



## Using PowerOn Auto Provisioning

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This chapter describes how to deploy and use PowerOn Auto Provisioning (POAP)

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## Information About PowerOn Auto Provisioning

PowerOn Auto Provisioning (POAP) automates the process of upgrading software images and installing configuration files on Cisco Nexus switches that are being deployed in the network for the first time.

When a Cisco Nexus Series switch with the POAP feature boots and does not find the startup configuration, the switch enters POAP mode and checks for a USB device containing the configuration script file. If it finds one, it checks that device to see if it also contains the software image files and the switch configuration file.

If the switch does not find a USB device, or if the USB device does not contain the needed image files or switch configuration file, the switch also locates a DHCP server and bootstraps itself with its interface IP address, gateway, and DNS server IP addresses. The switch then obtains the IP address of a TFTP server or the URL of an HTTP server from which it downloads the necessary configuration files.



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**Note**

The DHCP information is used only during the POAP process if any configuration files are unavailable on the USB device.

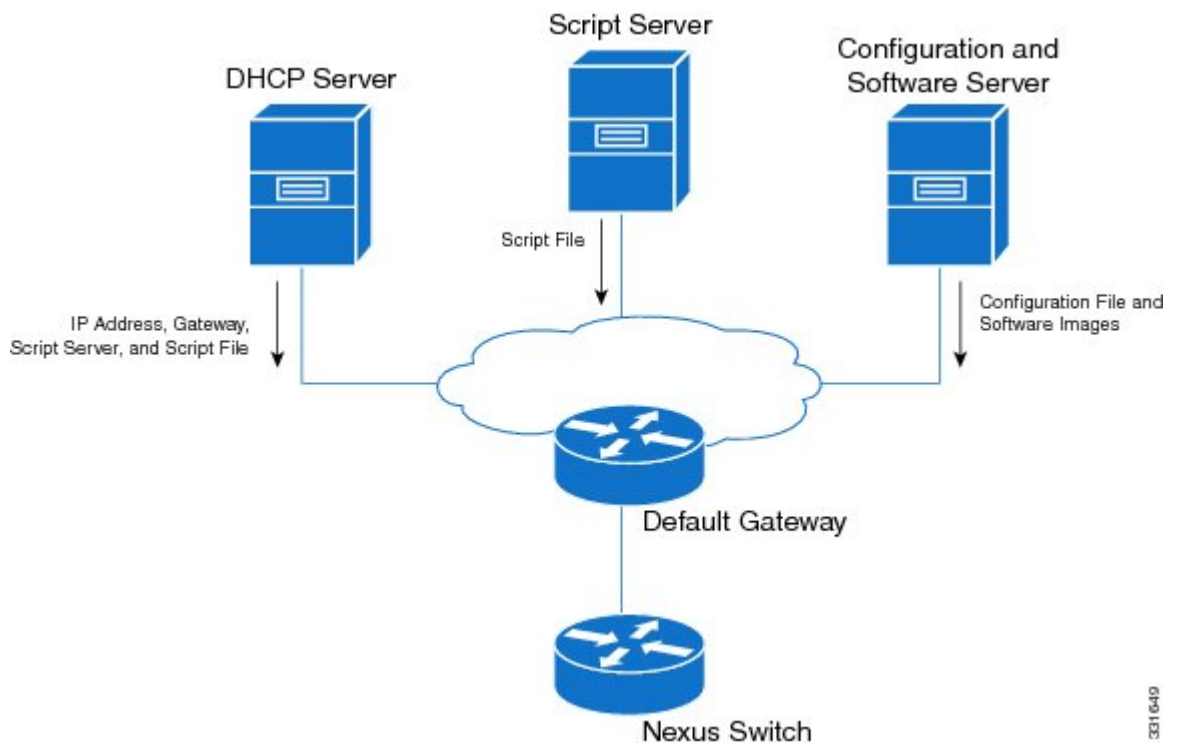
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## Network Requirements for POAP

If a USB device containing the required installation files is not available, POAP with requires the following network infrastructure:

- A DHCP server to bootstrap the interface IP address, gateway address, and DNS server
- A TFTP or HTTP server containing the configuration script used to automate the software image installation and configuration process
- One or more servers containing the desired software images and configuration files

**Figure 1: POAP Network Infrastructure**



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## POAP Configuration Script

The reference script supplied by Cisco supports the following functionality:

- Retrieves the switch-specific identifier, for example, the serial number.
- Downloads the software image (system and kickstart images) if the files do not already exist on the switch. The software image is installed on the switch and is used at the next reboot.
- Schedules the downloaded configuration to be applied at the next switch reboot.
- Stores the configuration as the startup-configuration.

We provide sample configuration scripts that were developed using the Python programming language and Tool Command Language (Tcl). You can customize one of these scripts to meet the requirements of your network environment.

For information about customizing this script using Python, see the Cisco Nexus 3000 Series NX-OS Python API Reference Guide at this URL: [http://www.cisco.com/en/US/products/ps11541/products\\_programming\\_reference\\_guides\\_list.html](http://www.cisco.com/en/US/products/ps11541/products_programming_reference_guides_list.html).

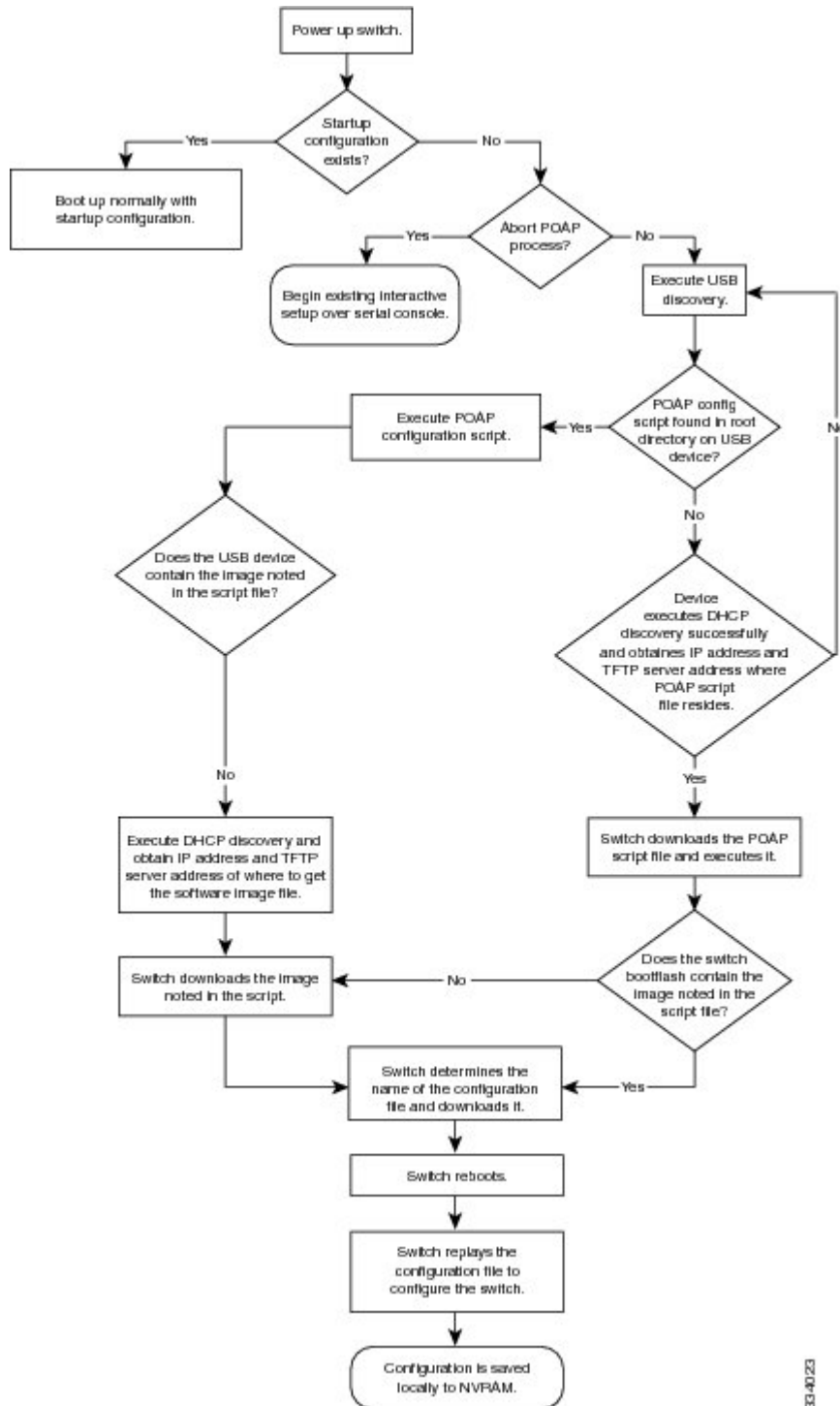
## POAP Process

The POAP process has the following phases:

- 1 Power up
- 2 USB discovery
- 3 DHCP discovery
- 4 Script execution
- 5 Post-installation reload

Within these phases, other process and decision points occur. The following illustration shows a flow diagram of the POAP process.

**Figure 2: POAP Process**



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## Power-Up Phase

When you power-up a switch for the first time, it loads the software image installed at manufacturing and tries to find a configuration file from which to boot. When no configuration file is found, POAP mode starts.

During startup, a prompt appears asking if you want to abort POAP and continue with normal setup. You can choose to exit or continue with POAP.

**Note**

No user intervention is required for POAP to continue. The prompt that asks if you want to abort POAP remains available until the POAP process is complete.

If you exit POAP mode, you enter the normal interactive setup script. If you continue in POAP mode, all the front-panel interfaces are set up in Layer 3 mode, which ensures that the device does not participate in any Layer 2 forwarding.

## USB Discovery Phase

When POAP starts, the process searches the root directory of all accessible USB devices for the POAP configuration script file (either the Python script file, `poap_script.py`, or the Tcl script file, `poap_script.tcl`), configuration files, and system and kickstart images.

If the configuration script file is found on a USB device, POAP begins running the configuration script. If the configuration script file is not found on the USB device, POAP executes DHCP discovery. (When failures occur, the POAP process alternates between USB discovery and DHCP discovery, until POAP succeeds or you manually abort the POAP process.)

If the software image and switch configuration files specified in the configuration script are present, POAP uses those files to install the software and configure the switch. If the software image and switch configuration files are not on the USB device, POAP does some cleanup and starts DHCP phase from the beginning.

## DHCP Discovery Phase

The switch sends out DHCP discover messages on all of the active interfaces (including the mgmt interface) soliciting DHCP offers from the DHCP server or servers. The DHCP client on the Cisco Nexus switch uses the switch serial number in the client-identifier option to identify itself to the DHCP server. The DHCP server can use this identifier to send information, such as the IP address and script file name, back to the DHCP client.

POAP requires a minimum DHCP lease period of 3600 seconds (1 hour). POAP checks the DHCP lease period. If the DHCP lease period is set to less than 3600 seconds (1 hour), POAP does not complete DHCP negotiation.

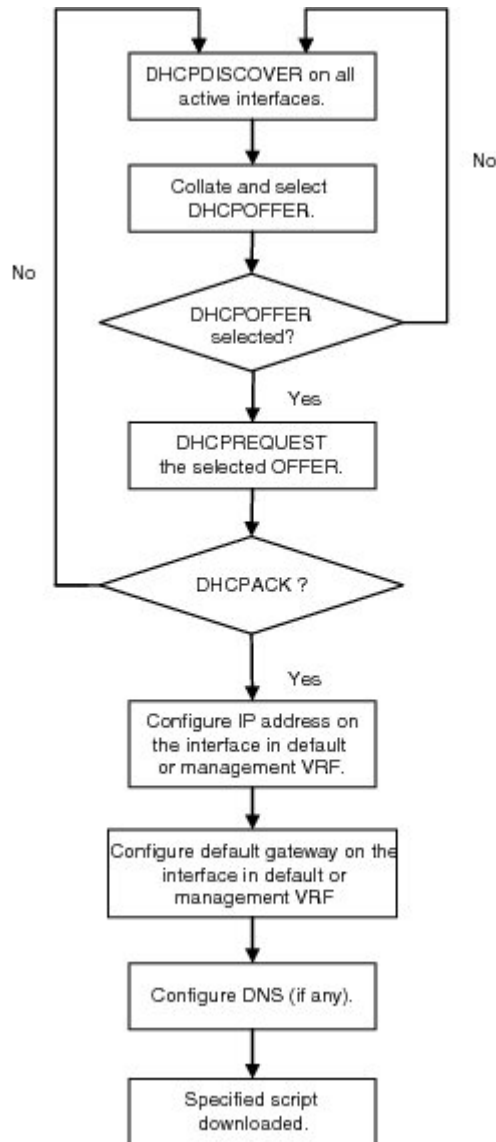
The DHCP discover message also solicits the following options from the DHCP server.

- TFTP server name or TFTP server address—The DHCP server relays the TFTP server name or TFTP server address to the DHCP client. The DHCP client uses this information to contact the TFTP server to obtain the script file.
- Bootfile name—The DHCP server relays the bootfile name to the DHCP client. The bootfile name includes the complete path to the bootfile on the TFTP server. The DHCP client uses this information to download the script file.

When multiple DHCP offers that meet the requirement are received, an offer is randomly chosen. The device completes the DHCP negotiation (request and acknowledgment) with the selected DHCP server, and the DHCP server assigns an IP address to the switch. If there is a failure in any of the subsequent steps in the POAP process, the IP address is released back to the DHCP server.

If no DHCP offers meet the requirements, the switch does not complete the DHCP negotiation (request and acknowledgment) and an IP address is not assigned.

**Figure 3: DHCP Discovery Phase**



## Script Execution Phase

Once the device has bootstrapped itself using the information in the DHCP acknowledgement, the script file is downloaded from the TFTP server or the HTTP server.

The switch runs the configuration script, which downloads and installs the software image and downloads a switch-specific configuration file.

However, the configuration file is not applied to the switch at this point, because the software image currently running on the switch might not support all of the commands in the configuration file. After the switch reboots, it begins running the new software image, if one was installed. At that point, the configuration is applied to the switch.

**Note**

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If the switch loses connectivity, the script stops, and the switch reloads its original software images and bootup variables.

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## Post-Installation Reload Phase

The switch restarts and applies (replays) the configuration on the upgraded software image. Afterward, the switch copies the running configuration to the startup configuration.

# Guidelines and Limitations for POAP

- The Cisco Nexus switch software image must support POAP for this feature to function.
- POAP can be triggered even when the startup-config is present using the **boot poap enable** command.
- If a LACP Layer 3 port-channel is configured on an uplink device connected to the Cisco Nexus device that is being bootstrapped using POAP, the port-channel is not active because all the member links are in a suspended state. Therefore, the Cisco Nexus device that is being bootstrapped using POAP cannot reach the DHCP server or any other infrastructure device needed for POAP. To work around this issue, configure a static L3 port-channel on the uplink device connected to the Cisco Nexus device that is being bootstrapped using POAP.
- If you use POAP to bootstrap a Cisco Nexus device that is a part of a vPC pair using static port-channels on the VPC links, the Cisco Nexus device activates all of its links upon POAP startup. The dually connected device at the end of the VPC links might start sending some or all of its traffic to the port-channel member links connected to the Cisco Nexus device, and the traffic would be lost.  
To work around this issue, you can configure LACP on the vPC links so that the links do not incorrectly start forwarding traffic to the Cisco Nexus device that is being bootstrapped using POAP.
- If you use POAP to bootstrap a Cisco Nexus device that is connected downstream to a Cisco Nexus Series 7000 device through a LACP port-channel, the Cisco Nexus 7000 Series device defaults to suspend its member port if it cannot bundle it as a part of a port-channel. To work around this issue, configure the Cisco Nexus 7000 Series device to not suspend its member ports using the `no lacp suspend-individual` command from interface configuration mode.
- Important POAP updates are logged in the syslog and are available from the serial console.
- Critical POAP errors are logged to the bootflash. The filename format is `date-time_poap_PID_[init,1,2].log`, where `date-time` is in the YYYYMMDD\_hhmmss format and `PID` is the process ID.
- Script logs are saved in the bootflash directory. The filename format is `date-time_poap_PID_script.log`, where `date-time` is in the YYYYMMDD\_hhmmss format and `PID` is the process ID.

- The Scheduler configuration cannot be replayed using POAP. The reason that the Scheduler configuration cannot be replayed is that it is associated with the user (for example "admin") that was logged in when the Scheduler configuration was created. Because the configuration replay using POAP is not associated with any specific user, the scheduler configuration cannot be replayed and fails.

Instead of configuring the Scheduler, configure the Embedded Event Manager (EEM). An EEM configuration can be downloaded and replayed using POAP.

## Setting Up the Network Environment To Use POAP

### Procedure

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- Step 1** Modify the basic configuration script provided by Cisco or create your own script. For information, see the *Python Scripting and API Configuration Guide*.
- Step 2** Every time you make a change to the configuration script, ensure that you recalculate the MD5 checksum by running `# f=poap_fabric.py ; cat $f | sed '/^#md5sum/d' > $f.md5 ; sed -i "s/^#md5sum=.*/#md5sum=\"$md5sum $f.md5 | sed 's/ .*//'" $f` using a bash shell. For more information, see the *Python API Reference Guide*.
- Step 3** (Optional) Put the POAP configuration script and any other desired software image and switch configuration files on a USB device accessible to the switch.
- Step 4** Deploy a DHCP server and configure it with the interface, gateway, and TFTP server IP addresses and a bootfile with the path and name of the configuration script file. (This information is provided to the switch when it first boots.)  
You do not need to deploy a DHCP server if all software image and switch configuration files are on the USB device.
- Step 5** Deploy a TFTP or HTTP server to host the configuration script.
- Step 6** Deploy one or more servers to host the software images and configuration files.
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## Configuring a Switch Using POAP

### Before You Begin

Make sure the network environment is set up to use POAP. For information, see the [Setting Up the Network Environment To Use POAP](#), on page 8 section.

### Procedure

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- Step 1** Install the switch in the network.
- Step 2** Power on the switch.  
If no configuration file is found, the switch boots in POAP mode and displays a prompt asking if you want to abort POAP and continue with normal setup.



- Step 3** No entry is required to continue to boot in POAP mode. If you want to exit POAP mode and enter the normal interactive setup script, enter y (yes).  
The switch boots, and the POAP process begins. For information, see the [POAP Process](#) section.

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### What to Do Next

Verify the configuration.

## Verifying the Device Configuration

Use one of the following commands to verify the configuration after bootstrapping the device using POAP:

Command	Purpose
<code>show running-config</code>	Displays the running configuration.
<code>show startup-config</code>	Displays the startup configuration.

For detailed information about the fields in the output from these commands, see the *Cisco Nexus 3000 Series NX-OS Command Reference*.

## Related Documents for POAP

Related Topic	Document Title
Configuration Script	<i>Cisco Nexus 3000 Series NX-OS Python API Reference Guide</i>
DHCP Options and BOOTP Vendor Extensions	RFC2132— <a href="http://tools.ietf.org/html/rfc2132">http://tools.ietf.org/html/rfc2132</a>
TFTP Server Address Option for DHCPv4	RFC5859— <a href="http://tools.ietf.org/html/rfc5859">http://tools.ietf.org/html/rfc5859</a>

