



# Set Up Cisco ISE in a Distributed Environment

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# Cisco ISE Distributed Deployment

A deployment that has more than one Cisco ISE node is called a distributed deployment. To support failover and to improve performance, you can set up your deployment with multiple Cisco ISE nodes in a distributed fashion. In Cisco ISE distributed deployment, administration and monitoring activities are centralized, and processing is distributed across the Policy Service nodes. Depending on your performance needs, you can scale your deployment. Each Cisco ISE node in a deployment can assume any of the following personas: Administration, Policy Service, and Monitoring.

## Cisco ISE Deployment Terminology

The following terms are commonly used when discussing Cisco ISE deployment scenarios:

- **Service**—A service is a specific feature that a persona provides such as network access, profiler, posture, security group access, monitoring and troubleshooting, and so on.
- **Node**—A node is an individual instance that runs the Cisco ISE software. Cisco ISE is available as an appliance and also as a software that can be run on VMware. Each instance, appliance or VMware that runs the Cisco ISE software is called a node.
- **Persona**—The persona or personas of a node determine the services provided by a node. A Cisco ISE node can assume any of the following personas: Administration, Policy Service, Monitoring, and pxGrid. The menu options that are available through the Admin portal are dependent on the role and personas that an Cisco ISE node assumes.
- **Deployment Model**—Determines if your deployment is distributed, standalone, or high availability in standalone, which is a basic two-node deployment.

## Personas in Distributed Cisco ISE Deployments

A Cisco ISE node can assume the Administration, Policy Service, or Monitoring personas.

A Cisco ISE node can provide various services based on the persona that it assumes. Each node in a deployment can assume the Administration, Policy Service, and Monitoring personas. In a distributed deployment, you can have the following combination of nodes on your network:

- Primary and secondary Administration nodes for high availability
- A single or a pair of non-administration nodes for health check of Administration nodes for automatic failover
- A pair of health check nodes or a single health check node for PAN automatic failover
- One or more Policy Service nodes for session failover

## Administration Node

A Cisco ISE node with the Administration persona allows you to perform all administrative operations on Cisco ISE. It handles all system-related configurations that are related to functionality such as authentication,

authorization, auditing, and so on. In a distributed environment, you can have a maximum of two nodes running the administration persona. The administration persona can take on any one of the following roles: Standalone, Primary, or Secondary.

## High Availability in Administration Nodes

In a high availability configuration, the Primary PAN is in the active state to which all configuration changes are made. The Secondary PAN is in the standby state, and will receive all configuration updates from the Primary PAN. Therefore, it will always have a complete copy of the configuration from the Primary PAN.

Cisco ISE supports automatic failover for the Administration persona. If the Primary PAN goes down, an automatic promotion of the Secondary PAN is initiated. For this, a non-administration secondary node is designated as the health check node for each of the administration nodes. The health check node checks the health of Primary PAN in the configured interval called the 'Polling Interval'. If the health check response received for the Primary PAN health is down or unreachable, the health check node initiates the promotion of the Secondary PAN to take over the primary role after waiting for configured threshold value of 'Count of failures before failover'.

To enable the auto-failover feature, at least two nodes in your distributed setup should assume the Administration persona and one node should assume the non-Administration persona.

The following table lists the features that are affected when the Primary PAN goes down and the Secondary PAN is yet to take over.

Features	Available When Primary PAN is Down (Yes/No)
Existing internal user RADIUS authentication	Yes
Existing or New AD user RADIUS authentication	Yes
Existing endpoint with no profile change	Yes
Existing endpoint with profile change	No
New endpoint learned through profiling	No
Existing guest – LWA	Yes
Existing guest – CWA	Yes (apart from flows enabled for device registration, such as Hotspot, BYOD, and CWA with automatic device registration)
Guest change password	No
Guest – AUP	No
Guest – Max Failed Login Enforcement	No
New Guest (Sponsored or Self-registered)	No
Posture	Yes

Features	Available When Primary PAN is Down (Yes/No)
BYOD with Internal CA	No
Existing Registered Devices	Yes
MDM On-boarding	No
pxGrid Service	No

For certificate provisioning with the internal certificate authority, you have to import the root certificate of the original Primary PAN and its key in to the new primary node, after promotion. Certificate provisioning will not work post auto-failover from PSN nodes that are newly added, that is, added after the promotion of the secondary node to Primary PAN.

## High-Availability Health Check Nodes

Health check node for Primary PAN is called active health check node whereas health check node for Secondary PAN is called passive health check node. Active health check node is responsible for checking status of Primary PAN and managing the automatic failover of Administration nodes. It is recommended to have two non-administration ISE nodes designated as the health check nodes, one each for the Primary and Secondary PANs. You can also designate a single non-administration ISE node as the health check node for both the Primary PAN and the Secondary PAN. In case a single health check node is checking the health of both the Primary PAN and the Secondary PAN, it assumes both the active and passive roles.

A health check node is a non-administration node and can be a Policy Service, Monitoring, or pxGrid node, or a combination of these. It is recommended that PSN nodes that are in the same data center as the Administration nodes, are designated as high-availability health check nodes. However, in a small or a centralized deployment where the two Administration nodes are in the same location (LAN or data center), any node (PSN/pxGrid/MnT) not having the Administration persona can be used as high-availability health check node.

### Health Probe by Health Check Nodes

The health check node for the Primary PAN reaches out for its health status, for the configured polling intervals. If the health status of the Primary PAN is down or unreachable for the configured 'Number of failure polls before failover' value, the primary health check node notifies the Secondary PAN to take over as the Primary PAN of the deployment.

The health check node for automatic failover is the single point of failure. If the health check node for the Primary PAN itself goes down, high-availability failover will not happen.

### Startup of Health Check Node

The health check node for the Secondary PAN is a passive monitor. It does not take any action until the Secondary PAN has been promoted as the Primary PAN. When the Secondary PAN takes over the primary role, its associated health check node takes the active role for managing automatic failover of Administration nodes. The health check node of the previous Primary PAN becomes the health check node for the Secondary PAN now and would monitor it passively.

## Shutdown of Health Check Node

When a node is removed from the health check role or auto-failover configuration is disabled, the health check service is stopped on that node. When the auto-failover configuration is enabled on the designated high-availability health check node, the node starts checking health of Administration nodes again. Designating or removing the high-availability health check role on a node does not involve any application restart on that node; only the health check activities are started or stopped.

## Restart of Health Check Node

If the high-availability health check node is restarted, it ignores the previous downtimes of Primary PAN and starts checking the health status afresh.

## Health Check of the Primary Policy Administration Node

The active health check node checks the health status of the Primary PAN at a configured polling interval. It sends a request to the Primary PAN, and if the response that it receives satisfies the specified configuration, then the health check node considers the Primary PAN to be in good health. Otherwise, the health check node considers the Primary PAN to be in bad health. If the health of the Primary PAN is bad continuously for more than the configured 'Number of Failure Polls before Failover' value, health check node initiates failover to the Secondary PAN.

If at any time during the health check, health status is found to be good after being reported as bad previously within the 'Number of Failure Polls before Failover' value, health check node marks the Primary PAN status as good and resets the health check cycle.

Response from health check of the Primary PAN is validated against the configuration values available on its health check node. If the response does not match it would raise an alarm. However, a promotion request will be made to the Secondary PAN.

For example, assume that the health check node (N1) goes out-of-sync and some other node (N2) is made the health check node of the Primary PAN. In such a case, once the Primary PAN goes down, there is no way for N1 to know that there is another node (N2) checking the same Primary PAN. Later, if N2 too goes down or out of network, an actual failover would be required. The Secondary PAN, however, retains the right to reject the promotion request. So, once the Secondary PAN has been promoted to the primary role, further promotion request (from the node checking node N2) would be rejected with an error. Even if the high-availability health check node for Primary PAN is out of sync, it continues to check the health of Primary PAN. If the health check response is valid for failover (that is, response says that the correct Primary PAN is checked by the correct health check node and health check node has the correct Secondary PAN information), it would also attempt to failover to the Secondary PAN when the Primary PAN meets the failover criteria.

## Automatic Failover of the Secondary Policy Administration Node

When the Secondary PAN receives the failover call, it carries out the following validations before proceeding with the actual failover:

- Whether the Primary PAN is available in network.
- Whether failover request came from a valid health check node.
- Whether failover request was received by a wrong node.

If all the validations pass, the Secondary PAN promotes itself to the primary role.

The following are some sample (but not limited to) scenarios where automatic failover of the Secondary PAN would be attempted.

- Health of Primary PAN is consistently not good for the 'Number of failure polls before failover' value during the polling period.
- Cisco ISE services on the Primary PAN is manually stopped and remains so for the configured 'Number of Failure Polls before Failover' value.
- Primary PAN is shut down using soft halt or reboot option and remains shut for the configured 'Number of Failure Polls before Failover' value.
- Primary PAN goes down abruptly (power down) and remains down for the configured 'Number of Failure Polls before Failover' value.
- Network interface of Primary PAN is down (network port shut or network service down) or it is not reachable by the health check node for any other reason and remains so for the configured 'Number of Failure Polls before Failover' value.

## Sample Scenarios when Automatic Failover is Avoided

The following are some sample scenarios that depict cases where automatic failover by the health check node would be avoided or promotion request to the secondary node would be rejected.

- Node receiving the promotion request is not the secondary node.
- Promotion request does not have the correct Primary PAN information.
- Promotion request is received from an incorrect health check node.
- Promotion request is received but the Primary PAN is up and in good health.
- Node receiving the promotion request goes out-of-sync.

### Fallback to the Original Primary PAN



Cisco ISE does not support fallback to original Primary PAN. This means that after the automatic failover to the Secondary PAN is initiated, if the original Primary PAN is brought back into the network, the original primary node would continue to have the secondary role and would not be promoted back to the primary role.

## Manual Promotion of the Secondary PAN

Cisco ISE supports both automatic and manual promotion of Secondary PAN to the primary role. When auto-failover is enabled, you can still perform manual promotion of the Secondary PAN. Promotion of the Secondary PAN to primary role is fairly independent and is not affected whether the promotion is performed manually or automatically.

## Functionalities Affected by the PAN Auto-Failover Feature

The following table lists the functionalities that are blocked or require additional configuration changes if PAN auto-failover configuration is enabled in your deployment.

Functionality	Affect Details
<b>Operations that are Blocked</b>	
Upgrade	<p><b>Upgrade via the CLI is blocked.</b></p> <p>The PAN auto-failover feature will be available for configuration after you upgrade from a previous version of Cisco ISE to release 1.4. By default, this feature is disabled. You must have at least two Administrative nodes and one non-Administrative node in your deployment to enable PAN auto-failover.</p>
Restore of Backup	<p><b>Restore via the CLI and user interface will be blocked.</b></p> <p>If PAN auto-failover configuration was enabled prior to restore, you must reconfigure it after a successful restore.</p>
Change Node Persona	<p>Change of the following node personas via the user interface will be blocked:</p> <ul style="list-style-type: none"> <li>• Admin persona in both the Administration nodes.</li> <li>• Persona of the PAN.</li> <li>• Deregistration of health check node after enabling the PAN auto-failover feature.</li> </ul>
Other CLI Operations	<p>The following admin operations via the CLI will be blocked:</p> <ul style="list-style-type: none"> <li>• Patch Installation and Roll back</li> <li>• DNS Server change</li> <li>• IP address change of eth1, eth2, and eth3 interfaces</li> <li>• Host alias change of eth1, eth2, and eth3 interfaces</li> <li>• Timezone change</li> </ul>

Functionality	Affect Details
Other Administration Portal Operations	<p>The following admin operations via the user interface will be blocked:</p> <ul style="list-style-type: none"> <li>• Patch Installation and Roll back</li> <li>• Change HTTPS certificate.</li> <li>• Change admin authentication type from password-based authentication to certificate-based authentication and viceversa.</li> </ul>
<b>Operations that Require PAN Auto-Failover to be Disabled</b>	
CLI Operations	<p>The following admin operations via the CLI will display a warning message if PAN auto-failover configuration is enabled. These operations may trigger auto-failover if service/system is not restarted within failover window. Hence, while performing the below operations it is recommended to disable PAN auto-failover configuration:</p> <ul style="list-style-type: none"> <li>• Manual ISE service stop</li> <li>• Soft reload (reboot) using admin CLI</li> </ul>

## Policy Service Node

A Cisco ISE node with the Policy Service persona provides network access, posture, guest access, client provisioning, and profiling services. This persona evaluates the policies and makes all the decisions. You can have more than one node assume this persona. Typically, there would be more than one Policy Service node in a distributed deployment. All Policy Service nodes that reside in the same high-speed Local Area Network (LAN) or behind a load balancer can be grouped together to form a node group. If one of the nodes in a node group fails, the other nodes detect the failure and reset any URL-redirectioned sessions.

At least one node in your distributed setup should assume the Policy Service persona.

## High Availability in Policy Service Nodes

To detect node failure and to reset all URL-redirectioned sessions on the failed node, two or more Policy Service nodes can be placed in the same node group. When a node that belongs to a node group fails, another node in the same node group issues a Change of Authorization (CoA) for all URL-redirectioned sessions on the failed node.

All the nodes within the same node group should be configured on the network access device (NAD) as RADIUS clients and authorized for CoA, because any one of them can issue a CoA request for the sessions that are established through any node in the node group. If you are not using a load balancer, the nodes in a



node group should be the same as, or a subset of, the RADIUS servers and clients configured on the NAD. These nodes would also be configured as RADIUS servers.

While a single NAD can be configured with many ISE nodes as RADIUS servers and dynamic-authorization clients, it is not necessary for all the nodes to be in the same node group.

The members of a node group should be connected to each other using high-speed LAN connection such as Gigabit Ethernet. The node group members need not be L2 adjacent, but L2 adjacency is highly recommended to ensure sufficient bandwidth and reachability. See [Create a Policy Service Node Group](#), on page 20 section for more details.

## Load Balancer To Distribute Requests Evenly Among PSNs

When you have multiple Policy Service nodes in the deployment, you can use a load balancer to distribute the requests evenly. The load balancer distributes the requests to the functional nodes behind it. Refer to the [Cisco and F5 Deployment Guide: ISE Load Balancing using BIG-IP](#) for information on and best practices about deploying PSNs behind a load balancer.

## Session Failover in Policy Service Nodes



When a Policy Service node that has active URL-redirectioned sessions fails, the endpoints are stuck in an intermediate state. Even if the redirect endpoint detects that the Policy Service node that it has been communicating with has failed, it cannot re-initiate authorization.

If the Policy Service nodes are part of a node group, the nodes within a node group exchange heartbeat messages to detect node failures. If a node fails, one of its peers from the node group learns about the active URL-redirectioned sessions on the failed node and issues a CoA to disconnect those sessions.

As a result, the sessions are handled by another Policy Service node that is available in the same node group. The session failover does not automatically move the sessions over from a Policy Service node that has gone down to one that is available, but issues a CoA to achieve that.

The Policy Service nodes in a distributed deployment do not share their Machine Access Restriction (MAR) cache with each other. If you have enabled the MAR feature in Cisco ISE and the client machine is authenticated by a Policy Service node that fails, then another Policy Service node in the deployment handles the user authentication. However, the user authentication fails because the second Policy Service node does not have the host authentication information in its MAR cache.

## Number of Nodes in a Policy Service Node Group

The number of nodes that you can have in a node group depends on your deployment requirements. Node groups ensure that node failures are detected and that a peer issues a CoA for sessions that are authorized, but not yet postured. The size of the node group does not have to be very large.

If the size of the node group increases, the number of messages and heartbeats that are exchanged between nodes increases significantly. As a result, traffic also increases. Having fewer nodes in a node group helps reduce the traffic and at the same time provides sufficient redundancy to detect Policy Service node failures.

There is no hard limit on the number of Policy Service nodes that you can have in a node group cluster.

# Monitoring Node

A Cisco ISE node with the Monitoring persona functions as the log collector and stores log messages from all the administration and Policy Service nodes in your network. This persona provides advanced monitoring and troubleshooting tools that you can use to effectively manage your network and resources. A node with this persona aggregates and correlates the data that it collects to provide you with meaningful information in the form of reports.

Cisco ISE allows you to have a maximum of two nodes with this persona that can take on primary or secondary roles for high availability. Both the primary and secondary Monitoring nodes collect log messages. In case the primary Monitoring node goes down, the secondary Monitoring node automatically becomes the primary Monitoring node.

At least one node in your distributed setup should assume the Monitoring persona. We recommend that you not have the Monitoring and Policy Service personas enabled on the same Cisco ISE node. We recommend that the node be dedicated solely to monitoring for optimum performance.

You can access the Monitoring menu from the PAN in your deployment.

## Automatic Failover in Monitoring Nodes

The term automatic failover is used because high availability is not supported on Monitoring nodes in the true sense. For Monitoring nodes, operation audit data is duplicated by the Policy Service node(s), which then sends copies to both the primary and secondary Monitoring nodes.



### Note

Monitoring is served from the primary (active) Monitoring node. Monitoring data is only served from the secondary (standby) Monitoring node when the active node is down. The secondary monitoring node is read-only.

### Automatic Failover Process

When a primary Monitoring node goes down, the secondary Monitoring node takes over all monitoring and troubleshooting information. The secondary node provides read-only capabilities.

To convert the existing secondary node to an active primary node, the administrator must first manually promote the secondary node to a primary role. If the primary node comes back up after the secondary node has been promoted, it assumes the secondary role. If the secondary node was not promoted, the primary Monitoring node will resume its role after it comes back up.



### Caution

When the primary node comes back up after a failover, obtain a backup and restore the data to update the primary node.

### Guidelines for Setting Up an Active-Standby Pair of Monitoring Nodes

You can specify two Monitoring nodes on an ISE network and create an active-standby pair. When you register a secondary Monitoring node, we recommend that you back up the primary Monitoring node and then restore the data to the new secondary Monitoring node. This ensures that the history of the primary Monitoring node

is in sync with the new secondary node as new changes are replicated. Once the active-standby pair is defined, the following rules apply:

- All changes must be made on the primary Monitoring node. The secondary node is read-only.
- Changes made to the primary node are automatically replicated on the secondary node.
- Both the primary and secondary nodes are listed as log collectors to which all other nodes send logs.
- The Cisco ISE dashboard is the main entry point for monitoring and troubleshooting. Monitoring information is displayed on the dashboard from the PAN. If the primary node goes down, the information is served from the secondary node.
- Backing up and purging monitoring data is not part of a standard Cisco ISE node backup process. You must configure repositories for backup and data purging on both the primary and secondary Monitoring nodes, and use the same repositories for each.

### Monitoring Node Failover Scenarios

The following scenarios apply to the active-standby or single node configurations corresponding to the monitoring nodes:

- In an active-standby configuration of the monitoring nodes, the Primary Administration Node (PAN) always points to the active monitoring node to collect the monitoring data. After the active monitoring node fails, the PAN points to the standby monitoring node. The failover from the active monitoring node to the standby monitoring node happens after it is down for more than 5 minutes.  
However, after the active node fails, the standby node does not become the active node. In case the active node comes up, the Administration node starts collecting the monitoring data again from the resumed active node.
- During the time that the active monitoring node is down, if you want to promote the standby monitoring node to active status, you must de-register the existing active monitoring node. When you de-register the existing active monitoring node, the standby node becomes the active monitoring node and the PAN automatically starts pointing to the newly promoted active node.
- In an active-standby pair, if you choose to de-register the standby monitoring node from the deployment or if the standby monitoring node goes down, the existing active monitoring node still retains the active node status. The PAN points to the existing active node for data collection.
- If there is only one monitoring node in the ISE deployment, then that node acts as the active monitoring node that provides monitoring data to the PAN. However, when you register a new monitoring node and make it the active node in the deployment, the existing active monitoring node automatically becomes the standby node. The PAN begins to point to the newly registered active monitoring node for collecting monitoring data.

## pxGrid Node

You can use Cisco pxGrid to share the context-sensitive information from Cisco ISE session directory with other network systems such as ISE Eco system partner systems and other Cisco platforms. The pxGrid framework can also be used to exchange policy and configuration data between nodes like sharing tags and policy objects between Cisco ISE and third party vendors, and for other information exchanges. pxGrid also allows 3rd party systems to invoke adaptive network control actions (EPS) to quarantine users/devices in response to a network or security event. The TrustSec information like tag definition, value, and description

can be passed from Cisco ISE via TrustSec topic to other networks. The endpoint profiles with Fully Qualified Names (FQNs) can be passed from Cisco ISE to other networks through an endpoint profile meta topic. Cisco pxGrid also supports bulk download of tags and endpoint profiles.

You can publish and subscribe to SXP bindings (IP-SGT mappings) through pxGrid. For more information about SXP bindings, see [Source Group Tag Exchange Protocol](#).

In a high-availability configuration, Cisco pxGrid servers replicate information between the nodes through the PAN. When the PAN goes down, pxGrid server stops handling the client registration and subscription. You need to manually promote the PAN for the pxGrid server to become active.

## pxGrid Client and Capability Management

Clients connected to Cisco ISE need to register to use the pxGrid services. pxGrid clients should adopt the pxGrid Client Library available from Cisco through the pxGrid SDK to become the clients. Cisco pxGrid clients need an approved account to participate in pxGrid services. Cisco ISE supports both auto and manual approvals. A client can log in to pxGrid using a unique name and certificate-based mutual authentication. Similar to the AAA setting on a switch, clients can connect to either a configured pxGrid server host-name or an IP Address.

Capabilities are information topics or channels created on pxGrid for clients to publish and subscribe. In Cisco ISE, only capabilities such as Identity, adaptive network control, and SGA are supported. When a client creates a new capability, it appears in **Administration > pxGrid Services > View by Capabilities**. You can enable or disable capabilities individually. Capability information is available from the publisher through publish, directed query, or bulk download query.



### Note

Users that are assigned to EPS user group can perform actions in Session group, because pxGrid Session group is part of EPS group. If a user is assigned to EPS group, the user will be able to subscribe to Session group on pxGrid client.

## Enable pxGrid Clients

### Before You Begin

- Enable the pxGrid persona on at least one node to view the requests from the Cisco pxGrid clients.
- Enable Passive Identity Services. For more information, see [Easy Connect](#).

- 
- Step 1** Choose **Administration > pxGrid Services**.
- Step 2** Check the checkbox next to the client and click **Approve**.
- Step 3** Click **Refresh** to view the latest status.
-

## Enable pxGrid Capabilities

### Before You Begin

- Enable the pxGrid persona on at least one node to view the requests from the Cisco pxGrid clients.
- Enable a pxGrid client.

- 
- Step 1** Choose **Administration > pxGrid Services**.
- Step 2** Click **View by Capabilities** at the top-right.
- Step 3** Select the capability you want to enable and click **Enable**.
- Step 4** Click **Refresh** to view the latest status.
- 

## Cisco pxGrid Live Logs

The Live Logs page displays all the pxGrid management events. Event info includes the client and capability names along with the event type and timestamp.

Navigate to **Administration > pxGrid Services > Live Log** to view the list of events. You can also clear the logs and resynchronize or refresh the list.

## Configure pxGrid Settings

### Before You Begin

To perform the following task, you must be a Super Admin or System Admin.

- 
- Step 1** Choose **Administration > pxGrid Services > Settings**.
- Step 2** Select the following options based on your requirements:
- **Automatically Approve New Accounts**—Check this check box to automatically approve the connection requests from new pxGrid clients.
  - **Allow Password Based Account Creation**—Check this check box to enable username/password based authentication for pxGrid clients. If this option is enabled, the pxGrid clients cannot be automatically approved.
- A pxGrid client can register itself with the pxGrid controller by sending the username via REST API. The pxGrid controller generates a password for the pxGrid client during client registration. The administrator can approve or deny the connection request.
- Step 3** Click **Save**.
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You can use the **Test** option on the pxGrid Settings page to run a health check on the pxGrid node. You can view the details in the pxgrid/pxgrid-test.log file.

## Cisco ISE Distributed Deployment

A deployment that has more than one Cisco ISE node is called a distributed deployment. To support failover and to improve performance, you can set up your deployment with multiple Cisco ISE nodes in a distributed fashion. In Cisco ISE distributed deployment, **administration and monitoring activities are centralized, and processing is distributed across the Policy Service nodes.** Depending on your performance needs, you can scale your deployment. Each Cisco ISE node in a deployment can assume any of the following personas: Administration, Policy Service, and Monitoring.

## Cisco ISE Deployment Setup

After you install Cisco ISE on all your nodes, as described in the *Cisco Identity Services Engine Hardware Installation Guide*, the nodes come up in a standalone state. You must then define one node as your Primary Administration Node (PAN). While defining your PAN, you must enable the Administration and Monitoring personas on that node. You can optionally enable the Policy Service persona on the PAN. After you complete the task of defining personas on the PAN, you can then register other secondary nodes to the PAN and define personas for the secondary nodes.

All Cisco ISE system and functionality-related configurations should be done only on the PAN. **The configuration changes that you perform on the PAN are replicated to all the secondary nodes in your deployment.**

There must be at least one Monitoring node in a distributed deployment. At the time of configuring your PAN, you must enable the Monitoring persona. After you register a Monitoring node in your deployment, you can edit the PAN and disable the Monitoring persona, if required.

## Data Replication from Primary to Secondary ISE Nodes

**When you register an Cisco ISE node as a secondary node, Cisco ISE immediately creates a data replication channel from the primary to the secondary node and begins the process of replication. Replication is the process of sharing Cisco ISE configuration data from the primary to the secondary nodes. Replication ensures consistency among the configuration data present in all Cisco ISE nodes that are part of your deployment.**

**A full replication typically occurs when you first register an ISE node as a secondary node. Incremental replication occurs after a full replication and ensures that any new changes such as additions, modifications, or deletions to the configuration data in the PAN are reflected in the secondary nodes. The process of replication ensures that all Cisco ISE nodes in a deployment are in sync. You can view the status of replication in the Node Status column from the deployment pages of the Cisco ISE Admin portal. When you register a Cisco ISE node as a secondary node or perform a manual synchronization with the PAN, the node status shows an orange icon indicating that the requested action is in progress. Once it is complete, the node status turns green indicating that the secondary node is synchronized with the PAN.**

## Cisco ISE Node Deregistration

To remove a node from a deployment, you must deregister it. When you deregister a secondary node from the Primary PAN, the status of the deregistered node changes to standalone and the connection between the primary and the secondary node will be lost. Replication updates are no longer sent to the deregistered standalone node.

When a PSN is deregistered, the endpoint data is lost. If you want the PSN to retain the endpoint data after it becomes a standalone node, you can do one of the following:

- Obtain a backup from the Primary PAN and when the PSN becomes a standalone node, restore this data backup on it.
- Change the persona of the PSN to Administration (Secondary PAN), synchronize the data from the deployment page of the Admin portal, and then deregister the node. This node will now have all the data. You can then add a secondary Admin node to the existing deployment.

**Note**

You cannot deregister a Primary PAN.

## Automatic Restart of the Cisco ISE Application Server

The application server in an Cisco ISE node restarts which causes a delay when you make any of the following changes:

- Register a node (Standalone to Secondary)
- Deregister a node (Secondary to Standalone)
- Change a primary node to Standalone (if no other nodes are registered with it; Primary to Standalone)
- Promote an Administration node (Secondary to Primary)
- Change the personas (when you assign or remove the Policy Service or Monitoring persona from a node)
- Modify the services in the Policy Service node (enable or disable the session and profiler services)
- Restore a backup on the primary and a sync up operation is triggered to replicate data from primary to secondary nodes

## Guidelines for Setting Up a Distributed Deployment

Read the following statements carefully before you set up Cisco ISE in a distributed environment.

- Choose a node type, ISE node. For Administration, Policy Service, and Monitoring capabilities, you must choose an ISE node.
- Choose the same Network Time Protocol (NTP) server for all the nodes. To avoid timezone issues among the nodes, you must provide the same NTP server name during the setup of each node. This setting ensures that the reports and logs from the various nodes in your deployment are always synchronized with timestamps.

- Configure the Cisco ISE Admin password when you install Cisco ISE. The previous Cisco ISE Admin default login credentials (admin/cisco) are no longer valid. Use the username and password that was created during the initial setup or the current password if it was changed later.
- Configure the Domain Name System (DNS) server. Enter the IP addresses and fully qualified domain names (FQDNs) of all the Cisco ISE nodes that are part of your distributed deployment in the DNS server. Otherwise, node registration will fail.
- Configure the forward and reverse DNS lookup for all Cisco ISE nodes in your distributed deployment in the DNS server. Otherwise, you may run into deployment related issues when registering and restarting Cisco ISE nodes. Performance might be degraded if reverse DNS lookup is not configured for all the nodes.
- (Optional) Deregister a secondary Cisco ISE node from the Primary PAN to uninstall Cisco ISE from it.
- Back up the primary Monitoring node, and restore the data to the new secondary Monitoring node. This ensures that the history of the primary Monitoring node is in sync with the new secondary node as new changes are replicated.
- Ensure that the Primary PAN and the standalone node that you are about to register as a secondary node are running the same version of Cisco ISE.

## Menu Options Available on Primary and Secondary Nodes

Cisco ISE nodes provide you an Admin portal that you can use to perform your tasks. The menu options available in Cisco ISE nodes that are part of a distributed deployment depend on the personas that are enabled on them. You must perform all administration and monitoring activities through the Primary PAN. For some tasks, you must use the secondary nodes. Therefore, the user interface of the secondary nodes provides limited menu options based on the personas that are enabled on them.

If a node assumes more than one persona, for example, the Policy Service persona, and a Monitoring persona with an Active role, then the menu options listed for Policy Service nodes and Active Monitoring node will be available on that node.

The following table lists the menu options that are available on Cisco ISE nodes that assume different personas.

**Table 1: Cisco ISE Nodes and Available Menu Options**

Cisco ISE Node	Available Menu Options
All Nodes	<ul style="list-style-type: none"> <li>• View and configure system time and NTP server settings.</li> <li>• Install server certificate, manage certificate signing request. You can perform server certificate operations, for all the nodes in the deployment, via the Primary PAN that centrally manages all server certificates.</li> </ul> <p><b>Note</b> The private keys are not stored in the local database and are not copied from the relevant node; the private keys are stored in the local file system.</p>



Cisco ISE Node	Available Menu Options
Primary PAN	All menus and submenus.
Active Monitoring Node	<ul style="list-style-type: none"> <li>• Home and operations menus.</li> <li>• Provides redundant access to monitoring data that can be accessed from both the Primary and the Active Monitoring nodes.</li> </ul>
Policy Service Nodes	Option to join, leave, and test Active Directory connection. Each Policy Service node must be separately joined to the Active Directory domain. You must first define the domain information and join the PAN to the Active Directory domain. Then, join the other Policy Service nodes to the Active Directory domain individually.
Secondary PAN	<p>Option to promote the Secondary PAN to become the Primary PAN.</p> <p><b>Note</b> After you have registered the secondary nodes to the Primary PAN, while logging in to the Admin portal of any of the secondary nodes, you must use the login credentials of the Primary PAN.</p>

## Configure a Cisco ISE Node

After you install a Cisco ISE node, all the default services provided by the Administration, Policy Service, and Monitoring personas run on it. This node will be in a standalone state. You must log in to the Admin portal of the Cisco ISE node to configure it. You cannot edit the personas or services of a standalone Cisco ISE node. You can, however, edit the personas and services of the primary and secondary Cisco ISE nodes. You must first configure a primary ISE node and then register secondary ISE nodes to the primary ISE node.

If you are logging in to the node for the first time, you must change the default administrator password and install a valid license.

It is recommended not to change the host name and the domain name on Cisco ISE that have been configured or in production. If it is required, then reimagine the appliance, make changes, and configure the details during the initial deployment.

### Before You Begin

You should have a basic understanding of how distributed deployments are set up in Cisco ISE. Read the guidelines for setting up a distributed deployment.

- 
- Step 1** Choose **Administration** > **System** > **Deployment**.
  - Step 2** Check the check box next to the Cisco ISE node that you want to configure, and click **Edit**.
  - Step 3** Enter the values as required and click **Save**.
- 

## Configure a Primary PAN

To set up a distributed deployment, you must first configure a Cisco ISE node as your Primary PAN.

- 
- Step 1** Choose **Administration** > **System** > **Deployment**.  
The Register button will be disabled initially. To enable this button, you must configure a Primary PAN.
  - Step 2** Check the check box next to the current node, and click **Edit**.
  - Step 3** Click **Make Primary** to configure your Primary PAN.
  - Step 4** Enter data on the **General Settings** tab.
  - Step 5** Click **Save** to save the node configuration.
- 

### What to Do Next

- 1 Add secondary nodes to your deployment.
- 2 Enable the profiler service and configure the probes, if required.

## Register a Secondary Cisco ISE Node

After you register the secondary node, the configuration of the secondary node is added to the database of the primary node and the application server on the secondary node is restarted. After the restart is complete, the secondary node will be running the personas and services that you have enabled on it. You can view all the configuration changes that you make from the Deployment page of the Primary PAN. However, expect a delay of 5 minutes for your changes to take effect and appear on the Deployment page.

### Before You Begin

Ensure that the primary node's trusted certificate store has the appropriate certificate authority (CA) certificates to validate the HTTPS certificate of the secondary node that you are going to register. When you import the secondary node's certificate in to the trusted certificate store, check the **Trust for authentication within ISE** check box for the Primary PAN to validate the secondary node's certificate.

After you register the secondary node to the primary node, if you change the HTTPS certificate on the secondary node, you must import the appropriate CA certificates into the trusted certificate store of the primary node.

The certificates that you import into the trusted certificate store of the Primary PAN are replicated to the secondary nodes.

If you plan to deploy two Administration nodes for high availability, register the Secondary PAN before you register the other secondary nodes. If you register the nodes in this sequence, you do not have to restart the secondary ISE nodes after you promote the Secondary PAN as your primary.

If you plan to deploy multiple Policy Service nodes running Session services with mutual failover among these nodes, place the Policy Service nodes in a node group. You must create the node group before you register the nodes.

---

**Step 1** Log in to the Primary PAN.

**Step 2** Choose **Administration > System > Deployment**.

**Step 3** Choose **Register > Register an ISE Node** to register a secondary node.

**Step 4** Enter the DNS-resolvable hostname of the secondary node.

If you are using the hostname while registering the Cisco ISE node, the fully qualified domain name (FQDN) of the standalone node that you are going to register, for example, *abc.xyz.com*, must be DNS-resolvable from the Primary PAN. Otherwise, node registration fails. You must have previously defined the IP address and the FQDN of the secondary node in the DNS server.

**Step 5** Enter a UI-based administrator credential for the secondary node in the Username and Password fields.

**Step 6** Click **Next**.

Cisco ISE contacts the secondary node, obtains some basic information such as the hostname, default gateway, and so on, and displays it.

If you have chosen to register a secondary node, you can edit the configuration of the secondary node.

**Step 7** Click **Save**.

---

After a secondary node is registered successfully, you will receive an alarm on your Primary PAN that confirms a successful node registration. If the secondary node fails to register with the Primary PAN, the alarm is not generated. When a node is registered, the application server on that node is restarted. After successful registration and database synchronization, enter the credentials of the Primary PAN to log in to the user interface of the secondary node.

**Note**

In addition to the existing Primary node in the deployment, when you successfully register a new node, no alarm corresponding to the newly registered node is displayed. The Configuration Changed alarms reflect information corresponding to the newly registered nodes. You can use this information to ascertain the successful registration of the new node.

---

**What to Do Next**

- For time-sensitive tasks such as guest user access and authorization, logging, and so on, ensure that the system time on your nodes is synchronized.

- If you registered a Secondary PAN, and will be using the internal Cisco ISE CA service, you must back up the Cisco ISE CA certificates and keys from the Primary PAN and restore them on the Secondary PAN.

## View Nodes in a Deployment

In the Deployment Nodes page, you can view all the Cisco ISE nodes, primary and secondary, that are part of your deployment.

- 
- Step 1** Log in to the primary Cisco ISE Admin portal.
- Step 2** Choose **Administration** > **System** > **Deployment**.
- Step 3** Click **Deployment** from the navigation pane on the left.  
All the Cisco ISE nodes that are part of your deployment are listed.
- 

## Synchronize Primary and Secondary Cisco ISE Nodes

You can make configuration changes to Cisco ISE only through the Primary PAN. The configuration changes get replicated to all the secondary nodes. If, for some reason, this replication does not occur properly, you can manually synchronize the Secondary PAN with the Primary PAN.

### Before You Begin

You must click the Syncup button to force a full replication if the Sync Status is set to Out of Sync or if the Replication Status is Failed or Disabled.

- 
- Step 1** Log in to the Primary PAN.
- Step 2** Choose **Administration** > **System** > **Deployment**.
- Step 3** Check the check box next to the node that you want to synchronize with the Primary PAN, and click **Syncup** to force a full database replication.
- 

## Create a Policy Service Node Group

When two or more Policy Service nodes (PSNs) are connected to the same high-speed Local Area Network (LAN), we recommend that you place them in the same node group. This design optimizes the replication of endpoint profiling data by retaining less significant attributes local to the group and reducing the information that is replicated to the remote nodes in the network. Node group members also check on the availability of peer group members. If the group detects that a member has failed, it attempts to reset and recover all URL-redirectioned sessions on the failed node.

**Note**

We recommend that you make all PSNs in the same local network part of the same node group. PSNs need not be part of a load-balanced cluster to join the same node group. However, each local PSN in a load-balanced cluster should typically be part of the same node group.

Before you can add PSNs as members to a node group, you must create the node group first. You can create, edit, and delete Policy Service node groups from the Deployment pages of the Admin portal.

**Before You Begin**

Node group members can communicate over TCP/7800 and TCP/7802.

- 
- Step 1** Choose **Administration > System > Deployment**.
- Step 2** Click the **action** icon, and then click **Create Node Group**.
- Step 3** Enter a unique name for your node group.
- Step 4** (Optional) Enter a description for your node group.
- Step 5** Click **Submit** to save the node group.
- 

After you save the node group, it should appear in the navigation pane on the left. If you do not see the node group in the left pane, it may be hidden. Click the Expand button on the navigation pane to view the hidden objects.

**What to Do Next**

Add a node to a node group. Edit the node by choosing the node group from the Member of Node Group drop-down list.

## Deploy pxGrid Node

You can enable Cisco pxGrid persona both on a standalone node and distributed deployment node.

**Before You Begin**

- You need a Plus license to enable the Cisco pxGrid persona.
- Cisco pxGrid services running on a Cisco ISE SNS 3415/3495 Appliance or in VMWare.
- All nodes are configured to use the CA certificate for pxGrid usage. If default certificate is used for pxGrid before upgrade, it will be replaced by the internal CA certificate after upgrade.
- If you are using a distributed deployment or upgrading from Cisco ISE 1.2, then you need to enable the pxGrid Usage option for the certificates. To enable the pxGrid Usage option, go to **Administration > Certificates > System Certificates**. Choose the certificate being used in the deployment and click **Edit**. Check the pxGrid: use certificate for the pxGrid Controller checkbox.
- If you have enabled FIPS mode in Cisco ISE 1.2, after upgrading to 1.4, pxGrid option will be disabled while you are generating or editing the certificates (including the self-signed and CA signed certificates). pxGrid option cannot be enabled on FIPS-enabled Cisco ISE appliance, as the XCP server that is used

to integrate pxGrid with Cisco ISE is not FIPS compliant. If FIPS mode was not enabled in Cisco ISE 1.2, after upgrading to 1.4, pxGrid option will be enabled for the certificates.

- 
- Step 1** Choose **Administration > System > Deployment**.
- Step 2** In the Deployment Nodes page, check the check box next to the node to which you want to enable the pxGrid services, and click **Edit**.
- Step 3** Click the **General Settings** tab and check the pxGrid checkbox.
- Step 4** Click **Save**.  
When you upgrade from the previous version, the Save option might be disabled. This happens when the browser cache refers to the old files from the previous version of Cisco ISE. Clear the browser cache to enable the Save option.
- 

## Change Node Personas and Services

You can edit the Cisco ISE node configuration to change the personas and services that run on the node.

### Before You Begin

- When you enable or disable any of the services that run on a Policy Service node or make any changes to a Policy Service node, you will be restarting the application server processes on which these services run. Expect a delay while these services restart.
- Due to this delay in restart of services, auto-failover if enabled in your deployment, might get initiated. To avoid this, make sure that the auto-failover configuration is turned off.

- 
- Step 1** Log in to the Primary PAN.
- Step 2** Choose **Administration > System > Deployment**.
- Step 3** Check the check box next to the node whose personas or services you want to change, and then click **Edit**.
- Step 4** Choose the personas and services that you want.
- Step 5** Click **Save**.
- Step 6** Verify receipt of an alarm on your Primary PAN to confirm the persona or service change. If the persona or service change is not saved successfully, an alarm is not generated.
- 

## Manually Promote Secondary PAN To Primary

If the Primary PAN fails and you have not configured PAN auto-failover, you must manually promote the Secondary PAN to become the new Primary PAN.

### Before You Begin

Ensure that you have a second Cisco ISE node configured with the Administration persona to promote as your Primary PAN.

- 
- Step 1** Log in to the user interface of the Secondary PAN.
- Step 2** Choose **Administration > System > Deployment**.
- Step 3** In the Edit Node page, click **Promote to Primary**.  
You can only promote a Secondary PAN to become the Primary PAN. Cisco ISE nodes that assume only the Policy Service or Monitoring persona, or both, cannot be promoted to become the Primary PAN.
- Step 4** Click **Save**.
- 

### What to Do Next

If the node that was originally the Primary PAN comes back up, it will be demoted automatically and become the Secondary PAN. In the Edit Node page of a secondary node, you cannot modify the personas or services because the options are disabled. You have to log in to the Admin portal to make changes.

## Configure Primary PAN for Automatic Failover

### Before You Begin

To enable the auto-failover feature, make sure that at least two nodes in your distributed setup assume the Administration persona and one node assume the non-Administration persona.

- 
- Step 1** Log in to the user interface of the Primary PAN.
- Step 2** Choose **Administration > System > Deployment > PAN Failover**.
- Step 3** Check the **Enable PAN Auto Failover** check box, to enable automatic failover of the Primary PAN.  
You can only promote a Secondary PAN to become the Primary PAN. Cisco ISE nodes that assume only the Policy Service, Monitoring, or pxGrid persona, or a combination of these, cannot be promoted to become the Primary PAN.
- Step 4** Select the health check node for Primary PAN from the **Primary Health Check Node** drop down list containing all the available secondary nodes.  
It is recommended to have this node in the same location or data center as the Primary PAN.
- Step 5** Select the health check node for Secondary PAN, from the **Secondary Health Check Node** drop down list containing all the available secondary nodes.  
It is recommended to have this node in the same location or data center as the Secondary PAN.
- Step 6** Provide the **Polling Interval** time after which the Administration node status will be checked. The valid range is from 30 to 300 seconds.
- Step 7** Provide the count for **Number of Failure Polls before Failover**.  
The failover will occur if the status of the Administration node is not good for the specified number of failure polls. The valid range is from 2 to 60 counts.

**Step 8** Click Save.

---

### What to Do Next

After the promotion of Secondary PAN to the Primary PAN, do the following:

- Manually sync the old Primary PAN to bring it back into the deployment.
- Manually sync any other secondary node that is out-of sync, to bring it back into the deployment.

## Configure Monitoring Nodes for Automatic Failover

If you have two Monitoring nodes in a deployment, you can configure a primary-secondary pair for automatic failover to avoid downtime in the Cisco ISE Monitoring service. A primary-secondary pair ensures that a secondary Monitoring node automatically provides monitoring should the primary node fail.

### Before You Begin

- Before you can configure Monitoring nodes for automatic failover, they must be registered as Cisco ISE nodes.
- Configure monitoring roles and services on both nodes and name them for their primary and secondary roles, as appropriate.
- Configure repositories for backup and data purging on both the primary and secondary Monitoring nodes. For the backup and purging features to work properly, use the same repositories for both the nodes. Purging takes place on both the primary and secondary nodes of a redundant pair. For example, if the primary Monitoring node uses two repositories for backup and purging, you must specify the same repositories for the secondary node.

Configure a data repository for a Monitoring node using the **repository** command in the system CLI.



**Caution** For scheduled backup and purge to work properly on the nodes of a Monitoring redundant pair, configure the same repository, or repositories, on both the primary and secondary nodes using the CLI. The repositories are not automatically synced between the two nodes.

---

From the Cisco ISE dashboard, verify that the Monitoring nodes are ready. The System Summary dashlet shows the Monitoring nodes with a green check mark to the left when their services are ready.

---

**Step 1** Choose **Administration** > **System** > **Deployment**.

**Step 2** In the Deployment Nodes page, check the check box next to the Monitoring node that you want to specify as active, and click **Edit**.

**Step 3** Click the **General Settings** tab and choose **Primary** from the **Role** drop-down list. When you choose a Monitoring node as primary, the other Monitoring node automatically becomes secondary. In the case of a standalone deployment, primary and secondary role configuration is disabled.



**Step 4** Click **Save**. The active and standby nodes restart.

---

## Remove a Node from Deployment

To remove a node from a deployment, you must deregister it. The deregistered node becomes a standalone Cisco ISE node.

It retains the last configuration that it received from the Primary PAN and assumes the default personas of a standalone node that are Administration, Policy Service, and Monitoring. If you deregister a Monitoring node, this node will no longer be a syslog target.

When a Primary PSN is deregistered, the endpoint data is lost. If you want the PSN to retain the endpoint data after it becomes a standalone node, you can do one of the following:

- Obtain a backup from the Primary PAN and when the PSN becomes a standalone node, restore this data backup on it.

You can view these changes from the Deployment page of the Primary PAN. However, expect a delay of 5 minutes for the changes to take effect and appear on the Deployment page.

### Before You Begin

Before you remove any secondary node from a deployment, perform a backup of Cisco ISE configuration, which you can then restore later on, if needed.

---

**Step 1** Choose **Administration > System > Deployment**.

**Step 2** Check the check box next to the secondary node that you want to remove, and then click **Deregister**.

**Step 3** Click **OK**.

**Step 4** Verify receipt of an alarm on your Primary PAN to confirm that the secondary node is deregistered successfully. If the secondary node fails to deregister from the Primary PAN, the alarm is not generated.

---

## Change the Hostname or IP Address of a Standalone Cisco ISE Node

You can change the hostname, IP address, or domain name of standalone Cisco ISE nodes. You cannot use "localhost" as the hostname for a node.

### Before You Begin

If the Cisco ISE node is part of a distributed deployment, you must first remove it from the deployment and ensure that it is a standalone node.

- 
- Step 1** Change the hostname or IP address of the Cisco ISE node using the **hostname**, **ip address**, or **ip domain-name** command from the Cisco ISE CLI.
- Step 2** Reset the Cisco ISE application configuration using the **application stop ise** command from the Cisco ISE CLI to restart all the services.
- Step 3** Register the Cisco ISE node to the Primary PAN if it is part of a distributed deployment.
- Note** If you are using the hostname while registering the Cisco ISE node, the fully qualified domain name (FQDN) of the standalone node that you are going to register, for example, *abc.xyz.com* must be DNS-resolvable from the Primary PAN. Otherwise, node registration fails. You must enter the IP addresses and FQDNs of the Cisco ISE nodes that are part of your distributed deployment in the DNS server.
- After you register the Cisco ISE node as a secondary node, the Primary PAN replicates the change in the IP address, hostname, or domain name to the other Cisco ISE nodes in your deployment.
- 

## Replace the Cisco ISE Appliance Hardware

You should replace the Cisco ISE appliance hardware only if there is an issue with the hardware. For any software issues, you can reimage the appliance and reinstall the Cisco ISE software.

- 
- Step 1** Re-image or re-install the Cisco ISE software on the new nodes.
- Step 2** Obtain a license with the UDI for the Primary and Secondary PANs and install it on the Primary PAN.
- Step 3** Restore the backup on the replaced Primary PAN.  
The restore script will try to sync the data on the Secondary PAN, but the Secondary PAN is now a standalone node and the sync will fail. Data is set to the time the backup was taken on the Primary PAN.
- Step 4** Register the new node as a secondary server with the Primary PAN.
-