



# Overview of Cisco Unified Computing System

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## About Cisco Unified Computing System

Cisco Unified Computing System (Cisco UCS) fuses access layer networking and servers. This high-performance, next-generation server system provides a data center with a high degree of workload agility and scalability.

The hardware and software components support Cisco's unified fabric, which runs multiple types of data center traffic over a single converged network adapter.

### **Architectural Simplification**

The simplified architecture of Cisco UCS reduces the number of required devices and centralizes switching resources. By eliminating switching inside a chassis, network access-layer fragmentation is significantly reduced.

Cisco UCS implements Cisco unified fabric within racks and groups of racks, supporting Ethernet and Fibre Channel protocols over 10 Gigabit Cisco Data Center Ethernet and Fibre Channel over Ethernet (FCoE) links.

This radical simplification reduces the number of switches, cables, adapters, and management points by up to two-thirds. All devices in a Cisco UCS domain remain under a single management domain, which remains highly available through the use of redundant components.

### High Availability

The management and data plane of Cisco UCS is designed for high availability and redundant access layer fabric interconnects. In addition, Cisco UCS supports existing high availability and disaster recovery solutions for the data center, such as data replication and application-level clustering technologies.

### Scalability

A single Cisco UCS domain supports multiple chassis and their servers, all of which are administered through one Cisco UCS Manager. For more detailed information about the scalability, speak to your Cisco representative.

### Flexibility

A Cisco UCS domain allows you to quickly align computing resources in the data center with rapidly changing business requirements. This built-in flexibility is determined by whether you choose to fully implement the stateless computing feature.

Pools of servers and other system resources can be applied as necessary to respond to workload fluctuations, support new applications, scale existing software and business services, and accommodate both scheduled and unscheduled downtime. Server identity can be abstracted into a mobile service profile that can be moved from server to server with minimal downtime and no need for additional network configuration.

With this level of flexibility, you can quickly and easily scale server capacity without having to change the server identity or reconfigure the server, LAN, or SAN. During a maintenance window, you can quickly do the following:

- Deploy new servers to meet unexpected workload demand and rebalance resources and traffic.
- Shut down an application, such as a database management system, on one server and then boot it up again on another server with increased I/O capacity and memory resources.

### Optimized for Server Virtualization

Cisco UCS has been optimized to implement VM-FEX technology. This technology provides improved support for server virtualization, including better policy-based configuration and security, conformance with a company's operational model, and accommodation for VMware's VMotion.

## Unified Fabric

With unified fabric, multiple types of data center traffic can run over a single Data Center Ethernet (DCE) network. Instead of having a series of different host bus adapters (HBAs) and network interface cards (NICs) present in a server, unified fabric uses a single converged network adapter. This type of adapter can carry LAN and SAN traffic on the same cable.

Cisco UCS uses Fibre Channel over Ethernet (FCoE) to carry Fibre Channel and Ethernet traffic on the same physical Ethernet connection between the fabric interconnect and the server. This connection terminates at a converged network adapter on the server, and the unified fabric terminates on the uplink ports of the fabric interconnect. On the core network, the LAN and SAN traffic remains separated. Cisco UCS does not require that you implement unified fabric across the data center.

The converged network adapter presents an Ethernet interface and Fibre Channel interface to the operating system. At the server, the operating system is not aware of the FCoE encapsulation because it sees a standard Fibre Channel HBA.

At the fabric interconnect, the server-facing Ethernet port receives the Ethernet and Fibre Channel traffic. The fabric interconnect (using Ethertype to differentiate the frames) separates the two traffic types. Ethernet frames and Fibre Channel frames are switched to their respective uplink interfaces.

## Fibre Channel over Ethernet

Cisco UCS leverages Fibre Channel over Ethernet (FCoE) standard protocol to deliver Fibre Channel. The upper Fibre Channel layers are unchanged, so the Fibre Channel operational model is maintained. FCoE network management and configuration is similar to a native Fibre Channel network.

FCoE encapsulates Fibre Channel traffic over a physical Ethernet link. FCoE is encapsulated over Ethernet with the use of a dedicated Ethertype, 0x8906, so that FCoE traffic and standard Ethernet traffic can be carried on the same link. FCoE has been standardized by the ANSI T11 Standards Committee.

Fibre Channel traffic requires a lossless transport layer. Instead of the buffer-to-buffer credit system used by native Fibre Channel, FCoE depends upon the Ethernet link to implement lossless service.

Ethernet links on the fabric interconnect provide two mechanisms to ensure lossless transport for FCoE traffic:

- Link-level flow control
- Priority flow control

### Link-Level Flow Control

IEEE 802.3x link-level flow control allows a congested receiver to signal the endpoint to pause data transmission for a short time. This link-level flow control pauses all traffic on the link.

The transmit and receive directions are separately configurable. By default, link-level flow control is disabled for both directions.

On each Ethernet interface, the fabric interconnect can enable either priority flow control or link-level flow control (but not both).

### Priority Flow Control

The priority flow control (PFC) feature applies pause functionality to specific classes of traffic on the Ethernet link. For example, PFC can provide lossless service for the FCoE traffic, and best-effort service for the standard Ethernet traffic. PFC can provide different levels of service to specific classes of Ethernet traffic (using IEEE 802.1p traffic classes).

PFC decides whether to apply pause based on the IEEE 802.1p CoS value. When the fabric interconnect enables PFC, it configures the connected adapter to apply the pause functionality to packets with specific CoS values.

By default, the fabric interconnect negotiates to enable the PFC capability. If the negotiation succeeds, PFC is enabled and link-level flow control remains disabled (regardless of its configuration settings). If the PFC negotiation fails, you can either force PFC to be enabled on the interface or you can enable IEEE 802.x link-level flow control.

# Server Architecture and Connectivity

## Overview of Service Profiles

Service profiles are the central concept of Cisco UCS. Each service profile serves a specific purpose: ensuring that the associated server hardware has the configuration required to support the applications it will host.

The service profile maintains configuration information about the server hardware, interfaces, fabric connectivity, and server and network identity. This information is stored in a format that you can manage through Cisco UCS Manager. All service profiles are centrally managed and stored in a database on the fabric interconnect.

Every server must be associated with a service profile.



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**Important** At any given time, each server can be associated with only one service profile. Similarly, each service profile can be associated with only one server at a time.

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After you associate a service profile with a server, the server is ready to have an operating system and applications installed, and you can use the service profile to review the configuration of the server. If the server associated with a service profile fails, the service profile does not automatically fail over to another server.

When a service profile is disassociated from a server, the identity and connectivity information for the server is reset to factory defaults.

## Network Connectivity through Service Profiles

Each service profile specifies the LAN and SAN network connections for the server through the Cisco UCS infrastructure and out to the external network. You do not need to manually configure the network connections for Cisco UCS servers and other components. All network configuration is performed through the service profile.

When you associate a service profile with a server, the Cisco UCS internal fabric is configured with the information in the service profile. If the profile was previously associated with a different server, the network infrastructure reconfigures to support identical network connectivity to the new server.

## Configuration through Service Profiles

A service profile can take advantage of resource pools and policies to handle server and connectivity configuration.

### Hardware Components Configured by Service Profiles

When a service profile is associated with a server, the following components are configured according to the data in the profile:

- Server, including BIOS and CIMC
- Adapters

- Fabric interconnects

You do not need to configure these hardware components directly.

### Server Identity Management through Service Profiles

You can use the network and device identities burned into the server hardware at manufacture or you can use identities that you specify in the associated service profile either directly or through identity pools, such as MAC, WWN, and UUID.

The following are examples of configuration information that you can include in a service profile:

- Profile name and description
- Unique server identity (UUID)
- LAN connectivity attributes, such as the MAC address
- SAN connectivity attributes, such as the WWN

### Operational Aspects configured by Service Profiles

You can configure some of the operational functions for a server in a service profile, such as the following:

- Firmware packages and versions
- Operating system boot order and configuration
- IPMI and KVM access

### vNIC Configuration by Service Profiles

A vNIC is a virtualized network interface that is configured on a physical network adapter and appears to be a physical NIC to the operating system of the server. The type of adapter in the system determines how many vNICs you can create. For example, a converged network adapter has two NICs, which means you can create a maximum of two vNICs for each adapter.

A vNIC communicates over Ethernet and handles LAN traffic. At a minimum, each vNIC must be configured with a name and with fabric and network connectivity.

### vHBA Configuration by Service Profiles

A vHBA is a virtualized host bus adapter that is configured on a physical network adapter and appears to be a physical HBA to the operating system of the server. The type of adapter in the system determines how many vHBAs you can create. For example, a converged network adapter has two HBAs, which means you can create a maximum of two vHBAs for each of those adapters. In contrast, a network interface card does not have any HBAs, which means you cannot create any vHBAs for those adapters.

A vHBA communicates over FCoE and handles SAN traffic. At a minimum, each vHBA must be configured with a name and fabric connectivity.

## Service Profiles that Override Server Identity

This type of service profile provides the maximum amount of flexibility and control. This profile allows you to override the identity values that are on the server at the time of association and use the resource pools and policies set up in Cisco UCS Manager to automate some administration tasks.

You can disassociate this service profile from one server and then associate it with another server. This re-association can be done either manually or through an automated server pool policy. The burned-in settings, such as UUID and MAC address, on the new server are overwritten with the configuration in the service profile. As a result, the change in server is transparent to your network. You do not need to reconfigure any component or application on your network to begin using the new server.

This profile allows you to take advantage of and manage system resources through resource pools and policies, such as the following:

- Virtualized identity information, including pools of MAC addresses, WWN addresses, and UUIDs
- Ethernet and Fibre Channel adapter profile policies
- Firmware package policies
- Operating system boot order policies

Unless the service profile contains power management policies, a server pool qualification policy, or another policy that requires a specific hardware configuration, the profile can be used for any type of server in the Cisco UCS domain.

You can associate these service profiles with either a rack-mount server or a blade server. The ability to migrate the service profile depends upon whether you choose to restrict migration of the service profile.

**Note**

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If you choose not to restrict migration, Cisco UCS Manager does not perform any compatibility checks on the new server before migrating the existing service profile. If the hardware of both servers are not similar, the association might fail.

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## Service Profiles that Inherit Server Identity

This hardware-based service profile is the simplest to use and create. This profile uses the default values in the server and mimics the management of a rack-mounted server. It is tied to a specific server and cannot be moved or migrated to another server.

You do not need to create pools or configuration policies to use this service profile.

This service profile inherits and applies the identity and configuration information that is present at the time of association, such as the following:

- MAC addresses for the two NICs
- For a converged network adapter or a virtual interface card, the WWN addresses for the two HBAs
- BIOS versions
- Server UUID

**Important**

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The server identity and configuration information inherited through this service profile may not be the values burned into the server hardware at manufacture if those values were changed before this profile is associated with the server.

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## Service Profile Templates

With a service profile template, you can quickly create several service profiles with the same basic parameters, such as the number of vNICs and vHBAs, and with identity information drawn from the same pools.

**Tip**

If you need only one service profile with similar values to an existing service profile, you can clone a service profile in the Cisco UCS Manager GUI.

For example, if you need several service profiles with similar values to configure servers to host database software, you can create a service profile template, either manually or from an existing service profile. You then use the template to create the service profiles.

Cisco UCS supports the following types of service profile templates:

**Initial template**

Service profiles created from an initial template inherit all the properties of the template. However, after you create the profile, it is no longer connected to the template. If you need to make changes to one or more profiles created from this template, you must change each profile individually.

**Updating template**

Service profiles created from an updating template inherit all the properties of the template and remain connected to the template. Any changes to the template automatically update the service profiles created from the template.

## Policies

Policies determine how Cisco UCS components will act in specific circumstances. You can create multiple instances of most policies. For example, you might want different boot policies, so that some servers can PXE boot, some can SAN boot, and others can boot from local storage.

Policies allow separation of functions within the system. A subject matter expert can define policies that are used in a service profile, which is created by someone without that subject matter expertise. For example, a LAN administrator can create adapter policies and quality of service policies for the system. These policies can then be used in a service profile that is created by someone who has limited or no subject matter expertise with LAN administration.

You can create and use two types of policies in Cisco UCS Manager:

- Configuration policies that configure the servers and other components
- Operational policies that control certain management, monitoring, and access control functions

## Configuration Policies

### Boot Policy

The boot policy determines the following:

- Configuration of the boot device
- Location from which the server boots
- Order in which boot devices are invoked

For example, you can choose to have associated servers boot from a local device, such as a local disk or CD-ROM (VMedia), or you can select a SAN boot or a LAN (PXE) boot.

You must include this policy in a service profile, and that service profile must be associated with a server for it to take effect. If you do not include a boot policy in a service profile, the server uses the default settings in the BIOS to determine the boot order.



#### Important

Changes to a boot policy may be propagated to all servers created with an updating service profile template that includes that boot policy. Reassociation of the service profile with the server to rewrite the boot order information in the BIOS is auto-triggered.

## Chassis Discovery Policy

The chassis discovery policy determines how the system reacts when you add a new chassis. Cisco UCS Manager uses the settings in the chassis discovery policy to determine the minimum threshold for the number of links between the chassis and the fabric interconnect and whether to group links from the IOM to the fabric interconnect in a fabric port channel.

### Chassis Links

If you have a Cisco UCS domain that has some chassis wired with 1 link, some with 2 links, some with 4 links, and some with 8 links we recommend that you configure the chassis discovery policy for the minimum number links in the domain so that Cisco UCS Manager can discover all chassis.



#### Tip

For Cisco UCS implementations that mix IOMs with different numbers of links, we recommend using the platform max value. Using platform max insures that Cisco UCS Manager uses the maximum number of IOM uplinks available.

After the initial discovery, you must reacknowledge the chassis that are wired for a greater number of links and Cisco UCS Manager configures the chassis to use all available links.

Cisco UCS Manager cannot discover any chassis that is wired for fewer links than are configured in the chassis discovery policy. For example, if the chassis discovery policy is configured for 4 links, Cisco UCS Manager cannot discover any chassis that is wired for 1 link or 2 links. Reacknowledgement of the chassis does not resolve this issue.

The following table provides an overview of how the chassis discovery policy works in a multi-chassis Cisco UCS domain:

**Table 1: Chassis Discovery Policy and Chassis Links**

<b>Number of Links Wired for the Chassis</b>	<b>1-Link Chassis Discovery Policy</b>	<b>2-Link Chassis Discovery Policy</b>	<b>4-Link Chassis Discovery Policy</b>	<b>8-Link Chassis Discovery Policy</b>	<b>Platform-Max Discovery Policy</b>
<b>1 link between IOM and fabric interconnects</b>	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 1 link.	Chassis cannot be discovered by Cisco UCS Manager and is not added to the Cisco UCS domain.	Chassis cannot be discovered by Cisco UCS Manager and is not added to the Cisco UCS domain.	Chassis cannot be discovered by Cisco UCS Manager and is not added to the Cisco UCS domain.	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 1 link.
<b>2 links between IOM and fabric interconnects</b>	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 1 link.  After initial discovery, reacknowledge the chassis and Cisco UCS Manager recognizes and uses the additional links.	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 2 link.	Chassis cannot be discovered by Cisco UCS Manager and is not added to the Cisco UCS domain.	Chassis cannot be discovered by Cisco UCS Manager and is not added to the Cisco UCS domain.	Chassis cannot be discovered by Cisco UCS Manager and is not added to the Cisco UCS domain.

<b>Number of Links Wired for the Chassis</b>	<b>1-Link Chassis Discovery Policy</b>	<b>2-Link Chassis Discovery Policy</b>	<b>4-Link Chassis Discovery Policy</b>	<b>8-Link Chassis Discovery Policy</b>	<b>Platform-Max Discovery Policy</b>
<b>4 links between IOM and fabric interconnects</b>	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 1 link.  After initial discovery, reacknowledge the chassis and Cisco UCS Manager recognizes and uses the additional links.	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 2 links.  After initial discovery, reacknowledge the chassis and Cisco UCS Manager recognizes and uses the additional links.	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 4 link.	Chassis cannot be discovered by Cisco UCS Manager and is not added to the Cisco UCS domain.	If the IOM has 4 links, the chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 4 links.  If the IOM has 8 links, the chassis is not fully discovered by Cisco UCS Manager.
<b>8 links between IOM and fabric interconnects</b>	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 1 link.  After initial discovery, reacknowledge the chassis and Cisco UCS Manager recognizes and uses the additional links.	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 2 links.  After initial discovery, reacknowledge the chassis and Cisco UCS Manager recognizes and uses the additional links.	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 4 links.  After initial discovery, reacknowledge the chassis and Cisco UCS Manager recognizes and uses the additional links.	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 8 links.	Chassis is discovered by Cisco UCS Manager and added to the Cisco UCS domain as a chassis wired with 8 links.

### Link Grouping

For hardware configurations that support fabric port channels, link grouping determines whether all of the links from the IOM to the fabric interconnect are grouped into a fabric port channel during chassis discovery. If the link grouping preference is set to port channel, all of the links from the IOM to the fabric interconnect

are grouped in a fabric port channel. If set to no group, links from the IOM to the fabric interconnect are not grouped in a fabric port channel.

Once a fabric port channel is created, links can be added or removed by changing the link group preference and reacknowledging the chassis, or by enabling or disabling the chassis from the port channel.

**Note**

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The link grouping preference only takes effect if both sides of the links between an IOM or FEX and the fabric interconnect support fabric port channels. If one side of the links does not support fabric port channels, this preference is ignored and the links are not grouped in a port channel.

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## Dynamic vNIC Connection Policy

The dynamic vNIC connection policy determines how the connectivity between VMs and dynamic vNICs is configured. This policy is required for Cisco UCS domains that include servers with VIC adapters on which you have installed VMs and configured dynamic vNICs.

Each dynamic vNIC connection policy includes an Ethernet adapter policy and designates the number of vNICs that can be configured for any server associated with a service profile that includes the policy.

**Note**

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If you migrate a server that is configured with dynamic vNICs, the dynamic interface used by the vNICs fails and Cisco UCS Manager notifies you of that failure.

When the server comes back up, Cisco UCS Manager assigns new dynamic vNICs to the server. If you are monitoring traffic on the dynamic vNIC, you must reconfigure the monitoring source.

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## Ethernet and Fibre Channel Adapter Policies

These policies govern the host-side behavior of the adapter, including how the adapter handles traffic. For example, you can use these policies to change default settings for the following:

- Queues
- Interrupt handling
- Performance enhancement
- RSS hash
- Failover in an cluster configuration with two fabric interconnects

**Note**

For Fibre Channel adapter policies, the values displayed by Cisco UCS Manager may not match those displayed by applications such as QLogic SANsurfer. For example, the following values may result in an apparent mismatch between SANsurfer and Cisco UCS Manager:

- **Max LUNs Per Target**—SANsurfer has a maximum of 256 LUNs and does not display more than that number. Cisco UCS Manager supports a higher maximum number of LUNs.
- **Link Down Timeout**—In SANsurfer, you configure the timeout threshold for link down in seconds. In Cisco UCS Manager, you configure this value in milliseconds. Therefore, a value of 5500 ms in Cisco UCS Manager displays as 5s in SANsurfer.
- **Max Data Field Size**—SANsurfer has allowed values of 512, 1024, and 2048. Cisco UCS Manager allows you to set values of any size. Therefore, a value of 900 in Cisco UCS Manager displays as 512 in SANsurfer.

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### Operating System Specific Adapter Policies

By default, Cisco UCS provides a set of Ethernet adapter policies and Fibre Channel adapter policies. These policies include the recommended settings for each supported server operating system. Operating systems are sensitive to the settings in these policies. Storage vendors typically require non-default adapter settings. You can find the details of these required settings on the support list provided by those vendors.

**Important**

We recommend that you use the values in these policies for the applicable operating system. Do not modify any of the values in the default policies unless directed to do so by Cisco Technical Support.

However, if you are creating an Ethernet adapter policy for a Windows OS (instead of using the default Windows adapter policy), you must use the following formulas to calculate values that work with Windows:

$$\text{Completion Queues} = \text{Transmit Queues} + \text{Receive Queues}$$

$$\text{Interrupt Count} = (\text{Completion Queues} + 2) \text{ rounded up to nearest power of } 2$$

For example, if Transmit Queues = 1 and Receive Queues = 8 then:

$$\text{Completion Queues} = 1 + 8 = 9$$

$$\text{Interrupt Count} = (9 + 2) \text{ rounded up to the nearest power of } 2 = 16$$


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## Global Cap Policy

The global cap policy is a global policy that specifies whether policy-driven chassis group power capping or manual blade-level power capping will be applied to all servers in a chassis.

We recommend that you use the default power capping method: policy-driven chassis group power capping.

**Important**

Any change to the manual blade-level power cap configuration will result in the loss of any groups or configuration options set for policy-driven chassis group power capping.

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## Host Firmware Package

This policy enables you to specify a set of firmware versions that make up the host firmware package (also known as the host firmware pack). The host firmware includes the following firmware for server and adapter endpoints:

- **Adapter**
- **BIOS**
- **Board Controller**
- **FC Adapters**
- **HBA Option ROM**
- **Storage Controller**

**Tip**

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You can include more than one type of firmware in the same host firmware package. For example, a host firmware package can include both BIOS firmware and storage controller firmware or adapter firmware for two different models of adapters. However, you can only have one firmware version with the same type, vendor, and model number. The system recognizes which firmware version is required for an endpoint and ignores all other firmware versions.

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The firmware package is pushed to all servers associated with service profiles that include this policy.

This policy ensures that the host firmware is identical on all servers associated with service profiles which use the same policy. Therefore, if you move the service profile from one server to another, the firmware versions are maintained. Also, if you change the firmware version for an endpoint in the firmware package, new versions are applied to all the affected service profiles immediately, which could cause server reboots.

You must include this policy in a service profile, and that service profile must be associated with a server for it to take effect.

### Prerequisites

This policy is not dependent upon any other policies. However, you must ensure that the appropriate firmware has been downloaded to the fabric interconnect. If the firmware image is not available when Cisco UCS Manager is associating a server with a service profile, Cisco UCS Manager ignores the firmware upgrade and completes the association.

## IPMI Access Profile

This policy allows you to determine whether IPMI commands can be sent directly to the server, using the IP address. For example, you can send commands to retrieve sensor data from the CIMC. This policy defines the IPMI access, including a username and password that can be authenticated locally on the server, and whether the access is read-only or read-write.

You must include this policy in a service profile and that service profile must be associated with a server for it to take effect.

## Local Disk Configuration Policy

This policy configures any optional SAS local drives that have been installed on a server through the onboard RAID controller of the local drive. This policy enables you to set a local disk mode for all servers that are associated with a service profile that includes the local disk configuration policy.

The local disk modes include the following:

- **No Local Storage**—For a diskless server or a SAN only configuration. If you select this option, you cannot associate any service profile which uses this policy with a server that has a local disk.
- **RAID 0 Striped**—Data is striped across all disks in the array, providing fast throughput. There is no data redundancy, and all data is lost if any disk fails.
- **RAID 1 Mirrored**—Data is written to two disks, providing complete data redundancy if one disk fails. The maximum array size is equal to the available space on the smaller of the two drives.
- **Any Configuration**—For a server configuration that carries forward the local disk configuration without any changes.
- **No RAID**—For a server configuration that removes the RAID and leaves the disk MBR and payload unaltered.
- **RAID 5 Striped Parity**—Data is striped across all disks in the array. Part of the capacity of each disk stores parity information that can be used to reconstruct data if a disk fails. RAID 5 provides good data throughput for applications with high read request rates.
- **RAID 6 Striped Dual Parity**—Data is striped across all disks in the array and two parity disks are used to provide protection against the failure of up to two physical disks. In each row of data blocks, two sets of parity data are stored.
- **RAID10 Mirrored and Striped**— RAID 10 uses mirrored pairs of disks to provide complete data redundancy and high throughput rates.

You must include this policy in a service profile, and that service profile must be associated with a server for the policy to take effect.

## Management Firmware Package

This policy enables you to specify a set of firmware versions that make up the management firmware package (also known as a management firmware pack). The management firmware package includes the Cisco Integrated Management Controller (CIMC) on the server. You do not need to use this package if you upgrade the CIMC directly.

The firmware package is pushed to all servers associated with service profiles that include this policy. This policy ensures that the CIMC firmware is identical on all servers associated with service profiles which use the same policy. Therefore, if you move the service profile from one server to another, the firmware versions are maintained.

You must include this policy in a service profile, and that service profile must be associated with a server for it to take effect.

This policy is not dependent upon any other policies. However, you must ensure that the appropriate firmware has been downloaded to the fabric interconnect.

## Management Interfaces Monitoring Policy

This policy defines how the mgmt0 Ethernet interface on the fabric interconnect should be monitored. If Cisco UCS detects a management interface failure, a failure report is generated. If the configured number of failure reports is reached, the system assumes that the management interface is unavailable and generates a fault. By default, the management interfaces monitoring policy is disabled.

If the affected management interface belongs to a fabric interconnect which is the managing instance, Cisco UCS confirms that the subordinate fabric interconnect's status is up, that there are no current failure reports logged against it, and then modifies the managing instance for the end-points.

If the affected fabric interconnect is currently the primary inside of a high availability setup, a failover of the management plane is triggered. The data plane is not affected by this failover.

You can set the following properties related to monitoring the management interface:

- Type of mechanism used to monitor the management interface.
- Interval at which the management interface's status is monitored.
- Maximum number of monitoring attempts that can fail before the system assumes that the management is unavailable and generates a fault message.



### Important

In the event of a management interface failure on a fabric interconnect, the managing instance may not change if one of the following occurs:

- A path to the end-point through the subordinate fabric interconnect does not exist.
- The management interface for the subordinate fabric interconnect has failed.
- The path to the end-point through the subordinate fabric interconnect has failed.

## Network Control Policy

This policy configures the network control settings for the Cisco UCS domain, including the following:

- Whether the Cisco Discovery Protocol (CDP) is enabled or disabled
- How the VIF behaves if no uplink port is available in end-host mode
- The action that Cisco UCS Manager takes on the remote Ethernet interface, vEthernet interface, or vFibreChannel interface when the associated border port fails
- Whether the server can use different MAC addresses when sending packets to the fabric interconnect
- Whether MAC registration occurs on a per-VNIC basis or for all VLANs.

### Action on Uplink Fail

By default, the **Action on Uplink Fail** property in the network control policy is configured with a value of link-down. For adapters such as the Cisco UCS M81KR Virtual Interface Card, this default behavior directs Cisco UCS Manager to bring the vEthernet or vFibreChannel interface down if the associated border port fails. For Cisco UCS systems using a non-VM-FEX capable converged network adapter that supports both

Ethernet and FCoE traffic, such as Cisco UCS CNA M72KR-Q and the Cisco UCS CNA M72KR-E, this default behavior directs Cisco UCS Manager to bring the remote Ethernet interface down if the associated border port fails. In this scenario, any vFibreChannel interfaces that are bound to the remote Ethernet interface are brought down as well.




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**Note** Cisco UCS Manager, release 1.4(2) and earlier did not enforce the **Action on Uplink Fail** property for those types of non-VM-FEX capable converged network adapters mentioned above. If the **Action on Uplink Fail** property was set to link-down, Cisco UCS Manager would ignore this setting and instead issue a warning. In the current version of Cisco UCS Manager this setting is enforced. Therefore, if your implementation includes one of those converged network adapters and the adapter is expected to handle both Ethernet and FCoE traffic, we recommend that you configure the **Action on Uplink Fail** property with a value of warning.

Please note that this configuration may result in an Ethernet teaming driver not being able to detect a link failure when the border port goes down.

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### MAC Registration Mode

In Cisco UCS Manager, releases 1.4 and earlier, MAC addresses were installed on all of the VLANs belonging to an interface. Starting in release 2.0, MAC addresses are installed only on the native VLAN by default. In most implementations this maximizes the VLAN port count.




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**Note** If a trunking driver is being run on the host and the interface is in promiscuous mode, we recommend that you set the Mac Registration Mode to All VLANs.

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## Power Control Policy

Cisco UCS uses the priority set in the power control policy, along with the blade type and configuration, to calculate the initial power allocation for each blade within a chassis. During normal operation, the active blades within a chassis can borrow power from idle blades within the same chassis. If all blades are active and reach the power cap, service profiles with higher priority power control policies take precedence over service profiles with lower priority power control policies.

Priority is ranked on a scale of 1-10, where 1 indicates the highest priority and 10 indicates lowest priority. The default priority is 5.

For mission-critical application a special priority called no-cap is also available. Setting the priority to no-cap prevents Cisco UCS from leveraging unused power from that particular blade server. The server is allocated the maximum amount of power that that blade can reach.




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**Note** You must include this policy in a service profile and that service profile must be associated with a server for it to take effect.

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## Power Policy

The power policy is a global policy that specifies the redundancy for power supplies in all chassis in the Cisco UCS domain. This policy is also known as the PSU policy.

For more information about power supply redundancy, see *Cisco UCS 5108 Server Chassis Hardware Installation Guide*.

## Quality of Service Policy

A quality of service (QoS) policy assigns a system class to the outgoing traffic for a vNIC or vHBA. This system class determines the quality of service for that traffic. For certain adapters you can also specify additional controls on the outgoing traffic, such as burst and rate.

You must include a QoS policy in a vNIC policy or vHBA policy and then include that policy in a service profile to configure the vNIC or vHBA.

## Rack Server Discovery Policy

The rack server discovery policy determines how the system reacts when you add a new rack-mount server. Cisco UCS Manager uses the settings in the rack server discovery policy to determine whether any data on the hard disks are scrubbed and whether server discovery occurs immediately or needs to wait for explicit user acknowledgement.

Cisco UCS Manager cannot discover any rack-mount server that has not been correctly cabled and connected to the fabric interconnects. For information about how to integrate a supported Cisco UCS rack-mount server with Cisco UCS Manager, see the hardware installation guide for that server.

## Server Autoconfiguration Policy

Cisco UCS Manager uses this policy to determine how to configure a new server. If you create a server autoconfiguration policy, the following occurs when a new server starts:

- 1 The qualification in the server autoconfiguration policy is executed against the server.
- 2 If the server meets the required qualifications, the server is associated with a service profile created from the service profile template configured in the server autoconfiguration policy. The name of that service profile is based on the name given to the server by Cisco UCS Manager.
- 3 The service profile is assigned to the organization configured in the server autoconfiguration policy.

## Server Discovery Policy

This discovery policy determines how the system reacts when you add a new server. If you create a server discovery policy, you can control whether the system conducts a deep discovery when a server is added to a chassis, or whether a user must first acknowledge the new server. By default, the system conducts a full discovery.

If you create a server discovery policy, the following occurs when a new server starts:

- 1 The qualification in the server discovery policy is executed against the server.

- 2 If the server meets the required qualifications, Cisco UCS Manager applies the following to the server:
  - Depending upon the option selected for the action, either discovers the new server immediately or waits for a user to acknowledge the new server
  - Applies the scrub policy to the server

## Server Inheritance Policy

This policy is invoked during the server discovery process to create a service profile for the server. All service profiles created from this policy use the values burned into the blade at manufacture. The policy performs the following:

- Analyzes the inventory of the server
- If configured, assigns the server to the selected organization
- Creates a service profile for the server with the identity burned into the server at manufacture

You cannot migrate a service profile created with this policy to another server.

## Server Pool Policy

This policy is invoked during the server discovery process. It determines what happens if server pool policy qualifications match a server to the target pool specified in the policy.

If a server qualifies for more than one pool and those pools have server pool policies, the server is added to all those pools.

## Server Pool Policy Qualifications

This policy qualifies servers based on the inventory of a server conducted during the discovery process. The qualifications are individual rules that you configure in the policy to determine whether a server meets the selection criteria. For example, you can create a rule that specifies the minimum memory capacity for servers in a data center pool.

Qualifications are used in other policies to place servers, not just by the server pool policies. For example, if a server meets the criteria in a qualification policy, it can be added to one or more server pools or have a service profile automatically associated with it.

You can use the server pool policy qualifications to qualify servers according to the following criteria:

- Adapter type
- Chassis location
- Memory type and configuration
- Power group
- CPU cores, type, and configuration
- Storage configuration and capacity
- Server model

Depending upon the implementation, you may configure several policies with server pool policy qualifications including the following:

- Autoconfiguration policy
- Chassis discovery policy
- Server discovery policy
- Server inheritance policy
- Server pool policy

## vHBA Template

This template is a policy that defines how a vHBA on a server connects to the SAN. It is also referred to as a vHBA SAN connectivity template.

You need to include this policy in a service profile for it to take effect.

## VM Lifecycle Policy

The VM lifecycle policy determines how long Cisco UCS Manager retains offline VMs and offline dynamic vNICs in its database. If a VM or dynamic vNIC remains offline after that period, Cisco UCS Manager deletes the object from its database.

All virtual machines (VMs) on Cisco UCS servers are managed by vCenter. Cisco UCS Manager cannot determine whether an inactive VM is temporarily shutdown, has been deleted, or is in some other state that renders it inaccessible. Therefore, Cisco UCS Manager considers all inactive VMs to be in an offline state.

Cisco UCS Manager considers a dynamic vNIC to be offline when the associated VM is shutdown, or the link between the fabric interconnect and the I/O module fails. On rare occasions, an internal error can also cause Cisco UCS Manager to consider a dynamic vNIC to be offline.

The default VM and dynamic vNIC retention period is 15 minutes. You can set that for any period of time between 1 minute and 7200 minutes (or 5 days).

**Note**

The VMs that Cisco UCS Manager displays are for information and monitoring only. You cannot manage VMs through Cisco UCS Manager. Therefore, when you delete a VM from the Cisco UCS Manager database, you do not delete the VM from the server or from vCenter.

## vNIC Template

This policy defines how a vNIC on a server connects to the LAN. This policy is also referred to as a vNIC LAN connectivity policy.

Beginning in Cisco UCS, Release 2.0(2), Cisco UCS Manager does not automatically create a VM-FEX port profile with the correct settings when you create a vNIC template. If you want to create a VM-FEX port profile, you must configure the target of the vNIC template as a VM.

You need to include this policy in a service profile for it to take effect.

**Note**


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If your server has two Emulex or QLogic NICs (Cisco UCS CNA M71KR-E or Cisco UCS CNA M71KR-Q), you must configure vNIC policies for both adapters in your service profile to get a user-defined MAC address for both NICs. If you do not configure policies for both NICs, Windows still detects both of them in the PCI bus. Then because the second eth is not part of your service profile, Windows assigns it a hardware MAC address. If you then move the service profile to a different server, Windows sees additional NICs because one NIC did not have a user-defined MAC address.

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## vNIC/vHBA Placement Policies

vNIC/vHBA placement policies are used to determine what types of vNICs or vHBAs can be assigned to the physical adapters on a server. Each vNIC/vHBA placement policy contains four virtual network interface connections (vCons) that are virtual representations of the physical adapters. When a vNIC/vHBA placement policy is assigned to a service profile, and the service profile is associated with a server, the vCons in the vNIC/vHBA placement policy are assigned to the physical adapters.

If you do not include a vNIC/vHBA placement policy in the service profile or you use the default configuration for a server with two adapters, Cisco UCS Manager defaults to the **All** configuration and equally distributes the vNICs and vHBAs between the adapters.

You can use this policy to assign vNICs or vHBAs to either of the two vCons. Cisco UCS Manager uses the vCon assignment to determine how to assign the vNICs and vHBAs to the physical adapter during service profile association.

- **All**—All configured vNICs and vHBAs can be assigned to the vCon, whether they are explicitly assigned to it, unassigned, or dynamic.
- **Assigned Only**—vNICs and vHBAs must be explicitly assigned to the vCon. You can assign them explicitly through the service profile or the properties of the vNIC or vHBA.
- **Exclude Dynamic**—Dynamic vNICs and vHBAs cannot be assigned to the vCon. The vCon can be used for all static vNICs and vHBAs, whether they are unassigned or explicitly assigned to it.
- **Exclude Unassigned**—Unassigned vNICs and vHBAs cannot be assigned to the vCon. The vCon can be used for dynamic vNICs and vHBAs and for static vNICs and vHBAs that are explicitly assigned to it.

## Operational Policies

### Fault Collection Policy

The fault collection policy controls the lifecycle of a fault in a Cisco UCS domain, including when faults are cleared, the flapping interval (the length of time between the fault being raised and the condition being cleared), and the retention interval (the length of time a fault is retained in the system).

A fault in Cisco UCS has the following lifecycle:

- 1 A condition occurs in the system and Cisco UCS Manager raises a fault. This is the active state.

- 2 When the fault is alleviated, it enters a flapping or soaking interval that is designed to prevent flapping. Flapping occurs when a fault is raised and cleared several times in rapid succession. During the flapping interval, the fault retains its severity for the length of time specified in the fault collection policy.
- 3 If the condition reoccurs during the flapping interval, the fault returns to the active state. If the condition does not reoccur during the flapping interval, the fault is cleared.
- 4 The cleared fault enters the retention interval. This interval ensures that the fault reaches the attention of an administrator even if the condition that caused the fault has been alleviated and the fault has not been deleted prematurely. The retention interval retains the cleared fault for the length of time specified in the fault collection policy.
- 5 If the condition reoccurs during the retention interval, the fault returns to the active state. If the condition does not reoccur, the fault is deleted.

## Flow Control Policy

Flow control policies determine whether the uplink Ethernet ports in a Cisco UCS domain send and receive IEEE 802.3x pause frames when the receive buffer for a port fills. These pause frames request that the transmitting port stop sending data for a few milliseconds until the buffer clears.

For flow control to work between a LAN port and an uplink Ethernet port, you must enable the corresponding receive and send flow control parameters for both ports. For Cisco UCS, the flow control policies configure these parameters.

When you enable the send function, the uplink Ethernet port sends a pause request to the network port if the incoming packet rate becomes too high. The pause remains in effect for a few milliseconds before traffic is reset to normal levels. If you enable the receive function, the uplink Ethernet port honors all pause requests from the network port. All traffic is halted on that uplink port until the network port cancels the pause request.

Because you assign the flow control policy to the port, changes to the policy have an immediate effect on how the port reacts to a pause frame or a full receive buffer.

## Maintenance Policy

A maintenance policy determines how Cisco UCS Manager reacts when a change that requires a server reboot is made to a service profile associated with a server or to an updating service profile bound to one or more service profiles.

The maintenance policy specifies how Cisco UCS Manager deploys the service profile changes. The deployment can occur in one of the following ways:

- Immediately
- When acknowledged by a user with admin privileges
- Automatically at the time specified in the schedule

If the maintenance policy is configured to deploy the change during a scheduled maintenance window, the policy must include a valid schedule. The schedule deploys the changes in the first available maintenance window.

## Scrub Policy

This policy determines what happens to local data and to the BIOS settings on a server during the discovery process and when the server is disassociated from a service profile. Depending upon how you configure a scrub policy, the following can occur at those times:

### Disk Scrub

One of the following occurs to the data on any local drives on disassociation:

- If enabled, destroys all data on any local drives
- If disabled, preserves all data on any local drives, including local storage configuration

### BIOS Settings Scrub

One of the following occurs to the BIOS settings when a service profile containing the scrub policy is disassociated from a server:

- If enabled, erases all BIOS settings for the server and resets them to the BIOS defaults for that server type and vendor
- If disabled, preserves the existing BIOS settings on the server

## Serial over LAN Policy

This policy sets the configuration for the serial over LAN connection for all servers associated with service profiles that use the policy. By default, the serial over LAN connection is disabled.

If you implement a serial over LAN policy, we recommend that you also create an IPMI profile.

You must include this policy in a service profile and that service profile must be associated with a server for it to take effect.

## Statistics Collection Policy

A statistics collection policy defines how frequently statistics are to be collected (collection interval) and how frequently the statistics are to be reported (reporting interval). Reporting intervals are longer than collection intervals so that multiple statistical data points can be collected during the reporting interval, which provides Cisco UCS Manager with sufficient data to calculate and report minimum, maximum, and average values.

For NIC statistics, Cisco UCS Manager displays the average, minimum, and maximum of the change since the last collection of statistics. If the values are 0, there has been no change since the last collection.

Statistics can be collected and reported for the following five functional areas of the Cisco UCS system:

- Adapter—statistics related to the adapters
- Chassis—statistics related to the blade chassis
- Host—this policy is a placeholder for future support
- Port—statistics related to the ports, including server ports, uplink Ethernet ports, and uplink Fibre Channel ports

- Server—statistics related to servers

**Note**

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Cisco UCS Manager has one default statistics collection policy for each of the five functional areas. You cannot create additional statistics collection policies and you cannot delete the existing default policies. You can only modify the default policies.

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## Statistics Threshold Policy

A statistics threshold policy monitors statistics about certain aspects of the system and generates an event if the threshold is crossed. You can set both minimum and maximum thresholds. For example, you can configure the policy to raise an alarm if the CPU temperature exceeds a certain value, or if a server is overutilized or underutilized.

These threshold policies do not control the hardware or device-level thresholds enforced by endpoints, such as the CIMC. Those thresholds are burned in to the hardware components at manufacture.

Cisco UCS enables you to configure statistics threshold policies for the following components:

- Servers and server components
- Uplink Ethernet ports
- Ethernet server ports, chassis, and fabric interconnects
- Fibre Channel port

**Note**

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You cannot create or delete a statistics threshold policy for Ethernet server ports, uplink Ethernet ports, or uplink Fibre Channel ports. You can only configure the existing default policy.

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## Pools

Pools are collections of identities, or physical or logical resources, that are available in the system. All pools increase the flexibility of service profiles and allow you to centrally manage your system resources.

You can use pools to segment unconfigured servers or available ranges of server identity information into groupings that make sense for the data center. For example, if you create a pool of unconfigured servers with similar characteristics and include that pool in a service profile, you can use a policy to associate that service profile with an available, unconfigured server.

If you pool identifying information, such as MAC addresses, you can pre-assign ranges for servers that will host specific applications. For example, all database servers could be configured within the same range of MAC addresses, UUIDs, and WWNs.

### Server Pools

A server pool contains a set of servers. These servers typically share the same characteristics. Those characteristics can be their location in the chassis, or an attribute such as server type, amount of memory,

local storage, type of CPU, or local drive configuration. You can manually assign a server to a server pool, or use server pool policies and server pool policy qualifications to automate the assignment.

If your system implements multi-tenancy through organizations, you can designate one or more server pools to be used by a specific organization. For example, a pool that includes all servers with two CPUs could be assigned to the Marketing organization, while all servers with 64 GB memory could be assigned to the Finance organization.

A server pool can include servers from any chassis in the system. A given server can belong to multiple server pools.

## MAC Pools

A MAC pool is a collection of network identities, or MAC addresses, that are unique in their layer 2 environment and are available to be assigned to vNICs on a server. If you use MAC pools in service profiles, you do not have to manually configure the MAC addresses to be used by the server associated with the service profile.

In a system that implements multi-tenancy, you can use the organizational hierarchy to ensure that MAC pools can only be used by specific applications or business services. Cisco UCS Manager uses the name resolution policy to assign MAC addresses from the pool.

To assign a MAC address to a server, you must include the MAC pool in a vNIC policy. The vNIC policy is then included in the service profile assigned to that server.

You can specify your own MAC addresses or use a group of MAC addresses provided by Cisco.

## UUID Suffix Pools

A UUID suffix pool is a collection of SMBIOS UUIDs that are available to be assigned to servers. The first number of digits that constitute the prefix of the UUID are fixed. The remaining digits, the UUID suffix, are variable. A UUID suffix pool ensures that these variable values are unique for each server associated with a service profile which uses that particular pool to avoid conflicts.

If you use UUID suffix pools in service profiles, you do not have to manually configure the UUID of the server associated with the service profile.

## WWN Pools

A WWN pool is a collection of WWNs for use by the Fibre Channel vHBAs in a Cisco UCS domain. You create separate pools for the following:

- WW node names assigned to the server
- WW port names assigned to the vHBA



### Important

A WWN pool can include only WWNNs or WWPNS in the ranges from 20:00:00:00:00:00:00 to 20:FF:FF:FF:FF:FF:FF or from 50:00:00:00:00:00:00 to 5F:FF:FF:FF:FF:FF:FF. All other WWN ranges are reserved. To ensure the uniqueness of the Cisco UCS WWNNs and WWPNS in the SAN fabric, we recommend that you use the following WWN prefix for all blocks in a pool:  
20:00:00:25:B5:XX:XX:XX

If you use WWN pools in service profiles, you do not have to manually configure the WWNs that will be used by the server associated with the service profile. In a system that implements multi-tenancy, you can use a WWN pool to control the WWNs used by each organization.

You assign WWNs to pools in blocks. For each block or individual WWN, you can assign a boot target.

### WWNN Pools

A WWNN pool is a WWN pool that contains only WW node names. If you include a pool of WWNNs in a service profile, the associated server is assigned a WWNN from that pool.

### WWPN Pools

A WWPN pool is a WWN pool that contains only WW port names. If you include a pool of WWPNs in a service profile, the port on each vHBA of the associated server is assigned a WWPN from that pool.

## Management IP Pool

The management IP pool is a collection of external IP addresses. Cisco UCS Manager reserves each block of IP addresses in the management IP pool for external access that terminates in the CIMC on a server.

You can configure service profiles and service profile templates to use IP addresses from the management IP pool. You cannot configure servers to use the management IP pool.

All IP addresses in the management IP pool must be in the same subnet as the IP address of the fabric interconnect.

**Note**

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The management IP pool must not contain any IP addresses that have been assigned as static IP addresses for a server or service profile.

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# Traffic Management

## Oversubscription

Oversubscription occurs when multiple network devices are connected to the same fabric interconnect port. This practice optimizes fabric interconnect use, since ports rarely run at maximum speed for any length of time. As a result, when configured correctly, oversubscription allows you to take advantage of unused bandwidth. However, incorrectly configured oversubscription can result in contention for bandwidth and a lower quality of service to all services that use the oversubscribed port.

For example, oversubscription can occur if four servers share a single uplink port, and all four servers attempt to send data at a cumulative rate higher than available bandwidth of uplink port.

## Oversubscription Considerations

The following elements can impact how you configure oversubscription in a Cisco UCS domain:

### Ratio of Server-Facing Ports to Uplink Ports

You need to know what how many server-facing ports and uplink ports are in the system, because that ratio can impact performance. For example, if your system has twenty ports that can communicate down to the servers and only two ports that can communicate up to the network, your uplink ports will be oversubscribed. In this situation, the amount of traffic created by the servers can also affect performance.

### Number of Uplink Ports from Fabric Interconnect to Network

You can choose to add more uplink ports between the Cisco UCS fabric interconnect and the upper layers of the LAN to increase bandwidth. In Cisco UCS, you must have at least one uplink port per fabric interconnect to ensure that all servers and NICs to have access to the LAN. The number of LAN uplinks should be determined by the aggregate bandwidth needed by all Cisco UCS servers.

For the 6100 series fabric interconnects, Fibre Channel uplink ports are available on the expansion slots only. You must add more expansion slots to increase number of available Fibre Channel uplinks. Ethernet uplink ports can exist on the fixed slot and on expansion slots.

For the 6200 series fabric interconnects running Cisco UCS Manager, version 2.0 and higher, Ethernet uplink ports and Fibre Channel uplink ports are both configurable on the base module, as well as on the expansion module.

For example, if you have two Cisco UCS 5100 series chassis that are fully populated with half width Cisco UCS B200-M1 servers, you have 16 servers. In a cluster configuration, with one LAN uplink per fabric interconnect, these 16 servers share 20GbE of LAN bandwidth. If more capacity is needed, more uplinks from the fabric interconnect should be added. We recommend that you have symmetric configuration of the uplink in cluster configurations. In the same example, if 4 uplinks are used in each fabric interconnect, the 16 servers are sharing 80 GB of bandwidth, so each has approximately 5 GB of capacity. When multiple uplinks are used on a Cisco UCS fabric interconnect the network design team should consider using a port channel to make best use of the capacity.

### Number of Uplink Ports from I/O Module to Fabric Interconnect

You can choose to add more bandwidth between I/O module and fabric interconnect by using more uplink ports and increasing the number of cables. In Cisco UCS, you can have one, two, or four cables connecting a I/O module to a Cisco UCS 6100 series fabric interconnect. You can have up to eight cables if you're connecting a 2208 I/O module and a 6248 fabric interconnect. The number of cables determines the number of active uplink ports and the oversubscription ratio.

### Number of Active Links from Server to Fabric Interconnect

The amount of non-oversubscribed bandwidth available to each server depends on the number of I/O modules used and the number of cables used to connect those I/O modules to the fabric interconnects. Having a second I/O module in place provides additional bandwidth and redundancy to the servers. This level of flexibility in design ensures that you can provide anywhere from 80 Gbps (two I/O modules with four links each) to 10 Gbps (one I/O module with one link) to the chassis.

With 80 Gbps to the chassis, each half-width server in the Cisco UCS domain can get up to 10 Gbps in a non-oversubscribed configuration, with an ability to use up to 20 Gbps with 2:1 oversubscription.

## Guidelines for Estimating Oversubscription

When you estimate the optimal oversubscription ratio for a fabric interconnect port, consider the following guidelines:

### Cost/Performance Slider

The prioritization of cost and performance is different for each data center and has a direct impact on the configuration of oversubscription. When you plan hardware usage for oversubscription, you need to know where the data center is located on this slider. For example, oversubscription can be minimized if the data center is more concerned with performance than cost. However, cost is a significant factor in most data centers, and oversubscription requires careful planning.

### Bandwidth Usage

The estimated bandwidth that you expect each server to actually use is important when you determine the assignment of each server to a fabric interconnect port and, as a result, the oversubscription ratio of the ports. For oversubscription, you must consider how many GBs of traffic the server will consume on average, the ratio of configured bandwidth to used bandwidth, and the times when high bandwidth use will occur.

### Network Type

The network type is only relevant to traffic on uplink ports, because FCoE does not exist outside Cisco UCS. The rest of the data center network only differentiates between LAN and SAN traffic. Therefore, you do not need to take the network type into consideration when you estimate oversubscription of a fabric interconnect port.

## Pinning

Pinning in Cisco UCS is only relevant to uplink ports. You can pin Ethernet or FCoE traffic from a given server to a specific uplink Ethernet port or uplink FC port.

When you pin the NIC and HBA of both physical and virtual servers to uplink ports, you give the fabric interconnect greater control over the unified fabric. This control ensures more optimal utilization of uplink port bandwidth.

Cisco UCS uses pin groups to manage which NICs, vNICs, HBAs, and vHBAs are pinned to an uplink port. To configure pinning for a server, you can either assign a pin group directly, or include a pin group in a vNIC policy, and then add that vNIC policy to the service profile assigned to that server. All traffic from the vNIC or vHBA on the server travels through the I/O module to the same uplink port.

### Pinning Server Traffic to Server Ports

All server traffic travels through the I/O module to server ports on the fabric interconnect. The number of links for which the chassis is configured determines how this traffic is pinned.

The pinning determines which server traffic goes to which server port on the fabric interconnect. This pinning is fixed. You cannot modify it. As a result, you must consider the server location when you determine the appropriate allocation of bandwidth for a chassis.

**Note**

You must review the allocation of ports to links before you allocate servers to slots. The cabled ports are not necessarily port 1 and port 2 on the I/O module. If you change the number of links between the fabric interconnect and the I/O module, you must reacknowledge the chassis to have the traffic rerouted.

All port numbers refer to the fabric interconnect-side ports on the I/O module.

**Chassis with One I/O Module (Not Configured for Fabric Port Channels)****Note**

If the adapter in a server supports and is configured for adapter port channels, those port channels are pinned to the same link as described in the following table. If the I/O module in the chassis supports and is configured for fabric port channels, the server slots are pinned to a fabric port channel rather than to an individual link.

Links on Chassis	Link 1 / Fabric Port Channel	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8
1 link	All server slots	None	None	None	None	None	None	None
2 links	Server slots 1, 3, 5, and 7	Server slots 2, 4, 6, and 8	None	None	None	None	None	None
4 links	Server slots 1 and 5	Server slots 2 and 6	Server slots 3 and 7	Server slots 4 and 8	None	None	None	None
8 links	Server slot 1	Server slot 2	Server slot 3	Server slot 4	Server slot 5	Server slot 6	Server slot 7	Server slot 8
Fabric Port Channel	All server slots	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**Chassis with Two I/O Modules**

If a chassis has two I/O modules, traffic from one I/O module goes to one of the fabric interconnects and traffic from the other I/O module goes to the second fabric interconnect. You cannot connect two I/O modules to a single fabric interconnect.

Fabric Interconnect Configured in vNIC	Server Traffic Path
A	Server traffic goes to fabric interconnect A. If A fails, the server traffic does not fail over to B.
B	All server traffic goes to fabric interconnect B. If B fails, the server traffic does not fail over to A.
A-B	All server traffic goes to fabric interconnect A. If A fails, the server traffic fails over to B.
B-A	All server traffic goes to fabric interconnect B. If B fails, the server traffic fails over to A.

## Guidelines for Pinning

When you determine the optimal configuration for pin groups and pinning for an uplink port, consider the estimated bandwidth usage for the servers. If you know that some servers in the system will use a lot of bandwidth, ensure that you pin these servers to different uplink ports.

## Quality of Service

Cisco UCS provides the following methods to implement quality of service:

- System classes that specify the global configuration for certain types of traffic across the entire system
- QoS policies that assign system classes for individual vNICs
- Flow control policies that determine how uplink Ethernet ports handle pause frames

## System Classes

Cisco UCS uses Data Center Ethernet (DCE) to handle all traffic inside a Cisco UCS domain. This industry standard enhancement to Ethernet divides the bandwidth of the Ethernet pipe into eight virtual lanes. Two virtual lanes are reserved for internal system and management traffic. You can configure quality of service for the other six virtual lanes. System classes determine how the DCE bandwidth in these six virtual lanes is allocated across the entire Cisco UCS domain.

Each system class reserves a specific segment of the bandwidth for a specific type of traffic. This provides a level of traffic management, even in an oversubscribed system. For example, you can configure the Fibre Channel Priority system class to determine the percentage of DCE bandwidth allocated to FCoE traffic.

The following table describes the system classes that you can configure:

**Table 2: System Classes**

System Class	Description
Platinum Gold Silver Bronze	A configurable set of system classes that you can include in the QoS policy for a service profile. Each system class manages one lane of traffic.  All properties of these system classes are available for you to assign custom settings and policies.
Best Effort	A system class that sets the quality of service for the lane reserved for Basic Ethernet traffic.  Some properties of this system class are preset and cannot be modified. For example, this class has a drop policy that allows it to drop data packets if required. You cannot disable this system class.

System Class	Description
Fibre Channel	<p>A system class that sets the quality of service for the lane reserved for Fibre Channel over Ethernet traffic.</p> <p>Some properties of this system class are preset and cannot be modified. For example, this class has a no-drop policy that ensures it never drops data packets. You cannot disable this system class.</p>

## Quality of Service Policy

A quality of service (QoS) policy assigns a system class to the outgoing traffic for a vNIC or vHBA. This system class determines the quality of service for that traffic. For certain adapters you can also specify additional controls on the outgoing traffic, such as burst and rate.

You must include a QoS policy in a vNIC policy or vHBA policy and then include that policy in a service profile to configure the vNIC or vHBA.

## Flow Control Policy

Flow control policies determine whether the uplink Ethernet ports in a Cisco UCS domain send and receive IEEE 802.3x pause frames when the receive buffer for a port fills. These pause frames request that the transmitting port stop sending data for a few milliseconds until the buffer clears.

For flow control to work between a LAN port and an uplink Ethernet port, you must enable the corresponding receive and send flow control parameters for both ports. For Cisco UCS, the flow control policies configure these parameters.

When you enable the send function, the uplink Ethernet port sends a pause request to the network port if the incoming packet rate becomes too high. The pause remains in effect for a few milliseconds before traffic is reset to normal levels. If you enable the receive function, the uplink Ethernet port honors all pause requests from the network port. All traffic is halted on that uplink port until the network port cancels the pause request.

Because you assign the flow control policy to the port, changes to the policy have an immediate effect on how the port reacts to a pause frame or a full receive buffer.

# Opt-In Features

Each Cisco UCS domain is licensed for all functionality. Depending upon how the system is configured, you can decide to opt in to some features or opt out of them for easier integration into existing environment. If a process change happens, you can change your system configuration and include one or both of the opt-in features.

The opt-in features are as follows:

- Stateless computing, which takes advantage of mobile service profiles with pools and policies where each component, such as a server or an adapter, is stateless.
- Multi-tenancy, which uses organizations and role-based access control to divide the system into smaller logical segments.

## Stateless Computing

Stateless computing allows you to use a service profile to apply the personality of one server to a different server in the same Cisco UCS domain. The personality of the server includes the elements that identify that server and make it unique in the Cisco UCS domain. If you change any of these elements, the server could lose its ability to access, use, or even achieve booted status.

The elements that make up a server's personality include the following:

- Firmware versions
- UUID (used for server identification)
- MAC address (used for LAN connectivity)
- World Wide Names (used for SAN connectivity)
- Boot settings

Stateless computing creates a dynamic server environment with highly flexible servers. Every physical server in a Cisco UCS domain remains anonymous until you associate a service profile with it, then the server gets the identity configured in the service profile. If you no longer need a business service on that server, you can shut it down, disassociate the service profile, and then associate another service profile to create a different identity for the same physical server. The "new" server can then host another business service.

To take full advantage of the flexibility of statelessness, the optional local disks on the servers should only be used for swap or temp space and not to store operating system or application data.

You can choose to fully implement stateless computing for all physical servers in a Cisco UCS domain, to not have any stateless servers, or to have a mix of the two types.

### If You Opt In to Stateless Computing

Each physical server in the Cisco UCS domain is defined through a service profile. Any server can be used to host one set of applications, then reassigned to another set of applications or business services, if required by the needs of the data center.

You create service profiles that point to policies and pools of resources that are defined in the Cisco UCS domain. The server pools, WWN pools, and MAC pools ensure that all unassigned resources are available on an as-needed basis. For example, if a physical server fails, you can immediately assign the service profile to another server. Because the service profile provides the new server with the same identity as the original server, including WWN and MAC address, the rest of the data center infrastructure sees it as the same server and you do not need to make any configuration changes in the LAN or SAN.

### If You Opt Out of Stateless Computing

Each server in the Cisco UCS domain is treated as a traditional rack mount server.

You create service profiles that inherit the identify information burned into the hardware and use these profiles to configure LAN or SAN connectivity for the server. However, if the server hardware fails, you cannot reassign the service profile to a new server.

## Multi-Tenancy

Multi-tenancy allows you to divide up the large physical infrastructure of an Cisco UCS domain into logical entities known as organizations. As a result, you can achieve a logical isolation between organizations without providing a dedicated physical infrastructure for each organization.

You can assign unique resources to each tenant through the related organization, in the multi-tenant environment. These resources can include different policies, pools, and quality of service definitions. You can also implement locales to assign or restrict user privileges and roles by organization, if you do not want all users to have access to all organizations.

If you set up a multi-tenant environment, all organizations are hierarchical. The top-level organization is always root. The policies and pools that you create in root are system-wide and are available to all organizations in the system. However, any policies and pools created in other organizations are only available to organizations that are above it in the same hierarchy. For example, if a system has organizations named Finance and HR that are not in the same hierarchy, Finance cannot use any policies in the HR organization, and HR cannot access any policies in the Finance organization. However, both Finance and HR can use policies and pools in the root organization.

If you create organizations in a multi-tenant environment, you can also set up one or more of the following for each organization or for a sub-organization in the same hierarchy:

- Resource pools
- Policies
- Service profiles
- Service profile templates

### If You Opt In to Multi-Tenancy

Each Cisco UCS domain is divided into several distinct organizations. The types of organizations you create in a multi-tenancy implementation depends upon the business needs of the company. Examples include organizations that represent the following:

- Enterprise groups or divisions within a company, such as marketing, finance, engineering, or human resources
- Different customers or name service domains, for service providers

You can create locales to ensure that users have access only to those organizations that they are authorized to administer.

### If You Opt Out of Multi-Tenancy

The Cisco UCS domain remains a single logical entity with everything in the root organization. All policies and resource pools can be assigned to any server in the Cisco UCS domain.

# Virtualization in Cisco UCS

## Overview of Virtualization

Virtualization allows the creation of multiple virtual machines (VMs) to run in isolation, side by side on the same physical machine.

Each virtual machine has its own set of virtual hardware (RAM, CPU, NIC) upon which an operating system and fully configured applications are loaded. The operating system sees a consistent, normalized set of hardware regardless of the actual physical hardware components.

In a virtual machine, both hardware and software are encapsulated in a single file for rapid copying, provisioning, and moving between physical servers. You can move a virtual machine, within seconds, from one physical server to another for zero-downtime maintenance and continuous workload consolidation.

The virtual hardware makes it possible for many servers, each running in an independent virtual machine, to run on a single physical server. The advantages of virtualization include better use of computing resources, greater server density, and seamless server migration.

## Overview of Cisco Virtual Machine Fabric Extender

A virtualized server implementation consists of one or more VMs running as 'guests' on a single physical server. The guest VMs are hosted and managed by a software layer called the hypervisor or virtual machine manager (VMM). The hypervisor typically presents a virtual network interface to each VM and performs Layer 2 switching of traffic from a VM to other local VMs or to a physical interface to the external network.

Working with a Cisco virtual interface card (VIC) adapter, Cisco Virtual Machine Fabric Extender (VM-FEX) bypasses software-based switching of VM traffic by the hypervisor in favor of external hardware-based switching in the fabric interconnect. This method results in a reduced load on the server CPU, faster switching, and the ability to apply a rich set of network management features to local and remote traffic.

VM-FEX extends the (prestandard) IEEE 802.1Qbh port extender architecture to the VMs, providing each VM interface with a virtual Peripheral Component Interconnect Express (PCIe) device and a virtual port on a switch. This solution allows precise rate limiting and quality of service (QoS) guarantees on the VM interface.

## Virtualization with Network Interface Cards and Converged Network Adapters

Network interface card (NIC) and converged network adapters support virtualized environments with the standard VMware integration with ESX installed on the server and all virtual machine management performed through the VC.

### Portability of Virtual Machines

If you implement service profiles you retain the ability to easily move a server identity from one server to another. After you image the new server, the ESX treats that server as if it were the original.

### Communication between Virtual Machines on the Same Server

These adapters implement the standard communications between virtual machines on the same server. If an ESX host includes multiple virtual machines, all communications must go through the virtual switch on the server.

If the system uses the native VMware drivers, the virtual switch is out of the network administrator's domain and is not subject to any network policies. As a result, for example, QoS policies on the network are not applied to any data packets traveling from VM1 to VM2 through the virtual switch.

If the system includes another virtual switch, such as the Nexus 1000, that virtual switch is subject to the network policies configured on that switch by the network administrator.

## Virtualization with a Virtual Interface Card Adapter

A Cisco VIC adapter, such as the Cisco UCS M81KR Virtual Interface Card, is a converged network adapter (CNA) designed for both single-OS and VM-based deployments. The VIC adapter supports static or dynamic virtualized interfaces, including up to 128 virtual network interface cards (vNICs).

VIC adapters support VM-FEX to provide hardware-based switching of traffic to and from virtual machine interfaces.