Cisco ACI with Microsoft Windows Azure Pack

This chapter contains the following sections:

About Cisco ACI with Microsoft Windows Azure Pack

Cisco Application Centric Infrastructure (ACI) integrates in Microsoft Windows Azure Pack to provide a self-service experience for the tenant.

ACI enhances the network management capabilities of the platform. Microsoft Windows Azure Pack is built on top of an existing Microsoft System Center Virtual Machine Manager (SCVMM) installation. Cisco ACI has integration points at each of these layers, enabling you to leverage the work performed in a SCVMM environment and use it in a Microsoft Windows Azure Pack installation.

- Cisco ACI with Microsoft Windows Azure Pack—Microsoft Windows Azure Pack for Windows Server is a collection of Microsoft Azure technologies that include the following capabilities:
  - Management portal for tenants
  - Management portal for administrators
  - Service management API
- Cisco ACI with Microsoft System Center Virtual Machine Manager —For information about how to set up Cisco ACI with Microsoft System Center Virtual Machine Manager (SCVMM), see details in Cisco ACI with Microsoft SCVMM Solution Overview.

Note You cannot configure direct server return (DSR) through Windows Azure Pack. If you want to configure DSR, you must do so in Cisco APIC. See the chapter "Configuring Direct Server Return" in the *Cisco APIC Layer 4 to Layer 7 Services Deployment Guide* for information.

Cisco ACI with Microsoft Windows Azure Pack Solution Overview

Cisco Application Centric Infrastructure (ACI) integrates in Microsoft Windows Azure Pack to provide a self-service experience for tenants. ACI resource provider in Windows Azure Pack drives the Application Policy Infrastructure Controller (APIC) for network management. Networks are created in System Center Virtual Machine Manager (SCVMM) and are available in Windows Azure Pack for respective tenants. ACI Layer 4 to Layer 7 capabilities for F5 and Citrix load balancers and stateless firewall are provided for tenants. For details, see the About Load Balancing, on page 23.

Windows Azure Pack for Windows Server is a collection of Microsoft Azure technologies, available to Microsoft customers at no additional cost for installation into your data center. It runs on top of Windows Server 2012 R2 and System Center 2012 R2 and, through the use of the Windows Azure technologies, enables you to offer a rich, self-service, multi-tenant cloud, consistent with the public Windows Azure experience.

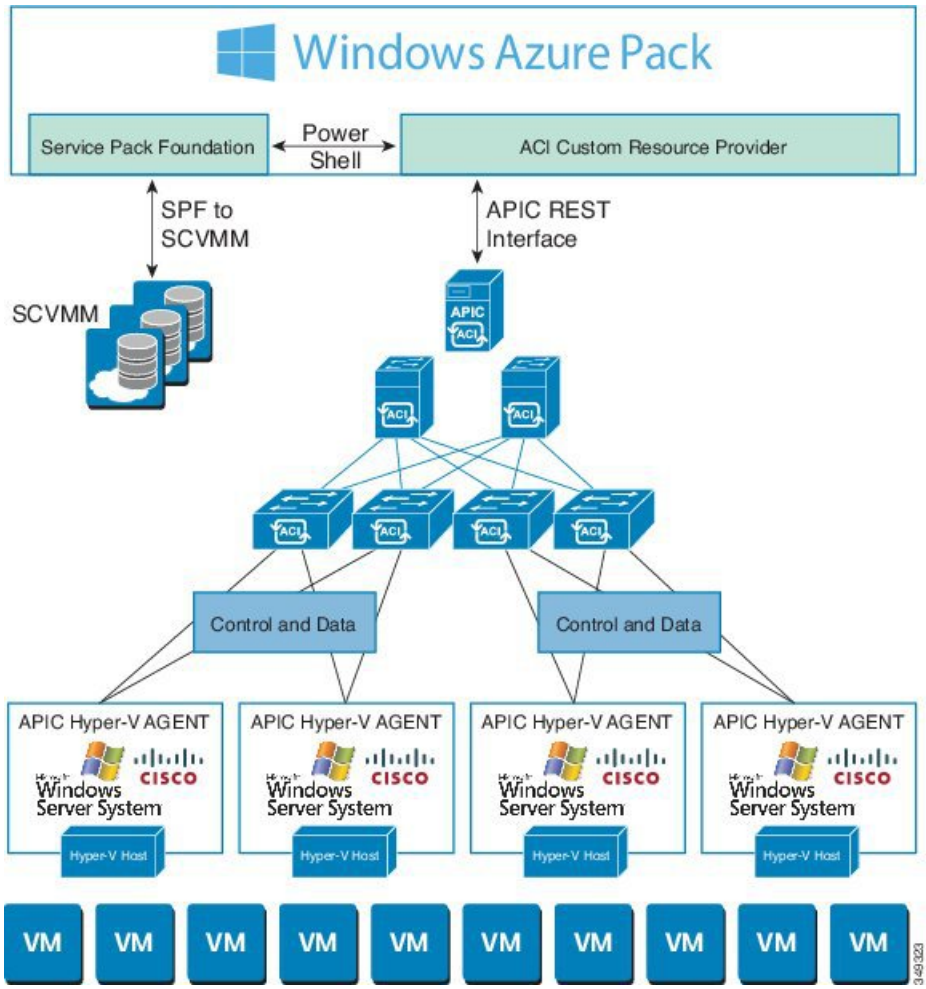
Windows Azure Pack includes the following capabilities:

- Management portal for tenants—a customizable self-service portal for provisioning, monitoring, and managing services such as networks, bridge domains, VMs, firewalls, load balancers, external connectivity, and shared services. See the User Portal GUI.
- Management portal for administrators—a portal for administrators to configure and manage resource clouds, user accounts, and tenant offers, quotas, pricing, Web Site Clouds, Virtual Machine Clouds, and Service Bus Clouds.
- Service management API—a REST API that helps enable a range of integration scenarios including custom portal and billing systems.

See Use Case Scenarios for the Administrator and Tenant Experience, on page 14 for details.

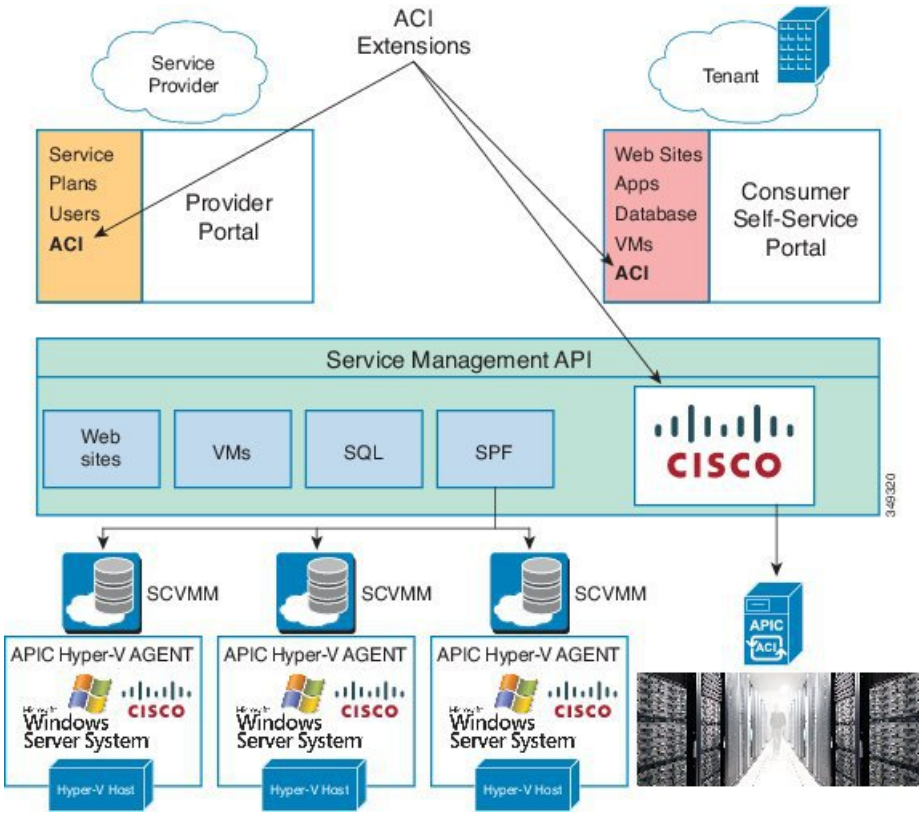
Physical and Logical Topology

Figure 1: Topology of a typical Windows Azure Pack deployment with ACI Fabric



The above figure shows a representative topology of a typical Windows Azure Pack deployment with Cisco Application Centric Infrastructure (ACI) fabric. Connectivity between Windows Azure Pack and Application Policy Infrastructure Controller (APIC) is over the management network. Tenants interface is only with Windows Azure Pack either through the GUI or REST API. Tenants do not have direct access to APIC.

Figure 2: ACI in Resource Provider Framework



About the Mapping of ACI Constructs in Microsoft Windows Azure Pack

This section shows a table of the mapping of Cisco Application Centric Infrastructure (ACI) constructs in Microsoft Windows Azure Pack.

Table 1: Mapping of ACI and Windows Azure Pack constructs

Windows Azure Pack	ACI
Subscription	Tenant
Network	EPG
Firewall Rule	Intra-tenant contract
Shared Service	Inter-tenant contract
SCVMM Cloud	VM Domain

Getting Started with Cisco ACI with Microsoft Windows Azure Pack

This section describes how to get started with Cisco ACI with Microsoft Windows Azure Pack.

Before you install Cisco ACI with Microsoft Windows Azure Pack, download and unzip the folder containing the Cisco ACI and matching Microsoft integration files for the Cisco APIC release.

1. Go to Cisco's Application Policy Infrastructure Controller (APIC) website.
2. Choose **All Downloads for this Product** > **APIC Software**.
3. Choose the release version and the matching zipped folder.
4. Click **Download**.
5. Unzip the zipped folder.

Note Cisco ACI with Microsoft Windows Azure Pack only supports ASCII characters. Non-ASCII characters are not supported.

Ensure that **English** is set in the System Locale settings for Windows, otherwise Cisco ACI with Windows Azure Pack will not install. Also, if the System Locale is modified to a non-English Locale after installation, the integration components may fail when communicating with Cisco APIC and the Cisco ACI fabric.

Prerequisites for Getting Started with Cisco ACI with Microsoft Windows Azure Pack

Before you get started, ensure that you have verified that your computing environment meets the following prerequisites:

- Ensure Cisco Application Centric Infrastructure (ACI) with Microsoft System Center Virtual Machine Manager (SCVMM) has been set up.

  For more information, see Getting Started with Cisco ACI with Microsoft SCVMM.
- Ensure that Microsoft Windows Azure Pack Update Rollup 5, 6, 7, 9, 10, or 11 is installed.

  See Microsoft's documentation.
- Ensure that Windows Server 2016 is installed.

  See Microsoft's documentation.
- Ensure that Hyper-V Host is installed.

  See Microsoft's documentation.
- Ensure a cloud is configured on SCVMM.

  See Microsoft's documentation.

- Ensure a VM cloud is configured on Windows Azure Pack.

  See Microsoft's documentation.

- Ensure "default" AEP exists with infrastructure VLAN enabled.
- Ensure "default" and "vpcDefault" bridge domains and corresponding "default" and "vpcDefault" EPGs exist in tenant common.
- Ensure you have the Cisco MSI files for APIC Windows Azure Pack Resource and the Host Agent.

  For more information, see Getting Started with Cisco ACI with Microsoft SCVMM.

Note Symptom: When you either create or update a plan it may fail with an error message.

Condition: If you have configured Microsoft's Windows Azure Pack without the FQDN, you will encounter the following error message:

```
Cannot validate the new quota settings because one of the underlying services failed to
respond. Details: An error has occurred.
```

Workaround: When you configure the VM Clouds, follow Microsoft's Windows Azure Pack UI instructions which informs you to use the FQDN for your SCVMM server.

Installing, Setting Up, and Verifying the Cisco ACI with Microsoft Windows Azure Pack Components

This section describes how to install, set up, and verify the Cisco ACI with Microsoft Windows Azure Pack components.

Component	Task
Install ACI Azure Pack Resource Provider	See Installing ACI Azure Pack Resource Provider, on page 7.
Install the OpflexAgent certificate	See Installing the OpflexAgent Certificate, on page 7.
Configure ACI Azure Pack Resource Provider Site	See Configuring ACI Azure Pack Resource Provider Site, on page 9.
Install ACI Azure Pack Admin site extension	See Installing ACI Azure Pack Admin Site Extension, on page 10.
Install ACI Azure Pack tenant site extension	See Installing ACI Azure Pack Tenant Site Extension, on page 10.
Set up the ACI	See Setting Up ACI, on page 10.
Verify the Windows Azure Pack Resource Provider	See Verifying the Windows Azure Pack Resource Provider, on page 11.

Installing ACI Azure Pack Resource Provider

This section describes how to install ACI Azure Pack Resource Provider on the Windows Azure Pack server.

Procedure

Step 1 Log in to the Microsoft Service Provider Foundation Server which provides VM Clouds in the Windows Azure Pack environment. Locate and copy over **ACI Azure Pack - Resource Provider Site.msi** file.

Step 2 Double-click the **ACI Azure Pack - Resource Provider Site.msi** file.

Step 3 In the **Setup** dialog box, perform the following actions to install ACI Azure Pack - Resource Provider:

a) Check the **I accept the terms in the License Agreement** check box.
b) Click **Install**.
c) Click **Install**.
d) Click **Finish**.

Installing the OpflexAgent Certificate

This section describes how to install the OpflexAgent Certificate.

Procedure

Step 1 Log in to the Windows Azure Pack server with administrator credentials.

Step 2 Use one of the following methods:

- For large-scale deployments, see Microsoft's documentation for Deploy Certificates by Using Group Policy:

  https://technet.microsoft.com/en-us/library/cc770315(v=ws.10).aspx.

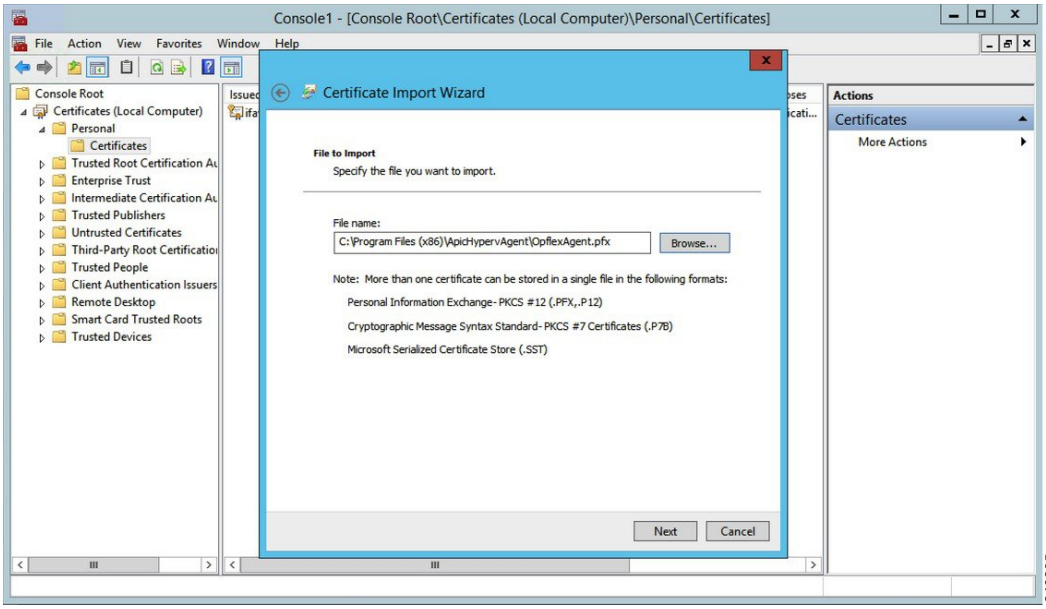
- For small-scale deployments follow these steps:

  You must add OpFlex security certificate to the local system. The ACI Windows Azure Pack resource provider uses the same security certificate file from the Cisco ACI SCVMM installation process located on your SCVMM Server at: **C:\Program Files (x86)\ApicVMMService\OpflexAgent.pfx**. Copy this file to the Windows Azure Pack Resource Provider Server. If the following steps are not performed on your ACI Windows Azure Pack resource provider servers, the APIC ACI Windows Azure Pack resource provider cannot communicate with the Application Policy Infrastructure Controller (APIC) .

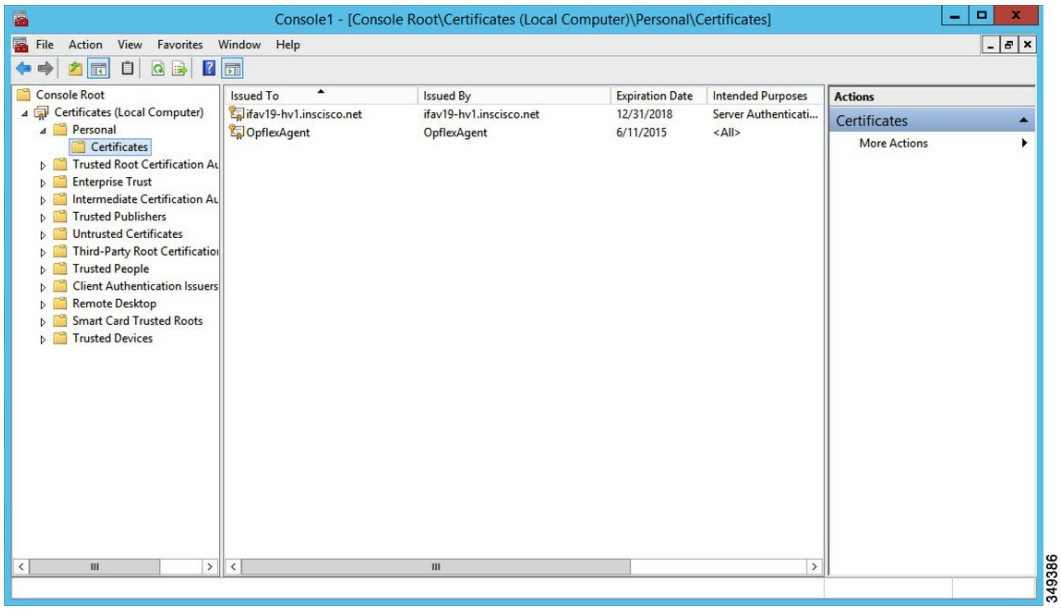
  Install the OpFlex security certificate on the ACI Windows Azure Pack resource provider Windows Server 2012 local machine’s certificate repository. On each ACI Windows Azure Pack resource provider server, install this certificate by performing the following steps:

  1. Choose **Start** > **Run**.
  2. Enter **mmc** and click **OK**.
  3. In the **Console Root** window, on the menu bar, choose **Add/Remove Snap-in**.
  4. In the **Available Snap-ins** field, choose **Certificates** and click **Add**.

5. In the **Certificates snap-in** dialog box, choose the **Computer Account** radio button, and click **Next**.
6. In the **Select Computer** dialog box, choose the **Local Computer** radio button, and click **Finish**.
7. Click **OK** to go back to the main **MMC Console** window.
8. In the **MMC Console** window, double-click **Certificates (local computer)** to expand its view.
9. Right-click **Certificates** under **Personal** and choose **All Tasks** > **Import**.
10. In the **Certificates Import Wizard** dialog box, perform the following actions:
    1. Click **Next**.
    2. Browse to the **Opflex Agent** file and click **Next**.



11. Enter the password for the certificate that was provided when you installed MSI.
12. You must choose the **Mark this key as exportable. This will allow you to back up or transport your keys at a later time** radio button.
13. Choose the **Include all extended properties** radio button.
14. Choose the **Place all certificates in the following store** radio button, browse to locate **Personal**, and click **Next**.
15. Click **Finish**.
16. Click **OK**.



Configuring ACI Azure Pack Resource Provider Site

This section describes how to configure ACI Azure Pack Resource Provider IIS Site on the Windows Azure Pack server.

Procedure

Step 1 Log in to the Windows Azure Pack server and open the **Internet Information Services Manager Application**.

Step 2 Navigate to **Application Pools** > **Cisco-ACI**.

Step 3 Click the **Advanced Settings** in the Actions tab.

a) Locate the Identity field and click on the ellipses to the left of the scroll bar.

b) Select Custom Account and input your account name and password credentials for Service Provider Foundation Administrator. The Service Provider Foundation Administrator user account should have the following group memberships: Administrators, SPF_Admin. This user account is required as the Resource Provider queries the attached SCVMM servers. In addition, the User Credentials must have permission to write to the Local Machine Registry and have Read/Write access to the following directory for Resource Provider Logging:

C:\Windows\System32\config\systemprofile\AppData\Local

c) Click **OK** to exit Application Pool Identity.

Step 4 Click **OK** to exit Advanced Settings

Installing ACI Azure Pack Admin Site Extension

This section describes how to install ACI Azure Pack Admin Site Extension on the Windows Azure Pack server.

Procedure

Step 1 Log in to the Windows Azure Pack server and locate the **ACI Azure Pack - Admin Site Extension.msi** file.

Step 2 Double-click the **ACI Azure Pack - Admin Site Extension.msi** file.

Step 3 In the **Setup** dialog box, perform the following actions to install ACI Azure Pack - Admin Site Extension:

a) Check the **I accept the terms in the License Agreement** check box.
b) Click **Install**.
c) Click **Finish**.

Installing ACI Azure Pack Tenant Site Extension

This section describes how to install ACI Azure Pack Tenant Site Extension on the Windows Azure Pack server.

Procedure

Step 1 Log in to the Windows Azure Pack server and locate the **ACI Azure Pack - Tenant Site Extension.msi** file.

Step 2 Double-click the **ACI Azure Pack - Tenant Site Extension.msi** file.

Step 3 In the **Setup** dialog box, perform the following actions to install ACI Azure Pack - Tenant Site Extension:

a) Check the **I accept the terms in the License Agreement** check box.
b) Click **Install**.
c) Click **Finish**.

Setting Up ACI

This section describes how to setup ACI.

Procedure

Step 1 Log in to the Service Management Portal.

Step 2 In the **navigation** pane, choose **ACI**.

If you do not see **ACI**, click **Refresh**.

Step 3 Click the QuickStart icon.

Step 4 In the **QuickStart** pane, perform the following actions in order:

a) Click on **Register your ACI REST endpoint**.

b) In the **ENDPOINT URL** field, enter the resource provider address:Cisco-ACI port (http://*resource_provider_address*:50030).
c) In the **USERSNAME** field, enter the user name (domain administrator).
d) In the **PASSWORD** field, enter the password (domain administrator password).

Step 5 Choose the **ACI** > **Setup** tab, and perform the following actions:

a) In the **APIC ADDRESS** field, enter the APIC IP Address(es).
b) In the **CERTIFICATE NAME** field, enter OpflexAgent.

Verifying the Windows Azure Pack Resource Provider

This section describes how to verify the Windows Azure Pack Resource Provider.

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the navigation pane, choose **ACI**.

Step 3 In the **aci** pane, choose the QuickStart Cloud icon.

Ensure the **Register your ACI REST Endpoint** link is greyed out.

Step 4 In the **aci** pane, choose **SETUP**.

Ensure that you see the APIC Address has valid apic addresses and the Certificate name is OpflexAgent.

Upgrading the Cisco ACI with Microsoft Windows Azure Pack Components

Prerequisites:

Microsoft servers that you integrate into ACI must be updated with the KB2919355 and KB3000850 update rollups prior to upgrading ACI to the 2.0(1) release. The KB2919355 update rollup includes the 2929781 patch, which adds new TLS cipher suites and changes the cipher suite priorities in Windows 8.1 and Windows Server 2012 R2.

You must patch the following Microsoft servers:

- Microsoft Windows Azure Pack Resource Provider Servers
- Microsoft Windows Azure Pack Tenant Site Servers
- Microsoft Windows Azure Pack Admin Site Servers
- Microsoft System Center Service Provider Foundation/Orchestration Servers
- Microsoft System Center 2012 R2 Servers
- Microsoft HyperV 2012 R2 Servers

To upgrade the `.msi` files for each Cisco ACI with Windows Azure Pack Integration follow the Microsoft general guidelines for upgrading Windows Azure Pack Components listed per Update Rollup. The general guidelines are:

- If the system is currently operational (handling customer traffic), schedule downtime for the Azure servers. The Windows Azure Pack does currently not support rolling upgrades.
- Stop or redirect customer traffic to sites that you consider satisfactory.
- Create backups of the computers.

Note If you are using virtual machines (VMs), take snapshots of their current state.

If you are not using VMs, take a backup of each `MgmtSvc-*` folder in the `inetpub` directory on each machine that has a Windows Azure Pack component installed.

Collect information and files that are related to your certificates, host headers, or any port changes.

Once the upgrade is complete and has been verified, follow Hyper-V best practices regarding managing VM snapshots: https://technet.microsoft.com/en-us/library/dd560637(v=ws.10).aspx

Upgrading the ACI Windows Azure Pack Workflow

This section describes upgrading the ACI Windows Azure Pack Workflow.

Procedure

Step 1 Upgrade the APIC Controller and the Switch Software.

See the *Cisco APIC Firmware Management Guide*.

Step 2 Upgrade the ACI Windows Azure Pack.

If upgrading from a prior release of 1.1(2x):

a) You must uninstall the APIC Windows Azure Pack Resource Provider, see Uninstalling the APIC Windows Azure Pack Resource Provider, on page 48.
b) Follow the steps that are outlined in the Installing, Setting Up, and Verifying the Cisco ACI with Microsoft Windows Azure Pack Components, on page 6.
c) Skip to step 6, Upgrade the APIC SCVMM Agent on SCVMM or Upgrade the APIC SCVMM Agent on a Highly Available SCVMM.

If upgrading from release 1.1(2x) or later:

a) Proceed to step 3.

Step 3 Upgrade the ACI Windows Azure Pack Resource Provider.

For more information, see Upgrading the ACI Windows Azure Pack Resource Provider, on page 13.

Step 4 Upgrade the ACI Azure Pack Admin Site Extension.

For more information, see Upgrading the ACI Azure Pack Admin Site Extension, on page 13.

Step 5 Upgrade the ACI Azure Pack Tenant Site Extension.

For more information, see Upgrading the ACI Azure Pack Tenant Site Extension, on page 14.

Step 6 Upgrade the APIC SCVMM Agent on SCVMM or Upgrade the APIC SCVMM Agent on a Highly Available SCVMM.

For more information, see Upgrading the APIC SCVMM Agent on SCVMM.

For more information, see Upgrading the APIC SCVMM Agent on a High Available SCVMM.

Step 7 Upgrade the APIC Hyper-V Agent.

For more information, see Upgrading the APIC Hyper-V Agent.

Upgrading the ACI Windows Azure Pack Resource Provider

This section describes how to upgrade the ACI Windows Azure Pack resource provider.

Procedure

Upgrade the ACI Windows Azure Pack resource provider.

If upgrading from release 1.1(2x) or later:

a) Follow the steps outlined in the Installing ACI Azure Pack Resource Provider, on page 7.

The MSI packages handles uninstalling the previous version and installing the new version as part of the upgrade.

b) Follow the steps outline in the Configuring ACI Azure Pack Resource Provider Site, on page 9.

If upgrading from a prior release of 1.1(2x):

a) Follow the steps outlined in the Uninstalling the APIC Windows Azure Pack Resource Provider, on page 48.

b) Follow the steps outlined in the Installing ACI Azure Pack Resource Provider, on page 7.

The MSI packages handles uninstalling the previous version and installing the new version as part of the upgrade.

c) Follow the steps outline in the Configuring ACI Azure Pack Resource Provider Site, on page 9.

Upgrading the ACI Azure Pack Admin Site Extension

This section describes how to upgrade the ACI Azure Pack Admin site extension.

Procedure

Upgrade the ACI Azure Pack Admin site extension.

a) Follow the steps outlined in the Installing ACI Azure Pack Admin Site Extension, on page 10.

The MSI packages handles uninstalling the previous version and installing the new version as part of the upgrade.

Upgrading the ACI Azure Pack Tenant Site Extension

This section describes how to upgrade the ACI Azure Pack Tenant site extension.

Procedure

Upgrade the ACI Azure Pack Tenant site extension.

a) Follow the steps outlined in the Installing ACI Azure Pack Tenant Site Extension, on page 10.

The MSI packages handles uninstalling the previous version and installing the new version as part of the upgrade.

Use Case Scenarios for the Administrator and Tenant Experience

This section describes the use case scenarios for the administrator and tenant experience.

Note If the shared service consumer is in a different VRF than the provider, route leaking between the VRFs will automatically occur in order to enable the communication.

Use case	Shared Plan	VPC Plan	User	Task
Creating a plan This allows the administrator to create plans with their own moderation values.	Yes	Yes	Admin	1. See About Plan Types, on page 17.
			Admin	2. See Creating a Plan, on page 19.
Creating a tenant This allows the administrator to create a tenant.	Yes	Yes	Admin	See Creating a Tenant, on page 20.

Use case	Shared Plan	VPC Plan	User	Task
Creating and verifying networks in a shared plan This allows the tenant to create and verify networks in a shared plan.	Yes	No	Tenant	1. See Creating Networks in a Shared Plan, on page 33.
			Tenant	2. See Verifying the Network you Created on Microsoft Windows Azure Pack on APIC, on page 33.
Creating the network in VPC plan This allows the tenant to create networks in a VPC plan.	No	Yes	Tenant	See Creating the Network in VPC Plan, on page 35.
Creating a bridge domain in a VPC plan and creating a network and associating to the bridge domain This applies only in a virtual private cloud (VPC) plan. This allows a tenant to bring its own IP address space for the networks.	No	Yes	Tenant	1. See Creating a Bridge Domain in a VPC Plan, on page 34.
			Tenant	2. See Creating a Network and Associating to a Bridge Domain in a VPC Plan, on page 34.
Creating a firewall within the same subscription. This allows the tenant to create a firewall within the same subscription.	Yes	Yes	Tenant	See Creating a Firewall Within the Same Subscription, on page 35.
Allowing tenants to provide shared services This allows tenants to create networks, attach compute services (servers) to those networks, and offer the connectivity to these services to other tenants. The administrator needs to explicitly enable this capability in the plan.	Yes	Yes	Admin	1. See Allowing Tenants to Provide Shared Services, on page 20.
			Tenant	2. See Providing a Shared Service, on page 36.
			Tenant	3. See Adding Access Control Lists, on page 38 or Deleting Access Control Lists, on page 39.
			Admin	4. See Allowing Tenants to Consume Shared Service, on page 21.
			Tenant	5. See Setting up the Shared Service to be Consumed, on page 37.
			Admin	6. See Viewing the Shared Service Providers and Consumers, on page 22.

Use case	Shared Plan	VPC Plan	User	Task
Allowing tenants to consume NAT firewall and ADC load balancer services	No	Yes	Admin	1. See Allowing Tenants to Consume NAT Firewall and ADC Load Balancer Services, on page 21.
			Tenant	2. See Adding NAT Firewall Layer 4 to Layer 7 Services to a VM Network, on page 42.
			Tenant	3. See Adding NAT Firewall Port-Forwarding Rules for a VM Network, on page 43.
			Tenant	4. See Adding NAT Firewall With a Private ADC Load Balancer Layer 4 to Layer 7 Services to a VM Network, on page 43.
			Tenant	5. See Adding a Public ADC Load Balancer Layer 4 to Layer 7 Services to a VM Network, on page 44.
			Tenant	6. See Adding ADC Load Balancer Configuration for a VM Network, on page 45.
Managing shared services This allows the administrator to deprecate a shared service from new tenants and revoke a tenant access from a shared service.	Yes	Yes	Admin	See Deprecating a Shared Service from New Tenants, on page 22. See Revoking a Tenant from a Shared Service, on page 23.
Creating VMs and attaching to networks	Yes	Yes	Tenant	See Creating VMs and Attaching to Networks, on page 36.
Creating the load balancer	Yes	Yes	Admin	1. See About Load Balancing, on page 23.
			Admin	2. See Importing the Device Package on APIC, on page 24.
			Admin	3. See Configuring the Load Balancer Device on APIC using XML POST, on page 24.
			Admin	4. See Creating a Load Balancer to a Plan, on page 30.
			Tenant	5. See Configuring the Load Balancer, on page 38.

Use case	Shared Plan	VPC Plan	User	Task
Creating external connectivity This allows a tenant network to initiate outgoing traffic destined outside the fabric and to attract traffic from outside.	Yes	Yes	APIC Admin	1. See About L3 External Connectivity, on page 31.
			APIC Admin	2. See Prerequisites for Configuring L3 External Connectivity for Windows Azure Pack, on page 31.
			APIC Admin	3. See Creating a Contract to be Provided by the l3extinstP "default", on page 32.
			APIC Admin	4. See Creating a Contract to be Provided by the l3extinstP "vpcDefault", on page 32.
			Tenant	5. See Creating a Network for External Connectivity, on page 40.
			Tenant	6. See Creating a Firewall for External Connectivity, on page 41.
			APIC Admin	7. See Verifying Tenant L3 External Connectivity on APIC, on page 41.

Admin Tasks

About Plan Types

The administrator creates the plan with their own values. The plan types are as follows:

	Shared Infrastructure	Virtual Private Cloud
Isolated Networks	Yes	Yes
Firewall	Yes	Yes
Provider DHCP	Yes	Yes *
Shared Load Balancer	Yes	Yes *
Public Internet Access	Yes	Yes
Shared Services between Tenants	Yes	Yes
Bring your own address space (Private Address Space) and DHCP Server	No	Yes

* In a Virtual Private Cloud (VPC) plan, a load balancer and DHCP is not supported for private address space. Both features are still offered to a tenant, but owned by the shared infrastructure.

About Plan Options

This section describes about the plan options.

- APIC Tenant: Disable Auto Creation of an APIC Tenant
  - Default: Unselected.

    Unselected: Cisco ACI Azure Pack Resource Provider will automatically create/delete an APIC tenant. The APIC tenant name will be the Subscription ID (GUID) of the Windows Azure Pack tenant. No manual intervention by the APIC admin is required as the Resource Provider will handle all the necessary mapping.

    Selected: Cisco ACI Azure Pack Resource Provider will NOT automatically create/delete an APIC tenant. The APIC tenant must be explicitly mapped to a Windows Azure Pack Subscription ID. Once this mapping is established on the APIC, the Azure Pack Tenant will be able to perform his normal operations of working with networks, firewalls, load balancers, etc.

- Features enabled by Disabling Auto Creation of an APIC Tenant
  - SCVMM and Windows Azure Pack VM Network names take on the APIC Tenant Name rather than a GUID. This increases readability for an SCVMM Admin and Azure Pack Tenant as VM Networks will have a friendly name rather than a GUID.

- Plan Quotas: Azure Pack Plan Admins can now create Plans which limit the number of EPGs, BDs, and VRFs an Azure Pack Tenant can create.
  - The EPG, BD, and VRF created by the APIC admin under an APIC Tenant count against their quota for Azure Pack Plan.
    - Example 1: Plan Admin creates an Azure Pack plan with a limit of 5 EPGs. Azure Pack Tenant creates 4 EPGs and the APIC Admin creates an EPG for the Azure Pack Tenant. The Azure Pack Tenant has now reached his plan quota and cannot create EPGs until he is below plan quota.
    - Example 2: Plan Admin creates an Azure Pack plan with a limit of 5 EPGs. Azure Pack Tenant creates 5 EPGs. An APIC Admin creates an EPG for the Azure Pack Tenant. The Azure Pack Tenant has now reached his plan quota and cannot create EPGs until he is below plan quota.
    - These quotas are enforced for the Azure Pack Tenant, but do not apply to the APIC Admin. An APIC admin can continue to create EPGs, BDs, and VRFs for an Azure Pack Tenant even when the Tenant has gone beyond his quota.

- All Plan Types - Publishing EPGs
  - Ability for an APIC admin to push EPGs to Windows Azure Pack tenants.
  - An APIC admin can now create EPGs for their Azure Pack Tenants by creating the EPG on the APIC and associating it to the VMM Domain (SCVMM Cloud) associated with the Tenant's Plan.
  - The "default" Application Profile under the tenant is considered Azure Pack Tenant owned space. This means that the Azure Pack Tenant is allowed to create contracts with it and delete it.
  - All other Application Profiles will be considered APIC Admin owned space. These EPGs will be available to the Azure Pack Tenant for consumption, but the Azure Pack tenant will not be allowed

to modify, delete, or work with the EPG outside of associating with a Virtual Machine Network Adapter.

Creating a Plan

This allows the administrator to create plans with their own values.

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the **navigation** pane, choose **PLANS**.

Step 3 Choose **NEW**.

Step 4 In the **NEW** pane, choose **CREATE PLAN**.

Step 5 In the **Let's Create a Hosting Plan** dialog box, enter the name for your plan (Bronze) and click the arrow for next.

Step 6 In the **Select services for a Hosting Plan** dialog box, choose your features. Check the check box for **VIRTUAL MACHINE CLOUDS**, **NETWORKING (ACI)**, and click the arrow for next.

Step 7 In the **Select add-ons for the plan** dialog box, click the checkmark for next.

Step 8 In the **plans** pane, wait for the plan (Bronze) to be created and choose the (Bronze) plan arrow to configure it.

Step 9 In the **Bronze** pane under plan services, choose **Virtual Machine Clouds** arrow.

Step 10 In the **virtual machine clouds** pane, perform the following actions:

a) In the **VMM MANAGEMENT SERVER** field, choose the VMM management server (172.23.142.63).
b) In the **VIRTUAL MACHINE CLOUD** field, choose the cloud name (Cloud01).
c) Scroll down and choose **Add templates**.
d) In the **Select templates to add to this plan** dialog box, check the check box for your template(s) and click the checkmark for next.
e) Scroll down to **Custom Settings**, check the **Disable built-in network extensions for tenants** check box for SCVMM.
f) Click **SAVE** at the bottom.
g) Once completed, click **OK**.

Step 11 In the Service Management Portal, click the back arrow which takes you back to the **Bronze** pane.

Step 12 In the **Bronze** pane under plan services, click **Networking (ACI)** and perform the following actions:

a) In the **PLAN TYPE** field, from the drop-down list, choose the plan type.
b) For Virtual Private Cloud plan type, enter a valid value between 1 to 4000 number for the “Maximum EPG allowed per tenant”, “Maximum BD allowed per tenant” and “Maximum CTX allowed per tenant”.

   For Shared Infrastructure Plan type, enter a valid value between 1 to 4000 number for the “Maximum EPG allowed per tenant”.

c) Click **SAVE**.

Step 13 Click **OK**.
You have now created a plan.

Creating a Tenant

This allows the administrator to create a tenant.

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the **navigation** pane, choose **USER ACCOUNTS**.

Step 3 Choose **NEW**.

Step 4 In the **NEW** pane, scroll down and choose **USER ACCOUNTS**.

Step 5 In the **NEW** pane, choose **QUICK CREATE** and perform the following actions:

a) In the **ENTER EMAIL ADDRESS** field, enter the email address (tenant@domain.com).
b) In the **ENTER PASSWORD** field, enter the password.
c) In the **CONFIRM PASSWORD** field, enter the password again.
d) In the **CHOOSE PLAN** field, choose a plan (BRONZE).
e) Click **CREATE**.
f) Click **OK**.
You have now created a tenant.

Step 6 For Windows Azure Pack Tenants associated with Plans that "Disable Auto Creation of an APIC Tenant", Take note of the Azure Pack Tenant Login and Subscription ID.

a) Log in to the APIC GUI, on the menu bar, choose **TENANTS** > **Tenant Name**. The Tenant is the intended APIC Tenant targeted for Azure Pack Subscription mapping.
b) Select the **Policy** Tab.
c) In the GUID section, click the + icon to add a new Azure Pack subscription mapping.
d) Populate the GUID with the Azure Pack Tenant Subscription ID and the Account Name with the Azure Pack Login Account.
e) Click **Submit** to save the changes.

Note An APIC Tenant can only map to a single Azure Pack Tenant Subscription ID.

Allowing Tenants to Provide Shared Services

This option allows tenants to create networks, attach compute services (servers) to those networks, and offer the connectivity to these services to other tenants. The administrator needs to explicitly enable this capability in the plan.

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the **navigation** pane, choose **PLANS**.

a) Choose a plan.
b) Click **Networking (ACI)** under plan services.

Step 3 In the **networking (aci)** pane, check the **allow tenants to provide shared services** check box and click **SAVE**.

Allowing Tenants to Consume Shared Service

Even though tenants are allowed to create a shared service to be used by other tenants, the administrator needs to select the services which can be shared across tenants. This procedure shows how Windows Azure Pack admin can choose the shared services for the plan:

Before you begin

- Ensure the administrator has allowed tenants to provide shared services.
- Ensure the tenant has provided a shared service.

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the **navigation** pane, choose **PLANS**.

Step 3 In the **plans** pane, choose **PLANS**.

a) Click on the plan (Gold).

Step 4 In the **Gold** pane, choose **Networking (ACI)**.

Step 5 In the **networking (aci)** pane, check the shared service check box you want to give access to (DBSrv).

Step 6 Click **SAVE**.

Allowing Tenants to Consume NAT Firewall and ADC Load Balancer Services

Cisco Application Centric Infrastructure (ACI) has the concept of service graphs, which allows a tenant to insert service nodes performing various Layer 4 to Layer 7 functions between two endpoint groups (EPGs) within the fabric.

Windows Azure Pack with ACI integration now includes the ability to easily and seamlessly provision and deploy services graphs in a Virtual Private Cloud (VPC) setting where the external NAT firewall IP and external ADC load balancer sit within a shared space. The most common use-case for this is the service provider model where a limited number externally accessible IP addresses are available for use, in which case various port-forwarding techniques or load balancing of an entire EPG is done against the one external IP.

Tenants within Azure Pack can utilize a strict VPC model where all their networking is contained within the tenant virtual routing and forwarding (VRF) or a split VRF model where an APIC admin can configure a set of L3Out which is accessible by all tenants utilizing the ACI fabric. The following are instructions on providing a split VRF workflow allowing Azure Pack tenants to consume the Layer 4 to Layer 7 service devices as well as being allocated public addresses for the services provided from within the tenant VRF:

Before you begin

- Ensure the Application Policy Infrastructure Controller (APIC) administrator has configured at least 1 Layer 4 to Layer 7 resource pool in tenant common. For information, see the chapter "Configuring Layer 4 to Layer 7 Resource Pools" in the *Cisco APIC Layer 4 to Layer 7 Services Deployment Guide*.

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the **navigation** pane, choose **PLANS**.

Step 3 In the **plans** pane, choose **PLANS**.

a) Click on the plan (Gold).

Step 4 In the **Gold** pane, choose **Networking (ACI)**.

Step 5 In the **networking (aci)** pane, choose the Layer 4 to Layer 7 services pool provisioned by the APIC admin for Azure Pack consumption.

Step 6 Click **SAVE**.

Viewing the Shared Service Providers and Consumers

This allows the administrator to view the shared service providers and consumers.

Before you begin

- Ensure the administrator has allowed tenants to provide shared services.
- Ensure the tenant has provided a shared service.
- Ensure the administrator has enabled the shared service on a plan.
- Ensure the tenant has set up the shared service to be consumed.

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 In the **ACI** pane, choose **SHARED SERVICES** to view the shared service providers.

Step 4 Click on the provider.

Step 5 Click **INFO** to display all the users that are consuming this shared service.

Managing Shared Services

Deprecating a Shared Service from New Tenants

This allows the administrator to deprecate a shared service from new tenants.

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the **navigation** pane, choose **PLANS**.

Step 3 In the **plans** pane, choose the plan (Gold).

Step 4 In the **gold** pane, choose **Networking (ACI)**.

Step 5 In the **networking (aci)** pane, uncheck the service from the plan and click **SAVE**.
You have deprecated the shared service from tenants.

Revoking a Tenant from a Shared Service

This allows the administrator to revoke a tenant from a shared service.

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 In the **aci** pane, choose the shared service (DBSrv).

Step 4 Click **INFO** to ensure that the user you want to revoke is present in that shared service.

Step 5 In the **navigation** pane, choose **PLANS**.

Step 6 In the **plans** pane, choose the plan (Gold).

Step 7 In the **gold** pane, choose **Networking (ACI)**.

Step 8 In the **networking (aci)** pane, uncheck the service from the plan and click **SAVE**.

Step 9 In the **navigation** pane, choose **ACI**.

Step 10 In the **aci** pane, choose **SHARED SERVICES**.

Step 11 In the **aci** pane, choose the shared service (DBSrv) and click **INFO**.

Step 12 In the **Revoke Consumers of DBSrv** dialog box, check the check box of the user you want to revoke.

Step 13 Click the checkmark.

About Load Balancing

VLAN, virtual routing and forwarding (VRF) stitching is supported by traditional service insertion models, the Application Policy Infrastructure Controller (APIC) can automate service insertion while acting as a central point of policy control. The APIC policies manage both the network fabric and services appliances. The APIC can configure the network automatically so that traffic flows through the services. The APIC can also automatically configure the service according to the application's requirements, which allows organizations to automate service insertion and eliminate the challenge of managing the complex techniques of traditional service insertion.

See the *Cisco APIC Layer 4 to Layer 7 Services Deployment Guide* for more information.

You must perform the following tasks to deploy Layer 4 to Layer 7 services using the APIC GUI:

Import the device package. Only the administrator can import the device package.	See Importing the Device Package on APIC, on page 24.

Configure and post the XML POST to Application Policy Infrastructure Controller (APIC) Refer to Microsoft's Windows Azure Pack Services section about the device package. Only the administrator can configure and post the XML POST.	See Configuring the Load Balancer Device on APIC using XML POST, on page 24.
Creating a load balancer to a plan The VIP range to Windows Azure Pack is set. Only the administrator can create a load balancer to a plan.	See Creating a Load Balancer to a Plan, on page 30.
Configure the load balancer Only the tenant can configure the load balancer.	See Configuring the Load Balancer, on page 38.

Importing the Device Package on APIC

Only the administrator can import the device package. The administrator can import a device package into the Application Policy Infrastructure Controller (APIC) so that the APIC knows what devices you have and what the devices can do.

Before you begin

Ensure you have downloaded the device package.

Procedure

Step 1 Log in to the APIC GUI, on the menu bar, choose **L4-L7 SERVICES** > **PACKAGES**.

Step 2 In the **navigation** pane, choose **Quick Start**.

Step 3 In the **Quick Start** pane, choose **Import a Device Package**.

Step 4 In the **Import Device Package** dialog box, perform the following action:

a) Click **BROWSE** and locate your device package such as F5 or Citrix device package.

b) Click **SUBMIT**.

Configuring the Load Balancer Device on APIC using XML POST

Only the administrator can configure and post the XML POST.

Before you begin

- The device package file should be uploaded on the Application Policy Infrastructure Controller (APIC).

  See *Cisco APIC Layer 4 to Layer 7 Device Package Development Guide* for more information.

- The tenant common should have the two bridge domains named "default" and "vpcDefault". Ensure that the subnets being used by the tenant who is consuming the load balancer is added to these bridge domains.

Typically you would have created these bridge domains and subnets while setting up the DHCP infrastructure for Windows Azure Pack tenants.

- For a non-VPC plan, the backend interface of the load balancer should be placed in the default EPG under the tenant common that was created above. For a VPC plan, the EPG should be "vpcDefault".
- The VIP interface of the load balancer should be placed in an EPG of your choice which should be linked to external world.

  See *Cisco APIC Layer 4 to Layer 7 Device Package Development Guide* for L3 extOut external connectivity outside the Fabric.
- (Optional) If desired, ensure the VIP subnet is linked with L3 or L2 extOut. One VIP per EPG will be allocated.

Procedure

Step 1 These are example XML POSTs for Citrix and F5:

a) Citrix example XML POST:

Example:

```
<polUni dn="uni">
    <fvTenant dn="uni/tn-common" name="common">

        <vnsLDevVip name="MyLB" devtype="VIRTUAL">

                                            <!-- Device Package -->
            <vnsRsMDevAtt tDn="uni/infra/mDev-Citrix-NetScaler-1.0"/>

                                            <!-- VmmDomain -->
            <vnsRsALDevToDomP tDn="uni/vmmp-VMware/dom-mininet"/>

            <vnsCMgmt name="devMgmt" host="172.31.208.179" port="80"/>
            <vnsCCred name="username" value="nsroot"/>
            <vnsCCredSecret name="password" value="nsroot"/>

            <vnsDevFolder key="enableFeature" name="EnableFeature">
                    <vnsDevParam key="LB" name="lb_1" value="ENABLE"/>
                    <vnsDevParam key="CS" name="cs_1" value="ENABLE"/>
                    <vnsDevParam key="SSL" name="ssl_1" value="ENABLE"/>
            </vnsDevFolder>
            <vnsDevFolder key="enableMode" name="EnableMode_1">
                    <vnsDevParam key="USIP" name="usip_1" value="DISABLE"/>
                    <vnsDevParam key="USNIP" name="usnip_1" value="ENABLE"/>
            </vnsDevFolder>

            <vnsCDev name="ADC1" devCtxLbl="C1">
                <vnsCIf name="1_1"/>
                <vnsCIf name="mgmt"/>

                <vnsCMgmt name="devMgmt" host="172.31.208.179" port="80"/>
                <vnsCCred name="username" value="nsroot"/>
                <vnsCCredSecret name="password" value="nsroot"/>
            </vnsCDev>

            <vnsLIf name="C5">
                <vnsRsMetaIf tDn="uni/infra/mDev-Citrix-NetScaler-1.0/mIfLbl-outside"/>

                <vnsRsCIfAtt tDn="uni/tn-common/lDevVip-MyLB/cDev-ADC1/cIf-[1_1]"/>
```

```
            </vnsLIf>
            <vnsLIf name="C4">
                <vnsRsMetaIf tDn="uni/infra/mDev-Citrix-NetScaler-1.0/mIfLbl-inside"/>
                <vnsRsCIfAtt tDn="uni/tn-common/lDevVip-MyLB/cDev-ADC1/cIf-[1_1]"/>
            </vnsLIf>

        </vnsLDevVip>

        <vnsAbsGraph name ="MyLB">

            <!-- Node2 Provides SLB functionality -->
            <vnsAbsNode name = "Node2" funcType="GoTo" >

                <vnsRsDefaultScopeToTerm
tDn="uni/tn-common/AbsGraph-MyLB/AbsTermNodeProv-Output1/outtmnl"/>

                <vnsAbsFuncConn name = "C4">
                    <vnsRsMConnAtt
tDn="uni/infra/mDev-Citrix-NetScaler-1.0/mFunc-LoadBalancing/mConn-external" />
                </vnsAbsFuncConn>

                <vnsAbsFuncConn name = "C5" attNotify="true">
                    <vnsRsMConnAtt
tDn="uni/infra/mDev-Citrix-NetScaler-1.0/mFunc-LoadBalancing/mConn-internal" />
                </vnsAbsFuncConn>

                <vnsAbsDevCfg>
                    <vnsAbsFolder key="Network"
                                  name="network"
                                  scopedBy="epg">
                        <vnsAbsFolder key="nsip" name="snip1">
                            <vnsAbsParam key="ipaddress" name="ip1" value="5.5.5.251"/>

                            <vnsAbsParam key="netmask" name="netmask1"
value="255.255.255.0"/>
                            <vnsAbsParam key="hostroute" name="hostroute"
value="DISABLED"/>
                            <vnsAbsParam key="dynamicrouting" name="dynamicrouting"
value="ENABLED"/>
                            <vnsAbsParam key="type" name="type" value="SNIP"/>
                        </vnsAbsFolder>
                    </vnsAbsFolder>

                </vnsAbsDevCfg>

                <vnsAbsFuncCfg>
                    <vnsAbsFolder key="internal_network"
                                  name="internal_network"
                                  scopedBy="epg">
                        <vnsAbsCfgRel name="internal_network_key"
                                      key="internal_network_key"
                                      targetName="network/snip1"/>
                    </vnsAbsFolder>
                </vnsAbsFuncCfg>

                <vnsRsNodeToMFunc
tDn="uni/infra/mDev-Citrix-NetScaler-1.0/mFunc-LoadBalancing"/>
            </vnsAbsNode>

            <vnsAbsTermNodeCon name = "Input1">
                <vnsAbsTermConn name = "C1"/>
            </vnsAbsTermNodeCon>

            <vnsAbsTermNodeProv name = "Output1">
```

```
                <vnsAbsTermConn name = "C6"/>
            </vnsAbsTermNodeProv>

            <vnsAbsConnection name = "CON1" adjType="L2">
                <vnsRsAbsConnectionConns
tDn="uni/tn-common/AbsGraph-MyLB/AbsTermNodeCon-Input1/AbsTConn" />
                <vnsRsAbsConnectionConns
tDn="uni/tn-common/AbsGraph-MyLB/AbsNode-Node2/AbsFConn-C4" />
            </vnsAbsConnection>

            <vnsAbsConnection name = "CON3" adjType="L2">
                <vnsRsAbsConnectionConns
tDn="uni/tn-common/AbsGraph-MyLB/AbsNode-Node2/AbsFConn-C5" />
                <vnsRsAbsConnectionConns
tDn="uni/tn-common/AbsGraph-MyLB/AbsTermNodeProv-Output1/AbsTConn" />
            </vnsAbsConnection>

        </vnsAbsGraph>

    </fvTenant>
</polUni>
```

b) F5 example XML POST:

Example:

```
<polUni dn="uni">
    <fvTenant name="common">

      <fvBD name="MyLB">
        <fvSubnet ip="6.6.6.254/24" />
        <fvRsCtx tnFvCtxName="default"/>
      </fvBD>

      <vnsLDevVip name="MyLB" devtype="VIRTUAL">
          <vnsRsMDevAtt tDn="uni/infra/mDev-F5-BIGIP-1.1.1"/>
          <vnsRsALDevToDomP tDn="uni/vmmp-VMware/dom-mininet"/>
          <vnsCMgmt name="devMgmt" host="172.31.210.88" port="443"/>
          <vnsCCred name="username" value="admin"/>
          <vnsCCredSecret name="password" value="admin"/>

          <vnsLIf name="internal">
              <vnsRsMetaIf tDn="uni/infra/mDev-F5-BIGIP-1.1.1/mIfLbl-internal"/>
              <vnsRsCIfAtt tDn="uni/tn-common/lDevVip-MyLB/cDev-BIGIP-1/cIf-[1_1]"/>
          </vnsLIf>

          <vnsLIf name="external">
              <vnsRsMetaIf tDn="uni/infra/mDev-F5-BIGIP-1.1.1/mIfLbl-external"/>
              <vnsRsCIfAtt tDn="uni/tn-common/lDevVip-MyLB/cDev-BIGIP-1/cIf-[1_2]"/>
          </vnsLIf>

      <vnsCDev name="BIGIP-1">
          <vnsCIf name="1_1"/>
          <vnsCIf name="1_2"/>

          <vnsCMgmt name="devMgmt" host="172.31.210.88" port="443"/>
          <vnsCCred name="username" value="admin"/>
          <vnsCCredSecret name="password" value="admin"/>

          <vnsDevFolder key="HostConfig" name="HostConfig">
            <vnsDevParam key="HostName" name="HostName"
value="example22-bigip1.ins.local"/>
            <vnsDevParam key="NTPServer" name="NTPServer" value="172.23.48.1"/>
        </vnsDevFolder>
```

```
      </vnsCDev>

    </vnsLDevVip>
    <vnsAbsGraph name = "MyLB">
    <vnsAbsTermNodeCon name = "Consumer">
        <vnsAbsTermConn name = "Consumer">
        </vnsAbsTermConn>
    </vnsAbsTermNodeCon>
      <!-- Node1 Provides Virtual-Server functionality -->
      <vnsAbsNode name = "Virtual-Server" funcType="GoTo">

        <vnsAbsFuncConn name = "internal" attNotify="yes">
          <vnsRsMConnAtt
              tDn="uni/infra/mDev-F5-BIGIP-1.1.1/mFunc-Virtual-Server/mConn-internal"
/>
        </vnsAbsFuncConn>
        <vnsAbsFuncConn name = "external">
          <vnsRsMConnAtt
              tDn="uni/infra/mDev-F5-BIGIP-1.1.1/mFunc-Virtual-Server/mConn-external"
/>
        </vnsAbsFuncConn>
        <vnsRsNodeToMFunc
            tDn="uni/infra/mDev-F5-BIGIP-1.1.1/mFunc-Virtual-Server"/>
        <vnsAbsDevCfg>
          <vnsAbsFolder key="Network" name="webNetwork">

            <!-- Active Bigip SelfIP -->
            <vnsAbsFolder key="ExternalSelfIP" name="External1" devCtxLbl="ADC1">
              <vnsAbsParam key="SelfIPAddress" name="seflfipaddress"
                           value="6.6.6.251"/>
              <vnsAbsParam key="SelfIPNetmask" name="selfipnetmask"
                           value="255.255.255.0"/>
              <vnsAbsParam key="Floating" name="floating"
                           value="NO"/>
            </vnsAbsFolder>
            <vnsAbsFolder key="InternalSelfIP" name="Internal1" devCtxLbl="ADC1">
              <vnsAbsParam key="SelfIPAddress" name="seflfipaddress"
                           value="12.0.251.251"/>
              <vnsAbsParam key="SelfIPNetmask" name="selfipnetmask"
                           value="255.255.0.0"/>
              <vnsAbsParam key="Floating" name="floating"
                           value="NO"/>
            </vnsAbsFolder>
            <vnsAbsFolder key="Route" name="Route">
              <vnsAbsParam key="DestinationIPAddress" name="DestinationIPAddress"
                           value="0.0.0.0" />
              <vnsAbsParam key="DestinationNetmask" name="DestinationNetmask"
                           value="0.0.0.0"/>
              <vnsAbsParam key="NextHopIPAddress" name="NextHopIP"
                           value="6.6.6.254"/>
            </vnsAbsFolder>
          </vnsAbsFolder>
        </vnsAbsDevCfg>
        <vnsAbsFuncCfg>
          <vnsAbsFolder key="NetworkRelation" name="webNetwork">
            <vnsAbsCfgRel key="NetworkRel" name="webNetworkRel"
                          targetName="webNetwork"/>
          </vnsAbsFolder>
        </vnsAbsFuncCfg>
      </vnsAbsNode>
    <vnsAbsTermNodeProv name = "Provider">
         <vnsAbsTermConn name = "Provider" >
         </vnsAbsTermConn>
    </vnsAbsTermNodeProv>
```

```
    <vnsAbsConnection name = "CON3" adjType="L3">
        <vnsRsAbsConnectionConns
tDn="uni/tn-common/AbsGraph-MyLB/AbsTermNodeCon-Consumer/AbsTConn" />
        <vnsRsAbsConnectionConns
tDn="uni/tn-common/AbsGraph-MyLB/AbsNode-Virtual-Server/AbsFConn-external" />
    </vnsAbsConnection>
    <vnsAbsConnection name = "CON1" adjType="L2">
        <vnsRsAbsConnectionConns
tDn="uni/tn-common/AbsGraph-MyLB/AbsNode-Virtual-Server/AbsFConn-internal" />
        <vnsRsAbsConnectionConns
tDn="uni/tn-common/AbsGraph-MyLB/AbsTermNodeProv-Provider/AbsTConn" />
    </vnsAbsConnection>
    </vnsAbsGraph>
  </fvTenant>

</polUni>
```

Step 2 These are the configurable parameters for Citrix and F5:

a) Configurable parameters for Citrix:

Parameter	Sample Value	Description
`vnsLDevVip name`	`"MyLB"`	This value is an identifier for your load balancer and is shown in the Windows Azure Pack admin portal in the plan section for the load balancer selection. You can modify this globally throughout the XML POST with the same alternate value.
`vnsRsALDevToDomP tDn`	`"uni/vmmp-VMware/dom-mininet"`	This is the VMM Domiain where your load balancer VM sits. For example, if you have a virtual load balancer you can associate it with a vCenter VMM domain, a SCVMM, or a physical domain. **Note** Whichever domain you give it should have an associated VLAN range with it.
`vnsCMgmt name="devMgmt" host`	`"172.31.208.179"`	This is the IP address of the load balancer that communicates to Cisco Application Centric Infrastructure (ACI) fabric.
`vnsCCred name`	`"username"`	This is the username.
`vnsCCredSecret name`	`"password"`	This is the password.
`vnsAbsParam key`	`"ipaddress"`	This is the IP address which the fabric identifies for this device.

Parameter	Sample Value	Description
`vnsAbsParam key="ipaddress" name="ip1" value`	`"5.5.5.251"`	This IP address should be one of your bridge domains.

b) Configurable parameters for F5:

Parameter	Sample Value	Description
`fvBD name`	`"MyLB"`	This value is an identifier for your load balancer and is shown in the Windows Azure Pack admin portal in the plan section for the load balancer selection. You can modify this globally throughout the XML POST with the same alternate value.
`vnsRsALDevToDomP tDn`	`"uni/vmmp-VMware/dom-mininet"`	This can be any VMM domain with a valid VLAN ENCAP Block. **Note** In this Windows Azure Pack load balancer configuration, this VMM domain has no other relevance for the LB configuration. This is used for backward compatibility.
`vnsCMgmt name="devMgmt" host`	`"172.31.210.88"`	This is the IP address of the load balancer that communicates to ACI fabric.
`vnsCCred name`	`"username"`	This is the username.
`vnsCCredSecret name`	`"password"`	This is the password.

Step 3 POST one of the device packages for either F5 or Citrix.

Creating a Load Balancer to a Plan

Only the administrator can import the device package.

Before you begin

- Import the device package.
- Configure and post the XML POST to Application Policy Infrastructure Controller (APIC) .

Procedure

Step 1 Log in to the Service Management Portal (Admin Portal).

Step 2 In the **Navigation** pane, choose **PLANS**.

Step 3 In the **plans** pane, choose the plan that you want to add a load balancer (shareplan).

Step 4 In the **shareplan** pane, choose **Networking (ACI)**.

Step 5 In the **networking (aci)** pane, perform the following actions to add a shared load balancer:

a) Check the **shared load balancer** check box

b) In the **LB DEVICE ID IN APIC** field, from the drop-down list, choose the load balancer (MyLB).

c) In the **VIP RANGE** field, provide the VIP range (5.5.5.1 - 5.5.5.100).

d) Click **SAVE**.

Note You can have a single load balancer that is shared across different plans as long as the VIP ranges do not over lap.

About L3 External Connectivity

Layer 3 (L3) external connectivity is an Cisco Application Centric Infrastructure (ACI) feature to connect ACI fabric to an external network by L3 routing protocols, including static routing, OSPF, EIGRP, and BGP. By setting up L3 external connectivity for Microsoft Windows Azure Pack, it allows a tenant network to initiate outgoing traffic destined outside the fabric and to attract traffic from outside. The assumption of this feature is the tenant virtual machine IP addresses are visible outside the fabric without NAT, ACI L3 external connectivity does not include NAT.

Prerequisites for Configuring L3 External Connectivity for Windows Azure Pack

To configure Layer 3 (L3) external connectivity for Windows Azure Pack, you must meet the following prerequisites:

- Ensure you have logged in to the Application Policy Infrastructure Controller (APIC) GUI, on the menu bar, choose **TENANT** > **common**.
  - Create a l3ExtOut called "**default**", refer to BD "**default**".
  - Create l3extInstP name="**defaultInstP**" under the l3ExtOut. This is to be used by shared service tenants.

  See the *Cisco APIC Basic Configuration Guide* for L3 external connectivity configuration.
- Ensure you have logged in to the APIC GUI, on the menu bar, choose **TENANT** > **common**.
  - Create a l3ExtOut called "**vpcDefault**", refer to BD "**vpcDefault**".
  - Create l3extInstP name="**vpcDefaultInstP**" under this l3ExtOut.

    This is to be used by VPC tenants.

  See the *Cisco APIC Basic Configuration Guide* for configuring external connectivity for tenants.

  Windows Azure Pack leverages the common l3ExtOut configuration with no special requirement other than the naming convention highlighted above

Creating a Contract to be Provided by the l3extinstP "default"

This section describes how to creating a contract to be provided by the l3extinstP "default".

See Prerequisites for Configuring L3 External Connectivity for Windows Azure Pack, on page 31.

Make sure the scope is "Global". This contract allows all traffic from consumer to provider, and only allow TCP established from provider to consumer.

Procedure

Step 1 Log in to the APIC GUI, on the menu bar, choose **TENANTS** > **common**.

Step 2 In the **Navigation** pane, expand **Tenant Name** > **Security Policies** > **Contracts**.

Step 3 Click **ACTION**, from the drop-down list, choose **Create Contract**.

Step 4 In the **Create Contract** dialog box, perform the following actions:

a) In the **Name** field, enter the name (L3_DefaultOut).
b) In the **Scope** field, from the drop-down list, choose **`Global`**.
c) In the **Subjects** field, click the + icon.
d) In the **Create Contract Subject** dialog box, perform the following actions:
e) In the **Name** field, enter the name of your choice.
f) Uncheck **Apply Both direction**.
g) In the **Filter Chain For Consumer to Provider** field, click the + icon, from the drop-down list, choose **default/common**, and click **Update**.
h) In the **Filter Chain For Provider to Consumer** field, click the + icon, from the drop-down list, choose **est/common**, and click **Update**.
i) Click **OK** to close the **Create Contract Subject** dialog box.
j) Click **OK** to close the **Create Contract**dialog box.

You have now creating a contract to be provided by the l3extinstP "default".

Creating a Contract to be Provided by the l3extinstP "vpcDefault"

This section describes how to creating a contract to be provided by the l3extinstP "vpcDefault".

See Prerequisites for Configuring L3 External Connectivity for Windows Azure Pack, on page 31.

Make sure the scope is "Global". This contract allows all traffic from consumer to provider, and only allow TCP established from provider to consumer.

Procedure

Step 1 Log in to the APIC GUI, on the menu bar, choose **TENANTS** > **common**.

Step 2 In the **Navigation** pane, expand **Tenant Name** > **Security Policies** > **Contracts**.

Step 3 Click **ACTION**, from the drop-down list, choose **Create Contract**.

Step 4 In the **Create Contract** dialog box, perform the following actions:

a) In the **Name** field, enter the name (L3_VpcDefaultOut).
b) In the **Scope** field, from the drop-down list, choose **`Global`**.
c) In the **Subjects** field, click the + icon.

d) In the **Create Contract Subject** dialog box, perform the following actions:
e) In the **Name** field, enter the name of your choice.
f) Uncheck **Apply Both direction**.
g) In the **Filter Chain For Consumer to Provider** field, click the + icon, from the drop-down list, choose **default/common**, and click **Update**.
h) In the **Filter Chain For Provider to Consumer** field, click the + icon, from the drop-down list, choose **est/common**, and click **Update**.
i) Click **OK** to close the **Create Contract Subject** dialog box.
j) Click **OK** to close the **Create Contract**dialog box.

You have now creating a contract to be provided by the l3extinstP "vpcDefault".

Tenant Tasks

This section describes the tenant tasks.

Note If the shared service consumer is in a different VRF than the provider, route leaking between the VRFs will automatically occur in order to enable the communication.

Shared or Virtual Private Cloud Plan Experience

This is an experience of a tenant in a shared or virtual private cloud (VPC) plan.

Creating Networks in a Shared Plan

This allows the administrator to create networks in a shared plan.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).
Step 2 In the **navigation** pane, choose **ACI**.
Step 3 In the **ACI** pane, choose **NETWORKS**.
Step 4 Click **NEW**.
Step 5 In the **NEW** pane, choose **NETWORKS** and perform the following actions:
a) In the **NETWORK NAME** field, enter the name of the network (S01).
b) Click **CREATE**.
c) Click **REFRESH**.

Verifying the Network you Created on Microsoft Windows Azure Pack on APIC

This section describes how to verify the network you created on Microsoft Windows Azure Pack on APIC.

Procedure

Step 1 Log in to the APIC GUI, on the menu bar, choose **TENANTS**.

Step 2 In the **Navigation** pane, expand **Tenant 018b2f7d-9e80-43f0-abff-7559c026bad5** > **Application Profiles** > **default** > **Application EPGs** > **EPG Network01** to verify that the network you created on Microsoft Windows Azure Pack was created on APIC.

Creating a Bridge Domain in a VPC Plan

This applies only in a virtual private cloud (VPC) plan. This allows a tenant to bring its own IP address space for the networks.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 Click **NEW**.

Step 4 In the **NEW** pane, choose **BRIDGE DOMAIN**.

Step 5 In the **BRIDGE DOMAIN** field, enter the bridge domain name (BD01).

Step 6 If the current tenant is subscribed to multiple Azure Pack Plans, select the Subscription to create the Bridge Domain against.

Step 7 Optional: In the **SUBNET'S GATEWAY** field, enter the subnet's gateway (192.168.1.1/24).

Step 8 In the **CONTEXT** field, select a Context that is already part of the subscription or choose **Create One** to create a new Context for the Bridge Domain.

Step 9 Click **CREATE**.

Creating a Network and Associating to a Bridge Domain in a VPC Plan

This allows the tenant to create a network and associate to a bridge domain in a VPC plan.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 Click **NEW**.

Step 4 In the **NEW** pane, choose **NETWORK**.

Step 5 In the **NETWORK NAME** field, enter the network name (S01).

Step 6 In the **BRIDGE NAME** field, enter the bridge name (BD01).

Step 7 Click **CREATE**.

Step 8 In the **aci** pane, choose **NETWORKS**.

You will see the network is now associated to the bridge domain.

Creating a Firewall Within the Same Subscription

This allows the tenant to create a firewall within the same subscription.

Before you begin

Ensure two networks have been created.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).
Step 2 In the **navigation** pane, choose **ACI**.
Step 3 Click **NEW**.
Step 4 In the **NEW** pane, choose **FIREWALL**.
Step 5 In the **FROM NETWORK** field, in the drop-down list, choose the network name (WEB01).
Step 6 In the **TO NETWORK** field, in the drop-down list, choose another network name (WEB02).
Step 7 In the **PROTOCOL** field, enter the protocol (tcp).
Step 8 In the **PORT RANGE BEGIN** field, enter the beginning port range (50).
Step 9 In the **PORT RANGE END** field, enter the end of the port range (150).
Step 10 Click **CREATE**.
You have added a firewall within the same subscription.

Creating the Network in VPC Plan

This allows the tenant to create networks in a VPC plan.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).
Step 2 In the **Navigation** pane, choose **ACI**.
Step 3 Click **NEW**.
Step 4 In the **NEW** pane, choose **ACI** > **NETWORK** and perform the following actions:
a) In the **NETWORK NAME** field, enter the network name (Network01).
b) Option 1: Creating a network in a shared Bridge Domain.
- In the **BRIDGE DOMAIN** field, from the drop-down, choose the bridge domain. (default).
- Click **CREATE**.

  This could take a few minutes for this process to complete.

c) Option 2: Creating a network in a Tenant Bridge Domain.

- In the **BRIDGE DOMAIN** field, from the drop-down, choose the bridge domain (myBridgeDomain).

d) Optional: To deploy the Network with a Static IP Address Pool, perform the following actions:

- Enter a Gateway in Address/Mask format (192.168.1.1/24). The resultant Static IP Address Pool will use the full range of the Gateway Subnet.
- Enter DNS Servers. If more than one is required, separate out the list with semicolons (192.168.1.2;192.168.1.3)

Note The Subnet will be validated against all other subnets in the Context. The Network create will return an error if an overlap is detected.

- Click **CREATE**.

  This could take a few minutes for this process to complete.

Creating VMs and Attaching to Networks

This allows the tenant to create VMs and attach to networks.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 Click **NEW**.

Step 4 In the **NEW** pane, choose **STANDALONE VIRTUAL MACHINE** > **FROM GALLERY**.

Step 5 In the **Virtual Machine Configuration** dialog box, choose your configuration (LinuxCentOS).

Step 6 Click the arrow for next.

Step 7 In the **Portal Virtual Machine Settings** dialog box, perform the following actions:

a) In the **NAME** field, enter the VM name (SVM01).
b) In the **ADMINISTRATOR ACCOUNT** field, root displays.
c) In the **NEW PASSWORD** field, enter a new password.
d) In the **CONFIRM** field, re-enter the password to confirm.
e) Click the arrow for next.

Step 8 In the **Provide Virtual Machine Hardware Information** dialog box, perform the following actions:

a) In the **NETWORK ADAPTER 1** field, from the drop-down list, choose the network adapter to associate and compute (6C6DB302-aObb-4d49-a22c-151f2fbad0e9|default|S01).
b) Click the checkmark.

Step 9 In the **navigation** pane, choose **Virtual Machines** to check the status of the VM (SVM01).

Providing a Shared Service

This allows the tenant to provide a shared service.

Before you begin

Ensure the administrator has allowed tenants to provide shared services.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 In the **ACI** pane, choose **SHARED SERVICE**.

Step 4 In the **SHARED SERVICES** dialog box, perform the following actions:

a) In the **ACTION** field, from the drop-down list, choose **PROVIDE A SHARED SERVICE CONTRACT**.
b) In the **NETWORK** field, from the drop-down list, choose the network (WEB01).
c) In the **SERVICE NAME** field, enter the service name (DBSrv).
d) In the **DESCRIPTION** field, enter the description.
e) In the **PROTOCOL** field, enter the protocol (tcp).
f) In the **PORT RANGE BEGIN** field, enter the beginning port range (139).
g) In the **PORT RANGE END** field, enter the end port range (139).
h) Click the checkmark.

Setting up the Shared Service to be Consumed

This allows the tenant to setup the shared service to be consumed.

Before you begin

- Ensure the administrator has allowed tenants to provide shared services.
- Ensure the tenant has provided a shared service.
- Ensure the administrator has enabled the shared service on a plan.
- If the shared service consumer is in a different VRF than the provider, route leaking between the VRFs will automatically occur in order to enable the communication.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI** > **SHARED SERVICE**.

Step 3 In the **SHARED SERVICE** dialog box, perform the following actions:

a) In the **Network** field, choose the network (V1).
b) In the **Consumed Services** field, check the service check box (DBSrv).
c) Check the checkmark.

Step 4 In the **aci** pane, choose **SHARED SERVICES** to check the consumer of the plan.

Configuring the Load Balancer

This allows the tenant to configure the load balancer.

Before you begin

- Ensure the administrator imported the device package.
- Ensure the administrator configured and posted the XML POST to Application Policy Infrastructure Controller (APIC).
- Ensure the administrator added the load balancer to a plan.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 Click **NEW**.

Step 4 In the **NEW** pane, choose **LOAD BALANCER**.

Step 5 In the **NETWORK NAME** field, enter the network name (WEB01).

Step 6 In the **PORT** field, enter the port (80).

Step 7 In the **PROTOCOL** field, enter the protocol (tcp).

Step 8 Click **CREATE**.

Step 9 In the **ACI** pane, choose **LOAD BALANCER** to check the network, virtual server, application server, port, and protocol of the load balancer.

The bridge domain should have the following subnets:

- SNIP subnet
- Host subnet
- VIP subnet

If you want the VIP subnet, it should be linked with L3 or L2 extOut.

Adding Access Control Lists

This allows the tenant to add access control lists (ACLs) to the shared service.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 In the **aci** pane, choose **SHARED SERVICES**.

Step 4 In the **aci** pane, choose a shared service to which you want to add more ACLs (DBSrv).

Step 5 Click **+ACL** to add ACLs.

Step 6 In the **Add ACL for DBSrv** dialog box, perform the following actions:

a) In the **PROTOCOL** field, enter the protocol (tcp).
b) In the **PORT NUMBER BEGIN** field, enter the beginning port number (301).
c) In the **PORT NUMBER END** field, enter the end port number (400).
d) Click the checkmark.

Deleting Access Control Lists

This allows the tenant to delete access control lists (ACLs) from the shared service.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 In the **aci** pane, perform the following actions:

a) Choose **SHARED SERVICES**.
b) Choose a shared service from which you want to delete ACLs (DBSrv).
c) Click **Trash ACL** to delete ACLs.

Step 4 In the **Delete ACL from DBSrv** dialog box, check the ACLs check box that you want to delete and click the checkmark.

Preparing a Tenant L3 External Out on APIC for Use at Windows Azure Pack

This section describes how to prepare a tenant L3 External Out on APIC for use at Windows Azure Pack.

Procedure

Step 1 Log in to the APIC GUI, on the menu bar, choose **TENANTS** > **Tenant Name**.

Step 2 In the **Navigation** pane, expand **Tenant Name** > **Networking** > **External Routed Networks**, right-click **External Routed Networks**, and choose **Create Routed Outside**.

Step 3 In the **Create Route Outside** dialog box, perform the following actions:

a) Enter a Name (myRouteOut).
b) Select a VRF (3b4efb29-f66e-4c93-aed4-dc88ed4be8f2/CTX_01).
c) Configure the current dialog box according to your network config requirements. The following website provides more information about ACI Fabric Layer 3 Outside Connectivity: http://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/1-x/basic-config/b_ACI_Config_Guide/b_ACI_Config_Guide_chapter_0110.html
d) Click **Next**.
e) Click **Finish**.

Step 4 In the **Navigation** pane, expand **Tenant Name** > **Networking** > **External Routed Networks** > **Route Outside Name**, right-click **Logical Node Profiles**, and choose **Create Node Profile**.

Step 5 Follow the L3ExtOut Guide to complete your Node Profile Creation. The following website provides more information about ACI Fabric Layer 3 Outside Connectivity: http://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/1-x/basic-config/b_ACI_Config_Guide/b_ACI_Config_Guide_chapter_0110.html

Step 6 In the Navigation pane, expand **Tenant Name** > **Networking** > **External Routed Networks** > **Route Outside Name**, right-click **Networks**, and choose **Create External Network**.

Step 7 In the **Create External Network** dialog box, perform the following actions:

a) Enter the Name in the following format: **<RouteOutsideName>InstP**. For example: Route Outside Name is **myRoutOut**, my External Network Name is **myRoutOutInstP**.
b) In the **Subnet** section, click the + icon .
c) Enter your External Subnet details in the **Create Subnet** dialog box per your network design.
d) In the **Create Subnet** dialog box, click **OK** to complete.
e) In the **Create External Network** dialog box, click **Submit**.

Step 8 In the **Navigation** pane, expand **Tenant Name** > **Networking** > **Bridge Domains** > **Bridge Domain Name**, select the **L3 Configurations** tab and perform the following actions:

a) Click the + icon to the right of **Associated L3 Outs**.
b) In the drop-down list, select the L3 Out (3b4efb29-f66e-4c93-aed4-dc88ed4be8f2/myRouteOut).
c) Click **UPDATE**.
d) Click **Submit** on the Bridge Domain - <Name> Page.

Step 9 Optional: For Tenant Networks which do not use the ACI Integrated Windows Azure Pack Integrated Static IP Address Pool feature.

In the **Navigation** pane, expand **Tenant Name** > **Networking** > **Bridge Domains** > **Bridge Domain Name**, select the **L3 Configurations** tab and perform the following actions:

a) Click the + icon to the right of **Subnets**.
b) In the **Create Subnet** dialog box, perform the following actions:

- Enter a Gateway IP in Address/Mask format.
- Check the **Advertised Externally** check box .
- Click **Submit**.

Creating a Network for External Connectivity

This allows the tenant to create a network for external connectivity.

External Connectivity can be established either through the ACI Common L3ExtOut or through a user defined L3ExtOut.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 Click **NEW**.

Step 4 In the **NEW** pane, choose **NETWORK**.

Step 5 In the **NETWORK NAME** field, enter the network name (wapL3test).

Step 6 Option 1: Uses the Bridge Domain's Subnet for Route Advertisement.

Click **CREATE**.

Step 7 Option 2: Uses the EPG's Subnet for Route Advertisement.

Enter a Gateway in Address/Mask format (192.168.1.1/24).

a) Click **CREATE**.

Creating a Firewall for External Connectivity

This allows the tenant to create a firewall for external connectivity.

External Connectivity can be established either through the ACI Common L3ExtOut or through a user defined L3ExtOut.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 Click **NEW**.

Step 4 In the **NEW** pane, choose **FIREWALL**.

Step 5 Option 1: For Shared Windows Azure Pack Plans or VPC Windows Azure Pack Plans using the ACI Common L3ExtOut *External:default.

a) In the **FROM NETWORK** field, in the drop-down list, choose the network name (*External:default).

Option 2: For VPC Windows Azure Pack Plans using a user defined External Network.

a) In the **FROM NETWORK** field, in the drop-down list, choose the network name (External:myRouteOut).

Step 6 In the **TO NETWORK** field, in the drop-down list, choose another network name (wapL3test).

Step 7 In the **PROTOCOL** field, enter the protocol (tcp).

Step 8 In the **PORT RANGE BEGIN** field, enter the beginning port range (12345).

Step 9 In the **PORT RANGE END** field, enter the end of the port range (45678).

Step 10 Click **CREATE**.
You have added a firewall for external connectivity.

Verifying Tenant L3 External Connectivity on APIC

This section describes how to verify the Tenant L3 External Connectivity on APIC.

Procedure

Step 1 Log in to the APIC GUI, on the menu bar, choose **TENANTS**.

Step 2 In the **Navigation** pane, expand **Tenant b81b7a5b-7ab8-4d75-a217-fee3bb23f427** > **Application Profiles** > **Application EPG**, ensure the network you created in Creating a Network for External Connectivity, on page 40 exists (wapL3test).

Step 3 In the **Navigation** pane, expand **EPG wapL3test** > **Contracts**, ensure the contract name exists in the format of L3+EPG name+protocols+port range (L3wapL3testtcp1234545678), the contract is **Provided** by the EPG, and the STATE is **formed**.

Step 4 Option1: For Shared L3 Out deployments, where the contract was created with *External:default, on the menu bar, choose **TENANTS** > **common**.

Option 2: For Tenant owned L3 Out deployments, on the menu bar, choose **TENANTS** > ***<your tenant-id>***.

Step 5 In the **Navigation** pane, expand **Security Policies** > **Imported Contracts**, ensure the contract that you verified in step 3 is imported as an contract interface.

Step 6 Option 1: For Shared L3 Out deployments, where the contract was created with *External:default, on the menu bar, choose **TENANTS** > **common**.

Option 2: For Tenant owned L3 Out deployments, choose **TENANTS** > ***<your tenant-id>***.

Step 7 In the **External Network Instance Profile -defaultInstP** pane, in the **Consumed Contracts** field, search for the contract interface that you verified in step 5 and ensure it exists and the STATE is **formed**.

Step 8 On the menu bar, choose **TENANTS**.

Step 9 In the **Navigation** pane, expand **Tenant b81b7a5b-7ab8-4d75-a217-fee3bb23f427** > **Application Profiles** > **Application EPG** > **EPG wapL3test** > **Contracts**.

Step 10 In the **Contracts** pane, in the **Consumed Contracts** field, ensure the default contract that you defined in Prerequisites for Configuring L3 External Connectivity for Windows Azure Pack, on page 31 for either shared service tenant or for VPC tenant is consumed by this EPG and the STATE is **formed**.

Step 11 Option 2: For VPC Windows Azure Pack Plans using a user defined External Network with a Tenant Network with a Gateway specified.

In the **Navigation** pane, select **Tenant Name** > **Application Profiles** > **Application EPG** > **EPG *wapL3test*** > **Subnets** > **Subnet Address**, verify that the Scope is marked as **Advertised Externally**.

Adding NAT Firewall Layer 4 to Layer 7 Services to a VM Network

This provisions an Adaptive Security Appliance (ASA) firewall or firewall context, dynamically allocate a network address translation (NAT) IP from the external IP address pool, configure dynamic PAT on the ASA to allow outbound traffic, and provision the rest of the service graph for an easy deployment.

Before you begin

- Ensure the Azure Pack plan is configured to access an Layer 4 to Layer 7 service pool.
- Ensure the ACI VM network has been created with a gateway or subnet.
- If the private subnet of the Layer 4 to Layer 7 resource pool was not provided by the APIC admin, attempting to add Layer 4 to Layer 7 services with an overlapping subnet results in an error and no configuration will be pushed. In this case, delete and recreate the VM network with an alternate subnet.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 In the **aci** pane, choose **NETWORKS**, click on the arrow to enter further network configuration.

Step 4 Click the **Enable direct internet access using NAT** check box.

Step 5 Click **SAVE**.

Adding NAT Firewall Port-Forwarding Rules for a VM Network

This configures the network address translation (NAT) firewall to forward traffic from the NAT IP to the internal IP within the VM network.

Before you begin

- Ensure the Cisco Application Centric Infrastructure (ACI) VM network has been configured to enable NAT.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 In the **aci** pane, choose **NETWORKS**, click on the arrow to enter further network configuration.

Step 4 In the **NETWORKS** pane, choose **RULES**.

Step 5 Click **ADD** at the bottom panel.

Step 6 Input the required information for the Port-Forwarding Rule.

Note The destination IP address should be an IP address within the bounds of the VM network subnet.

Step 7 Click the **SAVE** checkmark.

Adding NAT Firewall With a Private ADC Load Balancer Layer 4 to Layer 7 Services to a VM Network

In addition to deploying a NAT firewall, this configuration will also deploy an internal load balancer. In this scenario, the load balancer VIPs are dynamically allocated from the Layer 4 to Layer 7 private IP address subnet (per tenant VRF). In this 2-Node service graph deployment, it is assumed that the tenant creates a Port-Fowarding Rule to forward traffic to the internal load balancer for traffic load balancing.

Before you begin

- Ensure the Azure Pack Plan is configured to access an Layer 4 to Layer 7 service pool.
- Ensure the ACI VM network has been created with a gateway or subnet.

- If the private subnet of the Layer 4 to Layer 7 resource pool was not provided by the APIC admin, attempting to add Layer 4 to Layer 7 services with an overlapping subnet results in an error and no configuration will be pushed. In this case, delete and recreate the VM network with an alternate subnet.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).
Step 2 In the **navigation** pane, choose **ACI**.
Step 3 In the **aci** pane, choose **NETWORKS**, click on the arrow to enter further network configuration.
Step 4 Click the **Enable direct internet access using NAT** check box.
Step 5 Click the **Enable internal load balancer (internal)** check box.
Step 6 Click **SAVE**.

Requesting Additional NAT Firewall Public IP Addresses for a VRF

Use this procedure to allocate additional public IP addresses for use with NAT rules. You can request this public IP address from any EPG where NAT is enabled. It is therefore available for all EPGs in the VRF.

NAT rules are saved for each EPG. So we recommend that the destination IP of the NAT rule points only to an endpoint within the EPG and not somewhere else in the VRF.

Before you begin

Ensure the Cisco ACI VM network has been configured for the NAT firewall.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).
Step 2 In the **navigation** pane, choose **ACI**.
Step 3 In the **aci** pane, choose **NETWORKS**, and then click the arrow to enter further network configuration.
Step 4 In the **NETWORKS** pane, choose **IP ADDRESS**.
Step 5 At the bottom panel, click **REQUEST IP ADDRESS**.
Step 6 Click **OK**.

If there is an available public IP address in the L4-L7 resource pool, an IP address is allocated and be present in this table. This IP address also is present in the **RULES** tab, for configuring inbound NAT rules.

Adding a Public ADC Load Balancer Layer 4 to Layer 7 Services to a VM Network

This provisions a load balancer, dynamically allocate a VIP from the external IP address pool, add the necessary routes and provision the rest of the service graph for an easy deployment.

Before you begin

- Ensure the Azure Pack Plan is configured to access an Layer 4 to Layer 7 service pool.

- Ensure the ACI VM network has been created with a gateway or subnet.
- If the private subnet of the Layer 4 to Layer 7 resource pool was not provided by the APIC admin, attempting to add Layer 4 to Layer 7 services with an overlapping subnet results in an error and no configuration will be pushed. In this case, delete and recreate the VM network with an alternate subnet.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 In the **aci** pane, choose **NETWORKS**, click on the arrow to enter further network configuration.

Step 4 Click the **Enable load balancer (public)** check box.

Step 5 (Optional) Click the **Allow Outbound Connections** check box.

Note This option is only available if NAT has NOT been configured for this VM network.

Step 6 Click **SAVE**.

Adding ADC Load Balancer Configuration for a VM Network

This configures either the public, private ADC load balancer, listening on the VIP allocated to the VM network and forwarding load balancing traffic to the real servers based on the one with the least number of connections. The entire VM network will be load balanced. As VMs or VNICs come online, they will be added to the load balancer automatically. Since the entire VM Network is load balanced, it is assumed that all endpoints in the VM network are the same and can service the load balancer configuration defined.

Before you begin

- Ensure the ACI VM network has been configured for either public or private load balancing.

Procedure

Step 1 Log in to the Service Management Portal (Tenant Portal).

Step 2 In the **navigation** pane, choose **ACI**.

Step 3 In the **aci** pane, choose **NETWORKS**, click on the arrow to enter further network configuration.

Step 4 In the **NETWORKS** pane, choose **LOAD BALANCERS**.

Step 5 Click **ADD** at the bottom panel.

Step 6 Input the required information for the load balancer (Name: HTTP, Protocol: TCP, Port: 80).

Step 7 Click the **SAVE** checkmark.

Troubleshooting Cisco ACI with Microsoft Windows Azure Pack

Troubleshooting as an Admin

Procedure

Windows Azure Pack Administrator can look at all networks deployed by tenants in the admin portal. In case there is an issue, use the APIC GUI to look for any faults on the following objects:

a) VMM domain
b) Tenant and EPG corresponding to the Windows Azure Pack tenant networks.

Troubleshooting as a Tenant

If there is an error message, provide the error message along with the description of the workflow and action to your Administrator.

Troubleshooting the EPG Configuration Issue

If during the lifetime of the endpoint group (EPG), the VLAN ID of the EPG changes on the APIC then SCVMM needs to update the VLAN configuration on all virtual machines for the new setting to take effect.

Procedure

To perform this operation, run the following PowerShell commands on the SCVMM server:

Example:

```
$VMs = Get-SCVirtualMachine
$VMs | Read-SCVirtualMachine
$NonCompliantAdapters=Get-SCVirtualNetworkAdapter -All | Where-Object
{$_.VirtualNetworkAdapterComplianceStatus -eq "NonCompliant"}
$NonCompliantAdapters | Repair-SCVirtualNetworkAdapter
```

Programmability References

ACI Windows Azure Pack PowerShell Cmdlets

This section describes how to list the Cisco Application Centric Infrastructure (ACI) Windows Azure Pack PowerShell cmdlets, help, and examples.

Procedure

Step 1 Log in to the Windows Azure Pack server, choose **Start** > **Run** > **Windows PowerShell**.

Step 2 Enter the followings commands:

Example:

```
Windows PowerShell
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PS C:\Users\administrator> cd C:\inetpub\Cisco-ACI\bin
PS C:\inetpub\Cisco-ACI\bin> Import-Module .\ACIWapPsCmdlets.dll
PS C:\inetpub\Cisco-ACI\bin> Add-Type -Path .\Newtonsoft.Json.dll
PS C:\inetpub\Cisco-ACI\bin> Get-Command -Module ACIWapPsCmdlets

CommandType     Name                                               ModuleName
-----------     ----                                               ----------
Cmdlet          Add-ACIWAPEndpointGroup                            ACIWapPsCmdlets
Cmdlet          Get-ACIWAPAdminObjects                             ACIWapPsCmdlets
Cmdlet          Get-ACIWAPAllEndpointGroups                        ACIWapPsCmdlets
Cmdlet          Get-ACIWAPBDSubnets                                ACIWapPsCmdlets
Cmdlet          Get-ACIWAPConsumersForSharedService                ACIWapPsCmdlets
Cmdlet          Get-ACIWAPEndpointGroups                           ACIWapPsCmdlets
Cmdlet          Get-ACIWAPEndpoints                                ACIWapPsCmdlets
Cmdlet          Get-ACIWAPLBConfiguration                          ACIWapPsCmdlets
Cmdlet          Get-ACIWAPOpflexInfo                               ACIWapPsCmdlets
Cmdlet          Get-ACIWAPPlans                                    ACIWapPsCmdlets
Cmdlet          Get-ACIWAPStatelessFirewall                        ACIWapPsCmdlets
Cmdlet          Get-ACIWAPSubscriptions                            ACIWapPsCmdlets
Cmdlet          Get-ACIWAPTenantCtx                                ACIWapPsCmdlets
Cmdlet          Get-ACIWAPTenantPlan                               ACIWapPsCmdlets
Cmdlet          Get-ACIWAPTenantSharedService                      ACIWapPsCmdlets
Cmdlet          Get-ACIWAPVlanNamespace                            ACIWapPsCmdlets
Cmdlet          New-ApicOpflexCert                                 ACIWapPsCmdlets
Cmdlet          Read-ApicOpflexCert                                ACIWapPsCmdlets
Cmdlet          Remove-ACIWAPEndpointGroup                         ACIWapPsCmdlets
Cmdlet          Remove-ACIWAPPlan                                  ACIWapPsCmdlets
Cmdlet          Remove-ACIWAPTenantCtx                             ACIWapPsCmdlets
Cmdlet          Set-ACIWAPAdminLogin                               ACIWapPsCmdlets
Cmdlet          Set-ACIWAPBDSubnets                                ACIWapPsCmdlets
Cmdlet          Set-ACIWAPLBConfiguration                          ACIWapPsCmdlets
Cmdlet          Set-ACIWAPLogin                                    ACIWapPsCmdlets
Cmdlet          Set-ACIWAPOpflexOperation                          ACIWapPsCmdlets
Cmdlet          Set-ACIWAPPlan                                     ACIWapPsCmdlets
Cmdlet          Set-ACIWAPStatelessFirewall                        ACIWapPsCmdlets
Cmdlet          Set-ACIWAPTenantSharedService                      ACIWapPsCmdlets
Cmdlet          Set-ACIWAPUpdateShareServiceConsumption            ACIWapPsCmdlets
Cmdlet          Set-ACIWAPVlanNamespace                            ACIWapPsCmdlets
```

Step 3 Generating help:

Example:

```
commandname -?
```

Step 4 Generating examples:

Example:

```
get-help commandname -examples
```

Uninstalling the Cisco ACI with Microsoft Windows Azure Pack Components

This section describes how to uninstall the Cisco Application Centric Infrastructure (ACI) with Microsoft Windows Azure Pack components.

Note Uninstall involves removing artifacts such as VM and logical networks. Uninstalling succeeds only when no other resource, such as a VM or a host, is consuming them.

Component	Task
Detach all virtual machines from the VM networks	See Microsoft's documentation.
Delete VXLAN tunnel endpoint (VTEP) logical switch on all hyper-Vs	See Microsoft's documentation.
Delete cloud on System Center Virtual Machine Manager (SCVMM)	See Microsoft's documentation.
To uninstall the ACI with Microsoft Windows Azure Pack 1.1(1j) release, uninstall the APIC Windows Azure Pack Resource Provider	See Uninstalling the APIC Windows Azure Pack Resource Provider, on page 48.
To uninstall this release of ACI with Microsoft Windows Azure Pack, uninstall the following: • ACI Azure Pack Resource Provider • ACI Azure Pack Admin Site Extension • ACI Azure Pack Tenant Site Extension	See Uninstalling the ACI Azure Pack Resource Provider, on page 49. See Uninstalling the ACI Azure Pack Admin Site Extension, on page 49. See Uninstalling the ACI Azure Pack Tenant Site Extension, on page 49.
Uninstall the APIC Hyper-V Agent	See Uninstalling the APIC Hyper-V Agent, on page 50.

Uninstalling the APIC Windows Azure Pack Resource Provider

This section describes how to uninstall the APIC Windows Azure Pack Resource Provider.

Procedure

Step 1 Log in to the Windows Azure Pack server.

Step 2 Choose **Start** > **Control Panel** > **Uninstall a Program**.

Step 3 In the **Programs and Features** window, right-click **APIC Windows Azure Pack Resource Provider** and choose **Uninstall**.
This uninstalls the APIC Windows Azure Pack Resource Provider from the Windows Azure Pack server.

Step 4 To verify if the APIC Windows Azure Pack Resource Provider is uninstalled, perform the following actions:

a) Choose **Start** > **Control Panel** > **Uninstall a Program**.

b) In the **Programs and Features** window, verify that **APIC Windows Azure Pack Resource Provider** is not present.

Uninstalling the ACI Azure Pack Resource Provider

This section describes how to uninstall the ACI Azure Pack Resource Provider.

Procedure

Step 1 Log in to the Windows Azure Pack server.

Step 2 Choose **Start** > **Control Panel** > **Uninstall a Program**.

Step 3 In the **Programs and Features** window, right-click **ACI Azure Pack Resource Provider** and choose **Uninstall**.
This uninstalls the ACI Azure Pack Resource Provider from the Windows Azure Pack server.

Step 4 To verify if the ACI Azure Pack Resource Provider is uninstalled, perform the following actions:

a) Choose **Start** > **Control Panel** > **Uninstall a Program**.

b) In the **Programs and Features** window, verify that **ACI Azure Pack Resource Provider** is not present.

Uninstalling the ACI Azure Pack Admin Site Extension

This section describes how to uninstall the ACI Azure Pack Admin Site Extension.

Procedure

Step 1 Log in to the Windows Azure Pack server.

Step 2 Choose **Start** > **Control Panel** > **Uninstall a Program**.

Step 3 In the **Programs and Features** window, right-click **ACI Azure Pack Admin Site Extension** and choose **Uninstall**.
This uninstalls the ACI Azure Pack Admin Site Extension from the Windows Azure Pack server.

Step 4 To verify if the ACI Azure Pack Admin Site Extension is uninstalled, perform the following actions:

a) Choose **Start** > **Control Panel** > **Uninstall a Program**.

b) In the **Programs and Features** window, verify that **ACI Azure Pack Admin Site Extension** is not present.

Uninstalling the ACI Azure Pack Tenant Site Extension

This section describes how to uninstall the ACI Azure Pack Tenant Site Extension.

Procedure

Step 1 Log in to the Windows Azure Pack server.

Step 2 Choose **Start** > **Control Panel** > **Uninstall a Program**.

Step 3 In the **Programs and Features** window, right-click **ACI Azure Pack Tenant Site Extension** and choose **Uninstall**.
This uninstalls the ACI Azure Pack Tenant Site Extension from the Windows Azure Pack server.

Step 4 To verify if the ACI Azure Pack Tenant Site Extension is uninstalled, perform the following actions:

a) Choose **Start** > **Control Panel** > **Uninstall a Program**.

b) In the **Programs and Features** window, verify that **ACI Azure Pack Tenant Site Extension** is not present.

Uninstalling the APIC Hyper-V Agent

This section describes how to uninstall the APIC Hyper-V Agent.

Procedure

Step 1 Log in to the Hyper-V server.

Step 2 Choose **Start** > **Control Panel** > **Uninstall a Program**.

Step 3 In the **Programs and Features** window, right-click **Cisco APIC HyperV Agent** and choose **Uninstall**.
This uninstalls the APIC Hyper-V Agent from the Hyper-V server.

Step 4 To verify if the APIC Hyper-V Agent is uninstalled, perform the following actions:

a) Choose **Start** > **Control Panel** > **Uninstall a Program**.

b) In the **Programs and Features** window, verify that **Cisco APIC HyperV Agent** is not present.

Step 5 Repeat steps 1-4 for each Hyper-V server.

Downgrading Cisco APIC and the Switch Software with Cisco ACI and Microsoft Windows Azure Pack Components

This section describes how to downgrade the Cisco APIC and the switch software with Cisco ACI with Microsoft Windows Azure Pack components.

Note Layer 4 to Layer 7 resource pool configurations created and used in Cisco APIC 3.1(1) and later are not compatible with older Cisco APIC/Windows Azure Pack builds. Steps 1 to 3 apply when downgrading from Cisco APIC 3.1(1) or later to earlier versions.

Procedure

Step 1 Review the list of Layer 4 to Layer 7 resource pools on the Cisco APIC.

Note the list of resource pools that were created in Cisco APIC 3.1(1) or later. These resource pools have the Function Profiles tab in the GUI and have *version normalized* in the NX-OS Style CLI configuration.

Step 2 Windows Azure Pack Tenants Portal: Perform the following steps for each Cisco ACI VM network that has a Virtual Private Cloud using Layer 4 to Layer 7 Cloud orchestrator mode resource pools (resource pools created in Cisco APIC 3.1(1) or later):

a) Log in to the Service Management Portal (Tenant Portal).
b) In the navigation pane, choose **ACI**.
c) In the **aci** pane, choose **NETWORKS**, click the arrow to enter further network configuration.
d) Uncheck the box **Enable direct internet access using NAT** if it is checked.
e) Uncheck the box **Enable internal load balancer** (internal) if it is checked.
f) Uncheck the box **Enable load balancer** (public) if it is checked.
g) Click **SAVE**.

Step 3 Windows Azure Pack Admin: Perform the following steps for each Windows Azure Pack plan where ACI Networking has been added as a Plan Service and the Plan is using Layer 4 to Layer 7 cloud orchestrator mode resource pools.

a) Log in to the Service Management Portal (Admin Portal).
b) In the navigation pane, choose **PLANS**.
c) In the plans pane, choose **PLANS**, and then click the plan (Gold).
d) In the **Gold** pane, choose **Networking** (ACI).
e) In the **networking** (aci) pane, perform one of the following steps:

- Choose the Layer 4 to Layer 7 resource pools provisioned by the Cisco APIC admin in Cisco APIC 3.0(x) or earlier for Azure Pack consumption.
- Choose **Choose one…** to disable Virtual Private Cloud NAT Firewall and ADC Load Balancer services for Azure Pack Tenants.

f) Click **SAVE**.

Step 4 Uninstall Cisco ACI with Microsoft Windows Azure Pack components.

See Uninstalling the Cisco ACI with Microsoft Windows Azure Pack Components, on page 48.

Step 5 Downgrade the APIC controller and the switch software.

See the Cisco APIC Firmware Management, Installation, Upgrade, and Downgrade Guide.

Step 6 Install the downgrade version of Cisco ACI with Microsoft Windows Azure Pack components.

See the Installing, Setting Up, and Verifying the Cisco ACI with Microsoft Windows Azure Pack Components, on page 6.