Stretched EPG in Cisco Cloud APIC

Revised: February 19, 2022,

New and Changed Information

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

Table 1: New and Changed Information

Release	Feature or Change Description	Where Documented
Release 4.2(1)	Updated the document for Cloud APIC in Microsoft Azure	
Release 4.1(1)	First release of this document	

Stretched EPGs Use Case Overview

This document describes how you can stretch EPGs between an on-premises Cisco APIC site and a Cloud APIC site or between two Cloud APIC sites. Then endpoints of the stretched EPGs, for example App EPG and Web EPG, can communicate using a contract, regardless of the endpoint location. While communication between different EPGs requires a contract, communication between endpoints within the same EPG does not, regardless of whether the endpoints are in the same or different sites.

Figure 1: Stretched EPG, On-Premises and AWS

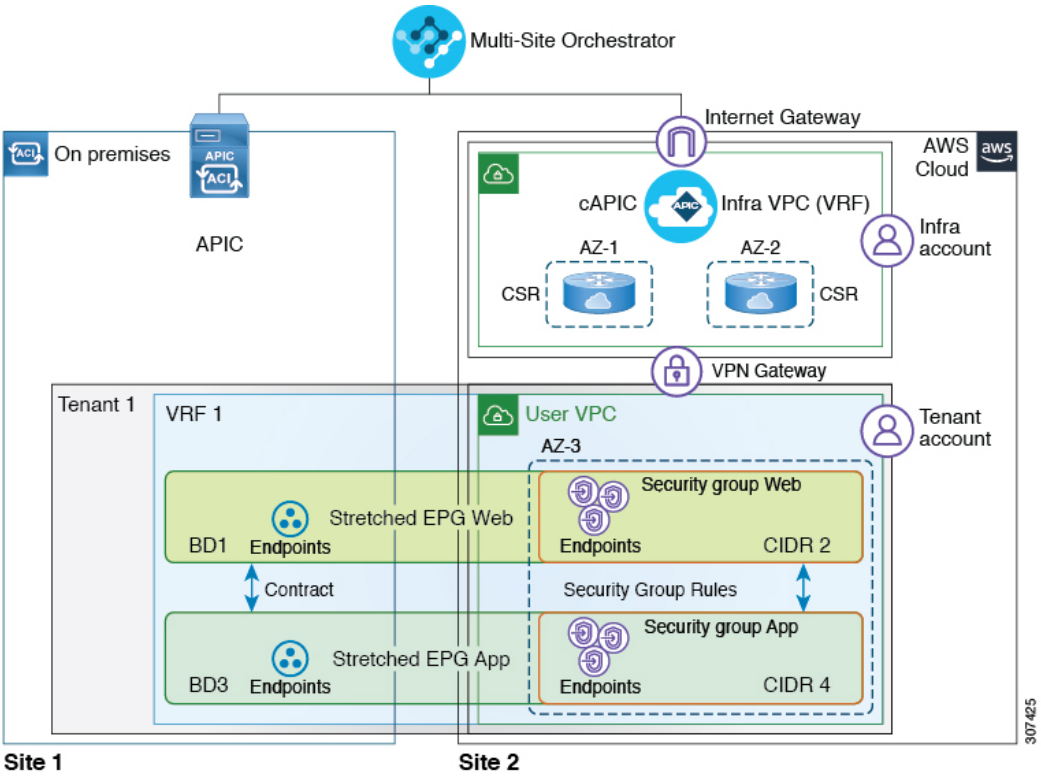


Figure 2: Stretched EPG, On-Premises and Azure

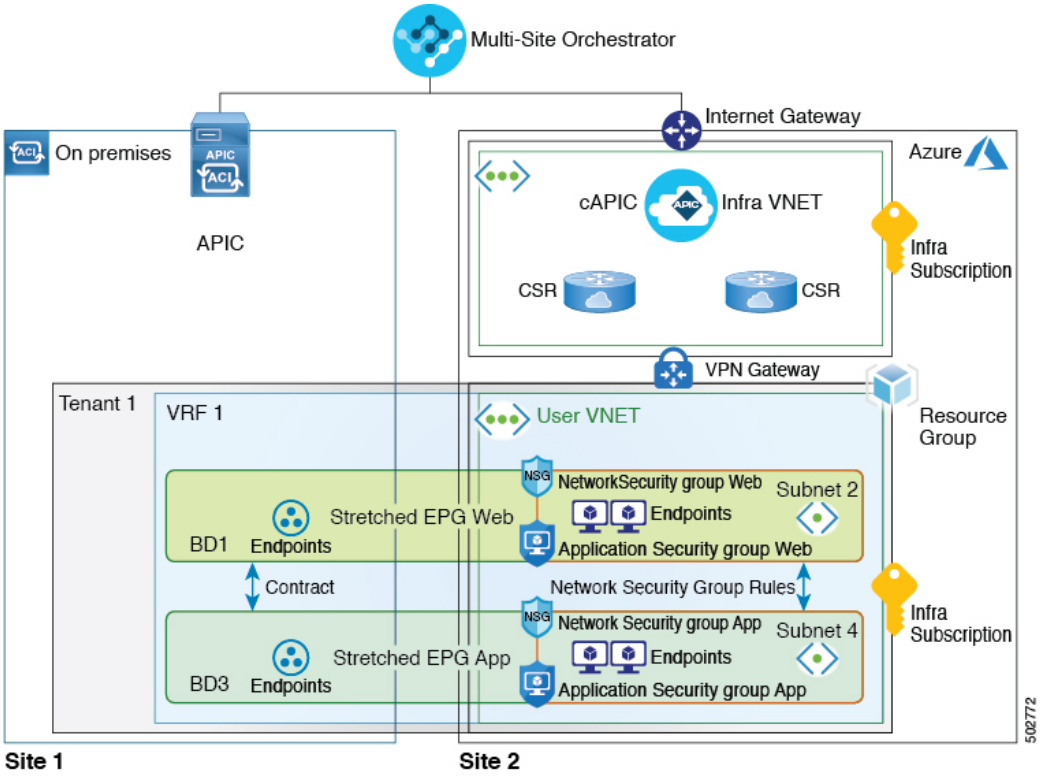
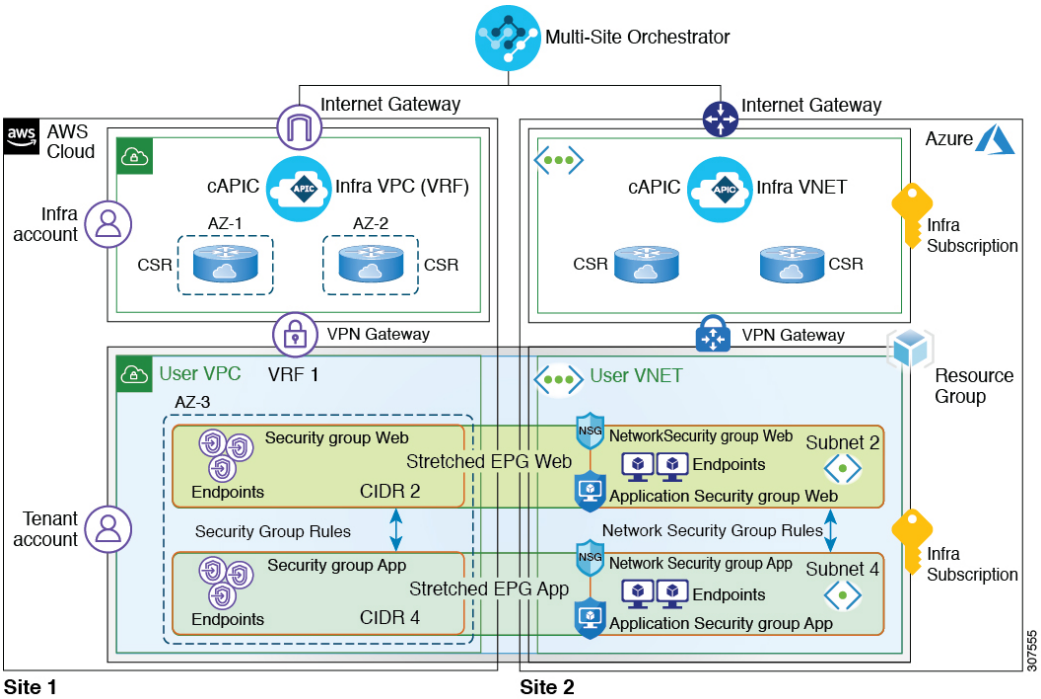


Figure 3: Stretched EPG, Multi-Cloud



Prerequisites

- You must have a Cisco ACI Multi-Site Orchestrator installed and configured and the on-premises site added, as described in Cisco ACI Multi-Site Orchestrator Installation and Upgrade Guide

  If you plan to use Cloud APIC in AWS, you must install Cisco ACI Multi-Site Release 2.1(1) or later.

  If you plan to use Cloud APIC in Azure, you must install Cisco ACI Multi-Site Release 2.2(1) or later.

- You must have a Cloud APIC installed, configured, and added to the Multi-Site Orchestrator.

  For AWS, you must install Cloud APIC Release 4.1(1) or later, as described in the Cisco Cloud APIC for AWS Installation Guide.

  For Azure, you must install Cloud APIC Release 4.2(1) or later, as described in the Cisco Cloud APIC for Azure Installation Guide.

- If you plan to use Amazon Web Services, you must have an AWS account set up and configured for the user tenant that will be used in this use case, as described in Setting Up the AWS Account for the User Tenant chapter of the Cisco Cloud APIC for AWS Installation Guide

  There is a one-to-one mapping between AWS accounts and Cisco Cloud APIC tenants, so each tenant must have a unique AWS account associated with it. However, if you already configured an AWS account and a user tenant in your Cisco Cloud APIC, you can choose to use the same tenant for this use-case.

- If you plan to use Microsoft Azure, you must have an Azure subscription set up and configured to use for the user tenant, as described in chapter of the Cisco Cloud APIC for Azure Installation Guide.

  You can create multiple Cloud APIC tenants under the same Azure subscription or you can choose to create a separate subscription for each Cloud APIC tenant. For this use case you can choose to create a new tenant or use an existing one you may have configured previously, for example the subscription configured under the `Infra` tenant used for the Cloud APIC installation.

Guidelines and Limitations

When configuring this use case, the following restrictions apply:

- ACI Multi-Site multi-cloud deployments support a combination of any two cloud sites (AWS, Azure, or both) and two on-premises sites for a total of four sites.
- If you plan to use Amazon Web Services cloud site, you cannot use the same account for multiple Tenants. This includes the `infra` Tenant as well as any user Tenants you may configure.
- When you stretch an EPG between on-premises and cloud sites, you are not stretching the Layer 2 domain. The endpoints connected to the stretched EPG are part of different IP subnets in the on-premises and cloud sites, so the communication between them is always routed.

Gathering the Necessary Information

There are several pieces of information that you will need as you go through the procedures in this document. Gather the information outlined in the following sections, then refer to the information that you enter in this section in later procedures, when necessary.

Cloud Tenant Information

When you add a tenant in Multi-Site Orchestrator GUI as described later in this document, you must provide cloud account information for the cloud service where the tenant will be created. You can obtain this information from either your AWS account or Azure account.

Note If you are planning to deploy the tenant to only one type of cloud service, you can skip the irrelevant information in the following tables.

Table 2: AWS Information for Cloud Tenant

Required Information	Your values	Where to locate the information
AWS account ID for the user tenant	_____	The Amazon account for your cloud tenant. Creating a new AWS account and user is described in Setting Up an AWS Account and User, on page 7.
AWS Access Key ID and Secret Access Key for the user tenant	AccessKey: _____ Secret Access Key: _____	The following information is required only for `Untrusted` tenants only. If you plan to add a `Trusted` tenant, you can skip this field. You can use the information from the .csv file you downloaded when you created the AWS account and user or follow the following procedures to locate this information in AWS: 1. Log into this new, separate Amazon Web Services account. 2. Go to Identity and Access Management (IAM). https://aws.amazon.com/iam/ 3. In the left pane, select Users. 4. Click the link for your Cisco Cloud APIC user tenant account. 5. On the Summary page, click the Security credentials tab. 6. Click Create access key if you do not already have an Amazon Web Services access key ID. 7. Locate the information from the Access key ID and Secret access key fields.

Table 3: Azure Information for Cloud Tenant

Required Information	Your values	Where to locate the information
Azure account subscription ID for the user tenant	_____	Use the Azure subscription ID. You can obtain the subscription ID by logging into your Azure account and navigating to Home > All Services > Subscriptions. **Note** Keep in mind, you must use the Subscription ID and not Subscription Name as listed in the Azure portal. Alternatively, if you'd like to create a new subscription specifically for the tenant you plan to use for this use case, follow the steps described in Setting Up an Azure Account with a Subscription, on page 8 for this field.
Azure Application ID, Directory ID, and Client Secret	Subscription ID: _____ Application ID: _____ Client Secret: _____	The following information is required only for `Unmanaged` tenants. If you plan to add a managed tenant, you can skip this field. You can locate this information using the following procedure: 1. Log into your Azure account. 2. Navigate to Home > All Services > App registrations > <application-name> and note the `Application (client) ID` and `Directory (tenant) ID`. 3. Then click Certificates & secrets > New client secret and create a Client Secret. **Note** The secret is only viewable immediately after you create it.

Setting Up an AWS Account and User

There is a one-to-one mapping between AWS accounts and Cisco Cloud APIC tenants, so each tenant must have a unique AWS account associated with it. This includes the `infra` tenant as well as any user tenants you may configure.

Note You must have a separate AWS user for each user tenant. However, if you are configuring several different use case scenarios, you can use the same user tenant for all the use cases. You can use the following procedure to create a new user within your AWS account, if necessary.

Procedure

Step 1 Create a new Amazon Web Services account for the Cloud APIC user tenant.

a) Browse to https://aws.amazon.com/.
b) Click Create an AWS Account.
c) Enter the necessary information to create a new AWS account.

Step 2 Log in to your AWS account.

https://signin.aws.amazon.com/

Step 3 Go to the AWS Management Console:

https://console.aws.amazon.com/

Step 4 Create a new user in your AWS account.

This step is required for `Untrusted` tenants only. If you are planning to add this tenant as a `Trusted` tenant, you only need the AWS account ID and can skip this step.

a) Click the Services link at the top of the screen, then click the IAM link.
b) In the left pane, click Users, then click the Add user button.

The Add User page appears.

c) In the User name field, enter a unique name for this user.
d) In the Access type field, check Programmatic access, then click the Next: Permissions button at the bottom of the page.
e) In the Set permissions area, select Attach existing policies directly.

The screen expands to display Filter policies information.

f) Check the box next to Administrator Access, then click the Next: Tags button at the bottom of the page.
g) Leave the information in the Add tags page as-is and click the Next: Review button at the bottom of the page.
h) Click the Create User button at the bottom of the page.

Ignore the warning that states This user has no permissions if that warning appears.

An access key is created for you at this point.

i) Make a note of the Access Key ID and Secret Access Key information for this Amazon Web Services admin account.

Download the .csv file or copy the information from the Access key ID and Secret access key fields to a file.

j) Click the Close button at the bottom of the page.

Setting Up an Azure Account with a Subscription

You can choose to deploy multiple tenants within the same subscription or create a separate subscription for each tenant.

If you want to use an existing subscription, for example the one where you deployed your Cloud APIC, skip this section. Otherwise, you can create a separate subscription specifically for the tenant in this use case.

Procedure

Step 1 Log in to your Azure account.

https://azure.microsoft.com

Step 2 In the left side bar, click All services.

Step 3 In the All services filter bar at the top, search for "subscriptions" and click Subscriptions.

Step 4 Create a subscription.

Provide all the required information to create a subscription.

Step 5 Create a new application.

This step is required for `Unmanaged` tenants only. If you are planning to add this tenant as a `Managed` tenant, you only need the subscription ID and can skip this step.

a) In the left side bar, click All services.
b) In the All services filter bar at the top, search for "registrations" and click App registrations.
c) In the main window, click +New registration.
d) In the Register an application screen, provide the information for your application.
e) Make a note of the Application (client) ID and Directory (tenant) ID fields values.
f) Click the Certificates & secrets, then click +New client secret.

   Provide the secret's description and duration.

   Once the secret is created, note the value.

   Note The secret's value is only viewable immediately after you create it.

Cloud Site CIDR Information

Each VRF you define creates a VPC in Amazon Web Services or a VNET in Azure. CIDR is a cloud context profile configuration linked to the VRF and is broken up into one or more subnets used by your cloud endpoints. You will need to provide the CIDR and subnet information when you configure VRF.

Keep in mind that while you can define one or more subnets within a CIDR in AWS, you would need to define at least 2 subnets in Azure. This is because when you create subnets in Azure, one subnet is always used as a gateway subnet, so you would need an additional subnet for the endpoints.

In AWS, subnets are linked to availability zones (AZ) and you will need one subnet per availability zone.

Cloud Site CIDR Information	Example	Your Entry
CIDR prefix (AWS VPC or Azure VNET) and netmask	3.3.0.0/16	
Subnet information	Endpoints subnet: 3.3.2.0/24 (Azure only) Gateway subnet: 3.3.1.0/24	
Endpoint information	3.3.2.1/24	

APIC Bridge Domain Information

You will need to provide bridge domain (BD) information when creating an EPG that contains on-premises endpoints. If you are configuring cloud-only deployments, you can skip this section.

Cisco APIC Bridge Domain Information	Example	Your Entry
Bridge Domain name	bd1	
Subnet information	2.2.2.254/24	

Cisco APIC Bridge Domain Information	Example	Your Entry
Endpoint information	2.2.2.1/24	

Creating a Tenant

Use the following procedure to create a Tenant and associate it with your on-premises and cloud sites.

Before you begin

- You must have AWS account or Azure cloud services subscription active and available.
- If you are creating a brand new tenant for use with AWS, there is a one-to-one mapping between AWS user accounts and APIC tenants, so you must have a separate AWS user account created and ready to be used by the tenant. For more information, see Setting Up an AWS Account and User, on page 7.

Procedure

Step 1 Log in to your Multi-Site Orchestrator GUI.

Step 2 In the left navigation menu, click Tenants.

Step 3 In the main pane, click Add Tenant.

Step 4 In the Add Tenant window, provide a name for the tenant.

You may also choose to provide a description of the tenant.

Step 5 In the Associated Sites area, select the on-premises site where you want to add the tenant.

When associating with an on-premises site, simply check the checkbox next to the site.

(Optional) If you want to assign the tenant to a specific security domain, you can choose it from the dropdown menu.

Step 6 If you want to add this tenant to an AWS site, check the checkbox next to it.

When associating an AWS cloud site with a tenant, you must also provide the AWS user account information.

a) After you check an AWS site, select the security domain from the dropdown list if necessary.
b) Then click Associate Account next to it.
c) In the AWS Account ID field, provide the ID of the AWS user account you have created for this tenant.

This is the AWS account that you logged into when setting up the AWS account for Trusted Tenant using the CFT.

d) In the Access Type field, choose the type of AWS user account you have created.

- Select Trusted, if you set up the AWS account for Trusted Tenant using CFT.
- Select Untrusted, if you set up the AWS account for an Untrusted User Tenant using the AWS access key ID and secret access key. In this case you must also provide the following:
  - Cloud Access Key ID: Enter the AWS access key ID information for the user tenant in this field.
  - Cloud Secret Access Key: Enter the AWS secret access key information for the user tenant in this field.

Step 7 If you want to add this tenant to an Azure site, check the checkbox next to it.

When associating an Azure cloud site with a tenant, you must also provide the Azure subscription information.

a) After you check an Azure site, select the security domain from the dropdown list if necessary.

Note Security domain must be specified if you plan to share a subscription that is already used by another tenant. In that case, both tenants must be assigned to the same security domain.

b) Then click Associate Account next to it.

c) Choose tenant mode.

You can choose one of the following two modes when adding a tenant:

- Choose Mode: Select Shared, if you want to use an existing subscription that is shared with an existing tenant.

  Unlike AWS user accounts, where there is always a one-to-one mapping between AWS accounts and Cloud APIC tenants, Azure allows you to create multiple tenants using the same subscription.

  If you choose Select Shared, you can then select a subscription from the dropdown list and your new tenant will be associated with the same Azure subscription. Note that you must have a security domain configured for the tenants that share the subscription for it to show up in the dropdown list.

- Choose Mode: Create Own, if you want to associate the tenant with a new Azure subscription.

  Then in the Azure Subscription ID field, provide the ID of the Azure subscription.

  You can obtain the subscription ID by logging into your Azure account and navigating to Home > Subscriptions. Keep in mind, you must use the Subscription ID and not Subscription Name as listed in the Azure portal.

d) In the Access Type field, choose the access type between the Cloud APIC VM and the tenant.

- Select Managed Identity, to allow the Cloud APIC VM to manage the cloud resources.
- Select Unmanaged Identity, to manage the cloud resources via a specific application. In this case you must also provide the application's credentials to the Cloud APIC:
  - Application ID: Enter the application ID for the Azure application. This ID is listed in Home > App registrations > <application-name> > Application (client) ID field in the Azure portal.
  - Client Secret: Enter the application secret. You can create a secret under Home > App registrations > <application-name> > Certificates & secrets > New client secret.
  - Azure Active Directory ID: Enter the application directory ID for the Azure application. This ID is listed in Home > App registrations > <application-name>, in the Directory (tenant) ID field.

Step 8 In the Associated Users area, select which users have access to the tenant

Step 9 (Optional) Enable consistency checker.

You may choose to enable scheduled consistency checker for this tenant. Additional information about consistency check is available in the Cisco ACI Multi-Site Configuration Guide.

Note Consistency checker is available only for on-premises fabrics.

Step 10 Click Save to add the tenant.

Step 11 Verify that the tenant was successfully pushed to the on-premises APIC site:

a) Log into your on-premises APIC site.

b) On the menu bar, choose Tenants > All Tenants.
c) In the main pane, verify that the tenant you created in the previous step is displayed in the on-premises APIC site.

Step 12 Verify that the tenant was successfully pushed to the Cloud APIC site:

a) Log into your Cloud APIC site.
b) On the main Cloud APIC page, under Application Management, click Tenants.
c) Verify that the tenant that you just created through the ACI Multi-Site Orchestrator in the previous step is displayed in the Cloud APIC site.

You may need to click the Refresh button at the top right corner of the screen before your new tenant is displayed.

Creating a Schema and Template

Use the following procedure to create a new schema and template for this use case. For this specific use case, we recommend creating a single schema and template for all the objects.

Procedure

Step 1 In the main menu, click Schemas.

Step 2 On the schema screen, click Add Schema.

Step 3 Specify a name for the schema.

At the top of the Untitled Schema screen, click the schema name to edit it. Then provide a descriptive name for the schema, for example `cloud-apic-example`).

Step 4 Specify a name for the template.

Mouse over the default name (`Template 1`) and click the Edit icon next to it. Then provide a new name for the template.

Step 5 Select the tenant

In the middle pane click + To build your schema please click here to select a tenant. Then in the right sidebar, select a tenant from the Select a Tenant dropdown.

Associating Templates with Sites

Use the following procedure to associate the templates with the appropriate sites.

Procedure

Step 1 In the left pane, click the + icon next to Sites.

Step 2 In the Add Sites window, check the checkbox next to your on-premises site and your cloud site.

Step 3 From the Assign to Template drop-down next to each site, select the template.

Step 4 Click Save.

Creating a VRF

This section describes how to create a VRF. The VRF will be stretched between the on-premises and cloud sites along with the EPG you will create later.

Procedure

Step 1 In the left pane, select the template you created.

Step 2 In the middle pane, scroll down to the VRF area, then click + in the dotted box.

Step 3 In the right pane, enter the name for the VRF in the Display Name field (for example, `vrf-stretched`).

Step 4 Click Save.

Creating Bridge Domains

After you created the stretched VRF, you create two bridge domains (BD) and associate them with the VRF. The two BDs will be used by two different stretched EPGs.

Note ACI Multi-Site does not support extending Layer 2 domains to the cloud, so you must configure different subnets for the on-premises and cloud sites regardless of whether you configure the BD as L2 stretched. If you plan to stretch BDs, configure the subnets at the template level; otherwise, configure the subnets at the site local level.

Procedure

Step 1 In the middle pane, scroll down to the Bridge Domain area, then click + in the dotted box to add a BD.

Step 2 In the right pane, enter a name for the bridge domain in the Display Name field (for example, `bd1`).

Step 3 In the right pane, in the Virtual Routing & Forwarding field select the VRF you created, for example `vrf-stretched`.

Step 4 In the right pane, scroll down to Subnets and click +Subnet to add a subnet.

In the Add Subnet dialog:

a) Enter the gateway IP address and the netmask.

Specify the subnet information that you have prepared in APIC Bridge Domain Information, on page 9.

b) Set the Scope to `Advertised Externally`.

The scope must be set to advertise externally to exchange the prefix information between the on-premises and cloud sites.

c) Click SAVE to add the subnet.

Step 5 Click SAVE.

Step 6 Repeat the steps to create a second bridge domain.

The second BD should be associated with the same stretched VRF, but have a different name and subnet information. All other settings should remain the same.

Configuring Cloud Region and CIDR

After you add a cloud site to your schema, you can associate a CIDR with the cloud VRF.

Procedure

Step 1 In the left pane, select the template under the cloud site that you have added.

Because you configure the CIDR information at the site-local level, you must select the template under the Sites category on the left, not from the general Templates category.

Step 2 In the middle pane, scroll down to the VRF area, then click the VRF you created.

Step 3 In the right pane, under the Site Local Properties click Regions + to add a region. Then select the region from the dropdown menu.

Step 4 In the right pane, under the Site Local Properties click + CIDR).

Step 5 Click Save.

Step 6 Enter the CIDR information for the VRF.

If it's the first CIDR you are adding for the region, select Primary. Otherwise, select Secondary.

Step 7 Click +Subnet to add a subnet to the CIDR.

Note The subnets you configure for your cloud site must be different from the subnets you configure for the on-premises bridge domain.

If you are configuring this for an AWS cloud, you can provide one or more subnets. In addition, if you have configured more than one availability zone for your AWS site, you must add one subnet per availability zone.

If you are configuring this for an Azure cloud, you must provide at least two different subnets. In this case, you will also have to designate one of the subnets to be used as the gateway subnet while the other subnets can be used for the cloud endpoints.

Step 8 Click SAVE.

Configuring an Application Profile and EPG

In this use case, you are creating a single EPG that will be stretched across both the on-premises ACI site and the cloud site. Use the following procedure to create the application profile and EPG that you will stretch.

Procedure

Step 1 In the middle pane click + Application Profile.

Step 2 In the right pane, enter the Application Profile name in the Display Name field (for example, `app1`).

Step 3 In the middle pane, click + Add EPG.

Step 4 In the right pane, enter an EPG name in the Display Name field (for example, `epg1-stretched`).

Step 5 In the On-Prem Properties area, select the first bridge domain you created from the Bridge Domain dropdown menu.

Step 6 In the Cloud Properties area, select the stretched VRF you create (for example, `vrf-stretched`).

On-Premises Endpoints

Multi-Site Orchestrator allows you to provision assignment of endpoints to physical (static port configuration) or virtual (VMM) domains. This section provides an example of how to assign endpoints to an EPG based on a VMM domain (VMware). It is assumed that you have the VMM domain already set up and configured in you on-premises site.

Procedure

Step 1 In the left sidebar, under Templates, select the template that contains your EPG.

If you created a separate templates for on-premises, cloud, or stretched objects, make sure to select the template that contains your on-premises EPG, for example `template-onprem`.

Step 2 In the middle pane, click the EPG.

Step 3 In the right pane, under the Site Local Properties heading, in the Domains area, click + Domain.

Step 4 Enter the necessary information in the Add Domain form:

- In the Domain Association Type field, choose a type.

  For example, you might select VMM for the domain association type.

- In the Domain Profile field, choose the profile for the on-premises domain that you want to use, using domain profile selections that are based on the domain association type that you entered in the previous step.

  For example, you might select a domain profile that was created based on VMware vDS, with a name such as `OnPrem-vDS`.

- In the Deployment Immediacy field, choose On Demand.

- In the Resolution Immediacy field, choose On Demand.

Click Save.

Adding Cloud Endpoint Selector

On the Cloud APIC, a cloud EPG is a collection of endpoints that share the same security policy. Cloud EPGs can have endpoints in one or more subnets and are tied to a CIDR.

You define the endpoints for a cloud EPG using an object called endpoint selector. The endpoint selector is essentially a set of rules run against the cloud instances assigned to either AWS VPC or Azure VNET managed by the Cloud APIC. Any endpoint selector rules that match endpoint instances will assign that endpoint to the Cloud EPG.

Unlike the traditional on-premises ACI fabrics where endpoints can only belong to a single EPG at any one time, it is possible to configure endpoint selectors to match multiple Cloud EPGs. This in turn would cause the same instance to belong to multiple Cloud EPGs. However, we recommend configuring endpoint selectors in such a way that each endpoint matches only a single EPG.

Configuring actual endpoints is described in the following two sections:

- Configuring endpoints in an AWS cloud site, see Endpoints in AWS Cloud, on page 19
- Configuring endpoints in an Azure cloud site, see Endpoints in Azure Cloud, on page 20

Procedure

Step 1 In the Multi-Site Orchestrator, select the EPG.

Step 2 In the right pane, in the Site Local Properties area, click + Selector under the Selectors heading to configure the endpoint selector.

If you plan to stretch this EPG, you can also choose to add the endpoint selector at the template level instead.

Step 3 In the Add New End Point Selector form, enter a name in the End Point Selector Name field, based on the classification that you use for this endpoint selector.

For example, for an endpoint selector with the IP Subnet classification, you might use a name such as `IP-Subnet-EPSelector`.

Step 4 Click + Expression, then use the three fields to configure the endpoint selector based on how you want to classify the endpoints in the cloud:

The Type field determines the expression that you want to use for the endpoint selector:

- Choose IP Address if you want to use an individual IP address or a subnet for the endpoint selector.

  Note If the endpoints are Azure scale sets and the selector is IP based, the selector must exactly match the subnet where the scale set is placed. For example, if you configured `10.1.0.0/16` CIDR, `10.1.0.0/24` subnet, and the scale set is in this subnet, then the IP selection must match `10.1.0.0/24` exactly and not a wider mask such as `10.1.0.1/32`.

- Choose Region if you want to use the cloud region for the endpoint selector, then choose the specific region that you want use.

  When you select `Region` for the endpoint selector, every instance within the tenant that is brought up in that region will be assigned to this cloud EPG.

- Choose Zone if you want to use the Amazon Web Services availability zone for the endpoint selector, then choose the specific zone that you want use.

  When you select `Zone` for the endpoint selector, every instance within the tenant that is brought up in that zone will be assigned to this cloud EPG.

  Note This selector type is supported only for AWS cloud sites.

- Choose Custom tags or labels if you want to create a custom tag or label for the endpoint selector. Start typing to enter the custom tag or label, then click Create on the new field to create a new custom tab or label.

The Operator field determines the relation between the type and its value:

- 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.
- Does Not Have Key: Used if the expression contains only a key.

The Value field determines the collection of endpoints that you want to use for the endpoint selector, based on the choices that you made for the two previous fields. This can be a single IP address, a subnet, AWS region or zone, or a custom tag value.

For this use case, you will be assigning endpoints based on IP subnets, so you will configure the endpoint selector using the following example values:

- Type: `IP Address`
- Operator: `Equals`
- Value: `3.3.1.0/24`

Step 5 Click the checkmark next to the new endpoint selector.

Step 6 Click Save in the Add New End Point Selector form.

Configuring a Second EPG

Now that you have created one stretched EPG, you can create a second EPG to later configure a contract between them. To create the second EPG, you repeat the steps described in Configuring an Application Profile and EPG, on page 14 with a few distinctions detailed below.

Procedure

Step 1 In the middle pane, in the Application Profile area, click + Add EPG.

This example uses the same application profile as the first EPG. Alternatively, you can create a separate application profile specifically for the second EPG.

Step 2 In the right pane, enter an EPG name in the Display Name field (for example, `epg2-stretched`).

Step 3 In the On-Prem Properties area, select the second bridge domain you created from the Bridge Domain dropdown menu.

Step 4 In the Cloud Properties area, select the same VRF you used for the first EPG (for example, `vrf-stretched`).

Step 5 Add endpoints to the EPG.

Adding cloud endpoints is described in Adding Cloud Endpoint Selector, on page 15.

Adding on-premises endpoints is described in On-Premises Endpoints, on page 15.

Creating a Filter and Contract

This section describes how to create the contract you will use to allow communication between the two stretched EPGs.

Procedure

Step 1 In the left pane, select the template you created earlier.

Step 2 In the middle pane, scroll down until you see the Filter area, then click + in the dotted box.

Step 3 In the right pane, enter a name for the filter in the Display Name field.

For example, `filter-https`

Step 4 Click + Entry to provide information for your schema filter on the Add Entry display:

The Add Entry window appears.

a) Enter a name for the schema filter entry in the Name field.
b) (Optional) Enter a description for the filter in the Description field.
c) Enter the details as appropriate to filter EPG communication.

For example, to add an entry allowing HTTPS traffic through a filter, choose:

- Ethertype: `ip`
- IP Protocol: `tcp`
- Destination Port Range From: `443`

  Destination Port Range To: `443`

d) Click SAVE.

Step 5 In the middle pane, scroll down until you see the Contract area, then click + in the dotted box.

Step 6 In the right pane, enter a name for the contract in the Display Name field (for example, `contract-stretched-vrf`).

Step 7 In the Scope area, leave the selection at VRF.

Step 8 In the Filter Chain area, click + Filter.

In the Add Filter Chain screen.

a) In the Name field, select the filter that you created earlier in this procedure.
b) Click Save.

Assigning the Contract to EPGs

This section describes how to add the contract between the two stretched EPGs.

Procedure

Step 1 Add the contract to the first EPG.

a) Select the template.
b) In the middle pane, select the first stretched EPG.
c) In the right pane, scroll down to the Common Properties area and click +Contract.
d) In the Add Contract window that opens, select the contract you created and it's type.

The type of the contract depends on your deployment, but for this example we'll use `consumer` for this EPG.

e) Click Save.

Step 2 Add the contract to the second EPG.

a) Select the template.
b) In the middle pane, select the first stretched EPG.
c) In the right pane, scroll down to the Common Properties area and click +Contract.
d) In the Add Contract window that opens, select the contract you created and it's type.

The type of the contract depends on your deployment, but for this example we'll use `provider` for this EPG.

e) Click Save.

Deploying to Sites

Once you have completed all of the other configuration tasks, deploy the templates you have configured to the sites.

Procedure

Step 1 Click on the Deploy to Sites button at the top right corner of the screen to deploy the templates to the sites.

Confirmation window will appear.

Step 2 Confirm the deployment.

The confirmation window lists the changes that will be made for each site. After you confirm the deployment, you should see a message saying `Successfully Deployed`.

Endpoints in AWS Cloud

This task describes how to create an AWS cloud endpoint (VM) with appropriate endpoint selector information that you defined when creating the cloud EPG in the Multi-Site Orchestrator.

Procedure

Step 1 Log in to the Amazon Web Services account.

Step 2 In the AWS Management Console, click All services.

Step 3 From All services, select Computer > EC2.

Step 4 Click Launch Instance to create a new instance (VM).

Step 5 Then select the type of instance you want to create and provide the required information.

Based on the endpoint selector you have chosen for the cloud EPG you created, specify one or more of the following parameters for the EC2 instance:

- If you plan on assigning endpoints based on an IP subnet, use the CIDR and subnet information you have specified in the endpoint selector.
- If you plan on assigning endpoints based on an Amazon Web Services region or zone, configure an appropriate Availability Zone for each instance.

  For example, you would use `us-west-1` for AWS region or `us-west-1a` for an availability zone.
- If you are assigning endpoints based on a custom tag or label, select the Tags tab and click Add/Edit Tags to create a new tag.

  Then enter the same value you chose in the Value field of the endpointer selector.

Endpoints in Azure Cloud

This task describes how to create an Azure cloud endpoint (VM) with appropriate endpoint selector information that you defined when creating the cloud EPG in the Multi-Site Orchestrator.

Procedure

Step 1 Log in to the Azure account.

Step 2 Navigate to Home > All services > Virtual Machines.

Step 3 Click +Add to create a new virtual machine.

Step 4 In the Create a virtual machine screen, provide the appropriate information based on the endpoint selector you created.

Provide all the required information, such as virtual machine name, size, administrator account, etc.

In the Subscription dropdown, select the subscription where you created your tenant.

If you are assigning endpoints based on an IP subnet, choose the subnet created by the Multi-Site Orchestrator.

If you plan on assigning endpoints based on a custom tag or label, choose a VM, then click the Tags tab on the left. Use an existing tag in this area, or click Add/Edit Tags to create a new one. You will use the entry in the Value field for this tag for the custom tag or label for the endpoint selector.

Verifying the Stretched EPG Configuration

Use the following procedure to verify that you configured the stretched EPG correctly.

Procedure

Step 1 In the on-premises APIC GUI: Verify that the configurations were deployed successfully on your on-premises APIC site:

a) Choose the tenant that you created in Creating a Tenant, on page 10.
b) Expand Application Profiles > ***app-profile*** > Application EPGs.
c) Verify that you see the application EPG that you created earlier under the Application EPGs area.
d) Expand Networking > Bridge Domains > ***bridge-domain*** > Subnets.
e) Verify that you see the subnet that you defined earlier under your bridge domain.

Step 2 In the Cloud APIC GUI: Verify that the configurations were deployed successfully on your Cloud APIC:

a) On the main Cloud APIC page, under Application Management, click Application Profiles.
b) Verify that the application profile that you created earlier is displayed, with the tenant that you created earlier shown under the application profile.
c) On the main Cloud APIC page, under Application Management, click EPGs.
d) Verify that the EPG that you created earlier is displayed.

Step 3 In the Cloud APIC GUI: Verify that the end points were deployed successfully for your EPG on your Cloud APIC:

a) On the main Cloud APIC page, under Application Management, click EPGs.
b) In the Name column, locate the EPG that you created earlier, then locate the entry under the Endpoints column for this EPG.

   The number shown in this column should match the number of endpoints that you have for this EPG. You might have to click the Refresh button at the top right corner of the screen (the circle with an arrow) to refresh the screen before the number is displayed properly in this column.

c) Click the number in this Endpoints column to bring up more information on the endpoints for this EPG.
d) Verify that the information that you used in the endpoint selector is being used for this endpoint.

   For example, if you used an IP address of `192.0.2.1` for your endpoint selector, you should see this same IP address in the Private IPv4 Address row in this page.

e) In this endpoint page, locate and note the ENI identifier in the Cloud Provider ID field.

   This is the elastic network interface, used by Amazon Web Services, which is a logical networking component in a VPC that represents a virtual network card.

Step 4 In the AWS management console: Log in to the AWS account for the user tenant, if you are not logged in already, and verify that the ENI identifier that you noted in 3.e, on page 21 matches the information in the AWS account:

a) Go to Services > EC2, then click the Running Instances link.
b) Choose an instance (click the box next to an instance).
c) Scroll down until you see Network Interfaces on the right side, then click the eth0 link and locate the entry shown in the Interface ID field.

   This Interface ID should match the ENI identifier that you noted in 3.e, on page 21.

Step 5 In the AWS management console: Verify that the CIDR configurations that you entered were pushed successfully to AWS:

a) Go to Services > VPC.
b) In the Resources by Region area, click VPCs.
c) Verify that the CIDR is listed under the IPv4 CIDR column.

d) If you used IP subnet for the endpoint selector, click Subnets in the left pane, then verify that the subnets are shown under the IPv4 CIDR column.

Step 6 In the AWS management console: Verify that EC2 instance brought up is classified in the correct security group (EPG):

a) Select the instance from AWS, the click the Description tab.
b) Locate the Security Groups field in the Description area and verify that you can see the application profile and EPG classification.

Step 7 In the Azure portal: Verify that the CIDR configurations that you entered were pushed successfully to Azure:

a) Go to All services > Virtual Networks.
b) Select the virtual network (VNET).
c) Verify that the CIDR is listed in the Address space field.
d) If you used IP subnet for the endpoint selector, click Subnets in the left pane, then verify that the subnets are shown in the Address range column.

Step 8 In the Azure portal: Verify that VMs were brought up successfully and classified in the correct network security group:

a) Go to All services > Virtual Machines.
b) Select the virtual machine.
c) In the left pane, select Settings > Networking.
d) In the description, verify that the correct network security group is listed.

Confirming AWS Connectivity

Use the following procedure to confirm AWS connectivity.

Procedure

Step 1 Log in to the Amazon Web Services account.

Step 2 Gather the necessary information:

a) Open the Amazon VPC console at https://console.aws.amazon.com/vpc/.
b) In the Resources by Region area, click VPCs.
c) In the navigation pane, choose Your VPCs.
d) Locate the CIDR listed under the IPv4 CIDR column where the workload instance will reside.

This should be the same CIDR that you entered in Associating Templates with Sites, on page 12.

e) Make a note of the entry in the VPC ID column for this CIDR.
f) In the navigation pane, choose Subnets.
g) Locate the subnets listed under the IPv4 CIDR column for this CIDR.

These should be the same subnets that you entered in Associating Templates with Sites, on page 12.

h) Make a note of the entries in the Subnet ID column for these subnets.

Step 3 Create and launch the appropriate instances in AWS:

a) Go to Services > EC2 > Instances.
b) In the Create Instance area, click Launch Instance.
c) In the Step 1: Choose an Amazon Machine Instance (AMI) page, select an instance that you would like to run.

d) In the Step2: Choose an Instance Type page, choose an instance type.

   For example, you might choose the instance type with General Purpose in the Family column and t2.micro in the Type column.

e) Click Next: Configure Instance Details in the lower right corner.

f) In the Step 3: Configure Instance Details page, apply the necessary configuration settings that you want for this instance.

   For example:

   - Network: Choose the VPC that you noted in 2.e, on page 22 for this instance.
   - Subnet: Choose the first subnet that you noted in 2.h, on page 22 for this instance.

     For example, you might choose the AWS Subnet ID that corresponds with the 3.3.1.0/24 subnet in the us-west-1a availability zone that you set up in Associating Templates with Sites, on page 12.

g) Click Review and Launch at the bottom right corner.

h) In the Review Instance Launch page, verify that the information is correct, then click Launch at the bottom right corner.

   Click the checkbox for the acknowledgement window and click Launch Instance, if necessary.

i) Repeat these steps to launch a second instance, using the same VPC but on the second subnet that you noted in 2.h, on page 22 for the second instance.

j) Verify that the two instances initialized properly.

   Go back to Services > EC2 > Instances and wait for the values in the Status Checks column for the two instances to change from Initializing to 2/2 checks.

k) Get the IP address for the first instance by clicking on that instance, then make a note of the entry in the Private IPs area.

   Repeat this step for the second instance.

Step 4 In the Cloud APIC site: Verify that the configurations that you entered in Azure are shown in the Cloud APIC site:

a) On the main Cloud APIC page, under Application Management, click EPGs.

b) In the Name column, locate the EPG that you created earlier, then locate the entry under the Endpoints column for this EPG.

c) Click the number in this Endpoints column to bring up more information on the endpoints for this EPG.

d) Locate the Private IPv4 Address field and verify that the entry in this field matches the entry from AWS that you noted in previous.

Confirming Azure Connectivity

Use the following procedure to confirm Azure connectivity.

Procedure

Step 1 Log in to your Azure portal.

Step 2 Gather the necessary information:

a) Log in to the Azure portal.
b) Go to All services > Virtual Networks.
c) Select the virtual network (VNET).
d) Locate the CIDR listed in the Address space field and make a note of it.

   This should be the same CIDR that you entered when associating the template with the site.

e) Click Subnets in the left pane and make a note of the subnets shown in the Address range column.

   This should be the same CIDR that you entered when associating the template with the site.

Step 3 Create and launch the appropriate virtual machines:

a) Go to All services > Virtual Machines.
b) Click Add to create a new virtual machine (VM).
c) Provide the required VM details.

   When asked to provide network information, choose the CIDR and subnet you noted in previous step.

d) Repeat these steps to create and start a second VM, using the same CIDR but the second subnet that you noted in previous step.
e) After both VMs are up and running, select them in the Azure portal and note their IP addresses.

Step 4 In the Cloud APIC site: Verify that the configurations that you entered in Azure are shown in the Cloud APIC site:

a) On the main Cloud APIC page, under Application Management, click EPGs.
b) In the Name column, locate the EPG that you created earlier, then locate the entry under the Endpoints column for this EPG.
c) Click the number in this Endpoints column to bring up more information on the endpoints for this EPG.
d) Locate the Private IPv4 Address field and verify that the entry in this field matches the entry from Azure that you noted in previous.

Confirming On Premises Site Connectivity

Use the following procedure to confirm the on premises site connectivity. For this use case, it is assumed that you have certain configurations already set up in your on premises site, such as an on premises VMM domain using VMware vDS.

Procedure

Step 1 In the on-premises APIC GUI: Verify that the on-premises site configurations that you entered in ACI Multi-Site Orchestrator was pushed to the on-premises APIC site:

a) Choose the tenant that you created in Creating a Tenant, on page 10.
b) Expand Application Profiles > app1 > Application EPGs > stretched-epg.
c) Click Domains (VMs and Bare-Metals).
d) Verify that the VM domain binding that you pushed in the ACI Multi-Site Orchestrator is displayed in this page.

Step 2 In the VMware vCenter GUI:

a) Log into the VMware vCenter site.

b) Navigate to your VM in the VMware vCenter site.

   For example, assume you have a VM named `OnPrem-Web` in the VMware vCenter site.

c) Modify the network adapter for the `OnPrem-Web` VM by right-clicking the VM, then selecting Edit Settings...
d) In the Virtual Hardware tab, locate the Network Adapter 1 field and choose the Show More Networks...
e) Select the EPG that you created earlier, which will be shown as username/application-domain/epg, and click OK.

   For example, `UseCaseUser/app1/stretched-epg`.

f) Right-click on your VM again, and choose Open Console.
g) Verify that the IP address shown in the `eth0; inet addr` area is the IP address for the endpoint in the EPG in your on-premises site.

   For example, using the information in APIC Bridge Domain Information, on page 9, the IP address shown in this field should be `2.2.2.1`.

h) Verify that you can reach the instances in the cloud site, using the information from 3.k, on page 23.

   For example, if the IP address for the first instance in the cloud site is 3.3.1.212, then verify that ping 3.3.1.212 is successful.

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