTCFNhbiBKb3NlMRIwEAYDVQQK
EwlNeUNvbXBhbnkxDjAMBgNVBAsTBU15T3JnMRgwFgYDVQQDFA8qLmFtYXpvbmF3
cy5jb20xIDAeBgkqhkiG9w0BCQEWEXJhbXNoYWhAY2lzY28uY29tMB4XDTE4MTAw
```

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

Creating an HTTPS Service Policy Using the REST API

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

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

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

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

Before you begin

You have already configured a key ring certificate.

To create an HTTPS service policy:

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

CHAPTER 7

Cisco Cloud APIC Statistics

About Cisco Cloud APIC Statistics

The Cisco Cloud APIC supports stats that are collected from the cloud routers. Additionally, it supports stats that are derived by processing AWS flow logs. Because AWS flow logs is not a free service, the Cisco Cloud APIC provides a policy that allows you to control this feature. This feature is not enabled by default.

See the AWS documentation for more information about CloudWatch and flow logs.

AWS Networking Interface Statistics Collection

AWS provides the nonreal-time IP traffic information per network interface through flow logs. Cisco Cloud APIC provides a policy for enabling flow logs per `cloudCtxProfile`. Because the `cloudCtxProfile` maps to a VPC in AWS, enabling flow logs per `cloudCtxProfile` or VPC means that you enabled flow logs for each interface belonging to that VPC. Once flow logs are enabled, flow records are periodically pushed to AWS Cloudwatch. The Cisco Cloud APIC then periodically polls AWS CloudWatch for these flow records and parses these records to extract statistics. Because it can take up to 15 minutes to publish flow records to CloudWatch, the Cisco Cloud APIC delays its flow logs query to CloudWatch by 15 minutes too. This means that there is a lag between the flow logs being present in CloudWatch and the corresponding statistics showing up on the Cisco Cloud APIC. Cisco Cloud APIC does not process flow records that take longer than 15 minutes to publish to CloudWatch.

Cisco Cloud APIC Endpoints and cloudEPg Statistics Processing

The Cisco Cloud APIC extracts the following statistics for each AWS networking endpoint that has flow logs present in CloudWatch:

- Number of bytes or packets sent
- Number of bytes or packets received
- Number of bytes or packets rejected

These statistics are associated with the `cloudEpInfoHolder` observable.

Also, the Cisco Cloud APIC maps the flow log records to one or more per region `cloudEPg` objects. This is because a `cloudEPg` can be present in multiple regions. These statistics are associated with the `cloudRgInfoHolder` observable. This observable is a child of `cloudEPg` and the accumulation of statistics for the cloudRgInfoHolder children results in statistics for `cloudEPg`. The `cloudEPg` supports the following statistics:

- Number of bytes or packets sent
- Number of bytes or packets received
- Number of bytes or packets rejected

The `cloudEPg` statistics are aggregated up `fvApp` and then up `fvTenant`.

Cisco Cloud APIC Statistics Filters

Beginning in Cisco Cloud Application Policy Infrastructure Controller Release 5.0(1), you can use filters to see specific information from the Amazon Web Services (AWS) flow logs.

Statistics are collected for each endpoint on which the filter is deployed. The filters enable you to see information about a flow, filtered by a combination of source or destination IP address, port, and protocol. You can define up to eight filters for a given AWS log group at the same time.

A statistics filter has the following three attributes:

- **PeerIP:** The IPv4 address to filter
- **PeerPort:** The port number to listen to
- **Protocol:** The protocol number to listen to

Note We recommend that you configure statistics filters using the Cisco Cloud APIC GUI. You can alternatively use REST API; however, if you do and then switch to the GUI, the feature will appear incomplete. You should stick to the method that you choose.

Use of statistics filters depend on enabling Virtual Private Cloud (VPC) flow log; you must enable the logs before you configure the statistics filters.

Flow logs, which are stored in AWS CloudWatch, consist of flow log records. Cisco Cloud Application Policy Infrastructure Controller (APIC) extracts statistics by parsing the flow log records.

It can take up to 15 minutes from the occurrence of a particular flow record to its being present in AWS CloudWatch. Cisco Cloud APIC polls for flow records that occurred 15 minutes or more in the past. It does not process flow records that take longer than 15 minutes to appear in AWS CloudWatch.

AWS Transit Gateway Statistics

You can collect statistics for traffic going through Amazon Web Services (AWS) Transit Gateways on both the infra tenant and the user tenant. Statistics reported for user tenant represent the traffic of an attachment between an user VPC and an AWS Transit Gateway. Statistics reported from infra tenant represents the traffic of an attachment between an infra VPC and a Transit Gateway.

The following statistics are collected for AWS Transit Gateway:

- Ingress packets
- Ingress packet bytes
- Ingress packet drops
- Ingress packet drop bytes
- Egress packets
- Egress packet bytes
- Egress packet drops
- Egress packet drop bytes

You can enable infra tenant Transit Gateway statistics collection from the Cisco Cloud Application Policy Infrastructure Controller **Setup - Region Management** page. See the section "Set Up the Cloud Site to Use AWS Transit Gateway" in *Increasing Bandwidth Between VPCs by Using AWS Transit Gateway*.

You can enable user tenant Transit Gateway statistics collection by enabling flow logs on the user VPC. See the sections Enabling VPC Flow Logs, on page 119 and Enabling VPC Flow Logs Using the Cisco Cloud APIC GUI, on page 120 in this guide.

To view AWS Transit Gateway statistics, in the Cisco Cloud APIC GUI, click the **Statistics** tab and then click **AWS Transit Gateway** in the left navigation pane. The central pane displays the information.

Enabling VPC Flow Logs

Steps to enable VPC Flow Logs:

1. Define a log group policy.
2. Define a flow log policy and associate the log group that you defined in the first step.
3. Associate the flow log policy to one or more `cloudCtxProfile`.

Log group properties:

- **name**—The location in CloudWatch where flow logs are sent.

Note The actual log group name that is programmed in AWS is the concatenation of `<tenant name><cloudCtxProfile name><log group name>`.

- **retention**—The length of duration for storing the logs in CloudWatch. The default is 5-days.

Flow log properties:

- **trafficType**—The type of traffic to collect. Supported types are **all**, **accepted only,** and **rejected only**. The default is **all**.

Enabling VPC Flow Logs Using the Cisco Cloud APIC GUI

This section explains how to enable VPC flow logs using the Cisco Cloud APIC GUI.

Step 1 Click the **Navigation** menu and choose **Application Management** > **Tenants**.

The **Tenants** window appears with the tenants listed as rows in a summary table.

Step 2 Double-click on a tenant.

The tenant dialog box appears over the Work pane. The tenant dialog box displays the **Overview**, **Cloud Resources**, **Application Management**, **Statistics**, and **Event Analytics** tabs.

Step 3 Click the **Statistics** tab.

The **EPGs**, **CSRs**, and **Flow Log Collection** subtabs appear.

Step 4 Click **Flow Log Collection**.

The **Flow Log Collection Settings** information appears at the top of the dialog box with the **edit** icon in the top-right corner.

Step 5 Click the **edit** icon.

The **Flow Log Collection Settings** dialog box appears.

Step 6 Enter the appropriate values in each field as listed in the following *Flow Log Collection Settings Dialog Box Fields* table then continue.

Table 33: Flow Log Collection Settings Dialog Box Fields

Properties	Description
Type of Traffic to be Logged	Click the **Type of Traffic to be Logged** drop-down list and choose one of the following options: • **All Traffic** (default) • **Accepted Only Traffic** • **Rejected Only Traffic**
Destination	Click the **Destination** drop-down list and choose **CloudWatch** (default).

Properties	Description
Retention	Click the **Retention** drop-down list and chose from the following options: • **1 day** • **3 days** • **5 days** (default) • **1 month** • **13 months** • **18 months** • **2 months** • **3 months** • **4 months** • **5 months** • **6 months** • **1 week** • **2 weeks** • **1 year** • **10 years** • **2 years** • **5 years**

Step 7 When finished, click **Save**.

Enabling VPC Flow Logs Using the REST API

This section demonstrates how to enable VPC flow logs using the REST API.

Step 1 Create a log group:

```
<cloudAwsLogGroup name="lg1" retention="days-3" status="">
    </cloudAwsLogGroup>
```

Step 2 Create a flow log policy:

```
<cloudAwsFlowLogPol name="flowLog1" trafficType="ALL" status="">
```

```
    <cloudRsToLogGrp tDn="uni/tn-t20/loggrp-lg1" status=""/>
</cloudAwsFlowLogPol>
```

Step 3 Create a relationship from a CtxProfile to a flow log policy:

```
<cloudCtxProfile name=" vrf1" status="">
  <cloudRsCtxToFlowLog tnCloudAwsFlowLogPolName="flowLog1" status=""/>
</cloudCtxProfile>
```

Cloud Router Statistics

These statistics are available for the cloud router:

- Ingress packets
- Egress packets
- Ingress bytes
- Egress bytes

The Cisco Cloud APIC collects and stores the cloud router statistics by the following granularities:

- 15-minutes
- 1-hour
- 1-month
- 1-year

Collection Mechanism

Each cloud router instance captures and stores the previously mentioned 4-stat values for each physical and tunnel interface.

The Cisco Cloud APIC queries the cloud routers for these statistics and maps the response to cloud router statistics on the Cisco Cloud APIC. The statistics query repeats every 5 minutes for as long as the tunnel is up and operational.

Raw Statistics

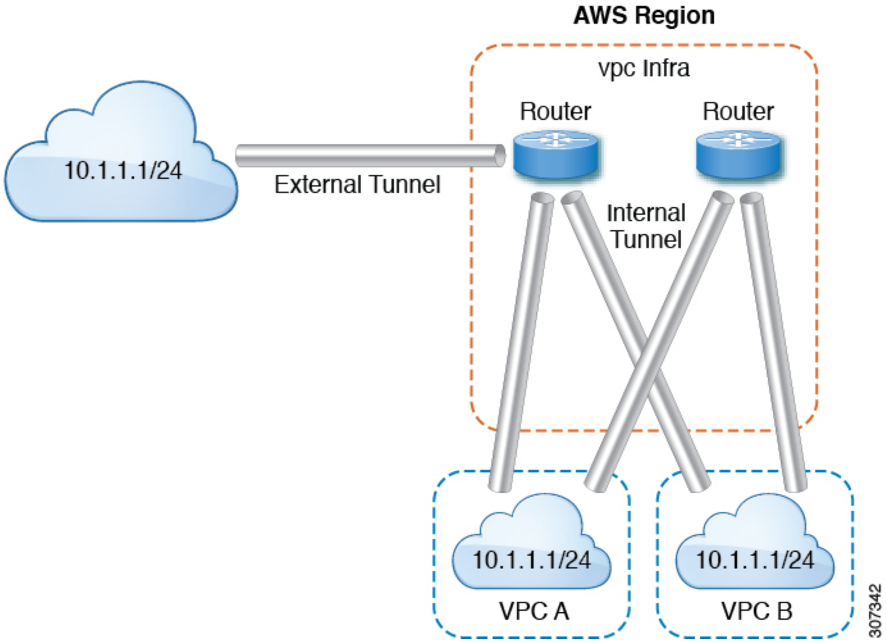
The raw statistics are stored under 2 Dns:

- `uni/tn-<infraTenant>/ctx-<infraCtx>/region-<infraRegion>/router-<csrname>/to-<ip or user-region>/tunn-<tunnel-id>`
- `uni/tn-<userTenant>/ctx-<userCtx>/region-<userRegion>/region-<infraRegion>/router-<csrname>/tunn-<tunnel-id>`

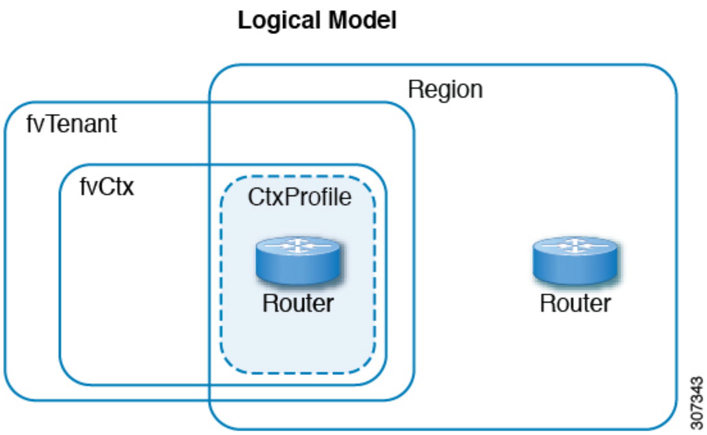
Note

- The second Dn holder is the statistics as seen from the user endpoints connected to the cloud router. These statistics are hence flipped (Ingress on the CSR becomes egress on the user region)
- Not all tunnels have a corresponding user dn. This is only applicable to internal tunnels. External tunnels statistics are only available on the 1st Dn.

In the following figure, internal tunnels are between the user VPC and infra VPC. The infra VPC contains the host router. The user VPC can contain the host or VGW router. The infra creates these tunnels. The tunnels are not explicitly configured. As a result, statistics are available for both the infra side and the user side. External tunnels are between infra VPC and an external IP address. Statistics are only available on the infra side (Dn-1).



In the logical model diagram, a tenant can be infra or a user tenant. You configure a VRF (or `fvCtx`) to be inside a tenant (per tenant). A VRF can be within one region or span across multiple regions.



Aggregated Statistics

Statistics are aggregated at each parent level of the DN. For the preceding case, statistics on tunnel, statistics are aggregated on to the destination IP, cloud router, region, vrf (`ctx`), and tenant.

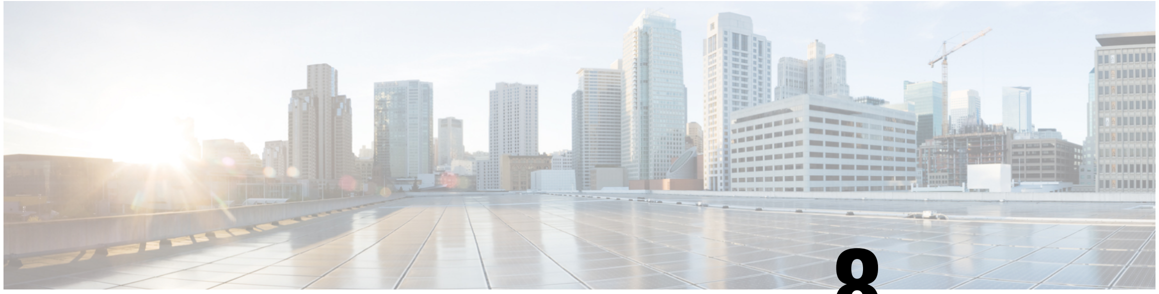
For example, if you want to find the egress packets from the infra cloud router to a user region, it is available under `uni/tn-<infraTenant>/ctx-<infraCtx>/region-<infraRegion>/router-<csrname>/to-<ip or user-region>/`

If you want to get all the packets between user region1 and infra region2, it is available under `uni/tn-<userTenant>/ctx-<userCtx>/region-<userRegion>/region-<infraRegion>/`

Also, if you want to find statistics per `cloudCtxProfile`, it is available under `uni/tn-<userTenant>/ctx-<userCtx>/region-<userRegion>/` or `uni/tn-<infraTenant>/ctx-<infraCtx>/region-<infraRegion>/`.

Cloud Router GUI Statistics

On the UI, statistics are available under the tenant, VRF, infra region, and `cloudCtxProfile`.



CHAPTER 8

Cisco Cloud APIC Security

This chapter contains the following sections:

Access, Authentication, and Accounting

Cisco Cloud Application Policy Infrastructure Controller (Cloud APIC) policies manage the authentication, authorization, and accounting (AAA) functions. The combination of user privileges, roles, and domains with access rights inheritance enables administrators to configure AAA functions at the managed object level in a granular fashion. These configurations can be implemented using the REST API or the GUI.

Note There is a known limitation where you cannot have more than 32 characters for the login domain name. In addition, the combined number of characters for the login domain name and the user name cannot exceed 64 characters.

For more access, authentication, and accounting configuration information, see ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Configuration

The admin account is configured in the initial configuration script, and the admin is the only user when the system starts.

Configuring a Local User

Refer to Creating a Local User Using the Cisco Cloud APIC GUI, on page 78 to configure a Local User and associate it to the OTP, SSH Public Key, and X.509 User Certificate using the Cisco Cloud APIC GUI.

Configuring TACACS+, RADIUS, LDAP and SAML Access

The following topics describe how to configure TACACS+, RADIUS, LDAP and SAML access for the Cisco Cloud APIC.

Overview

This topic provides step-by-step instructions on how to enable access to the Cisco Cloud APIC for RADIUS, TACACS+, LDAP, and SAML users, including ADFS, Okta, and PingID.

For additional TACACS+, RADIUS, LDAP, and SAML information, see ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Configuring Cloud APIC for TACACS+ Access

Before you begin

- The Cloud Application Policy Infrastructure Controller (Cloud APIC) is online.
- The TACACS+ server host name or IP address, port, and key are available.
- The Cloud APIC management endpoint group is available.

Step 1 In the Cloud APIC, create the **TACACS+ Provider**.

a) Click the **Global Create** icon.

The **Global Create** menu appears.

b) Scroll down until you see the **Administrative** area, then click **Create Provider** under the **Administrative** area.

The **Create Provider** dialog box appears.

c) In the **Host Name/IP Address** field, enter the Host Name/IP Address of the provider.
d) In the **Description** field, enter a description of the provider.
e) Click the **Type** drop-down list and choose **TACACS+**.
f) In **Settings** section, specify the **Key**, **Port**, **Authentication Protocol**, **Timeout**, **Retries**, **Management EPG**. Select either **Enabled** or **Disabled** for **Server Monitoring**.

Step 2 Create the **Login Domain** for TACACS+.

a) Click the **Global Create** icon.

The **Global Create** menu appears.

b) Click the drop-down arrow below the **Global Create** search box and choose **Administrative**.

A list of **Administrative** options appear in the **Global Create** menu.

c) From the **Administrative** list in the **Global Create** menu, click **Create Login Domain**.

The **Create Login Domain** dialog box appears.

d) Enter the appropriate values in each field as listed in the following *Create Login Domain Dialog Box Fields* table then continue.

Properties	Description
General	
Name	Enter the name of the Login Domain
Description	Enter the description of the Login Domain.
Settings	
Realm	Choose **TACACS+** from the dropdown menu
Providers	To choose a Provider(s): **1.** Click **Add Providers**. The **Select Providers** dialog appears. **2.** Click to choose a provider(s) in the column on the left. **3.** Click **Select**. You return to the **Create Login Domain** dialog box.

e) Click **Save** to save the configuration.

What to do next

This completes the APIC TACACS+ configuration steps. Next, if a RADIUS server will also be used, configure the APIC for RADIUS.

Configuring Cloud APIC for RADIUS Access

Before you begin

- The Cloud Application Policy Infrastructure Controller (Cloud APIC) is online.
- The RADIUS server host name or IP address, port, and key are available.
- The Cloud APIC management endpoint group is available.

Step 1 In the Cloud APIC, create the **RADIUS Provider**.

a) Click the **Global Create** icon.

The **Global Create** menu appears.

b) Scroll down until you see the **Administrative** area, then click **Create Provider** under the **Administrative** area.

The **Create Provider** dialog box appears.

c) In the **Host Name/IP Address** field, enter the Host Name/IP Address of the provider.

d) In the **Description** field, enter a description of the provider.

e) Click the **Type** drop-down list and choose **RADIUS**.

f) In the **Settings** section, specify the **Key**, **Port**, **Authentication Protocol**, **Timeout**, **Retries**, **Management EPG**. Select either **Enabled** or **Disabled** for **Server Monitoring**.

Step 2 Create the **Login Domain** for **RADIUS**.

a) Click the **Global Create** icon.

The **Global Create** menu appears.

b) Click the drop-down arrow below the **Global Create** search box and choose **Administrative**

A list of **Administrative** options appear in the **Global Create** menu.

c) From the **Administrative** list in the **Global Create** menu, click **Create Login Domain**.

The **Create Login Domain** dialog box appears.

d) Enter the appropriate values in each field as listed in the following *Create Login Domain Dialog Box Fields* table then continue.

Properties	Description
General	
Name	Enter the name of the Login Domain
Description	Enter the description of the Login Domain.
Settings	
Realm	Choose **RADIUS** from the dropdown menu
Providers	To choose a Provider(s): **1.** Click **Add Providers**. The **Select Providers** dialog appears. **2.** Click to choose a provider(s) in the column on the left. **3.** Click **Select**. You return to the **Create Login Domain** dialog box.

e) Click **Save** to save the configuration.

What to do next

This completes the Cloud APIC RADIUS configuration steps. Next, configure the RADIUS server.

Configuring a Cisco Secure Access Control Server for RADIUS and TACACS+ Access to the Cloud APIC

Refer to the section *Configuring a Cisco Secure Access Control Server for RADIUS and TACACS+ Access to the APIC*in the ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Configuring LDAP Access

There are two options for LDAP configurations:

- Configure a Cisco AVPair
- Configure LDAP group maps in the cloud APIC

The following sections contain instructions for both configuration options.

Configuring Windows Server 2008 LDAP for APIC Access with Cisco AVPair

Refer to the section *Configuring Windows Server 2008 LDAP for APIC Access with Cisco AVPair* in the ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Configuring Cloud APIC for LDAP Access

Before you begin

- The Cloud Application Policy Infrastructure Controller (Cloud APIC) is online.
- The LDAP server host name or IP address, port, bind DN, Base DN, and password are available.
- The cloud APIC management endpoint group is available.

Step 1 In the Cloud APIC, create the **LDAP Provider**.

a) On the menu bar, choose **Administrative** > **Authentication**.
b) In the Work pane, click on **Providers** tab and then click on the **Actions** drop-down and select **Create Provider**.
c) In the **Host Name/IP Address** field, enter the Host Name/IP Address of the provider.
d) In the **Description** field, enter a description of the provider.
e) Click the **Type** drop-down list and choose **LDAP**.
f) Specify the **Bind DN**, **Base DN**, **Password**, **Port**, **Attribute**, **Filter Type** and **Management EPG**.

Note

- The bind DN is the string that the Cloud APIC uses to log in to the LDAP server. The Cloud APIC uses this account to validate the remote user attempting to log in. The base DN is the container name and path in the LDAP server where the Cloud APIC searches for the remote user account. This is where the password is validated. Filter is used to locate the attribute that the Cloud APIC requests to use for the *cisco-av-pair*. This contains the user authorization and assigned RBAC roles for use on the Cloud APIC. The Cloud APIC requests the attribute from the LDAP server.
- **Attribute** field—Enter one of the following:
  - For LDAP server configurations with a Cisco AVPair, enter **CiscoAVPair**.
  - For LDAP server configurations with an LDAP group map, enter **memberOf**.

Step 2 Create the **Login Domain** for LDAP.

a) On the menu bar, choose **Administrative** > **Authentication**.

b) In the Work pane, click on **Login Domains** tab and then click on the **Actions** drop-down and select **Create Login Domain**.

c) Enter the appropriate values in each field as listed in the following *Create Login Domain Dialog Box Fields* table then continue.

Properties	Description
General	
Name	Enter the name of the Login Domain
Description	Enter the description of the Login Domain.
Settings	
Realm	Choose **LDAP** from the dropdown menu
Providers	To choose a Provider(s): **1.** Click **Add Providers**. The **Select Providers** dialog appears. **2.** Click to choose a provider(s) in the column on the left. **3.** Click **Select**. You return to the **Create Login Domain** dialog box.

Properties	Description
Authentication Type	1. Select **Cisco AV Pairs**, if provider(s) was configured with **CiscoAVPair** as the **Attribute**. 2. Select **LDAP Group Map Rules**, if provider(s) was configured with **memberOf** as the **Attribute**. a. Click **Add LDAP Group Map Rule**. The dialog box appears. b. Specify the map rule **Name**, **Description** (optional), and **Group DN**. c. Click the + next to **Add Security Domain**. The dialog box appears. d. Click the + to access the **Role** name and Role **Privilege** Type (**Read** or **Write**) fields. Click check mark. e. Repeat step 4 to add more roles. Then click **Add**. f. Repeat step 3 to add more security domains. Then click **Add**.

d) Click **Save** on Create Login Domain dialog box.

Configuring Cloud APIC for SAML Access

The following sections provide detailed information on configuring Cloud APIC for SAML access.

About SAML

Refer to the section *About SAML* in the ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Basic Elements of SAML

Refer to the section *Basic Elements of SAML* in the ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Supported IdPs and SAML Components

Refer to the section *Supported IdPs and SAML Components* in the ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Configuring Cloud APIC for SAML Access

Note SAML based Authentication is only for Cloud APIC GUI and not for REST.

Before you begin

- The SAML server host name or IP address, and the IdP's metadata URL are available.
- The Cloud APIC management endpoint group is available.
- Set up the following:
  - Time Synchronization and NTP
  - Configuring a DNS Provider Using the GUI
  - Configuring a Custom Certificate for Cisco ACI HTTPS Access Using the GUI

Step 1 In the Cloud APIC, create the **SAML Provider**.

a) On the menu bar, choose **Administrative** > **Authentication**.
b) In the **Work** pane, click on **Providers** tab and then click on the **Actions** drop-down and select **Create Provider**.
c) In the **Host Name/IP Address** field, enter the Host Name/IP Address of the provider.
d) In the **Description** field, enter a description of the provider.
e) Click the **Type** drop-down list and choose **SAML**.
f) In **Settings** pane, perform following:

- Specify the IdP metadata URL:
  - In case of AD FS, IdP Metadata URL is of the format *https://<FQDN ofADFS>/FederationMetadata/2007-06/FederationMetadata.xml*.
  - In case of Okta, to get the IdP Metadata URL, copy the link for **Identity Provider Metadata** in the **Sign On** section of the corresponding SAML Application from the Okta server.
- Specify the **Entity ID** for the SAML-based service.
- Configure the **HTTPS Proxy for Metadata URL** if it is needed to access the IdP metadata URL.
- Select the **Certificate Authority** if IdP is signed by a Private CA.
- Select the **Signature Algorithm Authentication User Requests** from the drop-down.
- Select checkbox to enable **Sign SAML Authentication Requests**, **Sign SAML Response Message**, **Sign Assertions in SAML Response**, **Encrypt SAML Assertions**.

g) Click **Save** to save the configuration.

Step 2 Create the login domain for SAML.

a) On the menu bar, choose **Administrative** > **Authentication**.
b) In the **Work** pane, click on the **Login Domains** tab and then click on the **Actions** drop-down and select **Create Login Domain**.

c) Enter the appropriate values in each field as listed in the following Create Login Domain Dialog Box Fields table then continue.

Properties	Description
General	
Name	Enter the name of the Login Domain
Description	Enter the description of the Login Domain.
Settings	
Realm	Choose **SAML** from the dropdown menu
Providers	To choose a Provider(s): **1.** Click **Add Providers**. The **Select Providers** dialog appears. **2.** Click to choose a provider(s) in the column on the left. **3.** Click **Select**. You return to the **Create Login Domain** dialog box.

d) Click **Save** to save the configuration.

Setting Up a SAML Application in Okta

Refer to the section *Setting Up a SAML Application in Okta* of ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Setting Up a Relying Party Trust in AD FS

Refer to the section *Setting Up a Relying Party Trust in AD FS* in the ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Configuring HTTPS Access

The following sections describe how to configure HTTPS access.

About HTTPS Access

This article provides an example of how to configure a custom certificate for HTTPS access when using Cisco ACI.

For more information, see the section *HTTPS Access* in the ***Cisco APIC Security Configuration Guide, Release 4.0(1)*** at https://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/4-x/security/Cisco-APIC-Security-Configuration-Guide-401.html.

Guidelines for Configuring Custom Certificates

- Wild card certificates (such as *.cisco.com, which is used across multiple devices) and its associated private key generated elsewhere are not supported on the Cisco Cloud APIC as there is no support to input the private key or password in the Cisco Cloud APIC. Also, exporting private keys for any certificates, including wild card certificates, is not supported.
- You must download and install the public intermediate and root CA certificates before generating a Certificate Signing Request (CSR). Although a root CA Certificate is not technically required to generate a CSR, Cisco requires the root CA certificate before generating the CSR to prevent mismatches between the intended CA authority and the actual one used to sign the CSR. The Cisco Cloud APIC verifies that the certificate submitted is signed by the configured CA.
- To use the same public and private keys for a renewed certificate generation, you must satisfy the following guidelines:
  - You must preserve the originating CSR as it contains the public key that pairs with the private key in the key ring.
  - The same CSR used for the originating certificate must be resubmitted for the renewed certificate if you want to re-use the public and private keys on the Cisco Cloud APIC.
  - Do not delete the original key ring when using the same public and private keys for the renewed certificate. Deleting the key ring will automatically delete the associated private key used with CSRs.
- Only one Certificate Based Root can be active per pod.
- Client Certificate based authentication is not supported for this release.

Configuring a Custom Certificate for Cisco ACI HTTPS Access Using the GUI

Determine from which authority you will obtain the trusted certification so that you can create the appropriate Certificate Authority.

Before you begin

CAUTION: PERFORM THIS TASK ONLY DURING A MAINTENANCE WINDOW AS THERE IS A POTENTIAL FOR DOWNTIME. Expect a restart of all web servers on Cloud APIC during this operation.

Step 1 On the menu bar, choose **Administrative** > **Security**.

Step 2 In the Work pane, click on **Certificate Authorities** tab and then click on the **Actions** drop-down and select **Create Certificate Authority**.

Step 3 In the **Create Certificate Authority** dialog box, in the **Name** field, enter a name for the certificate authority and in the **Description** field, enter a description.

Step 4 Select **System** in the **Used for** field.

Step 5 In the **Certificate Chain** field, copy the intermediate and root certificates for the certificate authority that will sign the Certificate Signing Request (CSR) for the Cloud Application Policy Infrastructure Controller (APIC). The certificate should be in Base64 encoded X.509 (CER) format. The intermediate certificate is placed before the root CA certificate. It should look similar to the following example:

```
-----BEGIN CERTIFICATE-----
<Intermediate Certificate>
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
<Root CA Certificate>
-----END CERTIFICATE-----
```

Step 6 Click **Save**.

Step 7 On the menu bar, choose **Administrative** > **Security**.

Step 8 In the Work pane, click on the **Key Rings** tab, then click on the Actions drop-down and select **Create Key Ring**.

Step 9 In the **Create Key Ring** dialog box, in the **Name** field, enter a name for the certificate authority and in **Description** enter description.

Step 10 Select **System** in the **Used for** field.

Step 11 For the **Certificate Authority** field, click on **Select Certificate Authority**and select the Certificate Authority that you created earlier.

Step 12 Select either **Generate New Key** or **Import Existing Key** for the field **Private Key**. If you select **Import Existing Key**, enter a private key in the **Private Key** text box.

Step 13 Select modulus from the **Modulus** drop-down. menu

Step 14 In the **Certificate** field, do not add any content.

Step 15 Click **Save**.

In the **Work** pane, in the **Key Rings** area, the **Admin State** for the key ring created displays **Started**.

Step 16 Double-click on the created Key Ring to open **Key Ring** *key_ring_name* dialog box from the **Work** pane.

Step 17 In the **Work** pane, click on **Create Certificate Request**.

Step 18 In the **Subject** field, enter the fully qualified domain name (FQDN) of the Cloud APIC.

Step 19 Fill in the remaining fields as appropriate.

Step 20 Click **Save**.

The **Key Ring** *key_ring_name* dialog box appears.

Step 21 Copy the contents from the field Request to submit to the **Certificate Authority** for signing.

Step 22 From the **Key Ring** *key_ring_name* dialog box, click on edit icon to display the **Key Ring** *key_ring_name* dialog box.

Step 23 In the **Certificate** field, paste the signed certificate that you received from the certificate authority.

Step 24 Click **Save** to return to the **Key Rings** work pane.

The key is verified, and in the **Work** pane, the **Admin State** changes to **Completed** and is now ready for use in the HTTPs policy.

Step 25 Navigate to **Infrastructure** > **System Configuration**, then click the **Management Access** tab.

Step 26 Click the edit icon on the **HTTPS** work pane to display the **HTTPS Settings** dialog box.

Step 27 Click on **Admin Key Ring** and associate the Key Ring that you created earlier.

Step 28 Click **Save**.

All web servers restart. The certificate is activated, and the non-default key ring is associated with HTTPS access.

What to do next

You must remain aware of the expiration date of the certificate and take action before it expires. To preserve the same key pair for the renewed certificate, you must preserve the CSR, as it contains the public key that pairs with the private key in the key ring. Before the certificate expires, the same CSR must be resubmitted. Do not delete or create a new key ring, as deleting the key ring will delete the private key stored internally on the Cloud APIC.

CHAPTER 9

AWS Transit Gateway on Cisco Cloud APIC

AWS Transit Gateway on Cisco Cloud APIC

Beginning in Cisco Cloud Application Policy Infrastructure Controller (APIC) Release 5.0(1), you can use Amazon Web Services (AWS) Transit Gateway with Cisco Cloud APIC. AWS Transit Gateway is a service that functions as an internal router to automate connectivity between virtual private clouds (VPCs). The VPCs can be in different AWS regions in a cloud site.

Virtual private clouds (VPC) can't communicate with each other without additional configuration. Without using AWS Transit Gateway, you can configure inter-VPC communication by configuring VPC peering. Alternatively, you can use VPN tunnels and Cisco Cloud Services Routers (CSRs).

However, when you use AWS Transit Gateway with Cisco Cloud APIC, you connect VPCs or VRFs in the cloud site simply by associating the VPCs or VRFs to the same AWS Transit Gateways.

Using AWS Transit Gateway with Cisco Cloud APIC provides several benefits: higher performance, simplicity, scalability and potential lower cost.

Note You can attach a Cisco Cloud APIC user tenant’s VPC (CtxProfile) to an AWS Transit Gateway (hub network) only if you have administrator privileges and the user is part of security domain “all". Without such access, you cannot attach the user tenant’s VPC to an AWS Transit Gateway.

For detailed information about using AWS Transit Gateway with Cisco Cloud APIC, see *Increasing Bandwidth Between VPCs by Using AWS Transit Gateway*.

APPENDIX A

Cisco Cloud APIC Error Codes

Cisco Cloud APIC Error Codes

This section describes the Cisco Cloud APIC error codes.

Table 34: Cisco Cloud APIC Error Codes

Component	Error Code	Constraint
cloud-template	CT_INFRANETWORK_COUNT	The count of the `cloudtemplateInfraNetwork` MO is at most 1
cloud-template	CT_INFRANETWORK_COUNT	The count of the `cloudtemplateInfraNetwork` MO is at most 1
cloud-template	CT_INFRANETWORK_VRF	In the `cloudtemplateInfraNetwork` MO, the `vrfName` must be overlay-1
cloud-template	CT_INFRANETWORK_PARENT	For the `cloudtemplateInfraNetwork` MO, the parent MO must be uni/tn-infra
cloud-template	CT_INFRANETWORK_NUMROUTERSPERREGION_MINIMUM	In the `cloudtemplateInfraNetwork` MO, for the attribute `numRoutersPerRegion`, the minimum allowed value is 2

Component	Error Code	Constraint
cloud-template	CT_INFRANETWORK_NUMROUTERSPERREGION_MAXIMUM	In the `cloudtemplateInfraNetwork` MO, for the attribute `numRoutersPerRegion`, the maximum allowed value is 4
cloud-template	CT_INFRANETWORK_NUMREMOTESITESUBNETPOOL_MINIMUM	In the `cloudtemplateInfraNetwork` MO, for the attribute `numRemoteSiteSubnetPool`, the minimum allowed value is 2
cloud-template	CT_INFRANETWORK_NUMREMOTESITESUBNETPOOL_MAXIMUM	In the `cloudtemplateInfraNetwork` MO, for the attribute `numRemoteSiteSubnetPool`, the maximum allowed value is 2
cloud-template	CT_INTNETWORK_COUNT	The count of the `cloudtemplateIntNework` MO is at most 1
cloud-template	CT_EXTNETWORK_COUNT	The count of the `cloudtemplateExtNework` MO is at most 1
cloud-template	CT_VPNNETWORK_COUNT	The count of the `cloudtemplateVpnNetwork` MO is at most 1
cloud-template	CT_OSPF_COUNT	The count of the `cloudtemplateOspf` MO is at most 1
cloud-template	CT_INTNETWORK_REGION_MATCH	The regions specified by `cloudRegionName` under `cloudtemplateIntNetwork` must have a corresponding `cloudRegion` under `cloudProvP`
cloud-template	CT_INTNETWORK_REGION_MANAGED	The regions specified by the `cloudRegionName` children of `cloudtemplateIntNetwork` must have corresponding `cloudRegion` with `adminSt` as managed

Component	Error Code	Constraint
cloud-template	CT_INTNETWORK_REGION_MAXIMUM	The maximum number of regions (`cloudRegionName`) specified under `cloudtemplateIntNetwork` is 4
cloud-template	CT_EXTNETWORK_REGION_SUBSET	The regions that are specified by the `cloudRegionName` children of `cloudtemplateExtNetwork` must also be specified by `cloudRegionName` children under `cloudtemplateIntNetwork`
cloud-template	CT_EXTSUBNETPOOL_COUNT	The count of the `cloudtemplateExtSubnetPool` is at most 1
cloud-template	CT_EXTSUBNETPOOL_SUBNETPOOL_ADDRESS	In `cloudtemplateExtSubnetPool`, the subnetpool must contain a network address
cloud-template	CT_EXTSUBNETPOOL_SUBNETPOOL_IP_VERSION	In `cloudtemplateExtSubnetPool`, the subnetpool must contain a IPv4 address
cloud-template	CT_EXTSUBNETPOOL_SUBNETPOOL_ADDRESS_TYPE	In `cloudtemplateExtSubnetPool`, the `subnetpool` IP address must not from multicast or loopback address space
cloud-template	CT_EXTSUBNETPOOL_SUBNETPOOL_MINIMUM_SIZE	In `cloudtemplateExtSubnetPool`, the `subnetpool` must be at least /22 (the netmask must be 22 or less)
cloud-template	CT_INTNETWORK_MISSING_HOME	If there are any `cloudRegionName` under `cloudtemplateIntNetwork`, then one of the `cloudRegonName` must be associated to a region that is the home region of the cAPIC (`capicDeployed`)

Component	Error Code	Constraint
cloud-template	CT_CLOUD_APICSUBNETPOOL_INSUFFICIENT	There must be enough `cloudApicSubnetPool` MOs to generate `cloudApicSubnet` MOs so that all the `cloudRegionName` MOs specified under `cloudtemplateIntNetwork` can be associated to a unique `cloudApicSubnet` MO. The subnets from the `cloudApicSubnet` MOs are used as the CIDRs in the `cloudCtxProfile` of the corresponding region.
cloud-template	CT_IPSECTUNNEL_PEERADDR_IP_VERSION	In `cloudtemplateIpSecTunnel`, the `peeraddr` must contain a IPv4 address
cloud-template	CT_IPSECTUNNEL_PEERADDR_IS_HOST	In `cloudtemplateIpSecTunnel`, the `peeraddr` must be host address (i.e. /32)
cloud-template	CT_PROFILE_COUNT	The count of the `cloudtemplateProfile` MO is at most 1
cloud-template	CT_PROFILE_DELETE	The `cloudtemplateProfile` MO cannot be deleted unless its parent `cloudtemplateInfraNetwork` is also deleted
cloud-template	CT_PROFILE_ROUTERUSERNAME_NONEMPTY	In `cloudtemplateProfile`, the `routerUsername` must be non-empty
cloud-template	CT_PROFILE_ROUTERPASSWORD_NONEMPTY	In `cloudtemplateProfile`, the `routerPassword` must be non-empty

Component	Error Code	Constraint
cloud-template	CT_PROFILE_ROUTERUSERNAME_MODIFY	In cloudtemplateProfile, the routerUsername cannot be modified when there are routers deployed in any region, i.e. any cloudRegionName under cloudtemplateIntNetwork (The modification is allowed when there are no router deployments in any region)
cloud-template	CT_PROFILE_ROUTERPASSWORD_MODIFY	In cloudtemplateProfile, the routerPassword cannot be modified when there are routers deployed in any region, i.e. any cloudRegionName under cloudtemplateIntNetwork (The modification is allowed when there are no router deployments in any region)
cloud-template	CT_PROFILE_ROUTERTHROUGHPUT_MODIFY	In cloudtemplateProfile, the routerThroughput cannot be modified when there are routers deployed in any region, i.e. any cloudRegionName under cloudtemplateIntNetwork (The modification is allowed when there are no router deployments in any region)
cloud	CT_APICSUBNET_INVALID_HOME_REGION	In a cloudApicSubnet MO, the region marked for capicDeployed must be a valid region
cloud	CT_APICSUBNET_REPEATED_REGION	In a cloudApicSubnet MO, a region can be associated with at most 1 subnet

Component	Error Code	Constraint
cloud	CT_APICSUBNET_MULTIPLE_HOME_REGION	In cloudApicSubnet MOs, at most, 1 region may have capicDeployed as true
cloud	CLOUD_APICSUBNETPOOL_CREATEDBY_USER	In cloudApicSubnetPool, the createdBy attribute must be USER
cloud	CLOUD_APICSUBNETPOOL_SUBNET_IP_VERSION	In cloudApicSubnetPool, the subnet must contain a IPv4 address
cloud	CLOUD_APICSUBNETPOOL_SUBNET_SIZE	In cloudApicSubnetPool, the subnet must be /24
cloud	CLOUD_APICSUBNETPOOL_DELETE_USAGE	A cloudApicSubnetPool cannot be deleted if at least one of its cloudApicSubnet child is in use by a region
cloud	CLOUD_APICSUBNETPOOL_DELETE_CREATEDBY	A cloudApicSubnetPool whose createdBy attribute is not USER cannot be deleted