Deploying Cisco Virtual APIC Using AWS

Revised: March 13, 2024,

New and Changed Information

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

Cisco APIC Release	Feature
6.0(2)	Support for deploying virtual APIC using AWS.

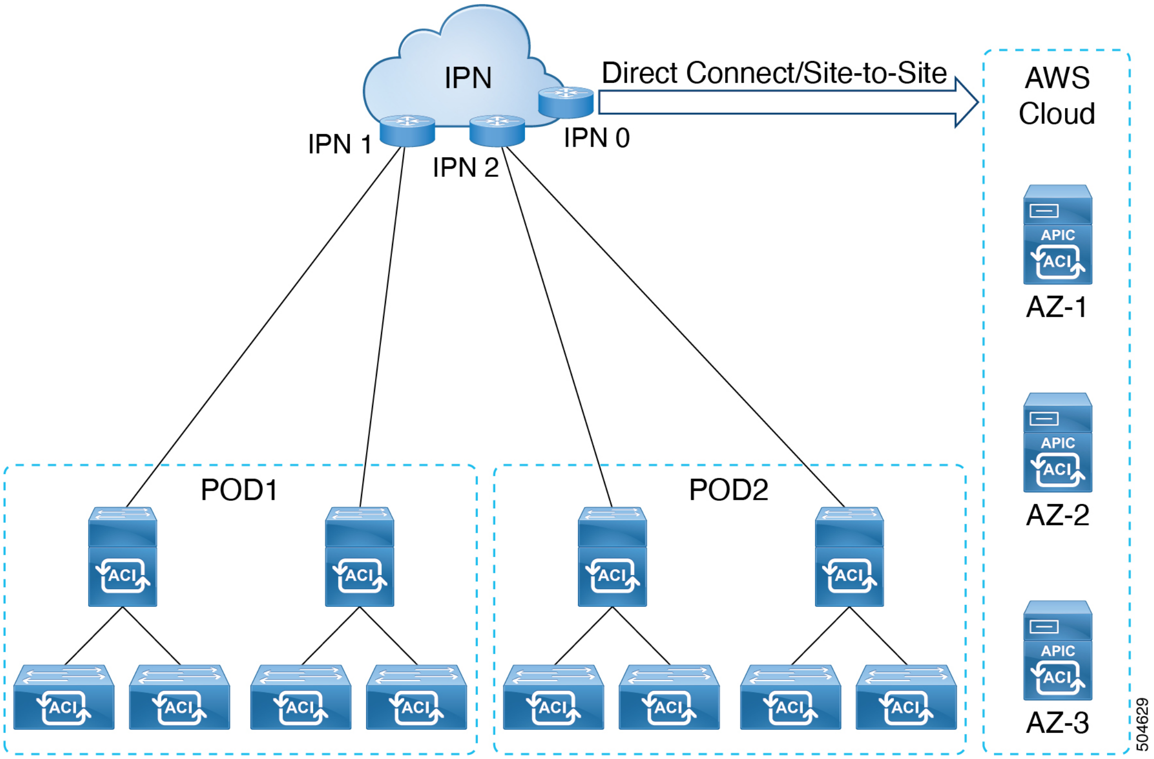
Overview

Beginning with Cisco APIC release 6.0(2), you can deploy a cluster wherein all the APICs in the cluster are virtual APICs. You can deploy virtual APIC(s) on an ESXi using the VMware vCenter, or you can deploy virtual APICs on a public cloud. The public cloud supported for this release is, Amazon Web Services (AWS).

This document provides details about deploying a virtual APIC using AWS; for details about deploying virtual APIC on an ESXi host using VMware vCenter, see the Deploying Virtual APIC Using VMware vCenter document.

In this deployment, the virtual APIC cluster is running on the AWS public cloud and the fabric switches are deployed on the customer premises (on-prem). The APICs are remotely connected to the fabric through a layer 3 network. A three-node cluster is recommended. To ensure high availability and redundancy, the three APICs are deployed under three different availability zones (AZ) in AWS. Each AZ requires a different subnet.

Figure 1: Deploying virtual APIC using AWS



The IPN can be connected to the AWS cloud using direct connect or site-to-site VPN. Ensure to have a minimum bandwidth of 10 Gbps between the on-prem device(s) connected via the IPN and the APIC cluster on the AWS cloud .

For more information about direct connect and site-to-site VPN, refer the relevant *AWS documentation.*

Guidelines and Limitations

Following are the guidelines and limitations for deploying virtual APIC using AWS:

- Fabric switches must be running Cisco APIC release 6.0(2) or later. Fabric switches running versions earlier than release 6.0(2) can be automatically upgraded to release 6.0(2) release during fabric discovery using Auto Firmware Update.
- No support for mixed mode, that is, all the APICs of a cluster must be of the same type.
  - Virtual APIC on AWS cannot form a cluster with a virtual APIC on an ESXi host.
  - Virtual APIC on AWS cannot form a cluster with a physical APIC.
- Virtual APICs deployed using ESXi cannot be migrated to AWS, and vice-versa (deployed on AWS to ESXi). Migrating from a virtual APIC deployed using AWS to a physical APIC is also not supported. For the supported migration scenario, see the *Migrating from a Physical APIC to a Virtual APIC* section.
- After you have deployed a virtual APIC (with release 6.0(2)) using AWS, you cannot downgrade it to a release prior to Cisco APIC release 6.0(2).
- No standby APIC support (no redundancy).

  In the case of a physical APIC cluster, the standby APIC is automatically updated with firmware updates to ensure it is the same firmware version as the active cluster. This enables APIC replacement in the event of a failure. However, in the case of a virtual APIC cluster, the user can create an instance of the APIC with the same version as needed, so a standby APIC is not necessary.
- Cluster and fabric security is provided using self-signed certificates.
- IPv6 is not supported on virtual APIC deployed using AWS.

  IPv6 is not supported for inband and out-of-band management with contracts.
- No apps or app-infra supported on a virtual APIC on AWS, that is, no external ACI apps can be downloaded and installed on a virtual APIC (deployed using AWS) from the DC AppCenter. Only pre-packaged apps are supported.
- Virtual APIC cluster is supported in all Multi-Pod, Remote Leaf, and Multi-Site topologies. Refer the Verified Scalability Guide for Cisco APIC for scalability limitations.

Deploying Virtual APIC Using AWS

Use this procedure to deploy Cisco virtual APIC using AWS.

Before you begin

Prerequisites:

- Log in to your Amazon account and verify that you have the administrator access on AWS.
- Ensure that your AWS account has an allowed limit to deploy the instances. You can check your account instance limits in the AWS Management Console, here: **Services** > **EC2** > **Limits**.

At least three EC instances are required for an APIC cluster in production, which means your AWS account needs to be able to launch three additional *r6i.4xlarge* EC2 instances.

The table below displays the cloud instance types supported by virtual APIC on AWS:

AWS EC2 Instance	**vCPU**	**Memory (in GB RAM)**
r6i.4xlarge (recommended)	16	128
r6i.8xlarge	32	256

- Create network resources which will be used for stack creation. Create the following resources:
  - VPC ID—Virtual Private Cloud (VPC) ID on which the virtual APIC will be deployed. Ensure that the VPC IP prefix is not conflicting with the IP prefixes of the on-prem devices.

    If you already have a VPC ID, that can be used. Creation of a new VPC is not mandatory.

  - Subnet ID—Subnet range for your VPC.

    For high availability, create three subnet IDs for each availability zone; one for out-of-band management, infra and inband management. In a 3-node cluster, we have three availability zones, and nine subnet IDs are required. Keep them handy as they will be used in the deployment procedure. Clearly indicate the subnet ids for each availability zone.

AZ1	APIC 1	Subnet ids for OOB, infra, inband management.
AZ2	APIC 2	Subnet ids for OOB, infra, inband management.
AZ3	APIC 3	Subnet ids for OOB, infra, inband management.

Note All the three subnets must belong to one availability zone for one APIC.

You can refer to the relevant *AWS documentation* for details about creating VPC and subnets.

Example:

```
Vpc : vpc-062429c055a4a7416
Subnets:
VPC: vapic-example1-vpc, AZ: AZ1
vapic-oob-az1-subnet:   10.1.0.0/28    GW: 10.1.0.1
vapic-infra-az1-subnet: 10.1.0.16/28   GW: 10.1.0.17
vapic-inb-az1-subnet:   10.1.0.128/28  GW: 10.1.0.129
```

See the Additional References, on page 16 section for an example of the cloud formation template that automates the creation pre-requisite configurations.

- Create an Amazon EC2 SSH key pair:

1. Click the **Services** link at the top left area of the screen, then click the EC2 link.

   The **EC2 Dashboard** screen appears.

2. In the EC2 Dashboard screen, click the **Key Pairs** link.

3. In the **Create Key Pair** screen, enter the following details:

  - Enter a unique name for this key pair; click **Create**.
  - A screen is displayed that shows the public key that is stored in AWS. In addition, a Privacy Enhanced Mail (PEM) file is downloaded locally to your system with the private key.
  - Move the private key PEM file to a safe location on your system and note the location.

    If you already have a key pair created, that can be used. Creation of a new key pair is not mandatory.

- Bandwidth of 10 Gbps is mandatory between the AWS cloud and the fabric (on-prem device(s)).
- Latency tolerance is up to 50 ms.

Procedure

Step 1 Log in to your AWS MarketPlace account.

Search for Cisco APIC 6.0(2h). You are directed to the Cisco APIC page which has the 6.0(2h) software details. You can see all the relevant details under the following tabs— Overview, Pricing, Usage, Support, Reviews. For Pricing details based on the instance type, click the Pricing tab. See the *Prerequisites* section above for the supported instance types.

Note This product is under *BYOL* category. Talk to your Cisco support/ representative to get the required license.

Step 2 Click the **Continue to Subscribe** button.

Step 3 Click the **Continue to Configuration** button.

Step 4 On the **Configure this software** page, enter the following details:

a) Fulfillment option—*APIC on AWS Deployment Scenario* is displayed (auto-populated).
b) Software version—the APIC software version, 6.0(2h), is displayed (auto-populated).
c) Region—select the required region (where the software is being deployed) from the drop-down list..

   The product code is displayed.

Step 5 Click the **Continue to Launch** button.

Step 6 On the **Launch this software** page, for the **Choose Action** field, select the *Launch CloudFormation* option from the drop-down list.

Step 7 Click **Launch**.

Step 8 In the **Create Stack** screen that is displayed, enter the following details:

a) In the Prerequisite, **Prepare template** pane, choose Template is Ready.
b) In the **Specify template** pane, for the **Template source** field, select the *Amazon S3 URL* option. You can copy the S3 URL link which is displayed on the screen (as shown in the image below) and download the template.

   Image to be added

Step 9 Click **Next**.

Step 10 In the **Specify stack details** screen, enter the following details:

- Specify the **Stack Name** , which is the identification name for the virtual APIC configuration in AWS.
- From the drop-down list, select the **VPC ID** in which you want to deploy the virtual APIC. See the *Prerequisites* section above for the details about VPC ID creation.

- From the drop-down list, select the required **OOB Mgmt Subnet ID** (out-of-band management subnet) to be used by the virtual APIC. Ensure to select the correct subnet id corresponding to the availability zone.
- From the drop-down list, select the required **Infra Subnet ID**; the infra subnet to be attached to the infra interface of the virtual APIC. Ensure to select the correct subnet id corresponding to the availability zone.
- From the drop-down list, select the required **Inband Mgmt Subnet ID**; the inband management subnet to be used by the virtual APIC for inband management. Ensure to select the correct subnet id corresponding to the availability zone.
- From the drop-down list, select the recommended **Instance Type**, that is, *r6l.4xlarge*.
- Select a **Key Pair** from the drop-down list.

  Note The key pair is mandatory as the password-based SSH authentication is disabled by default for virtual APIC on AWS. You can enable the password authentication manually on the Cisco APIC GUI . Navigate to the **Console Access** tab, and set the **Password Auth State** to *Enable*. The path is: **Fabric** > **Fabric Policies** > **Policies** > **Pod** > **Management Access** > **Default** .

- Enter an **Admin User Password**. This password will be used to access the virtual APIC after deployment.
- Enter the above password again in the **Confirm Admin User Password** field.

Step 11 Click **Next**. The **Configure Stack Options** page is displayed.

Step 12 Click **Next**. The **Review** virtual APIC page is displayed. Ensure that the information displayed in the Parameters pane is accurate.

Step 13 Click **Submit**. This initiates the stack creation.

You can check the progress of stack creation in the **Events** tab. Check the Status column which displays the current status, CREATE_IN_PROGRESS. The stack creation takes about 8-10 minutes. After the stack is successfully created, the Status column displays the status as, CREATE_COMPLETE.

Step 14 Check the **Outputs** tab. Note down the parameters displayed here. The OOBMgmt IP address displayed here (as seen below) is required while configuring the nodes using the APIC Cluster Bringup GUI.

Step 15 On the AWS home screen, in the search box, next to **Services**, search for EC2.

Step 16 Navigate to **Resources** > **Instances**.

Step 17 Check the **Status Check** column for the newly created stack. Ensure that *checks passed* is displayed.

Step 18 Repeat the steps detailed above to create each node in a cluster. For example, if you are building a 3-node cluster, perform the above procedure three times.

Ensure that the admin password is the same for all the APIC nodes. Also ensure to verify that the **Status Check** column for each node displays *checks passed* for all the newly created instances (stacks) before proceeding to the APIC Cluster Bringup GUI.

What to do next

For initial bootup and cluster bring up, see the Bringing Up the Cisco APIC Cluster Using the GUI procedure in the *Cisco APIC Getting Started Guide*. Use the OOB management IP address to reach the cluster bringup GUI.

Note To expand a virtual APIC AWS cluster, after the initial cluster bringup, you can use the Add Node option in the Cisco APIC GUI. Navigate to **System** > **Controllers**. In the Navigation pane, expand **Controllers** > *apic_controller_name* > **Cluster as Seen by Node** > **Actions** > **Add Node**.

Cluster expansion by increasing the cluster size and commissioning the node is not supported.

Creating an ACI Network with a Layer 3 Connected APIC Cluster

The procedures in this section establish the connectivity between the created virtual APIC cluster (on the cloud), and the remote ACI fabric. The APIC cluster on the cloud, is able to discover the fabric nodes using DHCP relay and an OSPF or BGP underlay provided by the IPN.

The following list outlines the steps to deploy an ACI network with an APIC cluster on the cloud:

Procedure

Step 1 Configure the IPN as described is these procedures —Provisioning the Fabric-Facing IPN Device, on page 9 and Provisioning the APIC Cluster-Facing IPN Device, on page 8.

Step 2 Bring up the APIC cluster as detailed above. See Deploying Virtual APIC Using AWS, on page 3.

Step 3 Configure a layer 3 connection for the APIC cluster to communicate over the IPN with the fabric pod. See Preparing Connectivity to the Fabric Pod, on page 10.

Step 4 Bring up the fabric pod. The fabric will be discovered by the APIC cluster over the layer 3 connection as described in Summary of Fabric Discovery and Registration, on page 13.

What to do next

You can connect additional fabric pods and remote leaf sites to the layer 3 connected APIC cluster in a similar manner.

Guidelines and Restrictions for Deploying APIC Cluster Connectivity to the Fabric Over a Layer 3 Network

When deploying a virtual layer 3-connected APIC cluster, follow these guidelines and limitations.

- All APIC cluster sizes are supported in a layer 3 connected APIC pod.
- APICs in a layer 3 connected APIC pod cannot form a cluster with APICs within the fabric pod. In this topology, there should be no APICs in the fabric pod.
- The layer 3 connected APICs can be in the same subnet or in different subnets.
- The layer 3 connected APICs can be geographically distributed from each other provided that the latency between APICs and with the fabric pod does not exceed 50 milliseconds round-trip time (RTT), which translates approximately to a geographical distance of up to 2,500 miles.
- Although any device that can meet the IPN network requirements can be used as an IPN device, we recommend to deploy, when possible, switches of the Cisco Nexus 9300 Cloud Scale family. These are the devices most commonly found in production and

also the devices more frequently validated in Cisco internal testing. For further information about IPN device requirements, see "Inter-Pod Connectivity Deployment Considerations" in the ACI Multi-Pod White Paper.

- The APIC subnets must be advertised to the spines as either OSPF or BGP routes. An OSPF/ BGP underlay is supported.
- As all control plane traffic between the APIC cluster and the fabric pod traverses the IPN, we recommend configuring QoS for this traffic. See the *Configuring QoS* section in this guide.
- APIC Cluster Connectivity to the Fabric Over a Layer 3 Network does not support the following:
  - ACI CNI for Kubernetes (Redhat Openshift, SUSE/Rancher RKE, Upstream Kubernetes on Ubuntu)
  - ACI ML2 for Openstack (Redhat Openstack, Canonical Openstack)
- Virtual APIC AWS cluster connectivity to the fabric over a layer 3 network supports permissive mode by default.

Provisioning the APIC Cluster-Facing IPN Device

This section describes the configuration of the IPN device connected to Pod 0, the APIC cluster pod. With reference to the topology in the Overview, on page 2 section, the cluster-facing IPN device is shown as IPN0. As a recommended practice, the IPN0 comprises two devices for redundancy. The fabric interface of each APIC is dual-homed to the two devices.

In the following configuration example, two Cisco Nexus 9000 series switches (IPN0a and IPN0b) are configured with the following choices:

- VLAN 1500 is used as interface VLAN for the APICs.
- The switch interfaces are configured as layer 2 trunk ports. As an alternative, the interfaces could be access ports if the APIC fabric interface is configured to use VLAN 0 during APIC setup.
- Both switches are configured using HSRP to share a single IP address that serves as the APIC subnet default gateway address.
- APIC subnets are advertised to the spines using OSPF as the underlay protocol. As an alternative, a BGP underlay could be deployed.

```
# Example configuration of IPN0a:

interface Vlan1500
  no shutdown
  vrf member IPN
  ip address 172.16.0.252/24
  ip ospf passive-interface
  ip router ospf 1 area 0.0.0.0
  hsrp version 2
  hsrp 1500
    ip 172.16.0.1

interface Ethernet1/1
  switchport mode trunk
  switchport trunk vlan 1500
  spanning-tree port type edge trunk


# Example configuration of IPN0b:

interface Vlan1500
  no shutdown
  vrf member IPN
  ip address 172.16.0.253/24
  ip ospf passive-interface
  ip router ospf 1 area 0.0.0.0
  hsrp version 2
  hsrp 1500
    ip 172.16.0.1

interface Ethernet1/1
  switchport mode trunk
  switchport trunk vlan 1500
  spanning-tree port type edge trunk
```

Provisioning the Fabric-Facing IPN Device

This section describes the configuration of the MPod IPN, which is the IPN device connected to a fabric pod. The IPN is not managed by the APIC. It must be preconfigured with the following information:

- Configure the interfaces connected to the spines of the fabric pod.
- Enable OSPF (or BGP) on the sub-interface specifying the OSPF process and area ID.
- Enable DHCP Relay on the IPN interfaces connected to spines.
- Enable PIM.
- Add bridge domain GIPo range as PIM Bidirectional (**bidir**) group range (default is 225.0.0.0/15).

  A group in **bidir** mode has only shared tree forwarding capabilities.
- Add 239.255.255.240/28 as PIM **bidir** group range.
- Enable PIM on the interfaces connected to all spines.

Note Multicast is not required for a single pod fabric with a layer 3-connected APIC cluster, but it is required between pods in a multi-pod fabric.

Note When deploying PIM **bidir**, at any given time it is only possible to have a single active RP (Rendezvous Point) for a given multicast group range. RP redundancy is hence achieved by leveraging a **Phantom RP** configuration. Because multicast source information is no longer available in Bidir, the Anycast or MSDP mechanism used to provide redundancy in sparse-mode is not an option for **bidir**.

The following switch configuration example is for a switch deployed as the MPod IPN. The DHCP relay configuration allows the fabric to be discovered by the APIC cluster. The deployment of a dedicated VRF in the IPN for inter-pod connectivity is optional, but is a best practice recommendation. As an alternative, you can use a global routing domain.

```
Example: OSPF as the underlay protocol
feature dhcp
feature pim
service dhcp
ip dhcp relay

# Create a new VRF.
vrf context overlay-1
  ip pim rp-address 12.1.1.1 group-list 225.0.0.0/15 bidir
  ip pim rp-address 12.1.1.1 group-list 239.255.255.240/28 bidir

interface Ethernet1/54.4    #spine connected interface
  mtu 9150
  encapsulation dot1q 4
  vrf member overlay-1
  ip address 192.168.0.1/30
  ip ospf network point-to-point
  ip router ospf infra area 0.0.0.0
  ip dhcp relay address 172.16.0.2  #infra address of APIC 1
  ip dhcp relay address 172.16.0.3  #infra address of APIC 2
  ip dhcp relay address 172.16.0.4  #infra address of APIC 3
  no shutdown

interface loopback29
  vrf member overlay-1
  ip address 12.1.1.2/30

router ospf infra
  vrf overlay-1
    router-id 29.29.29.29


Example: BGP as the underlay protocol
router bgp 65010
  vrf IPN
    neighbor 192.168.0.2 remote-as 65001
      address-family ipv4 unicast
        disable-peer-as-check
```

In the BGP configuration, the `disable-peer-as-check` command is needed for multi-pod because each pod uses the same ASN.

Preparing Connectivity to the Fabric Pod

Before bringing up the fabric pod (Pod 1), you first must pre-configure the layer 3-connected APIC cluster (Pod 0) for connectivity through the IPN to a spine in the fabric pod. This is necessary for automatic fabric discovery.

Before you begin

- If the layer 3 conncted virtual APIC cluster is deployed in a separate security zone from the fabric, configure the firewall to allow any necessary protocols and ports.
- Configure the inter-pod network (IPN) device that is connected to the fabric pod spines.
- Configure a fabric external routing profile.
- Configure an OSPF interface policy if you are using OSPF as the underlay protocol.

Procedure

Step 1 Log in to one of the APICs in the layer 3 connected cluster.

Step 2 Choose **Fabric** > **Inventory** > **Pod Fabric Setup Policy**.

Step 3 In the work pane, click the + symbol.

The **Set Up Pod TEP Pool** dialog box opens.

Step 4 In the **Set Up Pod TEP Pool** dialog box, complete the following steps:

a) Using the **Pod ID** selector, choose Pod 1.
b) In the **TEP Pool** field, enter the TEP pool of the fabric pod.
c) Click **Submit**.

Step 5 In the navigation pane, expand **Quick Start** and click **Add Pod**.

Step 6 In the work pane, click **Add Pod**.

Step 7 In the **Configure Interpod Connectivity STEP 1 > Overview** panel, review the tasks that are required to configure interpod network (IPN) connectivity, and then click **Get Started**.

Step 8 In the **Configure Interpod Connectivity STEP 2 > IP Connectivity** dialog box, complete the following steps:

a) If you see a **Name** field in an **L3 Outside Configuration** area, choose an existing fabric external routing profile from the **Name** drop-down list.
b) Using the **Spine ID** selector, choose one spine in Pod 1 that will be the initial spine to communicate with APIC 1 in Pod 0.
c) In the **Interfaces** area, in the **Interface** field, enter the spine switch interface (slot and port) used to connect to the IPN.

   Click the **+** (plus) icon to add more interfaces.

d) In the **IPV4 Address** field, enter the IPv4 gateway address and network mask for the interface.
e) From the **MTU (bytes)** drop-down list, choose a value for the maximum transmit unit of the external network.

   The MTU should be 9150 (the default). This value should also be configured on the IPN interface.

f) Click **Next**.

Step 9 In the **Configure Interpod Connectivity STEP 3 > Routing Protocols** dialog box, in the **OSPF** area, complete the following steps to configure OSPF for the spine to IPN interface:

a) Leave the **Use Defaults** checked or uncheck it.

   When the **Use Defaults** check box is checked, the GUI conceals the optional fields for configuring Open Shortest Path (OSPF). When it is unchecked, it displays all the fields. The check box is checked by default.

b) In the **Area ID** field, enter the OSPF area ID.
c) In the **Area Type** area, choose an OSPF area type.

   You can choose **NSSA area** or **Regular area** (the default). **Stub area** is not supported.

d) (Optional) With the **Area Cost** selector, choose an appropriate OSPF area cost value.
e) From the **Interface Policy** drop-down list, choose or configure an OSPF interface policy.

   You can choose an existing policy, or you can create one with the **Create OSPF Interface Policy** dialog box. An example is shown in the following table:

Table 1: OSPF Interface Policy Example

Property	**Setting**
Name	ospfIfPol
Network Type	Point-to-point
Priority	1
Cost of Interface	unspecified

Property	Setting
Interface Controls	none checked
Hello Interval (sec)	10
Dead Interval (sec)	40
Retransmit Interval (sec)	5

Step 10 In the **Configure Interpod Connectivity STEP 3 > Routing Protocols** dialog box, in the **BGP** area, leave the **Use Defaults** checked or uncheck it.

The **Use Defaults** check box is checked by default. When the check box is checked, the GUI conceals the fields for configuring Border Gateway Protocol (BGP). When it is unchecked, it displays all the fields. If you uncheck the box, configure the following steps:

a) Leave the **Use Defaults** checked or uncheck it.

b) In the **Community** field, enter the community name.

We recommend that you use the default community name. If you use a different name, follow the same format as the default.

c) In the **Peering Type** field, choose either **Full Mesh** or **Route Reflector** for the route peering type.

If you choose **Route Reflector** in the **Peering Type** field and you later want to remove the spine switch from the controller, you must first disable **Route Reflector** in the *BGP Route Reflector* page. Not doing so results in an error.

To disable a route reflector, right-click on the appropriate route reflector in the **Route Reflector Nodes** area in the **BGP Route Reflector** page and select **Delete**. See the section "Configuring an MP-BGP Route Reflector Using the GUI" in the chapter "MP-BGP Route Reflectors" in the *Cisco APIC Layer 3 Networking Configuration Guide*.

d) In the **Peer Password**, field, enter the BGP peer password. In the **Confirm Password** field, reenter the BGP peer password.

e) In the **Route Reflector Nodes** area, click the **+** (plus) icon to add nodes.

For redundancy purposes, more than one spine is configured as a route reflector node: one primary reflector and one secondary reflector. It is best practice to deploy at least one external route reflector per pod for redundancy purposes.

The **External Route Reflector Nodes** fields appear only if you chose **Route Reflector** as the peering type.

Step 11 Click **Next**.

Step 12 In the **Configure Interpod Connectivity STEP 4 > External TEP** dialog box, complete the following steps:

a) Leave the **Use Defaults** checked or uncheck it.

The **Use Defaults** check box is checked by default. When the check box is checked, the GUI conceals the optional fields for configuring the external TEP pool. When it is unchecked, it displays all the fields.

b) Note the nonconfigurable values in the **Pod** and **Internal TEP Pool** fields.

c) In the **External TEP Pool** field, enter the external TEP pool for the physical pod.

The external TEP pool must not overlap the internal TEP pool or external TEP pools belonging to other pods.

d) In the **Data Plane TEP IP** field, accept the default, which is generated when you configure the **External TEP Pool**; if you enter another address, it must be outside of the external TEP pool.

Step 13 Click **Next**.

The **Summary** panel appears, displaying a list of policies created by this wizard. You can change the names of these policies here.

Step 14 Click **Finish**.

What to do next

Monitor the discovery and registration of the fabric nodes by APIC, as summarized in the following section.

Summary of Fabric Discovery and Registration

The following is a summary of the switch registration and discovery process.

- The IPN, acting as a DHCP relay agent, forwards DHCP requests from the spine to the APIC.
- Spine switch is now visible to the APIC and appears the under **Nodes Pending Registration** in the **Fabric Membership** screen. Navigate to **Fabric** > **Inventory** > **Fabric Membership**.
- Register the spine switch on the APIC .
- The APIC allocates an IP address for the spine interface to the IPN and a TEP IP from the TEP pool configured for the fabric pod containing the spine. At this point, the spine joins the ACI fabric.
- The spine advertises the TEP subnet to the IPN through OSPF or BGP so that the IPN learns this subnet.
- The spine acts as a DHCP relay agent for its connected leaf switches, and forwards the requests to the APIC.
- The leaf switches are then visible to the APIC and appear in the section of **Nodes Pending Registration** in **Fabric > Inventory > Fabric Membership**.
- You must manually register these leaf switches on the APIC.
- After a leaf switch is registered, the APIC forwards the TEP IP address and DHCP configuration information to the leaf, which then joins the ACI fabric. Through this discovery process, the layer 3-connected APIC cluster discovers all switches in the fabric pod.

Password-based SSH Login

By default, password authentication for SSH is disabled on the virtual APIC on AWS. You can login via SSH using public key authentication.

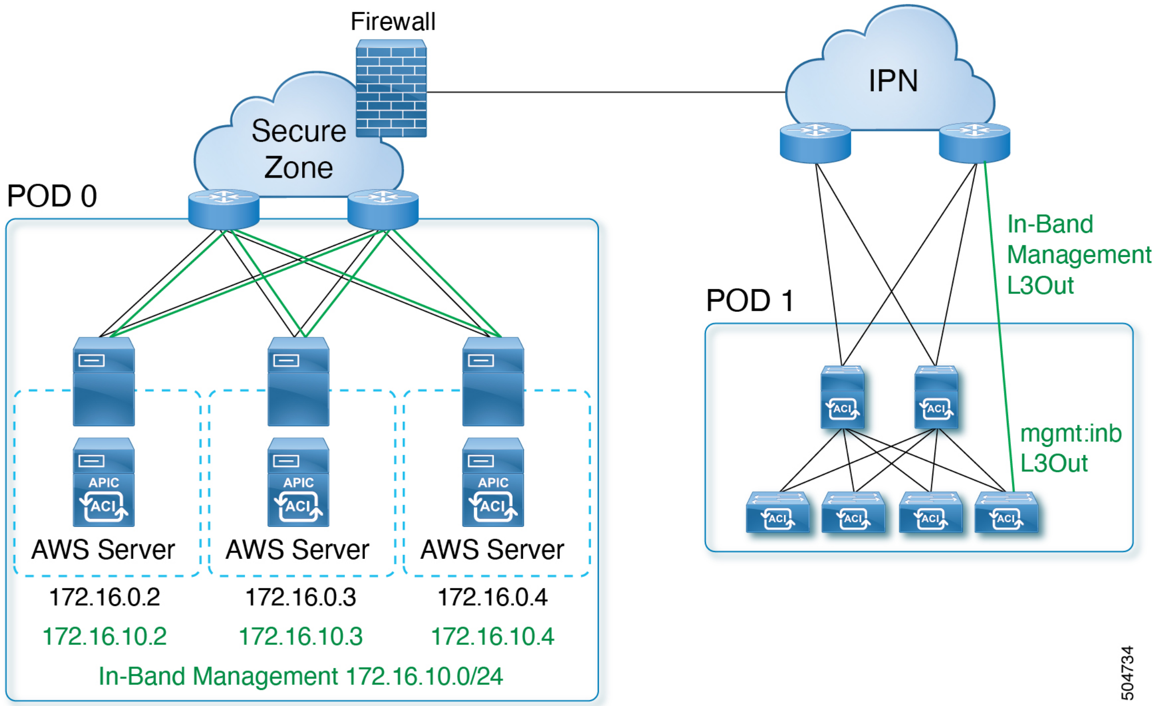
After the virtual APIC cluster is up and *fully-fit*, you can enable the Password Authentication using the standard Cisco APIC GUI. Navigate to **Fabric** > **Fabric Policies** > **Policies** > **Pod** > **Management Access**. On the Management Access-default page, in the SSH pane, for the **Password Auth State** field, select *Enabled* from the drop-down list (which was earlier set to *Disabled*.

For enabling password authentication using CLI, see below:

```
aws-vapic# config
aws-vapic(config)# comm-policy default
aws-vapic(config-comm-policy)# ssh-service
aws-vapic(config-ssh-service)# passwd-auth-enable
aws-vapic(config-ssh-service)# exit
```

Configuring Inband Management

Use this procedure to configure in-band management for the layer 3 connected APIC cluster.



Before you begin

When you deploy in-band management with a layer 3 connected APIC cluster, the in-band management VRF (mgmt:inb) is not routed through the spines to the IPN. Connectivity to the in-band management interfaces on the APIC must be routed from an L3Out configured from the leaf switches. This L3Out should be configured in the **mgmt** tenant for the in-band management VRF.

Guidelines and Limitations for inband management for virtual APIC on AWS

- During deployment, each APIC comes up with the inband management interfaces and IP addresses as allocated by AWS. Inband management interface is in disabled state. Inband management interface is enabled when inband policies are made available.
- Inband IP address configuration cannot be changed by a user.

Procedure

Step 1 Configure the APIC upstream switches.

Example:

```
interface Vlan100
  no shutdown
  vrf member IPN
  ip address 172.16.0.252/24
  ip ospf passive-interface
  ip router ospf 1 area 0.0.0.0
  hsrp version 2
  hsrp 100
    ip 172.16.0.1

interface Vlan101
  no shutdown
  vrf member IPN
  ip address 172.16.10.252/24
  ip ospf passive-interface
  ip router ospf 1 area 0.0.0.0
  hsrp version 2
  hsrp 101
    ip 172.16.10.1
```

Step 2 Configure the APICs for in-band management using the normal in-band management configuration procedure.

a) Configure the Static Node Management Addresses for each APIC.

b) Configure the In-Band EPG. For the encapsulation VLAN, you can use any VLAN except for the infrastructure VLAN ID specified during the initial cluster bringup.

For additional information about configuring in-band management, see the "Static In-band Management" chapter of the Cisco APIC and Static Management Access tech note.

Step 3 Configure the APIC interfaces on the upstream switches.

The APIC-connected interface must be a trunk interface. If the APICs were initialized with an infra VLAN other than 0, you can configure the interface as in the following example.

```
interface Ethernet1/1
  switchport mode trunk
  switchport trunk allowed vlan 100-101
```

Note You cannot change the APIC infra VLAN ID after the cluster is formed.

Migrating from a Physical APIC Cluster to a Virtual APIC Cluster on AWS

Use this procedure to migrate a physical APIC cluster to a virtual APIC cluster on AWS. Migration is only supported if both the APICs (physical and virtual) are remotely attached to the ACI fabric through a layer 3 network.

Procedure

Step 1 Export the config from a physical layer 3 cluster.

On the Cisco APIC GUI, navigate to **Admin** > **Import/ Export**. For the detailed procedure, see Configuring an Export Policy Using the GUI.

Step 2 Use the deployment procedure as explained earlier (Deploying Virtual APIC Using AWS, on page 3), and create a virtual APIC cluster using AWS.

Ensure the infra VLAN used in the physical APIC and the virtual APIC are the same.

Step 3 Check if the physical cluster is healthy.

Step 4 Import the configuration (from the physical to the virtual APIC) using the standard Cisco APIC GUI procedure. See Configuring an Import Policy Using the GUI.

a) After the import is a success, delete existing inband configuration (mgmtRsInBStNode Mo) for nodes configured previously and recreate them manually.

b) Navigate to **Tenants** > **mgmt** > **Node Management Addresses** > **Static Node Management Addresses**. In the **Create Static Node Management Addresses** screen, set the configuration mode to **Auto**

Step 5 All the fabric nodes must be clean reloaded to join the new layer 3 virtual APIC cluster on AWS.

Step 6 IPN must be manually updated with the infra IP addresses of the virtual APIC, so that virtual cluster is reachable from the ACI fabric nodes.

Additional References

This cloud formation template automates the creation of pre-requisite configuration required to launch Cisco virtual APIC (vAPIC).

```
Metadata:
  "AWS::CloudFormation::Interface":
    ParameterGroups:
      - Label:
          default: VAPIC Network configuration
        Parameters:
          - VPCCidrBlock
          - AvailabilityZones
          - NumberOfAZs

    ParameterLabels:
      VPCCidrBlock:
        default: VPC CIDR
      AvailabilityZones:
        default: Availability Zones
      NumberOfAZs:
        default: Number of Availability Zones

Parameters:
  VPCCidrBlock:
    Description: VPC Cidr block used to launch VAPIC cluster
    Type: String
    AllowedPattern: "^(([0-9]|[1-9][0-9]|1[0-9]{2}|2[0-4][0-9]|25[0-5])\\.){3}([0])(\\/(24))$"
    Default: 10.1.0.0/24
    ConstraintDescription: "must be a valid IP unused VPC CIDR - x.x.x.x/24"

  AvailabilityZones:
    Description: >-
      List of Availability Zones used to launch vAPIC nodes. Choose 3 AZs for high
      availability. For regions that only supports 2 AZs, choose 2 AZs (2nd &
      3rd vAPIC will be launched in the second AZ). Make sure that the value of the
      NumberOfAZs parameter matches the number of selections
    Type: "List<AWS::EC2::AvailabilityZone::Name>"
  NumberOfAZs:
    AllowedValues:
      - "2"
      - "3"
    Default: "3"
    Description: >-
```

```
      Number of Availability Zones used to launch vAPIC cluster. This count must
      match the number of AZ selections you make from the AvailabilityZones
      parameter; otherwise, deployment will fail.
    Type: String

Conditions:
  IsAZ3Available: !Equals
    - !Ref NumberOfAZs
    - "3"
Resources:
  VPC:
    Type: AWS::EC2::VPC
    Properties:
      CidrBlock: !Ref VPCCidrBlock
      EnableDnsSupport: true
      EnableDnsHostnames: true
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-vapic-vpc

  InternetGateway:
    Type: AWS::EC2::InternetGateway
    DependsOn: VPC
  AttachGateway:
    Type: AWS::EC2::VPCGatewayAttachment
    Properties:
      VpcId: !Ref VPC
      InternetGatewayId: !Ref InternetGateway

  #  subnets
  MgmtSubnet1:
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select
        - "0"
        - !Ref AvailabilityZones
      CidrBlock: !Select [0, !Cidr [!Ref VPCCidrBlock, 9, 4]]
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-oob-mgmt-subnet-1

  InfraSubnet1:
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select
        - "0"
        - !Ref AvailabilityZones
      CidrBlock: !Select [3, !Cidr [!Ref VPCCidrBlock, 9, 4]]
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-infra-subnet-1

  InbandSubnet1:
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select
        - "0"
        - !Ref AvailabilityZones
      CidrBlock: !Select [6, !Cidr [!Ref VPCCidrBlock, 9, 4]]
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-inband-subnet-1

  MgmtSubnet2:
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select
        - "1"
        - !Ref AvailabilityZones
      CidrBlock: !Select [1, !Cidr [!Ref VPCCidrBlock, 9, 4]]
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-oob-mgmt-subnet-2

  InfraSubnet2:
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select
        - "1"
        - !Ref AvailabilityZones
      CidrBlock: !Select [4, !Cidr [!Ref VPCCidrBlock, 9, 4]]
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-infra-subnet-2

  InbandSubnet2:
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select
        - "1"
        - !Ref AvailabilityZones
      CidrBlock: !Select [7, !Cidr [!Ref VPCCidrBlock, 9, 4]]
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-inband-subnet-2

  MgmtSubnet3:
    Condition: IsAZ3Available
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select
        - "2"
        - !Ref AvailabilityZones
      CidrBlock: !Select [2, !Cidr [!Ref VPCCidrBlock, 9, 4]]
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-oob-mgmt-subnet-3

  InfraSubnet3:
    Condition: IsAZ3Available
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select
        - "2"
        - !Ref AvailabilityZones
      CidrBlock: !Select [5, !Cidr [!Ref VPCCidrBlock, 9, 4]]
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-infra-subnet-3
  InbandSubnet3:
    Condition: IsAZ3Available
    Type: AWS::EC2::Subnet
    Properties:
      VpcId: !Ref VPC
      AvailabilityZone: !Select
        - "2"
        - !Ref AvailabilityZones
      CidrBlock: !Select [8, !Cidr [!Ref VPCCidrBlock, 9, 4]]
      Tags:
        - Key: Name
          Value: !Sub ${AWS::StackName}-inband-subnet-3

Outputs:
  VAPICVPC:
    Description: VPC ID.
    Value: !Ref VPC
```

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