



## Manage Inventory

---

This section contains the following topics:

- [Device Management Overview, on page 1](#)
- [Reachability and Operational State, on page 1](#)
- [Manage Credential Profiles, on page 3](#)
- [Manage Network Devices, on page 11](#)
- [Manage Devices Using Zero Touch Provisioning, on page 26](#)

## Device Management Overview

The Device Management application lets you create, edit, and delete:


- The **credential profiles** that control Cisco Crosswork Change Automation and Health Insights's access to devices and providers. See [Manage Credential Profiles, on page 3](#).
- The **devices** you manage using Cisco Crosswork Change Automation and Health Insights. See [Manage Network Devices, on page 11](#).

You can also use Device Management to review the **jobs** executed on your devices. See [View Device Job History, on page 25](#).

## Reachability and Operational State

Cisco Crosswork Change Automation and Health Insights computes the Reachability State of the providers it uses and devices it manages, as well as the Operational State of reachable managed devices. It indicates these states using the icons in the following table.

*Table 1: Reachability and Operational State Icons*

This Icon...	Indicates...
<b>Reachability State</b> icons show whether a device or a provider is reachable or not	
	Reachable: The device or provider can be reached by all configured protocols configured for it.

This Icon...	Indicates...
	Reachability Degraded: The device or provider can be reached by at least one protocol, but is not reachable by one or more of the other protocols configured for it.
	Unreachable: The device or provider cannot be reached by any protocol configured for it.
	Reachability Unknown: Cisco Crosswork Change Automation and Health Insights cannot determine if the device is reachable, degraded, or unreachable . This state can also occur if the device is not connected to Cisco Crosswork Data Gateway.
<b>Operational State</b> icons show whether a device is operational or not.	
	The device is operational and under management, and all individual protocols are "OK" ( also known as "up").
	The device is not operational ("down"). The same icon is used when the device has been set "administratively down" by an operator.
	The device's operational or configuration state is unknown.
	The device's operational or configuration state is degraded.
	The device's operational or configuration state is in an error condition. It is either not up, or unreachable, or both, due to errors encountered while attempting to reach it and compute its operational state. The number in the circle shown next to the icon indicates the number of recent errors. Click on the number to see a list of these errors. (Note that the icon badging for errors is not available in the Network Visualization application.)
	The device's operational state is currently being checked
	The device is being deleted.
	The device is unmanaged.

The Reachability State of a device is computed as follows:

1. Reachability is always computed for each device as long as the device's configured state (as configured by users) is UP. It is not computed if the device is administratively DOWN or UNMANAGED.
2. Reachability state is always either REACHABLE, UNREACHABLE, or UNKNOWN.
  - The Reachability state is REACHABLE if there is at least one route to the device via at least one protocol AND the device is discoverable.
  - The Reachability state is UNREACHABLE if there are no routes to the device via one protocol OR the device does not respond.
  - The Reachability state is UNKNOWN if the device is UNMANAGED.

The Operational State of a device is computed as follows:

1. Operational state is always computed for each device as long as the device's configured state (as configured by users) is UP. It is not computed if the device is administratively DOWN or UNMANAGED.
2. Operational state is always OK or ERROR.
3. For a device to be Operational=OK, the device must be REACHABLE and discoverable. Any other Reachability state is ERROR.
4. For XR or XE devices only, Operational=OK also requires that Clock Drift difference between the Crosswork host and device clocks is  $\leq$  the default Drift Value, currently 2 minutes.



---

**Note** Some timezone settings are known to result in Clock Drift errors when no clock drift actually exists. To work around this issue set your devices to use UTC time.

---

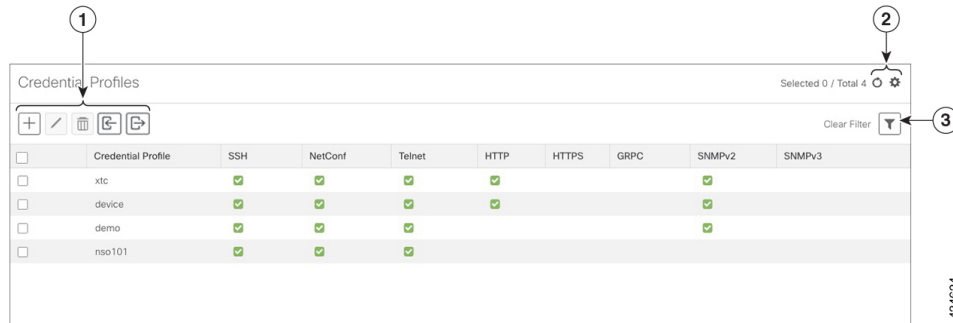
## Manage Credential Profiles

Credential profiles are collections of credentials for SNMP, Telnet, SSH, HTTP, and other network protocols. You can have multiple protocols and credentials in a single credential profile.

Using credential profiles lets you automate device configuration changes and monitoring, and communicate with providers. When you add or import devices, or create providers, you specify the credential profile.

From the **Credential Profiles** window, you can create a new credential profile, update the settings configured for an existing profile, or delete a profile. To open this window, choose **Device Management > Credential Profiles** from the main menu.

Figure 1: Credentials Profile window



Item	Description
1	Click  to add a credential profile. See <a href="#">Create Credential Profiles, on page 4</a> .
	Click  to edit the settings for the selected credential profile. See <a href="#">Edit Credential Profiles, on page 8</a> .
	Click  to delete the selected credential profile. See <a href="#">Delete Credential Profiles, on page 9</a> .
	Click  to import new credential profiles from a CSV file. You can also download a CSV file template by clicking this icon. The template includes sample data that you can use as a guide for building your own CSV file. See <a href="#">Import Credential Profiles, on page 6</a> .
	Click  to export credential profiles to a CSV file. See <a href="#">Export Credential Profiles, on page 9</a> .
2	Click  to refresh the <b>Credential Profiles</b> window.
	Click  to choose the columns to make visible in the <b>Credential Profiles</b> window (see <a href="#">Set, Sort and Filter Table Data</a> ).
3	Click  to set filter criteria on one or more columns in the <b>Credential Profiles</b> window.
	Click the <b>Clear Filter</b> link to clear any filter criteria you may have set.

## Create Credential Profiles

Follow the steps below to create a new credential profile. You can then use the profile to apply credentials consistently when you add new devices or providers. You can add as many protocols and corresponding credentials to the profile as you want.

If you have many credential profiles to add, you may find it more efficient to put the information in a CSV file and import the file. See [Import Credential Profiles, on page 6](#).

When creating device credential profiles that contain SNMP credentials, Cisco recommends that the profile contain credentials for the version of SNMP actually enabled on the device, and that version only. For example: If SNMPv3 is not enabled in the device configuration, do not include SNMPv3 credentials in the device credential profile.

If you plan to use the import and export features and CSV files to create credential profiles in bulk, please note that:

- All the characters in each password or community string entry in every credential profile exported to a CSV file are replaced with asterisks ([Export Credential Profiles, on page 9](#)).
- You cannot import credential profiles if the passwords and community strings in the CSV file are blank (see [Import Credential Profiles, on page 6](#)).

To maintain network security, Cisco recommends that you use asterisks in place of real passwords and community strings in any CSV file you plan to import. After the import, follow the steps in [Edit Credential Profiles, on page 8](#) to replace the asterisks with actual passwords and community strings.

**Step 1** From the main menu, choose **Device Management > Credential Profiles**.

**Step 2** Click .

**Step 3** In the **Profile Name** field, enter a descriptive profile name. The name can contain a maximum of 128 alphanumeric characters, plus dots (.), underscores ("\_") or hyphens ("-"). No other special characters are allowed.

If you will have many credential profiles, make the name as informative as possible because that information will be displayed on the Credential Profiles panel.

**Step 4** Select a protocol from the **Connectivity Type** dropdown.

**Step 5** Complete the credentials fields described in the following table. The required and optional fields displayed will vary with the connectivity type you chose. The values you enter must match the values configured on the device.

Connectivity Type	Fields
SSH	Enter the required <b>User Name</b> , <b>Password</b> , and <b>Confirm Password</b> . The <b>Enable Password</b> is optional.
SNMPv2	Enter the required SNMPv2 <b>Read Community</b> string. The <b>Write Community</b> string is optional.
NETCONF	Enter the required <b>User Name</b> , <b>Password</b> , and <b>Confirm Password</b> .
TELNET <b>Note</b> There may be some security limitations when using this protocol.	Enter the required <b>User Name</b> , <b>Password</b> , and <b>Confirm Password</b> . The <b>Enable Password</b> is optional.
HTTP	Enter the required <b>User Name</b> , <b>Password</b> , and <b>Confirm Password</b> .
HTTPS	Enter the required <b>User Name</b> , <b>Password</b> , and <b>Confirm Password</b> .
GRPC	Enter the required <b>User Name</b> , <b>Password</b> , and <b>Confirm Password</b> .

Connectivity Type	Fields
SNMPv3	<p>Choose the required <b>Security Level</b> and enter the <b>User Name</b>.</p> <p>If you chose the NO_AUTH_NO_PRIV <b>Security Level</b> of AUTH_NO_PRIV or AUTH_PRIV, the remaining fields are optional.</p> <p>If you chose the AUTH_NO_PRIV <b>Security Level</b>, you must choose an <b>Auth Type</b> and enter an <b>Auth Password</b>.</p> <p>If you chose the AUTH_PRIV <b>Security Level</b>, you must choose an <b>Auth Type</b> and <b>Priv Type</b>, and enter an <b>Auth Password</b> and <b>Priv Password</b>.</p> <p>Only the following SNMPv3 Privacy Types are supported</p> <ul style="list-style-type: none"> <li>• CFB_AES_128</li> <li>• CBC_DES_56</li> </ul> <p>The following Privacy Types are not supported:</p> <ul style="list-style-type: none"> <li>• AES192</li> <li>• AES256</li> <li>• 3DES</li> </ul>

**Step 6** (Optional) Click + **Add Another** and repeat the above steps, as needed, for all other protocols and corresponding credentials you want to add to this credential profile.

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


## Import Credential Profiles

Complete the steps below to create a CSV file that specifies multiple credential profiles and then import it into Cisco Crosswork Change Automation and Health Insights.

Importing credential profiles from a CSV file adds any profiles not already in the database. You cannot import a credential profile that already exists.

If you are re-importing a credential profile CSV file that you previously exported and modified, remember that all the passwords and community strings in the exported credential profile CSV file are replaced with asterisks. You cannot re-import an exported credential profile CSV file with blank passwords. To maintain security, Cisco recommends that you use asterisks in place of real passwords and community strings in the CSV file. After the import, follow the steps in [Edit Credential Profiles, on page 8](#) to replace the asterisks with actual passwords and community strings.

**Step 1** From the main menu, choose **Device Management > Credential Profiles**.

**Step 2** Click  to open the **Import CSV File** dialog box.

**Step 3** If you have not already created a credential profile CSV file to import:

- a) Click the **Download sample 'Credential template (\*.csv)' file** link and save the CSV file template to your local disk.

- b) Open the template using your preferred tool. Begin adding rows to the file, one row for each credential profile.

Use a semicolon to separate multiple entries in the same field. Use two semicolons with no space between them to indicate that you are leaving the field blank. When you separate multiple entries with semicolons, remember that the order in which you enter values in each field is important. For example, if you enter **SSH;NETCONF;TELNET** in the **Connectivity Type** field and you enter **UserTom;UserDick;UserHarry** in the **User Name** field, the order of entry determines the mapping between the two fields:

- SSH: UserTom
- NETCONF: UserDick
- TELNET: UserHarry

Also note:

- Be sure to enter SNMP community string information exactly as currently entered on your devices. Failure to do so will result in loss of device connectivity, and inability to collect certain KPI data or execute configured Playbooks on devices associated with the credential profile.
- Password and community string information associated with a user ID are stored in plain text in the CSV file you prepare. Be aware of the security implications of this, and apply appropriate safeguards.

Field	Entries	Required or Optional
<b>Credential Profile</b>	The name of the credential profile. For example: <b>nso</b> .	Required
<b>Connectivity Type</b>	Valid values are: <b>SSH, SNMPv2, NETCONF, TELNET, HTTP, HTTPS, GRPC</b> or <b>SNMPv3</b>	Required
<b>User Name</b>	For example: <b>NSOUser</b>	Required if <b>Connectivity Type</b> is <b>SSH, NETCONF, TELNET, HTTP, HTTPS, SNMPv3</b> or <b>GRPC</b> .
<b>Password</b>	The password for the preceding <b>User Name</b> .	Required if <b>Connectivity Type</b> is <b>SSH, NETCONF, TELNET, HTTP, HTTPS</b> or <b>GRPC</b>
<b>Enable Password</b>	Use an Enable password. Valid values are: <b>ENABLE, DISABLE</b>	Required if <b>Connectivity Type</b> is <b>SSH</b> or <b>TELNET</b> . Otherwise leave blank.
<b>Enable Password Value</b>	Specify the Enable password to use.	Required if <b>Connectivity Type</b> is <b>SSH</b> or <b>TELNET</b> and <b>Enable Password</b> is set to <b>ENABLE</b> . Otherwise leave blank.
<b>SNMPV2 Read Community</b>	For example: <b>readprivate</b>	Required if <b>Connectivity Type</b> is <b>SNMPv2</b>
<b>SNMPV2 Write Community</b>	For example: <b>writeprivate</b>	Required if <b>Connectivity Type</b> is <b>SNMPv2</b>
<b>SNMPV3 User Name</b>	For example: <b>DemoUser</b>	Required if <b>Connectivity Type</b> is <b>SNMPv3</b>

Field	Entries	Required or Optional
SNMPV3 Security Level	Valid values are <b>noAuthNoPriv</b> , <b>AuthNoPriv</b> or <b>AuthPriv</b>	Required if <b>Connectivity Type</b> is <b>SNMPv3</b>
SNMPV3 Auth Type	Valid values are <b>HMAC_MD5</b> or <b>HMAC_SHA</b>	Required if <b>Connectivity Type</b> is <b>SNMPv3</b> and <b>SnmV3 Security Level</b> is <b>AuthNoPriv</b> or <b>AuthPriv</b>
SNMPV3 Auth Password	The password for this authorization type.	Required if <b>Connectivity Type</b> is <b>SNMPv3</b> and <b>SnmV3 Security Level</b> is <b>AuthNoPriv</b> or <b>AuthPriv</b>
SNMPV3 Priv Type	Valid values are <b>CFB_AES_128</b> or <b>CBC_DES_56</b>  The following SNMPv3 privacy types are not supported: AES192, AES256, 3DES	Required if <b>Connectivity Type</b> is <b>SNMPv3</b> and <b>SnmV3 Security Level</b> is <b>AuthPriv</b>
SNMPV3 Priv Password	The password for this privilege type.	Required if <b>Connectivity Type</b> is <b>SNMPv3</b> and <b>SnmV3 Security Level</b> is <b>AuthPriv</b>

Be sure to delete the sample data rows before saving the file or they will be imported along with the data you want. The column header row can stay, as it is ignored during import.

c) When you are finished, save the new CSV file.

**Step 4** Click **Browse** to navigate to the CSV file you just created and then click **Open** to select it.

**Step 5** With the CSV file selected, click **Import**.

The credential profiles you imported should now be displayed in the **Credential Profiles** window.

## Edit Credential Profiles

A credential profile can be shared by multiple devices, even hundreds of devices in a large network. Complete the following procedure to edit credential profile settings.




### Warning

Changing the settings in a credential profile without first changing the settings on the device associated with the profile may result in a loss of connectivity, inability to collect certain KPI data, or an inability to execute configured playbooks on devices associated with the modified profile. For example: If the SNMP community string on the device no longer matches what is in the credential profile, SNMP-based KPIs will not function.

Before editing any credential profile, it is always good practice to export a CSV backup of the profiles you want to change (see [Export Credential Profiles, on page 9](#)).

**Step 1** From the main menu, choose **Device Management > Credentials**.

**Step 2** From the left-hand side of the **Credential Profiles** window, select the profile you want to update, and click . The **Edit Profile** window of the selected credential is displayed.



**Step 3** Make the necessary changes and then click **Save**.

**Note** If the device is not updated within 30 seconds when you modify connectivity or credential profile information, move the device state to DOWN and then UP. The CLI reachability is triggered and the updated values are displayed.

---

## Delete Credential Profiles


Follow the steps below to delete a credential profile.



---

**Note** You cannot delete a credential profile that is associated with one or more devices or providers.

---


- Step 1** Export a backup CSV file containing the credential profile you plan to delete (see [Export Credential Profiles, on page 9](#)).
- Step 2** Check whether any devices or providers are using the credential profile you plan to delete. You can do this by filtering on the **Credential Profile** column, which is available on both the **Devices** window (choose **Device Management > Credential Profiles**) and the Providers window (choose **Admin > Providers**).
- Step 3** Reassign the devices or providers to a different credential profile (for help with this task, see [Change the Credential Profile for a Device or Provider, on page 10](#) or [Change the Credential Profile for Multiple Network Devices, on page 10](#), and [Edit Providers](#)).
- Step 4** After all devices and providers have had their credential profiles reassigned: From the main menu, choose **Device Management > Credential Profiles**.
- Step 5** In the **Credential Profiles** window, choose the profile that you want to delete and then click .
- 

## Export Credential Profiles

Exporting credential profiles stores all the profiles you selected in a CSV file. This is a quick way to make backup copies of your credential profiles. You can also edit the CSV file as needed, and re-import it to add new or modify credential profile data.

The exported credential profiles CSV file does not contain real passwords or community strings. All the characters in the passwords and community strings entries in the credential profiles are replaced with asterisks in the exported CSV file. If you plan on modifying your exported CSV file and then re-importing it, Cisco recommends that you use asterisks in place of real passwords and community strings. After the import, follow the steps in [Edit Credential Profiles, on page 8](#) to replace the asterisks with actual passwords and community strings.

- 
- Step 1** From the main menu, choose **Device Management > Credential Profiles**.
- Step 2** (Optional) In the **Credential Profiles** window, filter the credential profile list as needed.
- Step 3** Check the check boxes for the profiles you want to export. Check the check box at the top of the column to select all the profiles for export.

- Step 4** Click . Depending on your browser, you will be prompted to select a path and file name to use when saving the CSV file, or to open it immediately

---

## Change the Credential Profile for a Device or Provider

You can edit device information, including changing the credential profile in the device record. This operation changes an existing association between a device and a credential profile.

### Before you begin


You need a credential profile to complete this task. To create a credential profile, see [Create Credential Profiles, on page 4](#).



---

**Note** Make sure the profile's credential settings are correct before following this procedure.

---

- Step 1** From the main menu, choose **Device Management > Devices**. The **Network Devices** tab is displayed by default.
- Step 2** (Optional) Filter the device list by entering text in the **Search** field or filtering specific columns.
- Step 3** Check the check box of the device you want to change, and click .
- Step 4** Choose a different credential profile from the **Credential Profile** drop-down list.
- Step 5** Click **Save**.

---





After the device record is updated, the system attempts to communicate with the device using the new profile. Confirm that the device is reachable without any errors.

## Change the Credential Profile for Multiple Network Devices

If you want to change the credential profile for a large number of network devices, you may find it more efficient to make the change by editing a devices CSV file. The basic method is:

1. Export a CSV file containing the devices whose credential profiles you want to change (see [Export Network Devices, on page 25](#)).
2. Edit the CSV file, changing the credential profile for each device (this credential profile must already exist). Save the edited file.

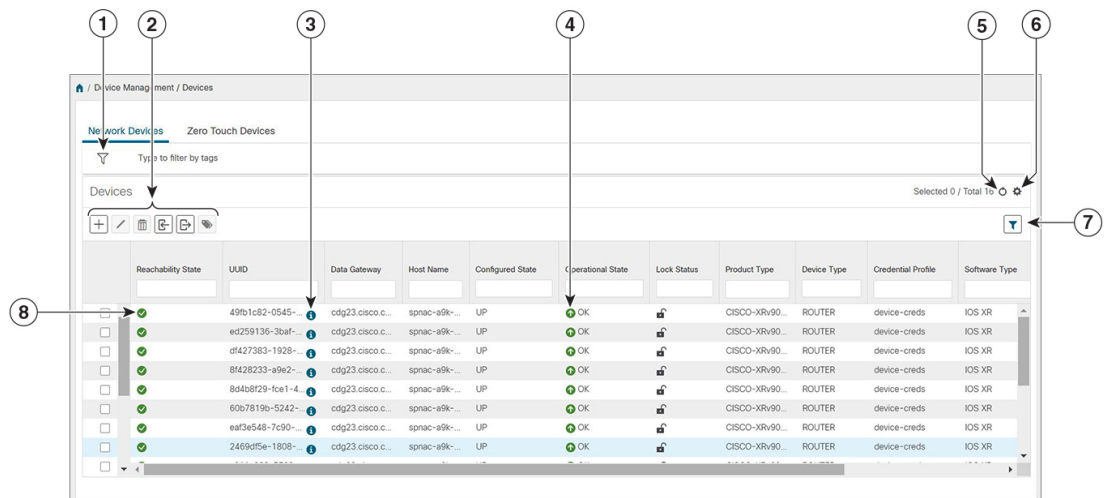
You will need to make sure that the credential profile to which you are changing already exists. If you have not yet created that credential profile, the CSV import will fail. The credential profile you associate with these devices must also have the authorization credentials for every protocol that was configured for these devices during onboarding. If any credential for a specific protocol configured on the devices is missing from or incorrect in the credential profile, then the CSV import will succeed, but reachability checks will fail for these devices.

- Step 1** From the main menu, choose **Device Management > Devices**. The **Network Devices** tab is displayed by default.
- Step 2** Choose the devices whose credential profiles you want to change. Your options are:
- Click  to include all devices.
  - Filter the device list by entering text in the **Search** field or by filtering specific columns. Then click  to include only the filtered list of devices.
  - Check the boxes next to the device records you want to change. Then click  to include only the devices that have been checked.
- Step 3** Edit and save the new CSV file using the tool of your choice. Be sure to enter the correct credential profile name in the **Credential Profile** field for each device.
- Step 4** Click .
- Step 5** In the **Import** dialog box, click **Browse**, choose the new CSV file, and click **Import**.











## Manage Network Devices

The Device Management application's **Network Devices** window (shown below) gives you a consolidated list of all your devices and their status. To view the **Network Devices** window, select **Device Management > Devices**. The **Network Devices** tab is displayed by default.

**Figure 2: Devices Window**



Item	Description
1	The <b>Filter by tags</b> field lets you filter the devices by the tags applied to them. Type the name of the tag that has been applied to the device that you are trying to find. See <a href="#">Filter Network Devices by Tags, on page 23</a> .

Item	Description
2	Click  to add a new device to the device inventory. See <a href="#">About Adding Devices to Inventory, on page 12</a> .
	Click  to edit the information for the currently selected devices. See <a href="#">Edit Network Devices, on page 23</a> .
	Click  to delete the currently selected devices. See <a href="#">Delete Network Devices, on page 24</a> .
	Click  to import new devices and update existing devices, using a CSV file. You can also download a CSV file template by clicking this icon. The template includes sample data that you can use as a guide for building your own CSV file. See <a href="#">Import Network Devices, on page 16</a> .
	Click  to export information for selected devices to a CSV file. See <a href="#">Export Network Devices, on page 25</a> .
	Click  to modify tags applied to the selected devices. See <a href="#">Apply or Remove Device Tags</a> .
3	Click  to open the <b>Device Details</b> pop-up window, where you can view important information for the selected device. See <a href="#">Get Network Device Details, on page 21</a> .
4	Icons in the <b>Operational State</b> column show whether a device is operational or not. See <a href="#">Reachability and Operational State, on page 1</a>
5	Click  to refresh the Devices list.
6	Click  to select which columns to display in the Devices list (see <a href="#">Set, Sort and Filter Table Data</a> ).
7	Click  to set filter criteria on one or more columns in the Devices list.
	Click the <b>Clear Filter</b> link to clear any filter criteria you may have set.
8	Icons in the <b>Reachability State</b> column show whether a device is reachable or not. See <a href="#">Reachability and Operational State, on page 1</a> .

## About Adding Devices to Inventory

There are six ways to add devices to Cisco Crosswork Change Automation and Health Insights. Each has its own set of prerequisites, which you must fulfill if the device addition is to succeed.

In order of preference for most users, the methods and their prerequisites are:

1. **Importing devices using the Cisco Crosswork Change Automation and Health Insights APIs:** This is the fastest and most efficient of the three methods, but requires programming skills and API knowledge. For more, see the [inventory management APIs on Cisco Devnet](#).
2. **Importing devices from a Devices CSV file:** This method is explained in [Import Network Devices, on page 16](#). This method is time-consuming and error-prone, as you must create and format all of the data

yourself beforehand (including not only devices, but also the providers, credential profiles and tags), and then ensure all of these items are properly associated with the devices after the CSV import. To succeed with this method, you must first:

- Create the provider(s) that will be associated with the devices (see [Manage Providers](#))
  - Create corresponding credential profiles for all of the devices and providers listed in the CSV file (see [Create Credential Profiles, on page 4](#))
  - Create tags for use in grouping the new devices (see [Manage Tags](#))
  - Download the CSV template file from Cisco Crosswork Change Automation and Health Insights and populate it with all the devices you will need.
3. **Adding them via the UI:** This method is explained in [Add Network Devices Through the UI, on page 17](#). It is the least error-prone of the three methods, as all data is validated during entry, but also the most time-consuming, being suitable only for adding a few devices at a time. Note that the providers, credential profiles and tags you want to apply to them must exist beforehand.
  4. **Auto-onboarding from a Cisco SR-PCE provider:** This method is explained in [Add Cisco SR-PCE Providers](#). Note that the device and provider credential profiles and tags you want to apply to these devices must exist beforehand. After onboarding devices from this source, you will need to edit each device to add device information that is not automatically discovered.
  5. **Auto-onboarding using Zero Touch Provisioning:** This method is explained in [Manage Devices Using Zero Touch Provisioning, on page 26](#). Note that the device and provider credential profiles and tags you want to apply to these devices must exist beforehand. After provisioning and onboarding devices using this method, you will need to edit each device to add information that is not automatically supplied.
  6. **Onboard the devices on Cisco Crosswork Data Gateway:** This method is explained in [Attach a Device to a Cisco Crosswork Data Gateway Instance](#).



---

**Note** Cisco Crosswork Change Automation and Health Insights version 3.2 supports only single stack deployment modes. Devices can be onboarded either with only IPv4 address or only IPv6 address.

---

## Prerequisites for Onboarding Devices

Before adding devices, you must ensure that the devices themselves are configured to collect and transmit telemetry data properly and communicate successfully with Cisco Crosswork Change Automation and Health Insights. The following sections provide sample configurations for a variety of communications options. Use them as a guide to configuring the devices you plan to manage using Cisco Crosswork Change Automation and Health Insights.



---

**Note** Only SNMPv2 and SNMPv3 (NoAuth/NoPriv) traps are supported.

---

### Pre-Onboarding SNMP v2 Device Configuration

The following commands provide a sample pre-onboarding device configuration that sets the correct SNMPv2 and NETCONF configuration, and SSH and Telnet rate limits. The NETCONF setting is only needed if the device is MDT-capable.

```
logging console debugging
logging monitor debugging
telnet vrf default ipv4 server max-servers 100
telnet vrf default ipv6 server max-servers 100
crypto key generate rsa
line default
  exec-timeout 0 0
  width 107
  length 37
  absolute-timeout 0
!
snmp-server community public RO
snmp-server community robot-demo2 RO
snmp-server ifindex persist
ntp
  server <NTPServerIPAddress>
!
service cli history size 5000
service cli interactive disable
ssh server v2
ssh server vrf default
ssh server netconf vrf default
ssh server logging
ssh server rate-limit 100
ssh server session-limit 100
!
netconf agent tty
!
netconf-yang agent
  ssh
!
```

### Pre-Onboarding SNMPv3 Device Configuration

If you want to enable SNMPv3 data collection, repeat the SNMPv2 configuration commands in the previous section, and add the following commands:

```
snmp-server group grpauthpriv v3 priv notify v1default
snmp-server user <user-ID> grpauthpriv v3 auth md5 <password> priv aes 128 <password>
```

### Pre-Onboarding SNMPv2 and SNMPv3 Trap Configuration

If you want the device to send SNMP traps to Cisco Crosswork Change Automation and Health Insights, use the following commands to perform a pre-onboarding device configuration and test for the trap version you want.

For SNMP v2 traps:

```
snmp-server trap link ietf

snmp-server host <CrossworkDataGatewaysouthboundIPAddress> traps version 2c cisco123 udp-port
1062

snmp-server community cisco123

snmp-server traps snmp linkup
```

```
snmp-server traps snmp linkdown
```

For SNMP v3 traps:

```
snmp-server trap link ietf
```

```
snmp-server host < CrossworkDataGatewaysouthboundIPAddress> traps version 3 cisco123 udp-port
1062
```

```
snmp-server community cisco123
```

```
snmp-server traps snmp linkup
```

```
snmp-server traps snmp linkdown
```

Please note that, for traps to be received, the `node_ip` field for the device as listed in the Cisco Crosswork Change Automation and Health Insights inventory must match the IP address of the device interface from which the traps are sent. If they do not, Cisco Crosswork Change Automation and Health Insights will reject the traps. Also, the device needs to be in `ADMIN_UP` state for traps to be received.

## Sample Configuration for Devices in Cisco NSO

If you plan to use Cisco NSO as a provider to configure devices managed by Cisco Crosswork Change Automation and Health Insights, be sure that the Cisco NSO device configurations observe the following guidelines.

The following example shows a Cisco NSO setup that uses the hostname as the device ID. If you are using a CSV file to import devices, use `ROBOT_PROVDEVKEY_HOST_NAME` as the enum value for the `provider_node_key` field. The example hostname `RouterFremont` used here must match the hostname for the device in the CSV file.

```
configure
set devices device RouterFremont address 198.18.1.11 port 22
set devices device RouterSFO address 198.18.1.12 port 830
```

In the following example, we are creating an authgroup called `cisco` with remote name and password of `cisco`. Next, we are setting all the devices with a name that starts with `Router` to a device type of `netconf` using `ned-id` `cisco-iosxr-nc-6.6`. Finally, we are setting all of the devices with a name starting with `Router` to be assigned to authgroup `cisco`. Edit the setting to match your environment. For example:

```
set devices authgroups group cisco default-map remote-name cisco remote-password cisco
set devices device Router* device-type netconf ned-id cisco-iosxr-nc-6.6
set devices device Router* authgroup cisco
```

The following steps unlock the devices and retrieve the ssh keys from all of the devices. NSO then synchronizes itself with the device by uploading the devices current configuration and stores the present configuration. It is important to perform these steps to ensure that the device, NSO, and Crosswork Network Automation applications are starting from a common configuration. For example:

```
set devices device Router* state admin-state unlocked
request devices device Router* ssh fetch-host-keys
request devices device Router* sync-from
commit
```

## Import Network Devices

Complete the steps below to create a CSV file that specifies multiple devices and then import it into Cisco Crosswork Change Automation and Health Insights.

Importing devices from a CSV file adds any devices not already in the database, and overwrites the data in any device record with an Inventory Key Type and device key field value that matches those of an imported device (this excludes the UUID, which is set by the system and not affected by import). For this reason, it is a good idea to export a backup copy of all your current devices before an import (see [Export Network Devices, on page 25](#)).




---

**Note** If you plan on using a CSV file to import devices managed by Cisco Network Services Orchestrator (Cisco NSO), you must prepare the CSV following the guidelines given in [Sample Configuration for Devices in Cisco NSO, on page 15](#).

---

**Step 1** From the main menu, choose **Device Management > Devices**. The **Network Devices** tab is displayed by default.

**Step 2** Click  to open the **Import CSV File** dialog box.

**Step 3** If you have not already created a device CSV file to import:

- a) Click the **Download sample 'Device Management template (\*.csv)' file** link and save the CSV file template to a local storage resource.
- b) Open the template using your preferred tool. Begin adding rows to the file, one row for each device.

**Note** Confirm that the TE router ID value for each device is populated. This value is used to uniquely identify the device in the topology which is learned from SR-PCE. Without a valid TE router ID for each device, the topology will not be displayed.

Use a semicolon to separate multiple entries in the same field. Use two semicolons with no space between them to indicate that you are leaving the field blank. When you separate multiple entries with semicolons, remember that the order in which you enter values in each field is important. For example, if you enter **SSH ; SNMP ; NETCONF** in the **Connectivity Type** field and you enter **22 ; 161 ; 830** in the **Connectivity Port** field, the order of entry determines the mapping between the two fields:

- SSH: port 22
- SNMP: port 161
- NETCONF: port 830

For a list of the fields and the mandatory values you must enter, see the "Add New Device" field table in [Add Network Devices Through the UI, on page 17](#).

Be sure to delete the sample data rows before saving the file, or they will be imported along with the data you want. The column header row can stay, as it is ignored during import.

- c) When you are finished, save the new CSV file.


**Step 4** Click **Browse** to navigate to the CSV file you just created and then click **Open** to select it.

**Step 5** With the CSV file selected, click **Import**.

**Step 6** Resolve any errors and confirm device reachability.



The device information you imported should be displayed in the **Devices** window within a few minutes (see [Manage Network Devices, on page 11](#)).


It is normal for devices to show as unreachable or not operational when they are first imported. However, if after 30 minutes they are still displayed as unreachable or not operational, there is an issue that needs to be investigated. To investigate, select **Device Management > Job History** and click on any  you see in the **Status** column. Common issues include failure to ensure the associated credential profile contains the correct credentials. You can test this by opening a terminal window on the Cisco Crosswork Change Automation and Health Insights server and then trying to access the device using the protocol and credentials specified in the associated credential profile.

## Add Network Devices Through the UI

Follow the steps below to add devices one by one, using the UI. Under normal circumstances, you will want to use this method when adding one or a few devices only. For the bulk of your devices, add them either by synchronization with a provider (see [Add Cisco SR-PCE Providers](#)), or by importation from a CSV file (see [Import Network Devices, on page 16](#)).

### Before you begin

Be sure you have completed the planning steps and setup requirements discussed in [Get Started](#), and that the devices themselves have been pre-configured as explained in [Prerequisites for Onboarding Devices, on page 13](#).

- Step 1** From the main menu, choose **Device Management > Devices**. The **Network Devices** tab is displayed by default.
- Step 2** Click .
- Step 3** Enter values for the new device, as listed in the table below.
- Step 4** Click **Save**. (The Save button is disabled until all mandatory fields are complete.)
- Step 5** (Optional) Repeat to add more devices.

*Table 2: Add New Device Window (\*=Required)*

Field	Description
* <b>Configured State</b>	<p>The management state of the device. Options are</p> <ul style="list-style-type: none"> <li>• <b>UNMANAGED</b>—Cisco Crosswork Change Automation and Health Insights is not monitoring the device.</li> <li>• <b>DOWN</b>—The device is being managed and is down.</li> <li>• <b>UP</b>—The device is being managed and is up.</li> </ul>

Field	Description
* <b>Reachability Check</b>	<p>Determines whether Cisco Crosswork Change Automation and Health Insights performs reachability checks on the device. Options are:</p> <ul style="list-style-type: none"> <li>• <b>ENABLE</b> (In CSV: <b>REACH_CHECK_ENABLE</b>)—Checks for reachability and then updates the Reachability State in the UI automatically.</li> <li>• <b>DISABLE</b> (In CSV: <b>REACH_CHECK_DISABLE</b>)—The device reachability check is disabled.</li> </ul> <p>Cisco recommends that you always set this to <b>ENABLE</b>. This field is optional if <b>Configured State</b> is marked as <b>UNMANAGED</b>.</p>
* <b>Credential Profile</b>	<p>The name of the credential profile to be used to access the device for data collection and configuration changes. For example: <b>nso23</b> or <b>srpce123</b>.</p> <p>This field is optional if <b>Configured State</b> is marked as <b>UNMANAGED</b>.</p>
<b>Host Name</b>	The hostname of the device. Cisco Crosswork Change Automation and Health Insights discovers it and updates it.
<b>Inventory ID</b>	Inventory ID value for the device. The value can contain a maximum of 128 alphanumeric characters, and can include dots (.), underscores ("_"), colons (":"), or hyphens ("-"). No other special characters are allowed.
<b>Software Type</b>	Software type of the device. For more information, see <a href="#">Supported Devices and Software Types</a> .
<b>Software Version</b>	Software version of the device. For more information, see <a href="#">Supported Devices and Software Types</a> .
<b>UUID</b>	Universally unique identifier (UUID) for the device.
<b>Serial Number</b>	Serial number for the device.
<b>MAC Address</b>	MAC address of the device.
* <b>Capability</b>	The capabilities that allow collection of device data and that are configured on the device. You must select at least <b>SNMP</b> as this is a required capability. The device will not be onboarded if <b>SNMP</b> is not configured. Other options are <b>YANG_MDT</b> , <b>TL1</b> , <b>YANG_CLI</b> , and <b>YANG-EPNM</b> . The capabilities you select will depend on the device software type and version.
<b>Tags</b>	<p>The available tags to assign to the device for identification and grouping purposes.</p> <p>Use device tags to group devices for monitoring, and to provide additional information that might be of interest to other users, such as the device's physical location or its administrator's email ID. For more information, see <a href="#">Manage Device Tags</a>.</p>
<b>Product Type</b>	Product type of the device.
<b>Connectivity Details</b>	

Field	Description
<b>Protocol</b>	<p>The connectivity protocols used by the device. Choices are: <b>SSH</b>, <b>SNMPv2</b>, <b>NETCONF</b>, <b>TELNET</b>, <b>HTTP</b>, <b>HTTPS</b>, <b>GRPC</b>, and <b>SNMPv3</b>.</p> <p>To add more connectivity protocols for this device, click <b>+</b> at the end of the first row in the <b>Connectivity Details</b> panel. To delete a protocol you have entered, click <b>×</b> shown next to that row in the panel.</p> <p>You can enter as many sets of connectivity details as you want, including multiple sets for the same protocol. You must enter details for at least <b>SSH</b> and <b>SNMP</b>. If you do not configure <b>SNMP</b>, the device will not be added. If you want to manage the device (or you are managing XR devices), you must enter details for <b>NETCONF</b>. <b>TELNET</b> connectivity is optional.</p>
<b>* IP Address / Subnet Mask</b>	<p>Enter the device's IP address (IPv4 or IPv6) and subnet mask.</p> <p><b>Note</b> Please ensure that the subnets chosen for the IP networks (including devices and destinations) do not have overlapping address space (subnets/supernets) as it may result in unpredictable connectivity issues.</p>
<b>* Port</b>	<p>The port used for this connectivity protocol. Each protocol is mapped to a port, so be sure to enter the port number that corresponds to the <b>Protocol</b> you chose. The standard port assignments for each protocol are:</p> <ul style="list-style-type: none"> <li>• SSH: 22</li> <li>• SNMP: 161</li> <li>• NETCONF: 830</li> <li>• TELNET: 23</li> <li>• HTTP: 80</li> <li>• HTTPS: 443</li> </ul>
<b>Timeout</b>	<p>The elapsed time (in seconds) before communication attempts using this protocol will time out. The default value is 30 seconds. For XE devices using NETCONF, the recommended minimum timeout value is 90 seconds. For all other devices and protocols, the recommended minimum timeout value is 60 seconds.</p>
<b>Routing Info</b>	
<b>ISIS System ID</b>	<p>The device's IS-IS system ID. This ID identifies the router in an IS-IS topology, and is required for SR-PCE integration.</p>
<b>OSPF Router ID</b>	<p>The device's OSPF router ID. This ID identifies the router in an OSPF topology, and is required for SR-PCE integration.</p>
<b>*TE Router ID</b>	<p>The device's OSPF Router ID or ISIS Router ID depending on the IGP used in the network topology.</p>
<b>Streaming Telemetry Config</b>	
<b>Telemetry Interface Source VRF</b>	<p>Name of the VRF within which Model Driven Telemetry (MDT) traffic is routed.</p>

Field	Description
<p><b>Location</b></p> <p>All location fields are optional, with the exception of <b>Longitude</b> and <b>Latitude</b>, which are required for the geographical view of your network topology.</p>	
<p><b>Longitude, Latitude</b></p>	<p>Longitude and latitude values are required so that the geographical map can present the correct geographical location of the device and its links to other devices. Enter the longitude and latitude in Decimal Degrees (DD) format.</p>
<p><b>Altitude</b></p>	<p>The altitude, in feet or meters, at which the device is located. For example, <b>123</b>.</p>
<p><b>Providers and Access</b></p>	
<p><b>Local Config: Provider and Device Key</b></p>	<p>Provider type used to configure devices. Choose a provider from the list.</p> <p>If a Cisco NSO provider is chosen, the Device Key will automatically populate and the Credential Profile appears.</p> <p>For CSV entry, use <code>ROBOT_PROVIDER_LOCAL_CONFIG</code> and enter the Provider name.</p>
<p><b>Compute Config: Provider</b></p>	<p>Provider type used for topology computation. Choose a provider from the list.</p> <p>For CSV entry, use <code>ROBOT_PROVIDER_COMPUTE</code> and enter the Provider name.</p>

## Example

**Figure 3: Add New Device Window**

The screenshot shows a 'Add New Device' window with the following sections and fields:

- General:** Configured State (dropdown), Reachability Check (dropdown), Credential Profile (dropdown), Host Name (text), Inventory ID (text), Software Type (text), Software Version (text), UUID (text), Serial Number (text), Mac Address (text), Capability (dropdown), Tags (dropdown), Product Type (text).
- Connectivity Details:** Protocol (dropdown), IP Address / Subnet Mask (text), Port (text), Timeout (text), + Add Another (button), trash icon.
- Routing Info:** IS-IS System ID (text), OSPF Router ID (text), TE Router ID (text).
- Streaming Telemetry config:** Vrf (text), Source Interface (dropdown, currently 'Loopback'), text field.
- Location:** Building (text), Street (text), City (text), State (text), Country (text), Region (text), Zip (text), Latitude (text), Longitude (text), Altitude (text).
- Providers and Access:** Local Config (dropdown), Provider (dropdown), Device Key (text), Compute Config (dropdown), Provider (dropdown).

Buttons at the bottom: Save, Cancel.

## Get Network Device Details


Whenever you select **Device Management > Devices** and display the list of devices under the **Network Devices** tab, you can click  next to any listed device to get more information about that device. Clicking this icon opens the **Details for DeviceName** pop-up window, as shown in the following example:

Figure 4: Details for DeviceName Window

Details for 1bce17d4-5219-4d97-880a-871428888888 ×

▼ Connectivity Details

Protocol	IP Address/Port	Timeout
<input checked="" type="checkbox"/> SSH	10.10.10.10:22	60
<input checked="" type="checkbox"/> TELNET	10.10.10.10:23	60
<input checked="" type="checkbox"/> SNMP	10.10.10.10:161	60
<input checked="" type="checkbox"/> NETCONF	10.10.10.10:830	60

▼ Identifiers

**Key Type**  
**Inventory ID**  
**Host Name** spnac-a9k-s105  
**UUID** 1bce17d4-5219-4d97-880a-871428888888  
**Node IP** 10.10.10.10  
**Serial #** 256E-88888888  
**Mac Address** 0050-8888-8888

▼ Hardware/Software

**Product Type** CISCO-XRv9000  
**Product Family** Cisco XRv9K  
**Product Series** Cisco XRV9000 Series Virtual Routers  
**Manufacturer** Cisco Systems Inc.  
**Software Type** IOS XR  
**Software Version** 6.6.3  
**Capability** YANG\_MDT;SNMP;YANG\_CLI

▼ Routing Info

**ISIS System ID**  
**OSPF Router ID**  
**TE Router ID** 10.10.10.10

▼ Streaming Telemetry config

**Telemetry Interface** default  
**Source VRF**

▼ Location

**Civic Address**  
**Latitude** 41.988888  
**Longitude** 12.488888  
**Altitude**

▼ Providers and Access

Local Config

**Device Key** cw-88888888  
**Provider Name** nso7  
**Credential Profile** nso-creds

Compute Config

**Provider Name**  
**Credential Profile**

Expand the **Connectivity Details** area at the top of the pop-up window (if it is not already expanded). This area shows the reachability status for all transport types (for help with the icons shown in this area, see [Device and Link Icons](#)).

Expand and collapse the other areas of the pop-up window, as needed. Click **×** to close the window.

## Filter Network Devices by Tags

By creating a tag and assigning it to a particular device, you can easily provide additional information that might be of interest to other users, such as the device's physical location and its administrator's email ID. You can also use tags to find and group devices with the same or similar tags in any window that lists devices.

For help with tagging your devices, see [Apply or Remove Device Tags](#). For help with creating and deleting tags, see [Manage Tags](#).

To filter devices by tags:

- 
- Step 1** Display the **Network Devices** tab or the **Network Topology** map:
    - a) Display the **Network Devices** tab by choosing **Device Management > Devices**.
    - b) Display the topology map by choosing **Network Visualization > View Topology**.
  - Step 2** In the **Type to filter by tags** bar at the top of the user interface, type all or part of the name of a tag.

The **Type to filter by Tags** bar has a type-ahead feature: As you start typing, the field shows a drop-down list of tags that match all the characters you have typed so far. To force the drop-down list to display all available tags, type **\***.
  - Step 3** Choose the name of the tag you want to add to the filter. The filter appears in the **Type to filter by tags** filter bar. The table or map shows only the devices with that tag.
  - Step 4** If you want to filter on more than one tag:
    - a) Repeat Steps 2 and 3 for each additional tag you want to set as part of the filter.
    - b) When you have selected all the tags you want, click **Apply Filters**. The table or map shows only the devices with tags that match **all** the tags in your filter.
  - Step 5** To clear all tag filters, click the **Clear Filters** link. To remove a tag from a filter containing multiple tags, click the **X** icon next to that tag's name in the filter.
- 

## Edit Network Devices

Complete the following procedure to update a device's information.

Before editing any device, it is always good practice to export a CSV backup of the devices you want to change (see [Export Network Devices, on page 25](#)).

- 
- Step 1** From the main menu, choose **Device Management > Devices**. The **Network Devices** tab is displayed by default.
  - Step 2** (Optional) Filter the list of devices by filtering specific columns.
  - Step 3** Check the check box of the device you want to change, then click
  - Step 4** Edit the values configured for the device, as needed. For a description of the fields you can update, see [Add Network Devices Through the UI](#).

**Note** In addition to the existing fields, you can also view the **Data Gateway** configured for the selected device. This field is read-only.
  - Step 5** Click **Save**. (The Save button remains dimmed until all required fields are filled in.)

**Step 6** Resolve any errors and confirm device reachability.

## Delete Network Devices

Complete the following procedure to delete devices.


### Before you begin

- If the auto-onboard **managed** or **unmanaged** options are set for an SR-PCE provider, you should set auto-onboard for the SR-PCE(s) to **off**.
- Confirm that the device is not connected to the network or that it is powered off before deleting the device.



### Note

- If devices are mapped to Cisco NSO with MDT capability, and telemetry configuration is pushed, then those configurations will be removed from the device.
- If auto-onboard is not set to **off**, and it is still functional and connected to the network, the device will be rediscovered as unmanaged as soon as it is deleted.

- Step 1** Export a backup CSV file containing the devices you plan to delete (see [Export Network Devices, on page 25](#)).
- Step 2** From the main menu, choose **Device Management > Devices**. The **Network Devices** tab is displayed by default.
- Step 3** (Optional) In the **Devices** window, filter the list of devices by entering text in the **Search** field or filtering specific columns.
- Step 4** Check the check boxes for the devices you want to delete.
- Step 5** Click  to edit the devices, as follows:
- Change each device's state to **DOWN** or **UNMANAGED**.
- If you want to delete devices in bulk, Cisco recommends that you change the device state in this manner in batches of 50 devices, then complete deletion of these devices before deleting another batch.
- Delete any KPIs currently running on the devices.
  - Abort any Playbooks running on or scheduled to run on the devices.
- Step 6** Click .
- Step 7** In the confirmation dialog box, click **Delete**.
- Step 8** After deleting a device from the user interface, delete any telemetry configuration objects on the router that match the regex pattern `*CW_*.*`. For example: You would find and delete router config objects like the three shown below:

```
!
destination-group CW_df5068767b68f9f0d9649cb32aca0cde917e5694
  address-family ipv4 172.16.2.31 port 31500
  encoding self-describing-gpb
  protocol tcp
!
!
sensor-group CW_df5068767b68f9f0d9649cb32aca0cde917e5694
  sensor-path Cisco-IOS-XR-nto-misc-oper:memory-summary/nodes/node/summary
```



```
!  
subscription CW_df5068767b68f9f0d9649cb32aca0cde917e5694  
  sensor-group-id CW_df5068767b68f9f0d9649cb32aca0cde917e5694 sample-interval 120000  
  destination-id CW_df5068767b68f9f0d9649cb32aca0cde917e5694  
!  
!
```

---

## Export Network Devices


When you export the device list, all device information is exported to a CSV file. Exporting the device list is a handy way to keep a record of all devices in the system at one time. You can also edit the CSV file as needed, and re-import it to overwrite existing device data.



---

**Note** The exported device CSV file will contain only the name of the credential profile for each device, not the credentials themselves.

---

- 
- Step 1** From the main menu, choose **Device Management > Devices**. The **Network Devices** tab is displayed by default.
  - Step 2** (Optional) Filter the device list as needed.
  - Step 3** Check the check boxes for the devices you want to export. Check the check box at the top of the column to select all the devices for export.
  - Step 4** Click . Your browser will prompt you to select a path and the file name to use when saving the CSV file, or to open it immediately
- 

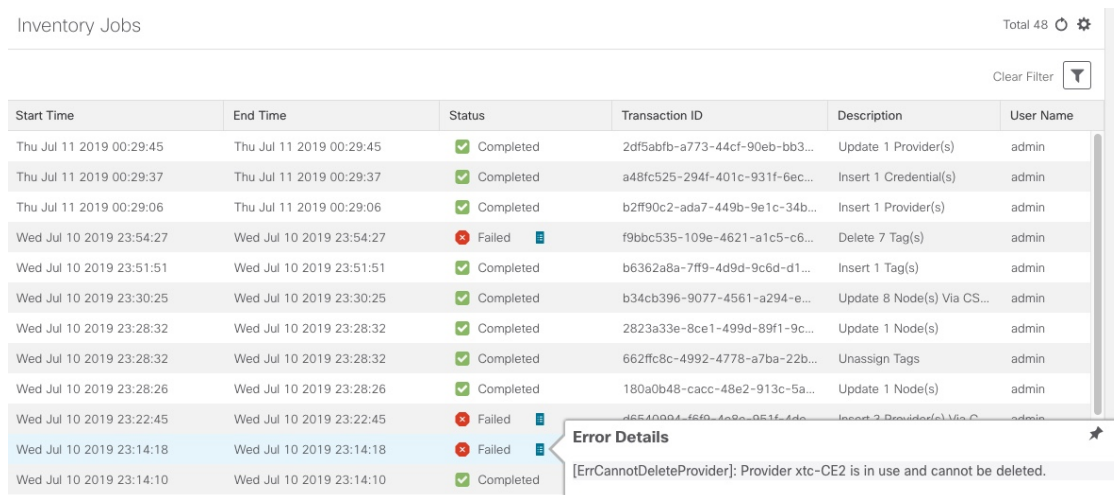
## View Device Job History

Device Management collects and stores information about device-related jobs. Follow the steps below to track all create, update and delete activities.

---


- Step 1** From the main menu, choose **Device Management > Job History**. The **Inventory Jobs** window displays a log of all device-related jobs, like the one shown below.

Figure 5: Job History Window With Error Details Popup



Start Time	End Time	Status	Transaction ID	Description	User Name
Thu Jul 11 2019 00:29:45	Thu Jul 11 2019 00:29:45	Completed	2df5abfb-a773-44cf-90eb-bb3...	Update 1 Provider(s)	admin
Thu Jul 11 2019 00:29:37	Thu Jul 11 2019 00:29:37	Completed	a48fc525-294f-401c-931f-6ec...	Insert 1 Credential(s)	admin
Thu Jul 11 2019 00:29:06	Thu Jul 11 2019 00:29:06	Completed	b2f90c2-ada7-449b-9e1c-34b...	Insert 1 Provider(s)	admin
Wed Jul 10 2019 23:54:27	Wed Jul 10 2019 23:54:27	Failed	f9bbc535-109e-4621-a1c5-c6...	Delete 7 Tag(s)	admin
Wed Jul 10 2019 23:51:51	Wed Jul 10 2019 23:51:51	Completed	b6362a8a-7ff9-4d9d-9c6d-d1...	Insert 1 Tag(s)	admin
Wed Jul 10 2019 23:30:25	Wed Jul 10 2019 23:30:25	Completed	b34cb396-9077-4561-a294-e...	Update 8 Node(s) Via CS...	admin
Wed Jul 10 2019 23:28:32	Wed Jul 10 2019 23:28:32	Completed	2823a33e-8ce1-499d-89f1-9c...	Update 1 Node(s)	admin
Wed Jul 10 2019 23:28:32	Wed Jul 10 2019 23:28:32	Completed	662ffc8c-4992-4778-a7ba-22b...	Unassign Tags	admin
Wed Jul 10 2019 23:28:26	Wed Jul 10 2019 23:28:26	Completed	180a0b48-cacc-48e2-913c-5a...	Update 1 Node(s)	admin
Wed Jul 10 2019 23:22:45	Wed Jul 10 2019 23:22:45	Failed	45540994-f6f9-4a8e-953f-4d...	Insert 2 Provider(s) Via C...	admin
Wed Jul 10 2019 23:14:18	Wed Jul 10 2019 23:14:18	Failed			
Wed Jul 10 2019 23:14:10	Wed Jul 10 2019 23:14:10	Completed			

The jobs display in descending order of creation time. The most recent job is shown first. To sort the data in the table, click a column heading. You can toggle between ascending and descending sort order (for more help, see [Set, Sort and Filter Table Data](#)).

**Step 2** The **Status** column shows three types of states: completed, failed, and partial. For any failed or partial job, click  shown next to the error for information.

Error information may include `clean-up failure` events as audit messages. These messages indicate that Cisco Crosswork Network Automation configuration objects on the device could not be removed, and will explain why they could not be removed. Users will need to take manual action to remove them. This typically involves deleting any XR telemetry configuration objects with names starting with `CW_`.

## Manage Devices Using Zero Touch Provisioning

### Introduction

The Crosswork Zero Touch Provisioning (ZTP) application allows users to quickly and easily bring up devices using a Cisco-certified software image and a day-zero software configuration of the customer's choice. Once provisioned in this way, the new device is onboarded to the Crosswork device inventory (and, if it is configured as a Crosswork Provider, to Cisco NSO), where it can be monitored and managed like other devices.

Crosswork ZTP can connect devices to the network either out-of-band, via the management network (if your organization has established one), or in-band, over the data network. The file integrity of software images is validated before upload to Crosswork using the Cisco-supplied MD5 checksum for each image file. Both image and configuration files are stored in the Crosswork inventory, as part of the ZTP controller service, which is accessible via API. ZTP uses the secure iPXE remote boot capability, and your organization's DHCP server, to download files to each device and install or execute them.

Crosswork ZTP is especially useful when factory-reset devices have been shipped to a branch office or other remote site and then cabled to the network, with no image or configuration. Using the ZTP application, a network administrator can establish an entry for the device with a corresponding image and configuration,

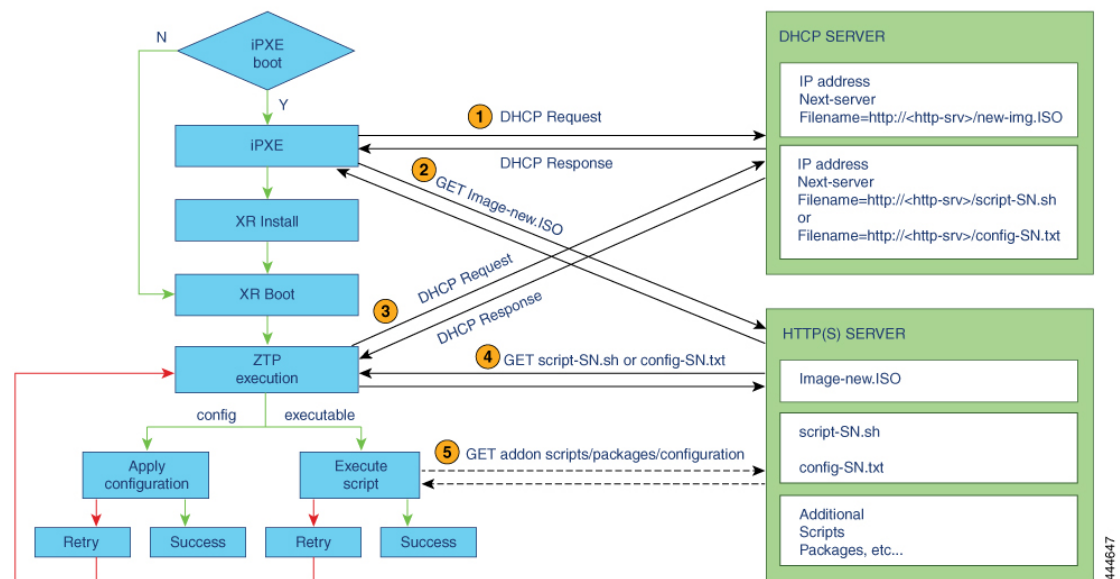
and both provision and onboard the device. The only intervention needed at the device is to press the reset button on the device chassis.

Crosswork ZTP is also useful for devices that are already in production. Users can trigger a CLI reboot of the already-imaged device, and then reload or replace the current software image, apply a Software Maintenance Update (SMU), run a day-one or later configuration script, or execute arbitrary CLI, shell or Python scripts on the device as needed.

Crosswork ZTP is fully integrated with Cisco Smart Licensing. Once provisioned and onboarded, each ZTP device's "Provisioned" status registers and activates a single Smart License for that device, based on its serial number. The license and the device are thereafter counted and tracked. Re-provisioning or configuring for the same device does not consume an additional license (see [Evaluation Licenses and ZTP](#), on page 28).

### ZTP Process Logic

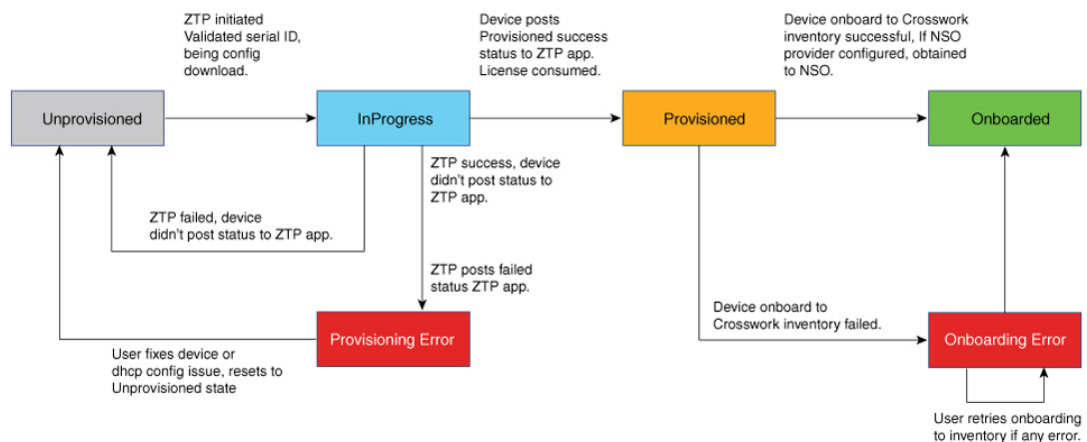
The illustration below shows the process logic that ZTP uses to provision and onboard devices.



### ZTP Device State Transitions

Once initiated by a factory reset or CLI reload, the ZTP process proceeds automatically, and updates the Zero Touch Devices window with status messages indicating which stage of the process the device has reached. The figure below shows the state changes as the process proceeds. ZTP device entries start out in the **Unprovisioned** state and, after ZTP is initiated, transition to the **Provisioned** state, where they are connected to the network. If the provisioning is successful, the device will transition to the **Onboarded** state, where it becomes part of the Crosswork inventory and can be monitored and managed like any other Crosswork network device.

The ZTP process is considered successful when the ZTP device loads all of its code successfully ("code" meaning both the image plus configuration files, or the configuration file alone), establishes connectivity with Crosswork, and updates its **Status to Provisioned**. Achieving this state causes one license to be counted for that specific device's serial number. Because the license is based on the device serial number, later transition to the **Onboarded** state, or any further ZTP re-provisioning, re-imaging, or re-configuration, does not affect the license count.



### Evaluation Licenses and ZTP

All licenses start with an evaluation period, typically 90 days. When the evaluation period expires, Crosswork will display a banner, warning users that evaluation licenses have expired. While this banner is displayed, some ZTP operations (such as configuration downloads) will be blocked. Users will need to purchase a valid license with an entitlement for the number of ZTP devices to be provisioned and onboarded to resume using blocked functions. The ZTP server treats licenses in a non-restrictive manner, in the sense that, even if all of the valid licenses are consumed, most ZTP functions will continue to work, but the warning banner will be displayed.

### ZTP Supported Platforms

Crosswork Zero Touch Provisioning supports the following platforms:

- **Software:** Cisco IOS-XR versions 6.6.3, 7.0.1, 7.0.2, and 7.0.12.
- **Hardware:** Cisco Network Convergence Systems (NCS) 5500 Series Routers, NCS 540 Series Routers, NCS 560 Series Routers, NCS 1000-1004 Series Routers, Cisco Aggregation Services (ASR) 9000 Series Routers, and Cisco 8000 and 8800 Series Routers.



**Note** Customers using the following Cisco IOS-XR versions, please contact Cisco Customer Experience (CX) to source SMUs/ISOs for the following caveats:

- IOS-XR 7.0.1: [CSCvs98093](#)
- IOS-XR 7.0.2: [CSCvt30758](#)

### ZTP Prerequisites

In addition to the other requirements mentioned in this section, using Crosswork ZTP to provision and onboard devices means your Crosswork installation must meet the following requirements:

- Ensure that Crosswork and your IOS XR devices are deployed in a secure network domain.

- Configure your organization's DHCP server to enable ZTP image and configuration file downloads. See [DHCP Setup for Crosswork ZTP, on page 50](#).
- The Crosswork server must be reachable from the devices, via an out-of-band management or in-band data network. See the network diagram in the "Network Requirements" topic in the *Cisco Crosswork Change Automation and Health Insights Installation Guide*.
- The Credential Profiles you plan to use to manage the ZTP devices once they have been onboarded must already exist in Crosswork. See [Manage Credential Profiles, on page 3](#).
- If you want Crosswork ZTP to onboard your devices to Cisco NSO, NSO must already be configured as a Crosswork Provider. See [Manage Providers](#) and [Sample Configuration for Devices in Cisco NSO, on page 15](#).

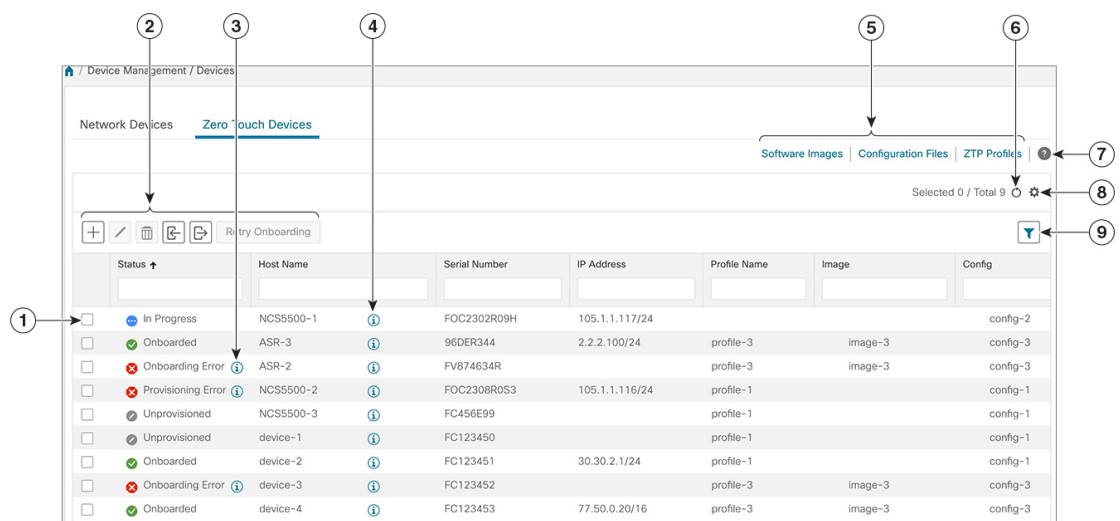
### Use the Zero Touch Devices Window to Work with Devices

The **Zero Touch Devices** window (shown below) gives you a list of all of the ZTP device entries you have created and enables you to add, import, edit, and delete them. Once ZTP processing is initiated, you can use the window's **Status** column to monitor each device's progress from the initial **Unprovisioned** state to the **Provisioned** and final **Onboarded** states (see [ZTP Device State Transitions, on page 27](#)). You can also get a summary view of current ZTP device status by viewing the **Zero Touch Provisioning** dashboard on the Crosswork Home page (see [Use the Zero Touch Provisioning Tile to Monitor Progress, on page 31](#)).













The same **Status** column notifies you when a **Provisioning Error** or **Onboarding Error** occurs for a device during ZTP processing. If errors are detected, you can use this window to view possible causes of an onboarding error, edit the device's **Status** back to **Unprovisioned**, and then either **Retry Onboarding** (in the case of an onboarding error) or trigger ZTP processing again (in the case of a provisioning error).


Once ZTP devices are successfully onboarded, you can manage and monitor them using the **Network Devices** tab.

To view the **Zero Touch Devices** window, select **Device Management > Devices > Zero Touch Devices**.



Item	Description
1	Text and icons in the <b>Status</b> column show the current provisioning status of each ZTP device.

Item	Description
2	<p>Click  to add a new ZTP device to the ZTP repository. See <a href="#">Create ZTP Device Entries Using the UI, on page 44</a>.</p> <p>Click  to edit the information for the currently selected ZTP device entry, including the device <b>Status</b>. See <a href="#">Edit ZTP Devices, on page 49</a>.</p> <p>For devices with an error <b>Status</b>, such as <b>Onboarding Error</b> or <b>Provisioning Error</b>, you must always use the  to reset the device's <b>Status</b> to <b>Unprovisioned</b> before attempting to retry onboarding.</p> <p>Click  to delete the currently selected ZTP device entry. See <a href="#">Delete ZTP Devices, on page 50</a>. Note that deleting a device that has successfully completed ZTP processing has no impact on the number of ZTP licenses that have been used.</p> <p>Click  to import new ZTP device entries using a CSV file. You can also download a CSV file template by clicking this icon. The template includes sample data that you can use as a guide for building your own CSV file. See <a href="#">Create ZTP Device Entries Using Import, on page 47</a> and <a href="#">Prepare ZTP Device Import Files, on page 48</a>.</p> <p>Click  to export information for selected ZTP devices to a CSV file. See <a href="#">Export Devices</a>.</p> <p>Click <b>Retry Onboarding</b> to attempt to onboard a selected ZTP device entry when a previous onboarding attempt failed. You must first select the device entry you want to retry. You cannot retry more than one device entry at a time.</p> <p>Before before attempting to retry onboarding for a device, you must use the  to reset the device's <b>Status</b> to <b>Unprovisioned</b>.</p> <p>You will want to review the error popup and log files, determine why the ZTP onboarding process failed (for example: bad IP address) and, where needed, update the device entry's image or configuration, or update the corresponding DHCP device entry (see <a href="#">DHCP Setup for Crosswork ZTP, on page 50</a>).</p>
3	Click  in the <b>Status</b> column for information on the cause of any detected provisioning or onboarding errors. See <a href="#">Troubleshoot ZTP Issues, on page 67</a> .
4	Click  in the <b>Host</b> column for details about the host.
5	Click these links to bypass the Crosswork main menu and navigate directly to the <b>Software Image</b> , <b>Configurations</b> or <b>ZTP Profiles</b> window.
6	Click  to refresh the <b>Zero Touch Devices</b> window.
7	Click  to display the <b>Zero Touch Provisioning Steps</b> page. It will remind you of the ZTP process workflow steps, and help you navigate to the parts of the ZTP user interface that will enable you to complete each step. See <a href="#">Workflow: Zero Touch Provisioning, on page 32</a> .
8	Click  to select which columns to display in the <b>Zero Touch Devices</b> window. See <a href="#">Set, Sort and Filter Table Data</a> .

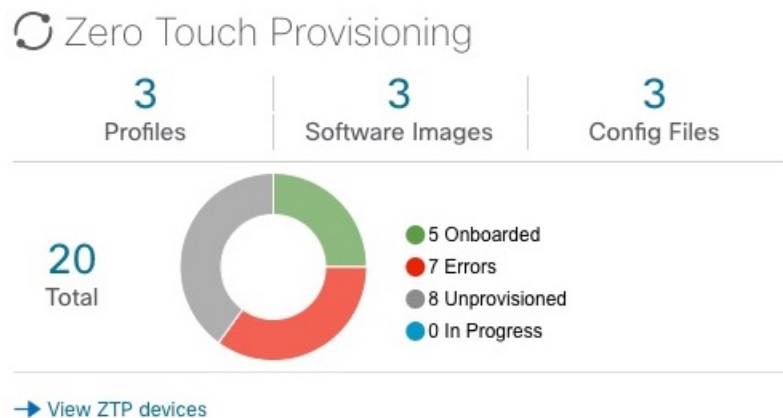
Item	Description
9	Click  to set filter criteria on one or more columns in the <b>Zero Touch Devices</b> window. See <a href="#">Set, Sort and Filter Table Data</a> .
	Click the <b>Clear Filter</b> link to clear any filter criteria you may have set.

### Use the Zero Touch Provisioning Tile to Monitor Progress

The **Zero Touch Provisioning** tile (shown below) lets you see a summary view of your current ZTP processing status. It provides a count for all the devices, images, configuration files and profiles currently in use, as well as the number of devices in each of the possible ZTP states (see [ZTP Device State Transitions, on page 27](#)).

Until you begin using ZTP device management, the tile will have counts of zero for all of these indicators. The counts will change as you work with the application. Clicking on the **View ZTP devices** link at the bottom of the tile will navigate directly to the **Zero Touch Devices** window, where you can begin creating ZTP device entries and ZTP profiles by uploading the associated software image and configuration files (see [Use the Zero Touch Devices Window to Work with Devices, on page 29](#)).

To view the **Zero Touch Provisioning** tile, click the **Home** icon on the main menu.



## Zero Touch Provisioning Concepts

Crosswork Zero Touch Provisioning (ZTP) makes use of the following basic terminology and concepts:


- **Image file:** A binary Cisco IOS-XR software image or Software Maintenance Update (SMU) file, used to install or maintain an installation of the Cisco Internet Operating System on a network device. The Crosswork ZTP process on the device downloads the image from Crosswork and installs the images using the [open-source boot firmware iPXE](#). If any SMU maintenance patches need to be deployed, they can be done via user script after image download via ZTP processing.
- **Configuration file:** A file used to set the operating parameters of the newly imaged or re-imaged device. This can be a Python script, Linux shell script, or a sequence of Cisco IOS CLI commands stored as an ASCII text file. The Crosswork ZTP process downloads the configuration file to the newly imaged device, which then executes it.
- **ZTP profile:** A Crosswork storage construct that combines (normally) one image and one configuration into a single unit. Crosswork uses ZTP profiles to automate imaging and configuration processes. While

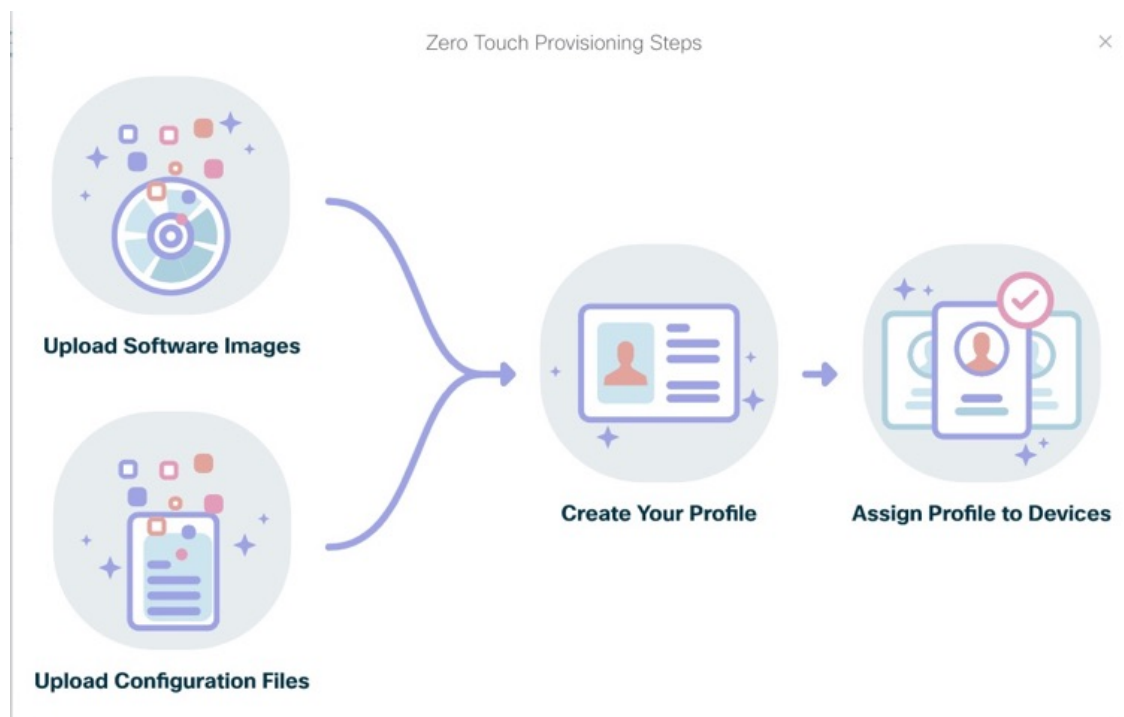


optional, creating ZTP profiles is recommended as the best way to combine a single image file and configuration file based on a product or device family, such as the Cisco ASR 9000 or Cisco NCS5500. It will also help you to configure your organization's DHCP server based on device family class, and use a single set of image/configuration files for devices in that class.

- **ZTP repository:** The location where Crosswork stores ZTP image and configuration files.
- **File path:** The explicit path to a stored image, SMU, or configuration file in the ZTP repository. Better known as the bootfile name, the file path is used in DHCP (option 67 for v4) configuration and represented as an HTTP/HTTPS URL image or configuration file path in the repository. File paths must be specified when you update DHCP for your ZTP devices. You can easily copy this URL from the ZTP repository and update it in the DHCP server configuration file (see [Copy Configuration File Paths and UUIDs, on page 41](#) and [Copy Image File Paths and UUIDs, on page 36](#)).
- **UUID:** The Universal Unique Identifier (UUID) uniquely identifies an image or configuration file uploaded to Crosswork. In the DHCP bootfile URL, for any change in the configuration or image file used for ZTP, it is sufficient to copy and then update the corresponding UUID in the URL.

## Workflow: Zero Touch Provisioning

For a reminder of the main steps in using Zero Touch Provisioning (ZTP) to provision and onboard your network devices, click  on any window in the ZTP application. The popup **Zero Touch Provisioning Steps** page shown below displays icons representing each major step in the process. Click on one of the icons to navigate directly to the part of the Crosswork ZTP user interface that allows you to perform that step.



The following table provides links to more detailed information on how to perform each step in the process



Step	For details, see...
1. Download from Cisco and then upload to the ZTP repository the IOS-XR device image files you want to use to image your ZTP devices.	<a href="#">Upload Software Image Files, on page 34</a>
2. Create and then upload to the ZTP repository the day-zero (or later) configuration files you want to use to configure your devices.	<a href="#">Upload Configuration Files, on page 36</a> <a href="#">Prepare Your Custom Day-Zero Configuration Files, on page 37</a> <a href="#">Use Custom Day-Zero Configuration Files, on page 39</a>
3. (Optional) Create one or more ZTP profiles to image and/or configure your devices. Note that specifying an image file in a ZTP profile is optional. You can also image or configure a device without a ZTP profile, by specifying the image and/or configuration file when you create the ZTP device entry.	<a href="#">Create Zero Touch Profiles, on page 42</a>
4. Create ZTP device entries to be provisioned and onboarded by ZTP processing. You can specify the device image and/or configuration file to be used in ZTP processing either in the ZTP device entry itself, or by specifying a ZTP profile (if you have created one).	<a href="#">Create ZTP Device Entries, on page 44</a>
5. Modify your organization's DHCP configuration, so that DHCP can properly respond to each device's request for an image and/or configuration download.	<a href="#">DHCP Setup for Crosswork ZTP, on page 50</a>
6. Initiate the ZTP process, which will then provision and onboard ZTP devices. You can trigger Crosswork ZTP processing by rebooting the device.	<p>You can do this either by:</p> <ul style="list-style-type: none"> <li>• If you have physical access to the device: Press the reset button on the device chassis.</li> <li>• If the device has been imaged: Connect to the device via the console, enter exec mode, and issue a <code>ztp initiate</code> command. The command will try to initiate on the management port first, then try other available ports.</li> </ul> <p>For details and options for the <code>ztp initiate</code> command, <a href="#">see the examples at this link</a>.</p>
7. Troubleshoot provisioning and onboarding issues as needed	<a href="#">Troubleshoot ZTP Issues, on page 67</a>

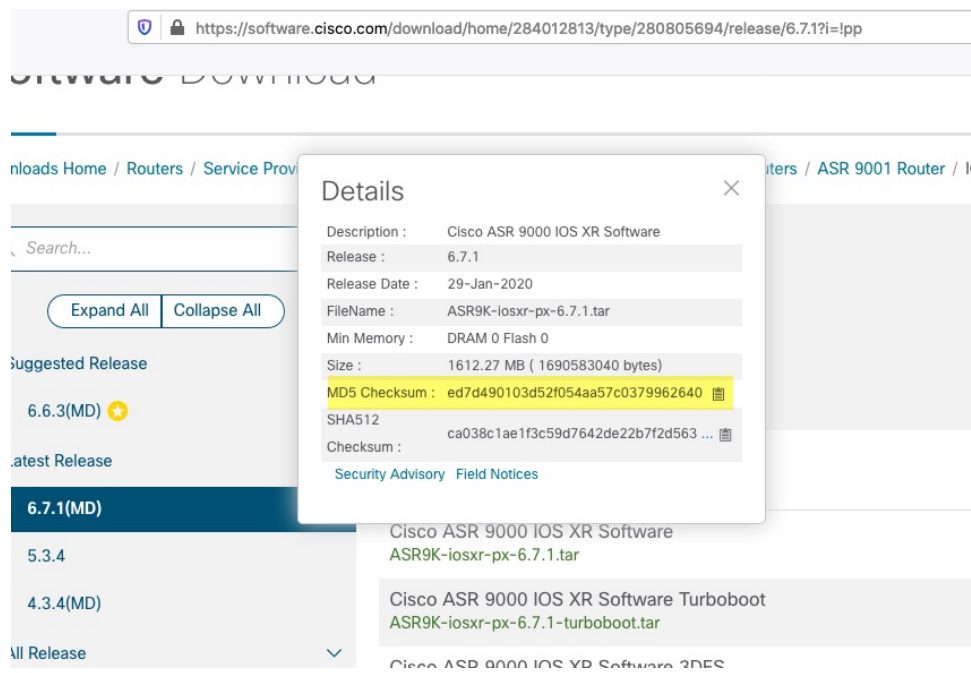
## Upload Software Image Files

The ZTP repository is intended for initial onboarding of devices. You can upload as many images as you want, up to the maximum image-file storage limit of 20GB. As image files tend to be large, Cisco recommends that you restrict uploads to only those images needed for day-zero imaging.

### Before you begin

Be sure to:

- Download the image files you plan to add to the ZTP repository. Licensed software images and SMU files are always available for download from the [Cisco Software Download site](#). Only image files with the filename extensions `iso`, `tar` or `rpm` can be uploaded to the ZTP repository. See [ZTP Supported Platforms, on page 28](#).
- Copy to your clipboard or record the MD5 checksum used to verify the integrity of each image file. The MD5 checksum for each image file is available on the **Details** popup window for the Cisco Software Download page from which you downloaded that file. You can quickly copy the checksum to your clipboard by clicking the clipboard icon shown on the same line as the MD5 checksum itself (highlighted in the example popup shown below).



**Step 1** From the main menu, choose **Device Management** > **Software Images**. Crosswork displays the **Image Repository** list.

**Step 2** Click . Crosswork displays the **Add Image** page.

**Step 3** Enter the values for the new file upload as shown in the table below.


Table 3: Add Image Fields (\*=required)

Field	Description
<b>Image Name *</b>	The unique name you want to assign to the uploaded image file.
<b>Image Type *</b>	Select <b>Image</b> or <b>SMU</b> .
<b>MD5 Checksum *</b>	Enter the image's MD5 checksum.
<b>OS Platform *</b>	Select the IOS device software platform. Currently, the <b>IOS-XR</b> platform is supported.
<b>OS Version *</b>	Select the IOS software platform version for the image or SMU. Currently, versions <b>6.6.3</b> , <b>7.0.1</b> , <b>7.0.2</b> and <b>7.0.12</b> are supported.
<b>Device Family *</b>	Select the device family on which this software image or SMU will be applied (for example, <b>CISCO ASR9000</b> ).
<b>Software Image *</b>	Click <b>Browse</b> to navigate to and select the image or SMU file to be uploaded.

- Step 4** When you have complete entries in all of the required fields, click **Add** to begin uploading the new file. Crosswork displays a progress bar during the upload. Once the upload is complete, Crosswork verifies the integrity of the image file using the MD5 checksum you entered. If these do not match, then either the checksum is incorrect or the file is corrupt. Crosswork will prompt you to either correct the checksum, or upload another version of the file.

## Edit Image Files

Except for the software image file name itself, you can change any of the properties for an image you have added to the ZTP repository.

- Step 1** From the main menu, choose **Device Management > Software Images**. Crosswork displays the **Image Repository** list.
- Step 2** In the **Image Repository** list, click the selection box next to the image file whose properties you want to edit.
- Step 3** Click . Crosswork displays the **Edit Image** page.
- Step 4** Change the values in the fields as needed.
- Step 5** When you have completed your changes, click **Update** to save them.


## Delete Image Files

Deleting an image associated with a ZTP profile will render that profile non-functional. A mistaken deletion cannot be undone, but the image can be uploaded again and re-associated with the ZTP profile.

As software image files tend to be very large, Cisco recommends that you restrict your ZTP repository to only those images needed for Day Zero and Day One configurations.

**Before you begin**

There are no checks to prevent deletion of an active image file. Be sure that any image you plan to delete from the ZTP repository is not already associated with ZTP device entries or ZTP profiles. You can check if an image file is associated with an individual ZTP device entry by checking your device entries listed on the **Zero Touch Devices** window (see [Use the Zero Touch Devices Window to Work with Devices, on page 29](#)). You can check if an image file is associated with a ZTP profile by selecting the **View Details** option for the ZTP profile with which you think it may be associated (see [View Zero Touch Profile Details, on page 44](#)).

- 
- Step 1** From the main menu, choose **Device Management > Software Images**. Crosswork displays the **Image Repository** list.
- Step 2** In the **Image Repository** list, click the selection box next to the image you want to delete.
- Step 3** Click .
- Crosswork prompts you to verify that the image file is not already associated with a ZTP profile.
- Step 4** Click **Delete** to delete the image file.
- 

**Copy Image File Paths and UUIDs**

When added to Crosswork, every image or SMU file is assigned a unique UUID and stored in the Crosswork repository. You will need to specify the unique repository file path and UUID for each device when modifying your DHCP server configuration file to permit provisioning (see [DHCP Setup for Crosswork ZTP, on page 50](#)). You can quickly copy to your clipboard the complete file path and UUID for any image or SMU file, directly from the **Software Images** list. You can also copy just the image file's UUID.

- 
- Step 1** From the main menu, choose **Device Management > Software Images**. Crosswork displays the **Image Repository** list.
- Step 2** If you want to copy:
- The image's full path and UUID: Click  in the **Image/SMU Name** column.
  - The image's UUID only: Click  in the **Image UUID** column.

Crosswork copies the file path and/or UUID to your clipboard. You can now paste it into your DHCP host entry.

When using the copied file path to create DHCP host entries, be sure to replace the *IP* variable with the IP address and port of your Crosswork server.

---

**Upload Configuration Files**

You can add a maximum of 5GB of configuration files to the ZTP repository. No single configuration file can exceed 2MB in size.

**Before you begin**

Be sure you have prepared one or more configuration or script files to add to the ZTP repository. Only IOS-XR CLI text configuration (`.txt`), Linux shell (`.sh`) or Python script (`.py`) files, with the appropriate filename extensions, can be added.

For guidance on creating and running custom configuration files using Crosswork ZTP, see [Prepare Your Custom Day-Zero Configuration Files, on page 37](#) and [Use Custom Day-Zero Configuration Files, on page 39](#).

**Step 1** From the main menu, choose **Device Management > Configuration Files**. Crosswork displays the **Configurations** window.

**Step 2** Click . Crosswork displays the **Add Configuration** page.

**Step 3** Enter the values for the new configuration file upload as shown in the table below.

*Table 4: Add Configuration Fields (\*=required)*

Field	Description
<b>Configuration Name *</b>	The unique name you want to assign to the uploaded configuration file. This is the name that distinguishes it from all other configuration files in the repository, and is the name that will appear on the <b>Configuration Files</b> list.
<b>OS Platform *</b>	Select the IOS device software platform appropriate for this configuration. Currently, the <b>IOS-XR</b> platform is supported.
<b>OS Version *</b>	Select the IOS software platform version appropriate for this configuration. Currently, versions <b>6.6.3</b> , <b>7.0.1</b> , <b>7.0.2</b> and <b>7.0.12</b> are supported.
<b>Device Family *</b>	Select the family of devices to which this configuration will be applied (for example, <b>CISCO ASR9000</b> ).
<b>Config/Script File *</b>	Click <b>Browse</b> to navigate to and select the configuration or script file to be uploaded.

**Step 4** When you have complete entries in all of the required fields, click **Add** to begin uploading the new configuration file. Crosswork displays the contents of the configuration file in a popup window. Verify that it is the file you want. You can scroll the popup window to verify the contents of the file.

**Step 5** When you are ready, click **OK** to continue. Then click **Add** to upload the file.

## Prepare Your Custom Day-Zero Configuration Files

Configuration files vary greatly in contents, depending on the needs of the organization using the device and the device capabilities. The following topics provide guidelines to follow when preparing day-zero configuration scripts for use with Crosswork ZTP

### A Sample Basic Day-Zero Configuration Script

The generic shell script does most of the work of configuring your IOS-XR devices (see [Use Custom Day-Zero Configuration Files, on page 39](#)). Your custom day-zero configuration file can be as simple as the example shown below:

```
#!/ IOS XR Configuration 7.0.1
!! Last configuration change at Wed Mar 1 10:38:34 2019 by admin
!
hostname {$HOSTNAME}
username {$SSH_USERNAME}
```

```

group root-lr
group cisco-support
secret {$SSH_PASSWORD}
!
tpa
vrf default
!
!
call-home
service active
contact smart-licensing
profile CiscoTAC-1
active
destination transport-method http
!
!
interface MgmtEth0/RP0/CPU0/0
ipv4 address dhcp

```

This example makes use of several placeholders, such as *{\$HOSTNAME}*, for which the system will insert corresponding values at runtime. See the next section for guidelines on using these placeholders in your configuration file

### ZTP Placeholders in Day-Zero Configuration Files

The following table lists the placeholders you can use in your custom day-zero configuration files. At runtime, for each of these placeholders, Crosswork will substitute the appropriate values for each device. For an example of the use of these placeholders, see the sample configuration script in the preceding topic.

**Table 5: ZTP Placeholders in Configuration Files**

This placeholder...	...is filled using the value from the...
<i>{\$HOSTNAME}</i>	Device's host name value as specified in the ZTP device entry.
<i>{\$IP_ADDRESS}</i>	Device's IP address value, as assigned by DHCP.
<i>{\$SSH_USERNAME}</i>	Credential Profile's <b>User Name</b> field (where the <b>Connectivity Type</b> is <b>SSH</b> ).
<i>{\$SSH_PASSWORD}</i>	Credential Profile's <b>Password</b> field (where the <b>Connectivity Type</b> is <b>SSH</b> ).
<i>{\$SSH_ENPASSWORD}</i>	Credential Profile's <b>Enable Password</b> field (where the <b>Connectivity Type</b> is <b>SSH</b> ).
<i>{\$SNMP_READ_COM}</i>	Credential Profile's <b>Read Community</b> field (where the <b>Connectivity Type</b> is <b>SNMPv2</b> ).
<i>{\$SNMP_WRITE_COM}</i>	Credential Profile's <b>Write Community</b> field (where the <b>Connectivity Type</b> is <b>SNMPv2</b> ).
<i>{\$SNMP_SEC_LEVEL}</i>	Credential Profile's <b>Security Level</b> field (where the <b>Connectivity Type</b> is <b>SNMPv3</b> ).
<i>{\$SNMP_USERNAME}</i>	Credential Profile's <b>User Name</b> field (where the <b>Connectivity Type</b> is either <b>SNMPv2</b> or <b>SNMPv3</b> ).
<i>{\$SNMP_AUTH_TYPE}</i>	Credential Profile's <b>User Name</b> field (where the <b>Connectivity Type</b> is <b>SNMPv3</b> and <b>Security Level</b> is <b>AUTH_NO_PRIV</b> ) or <b>AUTH_PRIV</b> ).

This placeholder...	...is filled using the value from the...
<code>{ \$SNMP_AUTH_PASS }</code>	Credential Profile's <b>User Name</b> field (where the <b>Connectivity Type</b> is <b>SNMPv3</b> and <b>Security Level</b> is <b>AUTH_NO_PRIV</b> or <b>AUTH_PRIV</b> ).
<code>{ \$SNMP_PRIV_TYPE }</code>	Credential Profile's <b>User Name</b> field (where the <b>Connectivity Type</b> is <b>SNMPv3</b> and <b>Security Level</b> is <b>AUTH_PRIV</b> ).
<code>{ \$SNMP_PRIV_PASS }</code>	Credential Profile's <b>Priv Password</b> field (where the <b>Connectivity Type</b> is <b>SNMPv3</b> and <b>Security Level</b> is <b>AUTH_PRIV</b> ).

## Use Custom Day-Zero Configuration Files

You will be applying your day-zero configuration using a generic shell script that works with all of the supported routers and does most of the work of configuring them. The modified shell script will call your own custom configuration file.

### Before you begin

Be sure you have prepared your own custom day-zero configuration file as explained in [Prepare Your Custom Day-Zero Configuration Files, on page 37](#). You will also need to add it to the Crosswork ZTP repository, as explained in [Upload Configuration Files, on page 36](#).

Once you have uploaded your own custom day-zero configuration file to Crosswork, copy or record its UUID, as explained in [Copy Configuration File Paths and UUIDs, on page 41](#). You will need it when you modify the generic shell script.

- 
- Step 1** From the main menu, choose **Device Management > Devices**. Crosswork displays the **Configuration Files** list.
- Step 2** Click **Download Sample Script**. Your browser will prompt you to save the generic script file on your local file system. Give the file a unique name and change the filename extension to **sh**, to indicate that it is a Linux shell script.
- Step 3** Open the saved shell script with the editor of your choice.
- Step 4** In the saved shell script, locate and modify the values assigned to the following variables, as follows:
- **XRZTP\_INTERFACE\_NAME**: The interface on the device where the ZTP process will be initiated. For example: **MgmtEth0/RP0/CPU0/0**.
  - **CW\_HOST\_IP**: The IP address of the Crosswork server. For example: **192.168.1.1**.
  - **CW\_PORT**: The Crosswork server port number on which to initiate download of your own custom configuration file. Use **30604** if this will be an HTTP download, or **30603** for an HTTPS download.
  - **CW\_CONFIG\_UUID**: The UUID of your own custom day-zero configuration file, previously uploaded to the Crosswork repository. For example: **30d2d77c-462a-4b4d-8960-fd94436cc0f9**.
- Step 5** (Optional) If you will be using the script to configure Cisco ASR 9000 devices: The generic script, as written, will work with all the supported device families except ASR 9000. The script contains commands that will make it work with ASR 9000, but these have been commented out. To make it work with ASR 9000, un-comment the ASR 9000 command sections and comment out the sections for other devices. These sections are clearly documented in the script.
- Step 6** Save the modified shell script.
- Step 7** Upload the modified shell script to the ZTP repository, as explained in [Upload Configuration Files, on page 36](#).

- Step 8** Create or modify ZTP device entries, or create ZTP profiles, with **Configuration** settings that point to the UUID of the modified shell script. For help with these tasks, see the topics under [Create ZTP Device Entries, on page 44](#) and [Create Zero Touch Profiles, on page 42](#).
- 

## Edit Configuration Files

You can change any of the stored field values for a configuration file you have uploaded to the ZTP repository. For a list of the field values you can change, see the "Add Configuration Fields" table in [Upload Configuration Files, on page 36](#).

If you change the value in the **Config/Script File** field during an edit session, you will trigger a configuration file upload to the repository, just as you do when uploading configuration files (see [Upload Configuration Files, on page 36](#)). Note that you will need to browse to and select the new configuration or script file to change the value in **Config/Script File**.

Except for uploads triggered by changes in **Config/Script File**, changing the value in these fields does not change the configuration file itself. In order to update a configuration file's contents:

1. Download the existing file, as explained in [Download Configuration Files, on page 40](#).
  2. Make your changes to the file, using your choice of editor.
  3. Upload the changed configuration file to the ZTP repository, as explained in [Upload Configuration Files, on page 36](#).
- 

- Step 1** From the main menu, choose **Device Management > Configuration Files**. Crosswork displays the **Configurations** window.
- Step 2** In the **Configurations** list, click the selection box next to the configuration file you want to edit.
- Step 3** Click . Crosswork displays the **Edit Configuration** page.
- Step 4** Change the values in the fields as needed.
- Step 5** When you have completed your changes, click **Update** to save them.
- 

## Download Configuration Files

You can download any configuration file previously added to the ZTP repository. This is handy when you want to make changes in an existing file, or create a new configuration using an existing one as a template.

---

- Step 1** From the main menu, choose **Device Management > Configuration Files**. Crosswork displays the **Configurations** window.
- Step 2** In the **Configuration Files** list, in the **Configuration Name** column next to the configuration file you want to download, click [↓](#).
- Crosswork displays the file download window for your client OS. Change the file name as needed, navigate to the folder where you want to store it, and confirm that you want to save the file.
-




## Delete Configuration Files

Follow the steps below to delete a configuration file.

### Before you begin



Be sure that any configuration file you plan to delete from the ZTP repository is not already associated with ZTP device entries or ZTP profiles. You can check if a configuration file is associated with an individual ZTP device entry by checking your device entries listed on the **Zero Touch Devices** window (see [Use the Zero Touch Devices Window to Work with Devices, on page 29](#)). You can check if a configuration file is associated with a ZTP profile by selecting the **View Details** option for the ZTP profile with which you think it may be associated (see [View Zero Touch Profile Details, on page 44](#)).

Deleting a configuration file associated with a ZTP profile will render that profile non-functional. A mistaken deletion cannot be undone, but the configuration file can be uploaded again and re-associated with the ZTP profile.

- 
- Step 1** From the main menu, choose **Device Management > Configuration Files**. Crosswork displays the **Configurations** window.
- Step 2** In the **Configurations** list, click the selection box next to the configuration file you want to delete.
- Step 3** Click .
- Crosswork prompts you to check that the file is not already associated with a device entry or ZTP profile.
- Step 4** Click **Delete** to delete the file.
- 

## Copy Configuration File Paths and UUIDs

When added to Crosswork, every configuration file is assigned a unique UUID and stored in the Crosswork ZTP repository. You will need to specify the unique repository file path and UUID for each device when modifying your DHCP server configuration file to permit provisioning (see [DHCP Setup for Crosswork ZTP, on page 50](#)). You can quickly copy to your clipboard the complete file path and UUID for any configuration file, directly from the **Configurations** list. You can also copy just the configuration file's UUID.

- 
- Step 1** From the main menu, choose **Device Management > Configuration Files**. Crosswork displays the **Configurations** window.
- Step 2** If you want to copy:
- The configuration file's full path and UUID: Click  in the **Configuration Name** column.
  - The configuration file's UUID only: Click  in the **Config UUID** column.

Crosswork copies the file path and/or UUID to your clipboard. You can now paste it into your DHCP host entry.

When using the copied file path to create DHCP host entries, be sure to replace the `CCW_HOST_IP` variable with the IP address and port of your Crosswork server.

---

## Create Zero Touch Profiles

You can create as many ZTP profiles as you like. However, Cisco recommends that you create one and only one day-zero ZTP profile per specific device group or device family. Each ZTP profile can have just one image file and one configuration file associated with it.

An image file is not required in every ZTP profile. You can create ZTP profiles that specify a configuration only. You can also associate image or configuration files directly with a device entry, without using a ZTP profile, by selecting a previously added image or configuration file from the dropdown menu in the ZTP device entry's **Software Image** and **Configuration File** fields (see [Create ZTP Device Entries Using the UI, on page 44](#)) or entering the file names in those columns in the CSV file you use to import device entries (see [Create ZTP Device Entries Using Import, on page 47](#)).

### Before you begin

Be sure you have added to the ZTP repository:

- All of the image files you plan to use in the ZTP profiles you create. For help with this task, see [Upload Software Image Files, on page 34](#).
- All of the configuration files you plan to use in the ZTP profiles you create. For help with this task, see [Upload Configuration Files, on page 36](#).

- 
- Step 1** From the main menu, choose **Device Management > Zero Touch Profiles**. Crosswork displays the **ZTP profile Management** page.
- Step 2** Click + **New Profile**. Crosswork displays the **Add Profile** page, with tiles representing your ZTP profiles.
- Step 3** Enter the values for the new ZTP profile as shown in the table below.
- Step 4** When you have completed entries in all of the required fields, click **Save** to create the new ZTP profile. Crosswork displays the **ZTP Profile Management** page, with a new tile for the new profile.

**Table 6: Add Profile Fields (\*=required)**

Field	Description
<b>Profile Name *</b>	The unique name you want to assign to this ZTP profile. This is the name as it will appear in the tile representing this ZTP profile on the <b>ZTP Profile Management</b> page, and when adding new ZTP devices.
<b>Description</b>	Enter a description of the ZTP profile. This description will appear in the tile representing this ZTP profile on the <b>ZTP Profile Management</b> page.
<b>OS Platform *</b>	Select the IOS software platform for the devices to which this ZTP profile will be applied. This should be the same platform as the image and configuration files the profile uses. Currently, the <b>IOS-XR</b> platform is supported.
<b>OS Version *</b>	Select the IOS software platform version for the devices to which this ZTP profile will be applied. This should be the same version as the image and configuration files the profile uses. Currently, IOS-XR versions <b>6.6.3</b> , <b>7.0.1</b> , <b>7.0.2</b> and <b>7.0.12</b> are supported.

Field	Description
<b>Device Family *</b>	Select the device family for the devices to which this ZTP profile will be applied. This should be the same device family as the image and configuration files the profile uses. The device family will appear in the tile representing this ZTP profile on the <b>ZTP Profile Management</b> page.
<b>Software Image</b>	Select from the dropdown menu the image file that this profile will apply to the devices. The file must already exist in the ZTP repository. See <a href="#">Upload Software Image Files, on page 34</a> . Note that an image file is optional for ZTP profiles; you may have profiles that only apply a configuration.
<b>Configuration File *</b>	Select from the dropdown menu the configuration file that this profile will apply to the devices. The file must already exist in the ZTP repository. See <a href="#">Upload Configuration Files, on page 36</a> .

## Edit Zero Touch Profiles

Follow the steps below to edit the stored field values for a ZTP profile.

- Step 1** From the main menu, choose **Device Management > Zero Touch Profiles**. Crosswork displays the **ZTP Profile Management** page.
- A tile icon represents each of the existing ZTP profiles.
- Step 2** (Optional) To find a specific profile: Click in the **Search Profiles** box and begin typing. The **ZTP Profile Management** page displays only the profile tiles that match the text you entered.
- Step 3** In the top right corner of the tile for the ZTP profile you want to edit, click \*\*\*.
- Step 4** From the drop down menu, select **Edit**. Crosswork displays the **Edit Profile** page.
- Step 5** Change the values in the fields as needed.
- Crosswork will verify that any changes you make to the **OS Platform**, **OS Version** or **Device Family** field values match the same values for the software image or configuration file you associated with the ZTP profile. You cannot change the **Profile Name**.
- Step 6** When you have completed your changes, click **Update** to save them.

## Delete Zero Touch Profiles

You can delete any ZTP profile as long as it is not already associated with an unprovisioned ZTP device. Deleting a ZTP profile does not affect the configuration or image files associated with it.

You can check if a ZTP profile is associated with an individual ZTP device entry by checking your device entries listed on the **Zero Touch Devices** window (see [Use the Zero Touch Devices Window to Work with Devices, on page 29](#)).

- 
- Step 1** From the main menu, choose **Device Management > Zero Touch Profiles**. Crosswork displays the **ZTP profile Management** page.
- A tile icon represents each of the existing ZTP profiles.
- Step 2** (Optional) To find a specific profile: Click in the **Search Profiles** box and begin typing. The **ZTP Profile Management** page displays only the profile tiles that match the text you entered.
- Step 3** In the top right corner of the tile for the ZTP profile you want to delete, click \*\*\*.
- Step 4** From the drop down menu, select **Delete**.
- Step 5** To confirm, click **Delete** again.
- 

## View Zero Touch Profile Details

You can view the stored field values for any ZTP profile without editing it. Profile details include the Profile Name, Description, Device Type, OS and OS Version, and the names of the associated image and configuration files.

- 
- Step 1** From the main menu, choose **Device Management > Zero Touch Profiles**. Crosswork displays the **ZTP Profile Management** page.
- A tile icon represents each of the existing ZTP profiles.
- Step 2** (Optional) To find a specific profile: Click in the **Search Profiles** box and begin typing. The **ZTP Profile Management** page displays only the profile tiles that match the text you entered.
- Step 3** In the top right corner of the tile representing the ZTP profile you want to view, click \*\*\*.
- Step 4** From the drop down menu, select **View Details**.
- Crosswork displays a popup window listing all the ZTP profile details.
- 

## Create ZTP Device Entries

Before you can provision and onboard ZTP devices, you must first create ZTP device entries. Crosswork uses these entries to provision and onboard the actual devices once ZTP processing is initiated.

You can create ZTP device entries one at a time, using the Crosswork user interface, or in bulk by importing a CSV file.

The following topics discuss both methods, as well as how to properly prepare CSV files, and ways to edit, delete, and export backups of your ZTP entries.

### Create ZTP Device Entries Using the UI

Follow the steps below to create ZTP device entries one by one, using the GUI. Under normal circumstances, you will want to use this method when adding a few devices only. For adding device entries in bulk, import them from a CSV file (see [Create ZTP Device Entries Using Import, on page 47](#)).

Newly added ZTP device entries always appear in the **Zero Touch Devices** tab with their **Status** set to **unprovisioned**. They will remain **unprovisioned** until you initiate ZTP processing.

### Before you begin

Be sure you have:

- Completed the planning steps and setup requirements discussed in [Get Started](#).
- Added the software image files you want loaded onto your ZTP devices when ZTP processing is initiated, as explained in [Upload Software Image Files](#).
- Added the configuration files you want to use to provision or configure your ZTP devices when ZTP processing is initiated, as explained in [Upload Configuration Files, on page 36](#).



As a convenience for users who may be testing a ZTP profile for a new family of devices, Crosswork provides fields for associating image and configuration files directly with a ZTP device entry, instead of via a ZTP profile. Once you have tested these files and provision/onboarding is successful, Cisco recommends that you create the ZTP profiles you want to use to provision/onboard other instances of this device family, before adding the device entries for them. This can be especially helpful if you are planning to add ZTP devices via import.

- 
- Step 1** From the main menu, choose **Device Management > Devices**. Crosswork displays the **Devices** list.
- Step 2** Click the **Zero Touch Devices** tab.
- Step 3** Click .
- Step 4** Enter values for the new ZTP device entry, as listed in the table below.  
Once devices are onboarded, additional attributes may be displayed.
- Step 5** Click **Save**. The Save button is disabled until all required fields are complete.

**Table 7: Add ZTP Device Fields (\*=required)**

Field	Description
<b>Host Name *</b>	The hostname of the device. Crosswork discovers it and updates it.
<b>Serial Number *</b>	Serial number for the device. ZTP uses the serial number as part of the device ID.
<b>Profile</b>	Choose whether you want to use a Zero Touch (ZT) profile to configure this device. Select <b>No Profile</b> if you have not yet created a ZTP profile for the new ZTP device. <b>No Profile</b> is the default. If you select <b>Use Profile</b> , you must select the ZTP profile in the next field.
<b>Profile Name *</b>	Select the ZTP profile you want to use to provision this device. Required only if you selected <b>Use Profile</b> in the <b>Profile</b> field
<b>IP Address</b>	The IP address of the device, obtained via script from your organizations DHCP server.

Field	Description
<b>Status</b>	Defaults to <b>Unprovisioned</b> during ZTP device entry creation. You cannot select a different status while adding an entry. The Status updates automatically after ZTP processing is initiated.
<b>MAC Address</b>	The MAC address for the device.
<b>Inventory ID</b>	The inventory ID for the device.
<b>UUID</b>	The Universally Unique Identifier (UUID) for the device. This is assigned by the system unless you elect to enter one yourself.
<b>OS Platform *</b>	Select the software platform for the device. This should be the same platform as the image and configuration files you will use to provision it. Currently, the <b>IOS-XR</b> platform is supported.  Required only if you selected <b>No Profile</b> in the <b>Profile</b> field.
<b>OS Version *</b>	Select the IOS software platform version for the device. This should be the same version as the image and configuration files you will use to provision it. Currently, IOS-XR versions <b>6.6.3</b> , <b>7.0.1</b> , <b>7.0.2</b> and <b>7.0.12</b> are supported.  Required only if you selected <b>No Profile</b> in the <b>Profile</b> field.
<b>Device Family *</b>	Select the device family for the device. This should be the same device family as the image and configuration files you will use to provision it.  Required only if you selected <b>No Profile</b> in the <b>Profile</b> field.
<b>Software Image</b>	Select from the dropdown menu the image file you will use to image the device.  A software image is not required, even if you selected <b>No Profile</b> in the <b>Profile</b> field.
<b>Configuration File *</b>	Select from the dropdown menu the configuration file you will use to configure the device.  Required only if you selected <b>No Profile</b> in the <b>Profile</b> field.
<b>Credential Profile *</b>	Select from the dropdown menu the Credential Profile to be assigned to the device, which will be used to access it for data collection and configuration changes. For example: <b>nso23</b> .
<b>Connectivity Details</b>	

Field	Description
<b>Protocol</b>	<p>The connectivity protocols used by the device. Choices are: <b>SSH</b>, <b>SNMPv2</b>, <b>NETCONF</b>, <b>TELNET</b>, <b>HTTP</b>, <b>HTTPS</b>, <b>GRPC</b>, and <b>SNMPv3</b>.</p> <p>You can add one protocol for this device by completing the fields in the first row of the <b>Connectivity Details</b> panel. To add more connectivity protocols, click  at the end of the first row. To delete a protocol you have entered, click  shown next to that row in the panel. You can enter as many sets of connectivity details as you want. You must enter connectivity details for at least <b>SSH</b>, <b>SNMPv2</b> or <b>SNMPv3</b>, and <b>NETCONF</b>. SNMP is required to onboard the device. NETCONF is required to manage IOS-XR devices. TELNET and other connectivity protocols are optional.</p> <p>Please note that the assigned IP address needs to be reachable from the Crosswork server. In some cases, this may require route creation. Consult the <i>Cisco Crosswork Change Automation and Health Insights Installation Guide</i> for additional details on network configuration.</p>
<b>* IP Address / Subnet Mask</b>	<p>Enter the device's IP address (IPv4 or IPv6) and subnet mask.</p> <p>Required only if you chose to set up a connectivity protocol.</p>
<b>* Port</b>	<p>The port used for this connectivity protocol. Each protocol is mapped to a port, so be sure to enter the port number that corresponds to the Protocol you chose. The standard port assignments for each protocol are:</p> <ul style="list-style-type: none"> <li>• SSH: 22</li> <li>• SNMP: 161</li> <li>• NETCONF: 830</li> <li>• HTTP: 80</li> <li>• HTTPS: 443</li> </ul> <p>Required only if you chose to set up a connectivity protocol.</p>
<b>Timeout</b>	<p>The elapsed time (in seconds) before communication attempts using this protocol will time out. The default value is 30 seconds; the recommended timeout value is 60 seconds.</p>
<b>Providers and Access</b>	
<b>Provider Names</b>	<p>Select the provider type used to manage devices. For ZTP, select an NSO provider only.</p>
<b>Device Key</b>	<p>If you choose Cisco NSO as a provider, the <b>Device Key</b> will automatically populate.</p>

## Create ZTP Device Entries Using Import


Follow the steps below to create multiple ZTP device entries all at once by importing a CSV file.

Imported ZTP device entries always appear in the **Zero Touch Devices** tab with their **Status** set to **Unprovisioned**. They will remain **Unprovisioned** until you initiate ZTP processing.

### Before you begin

Be sure you have:


- Completed the planning steps and setup requirements discussed in [Get Started](#).
- Uploaded to Crosswork the software files you will use to image the devices when ZTP processing is initiated, as explained in [Upload Software Image Files](#).
- Uploaded to Crosswork the configuration files you will use to configure the devices when ZTP processing is initiated, as explained in [Upload Configuration Files, on page 36](#).
- Used the template to prepare a CSV file describing the device entries you want to import. You can download the CSV template using the **Import Devices** dialog box, as explained in [Prepare ZTP Device Import Files, on page 48](#).

- 
- Step 1** From the main menu, choose **Device Management > Devices**. Crosswork displays the **Devices** list.
- Step 2** Click the **Zero Touch Devices** tab.
- Step 3** Click  to open the **Import Devices** dialog box.
- Step 4** Click **Browse** to navigate to the CSV file you created and then select it.
- Step 5** With the CSV file selected, click **Import**.
- 

## Prepare ZTP Device Import Files

Complete the steps below to create a CSV file specifying one or more ZTP devices that you can then import into Crosswork, as explained in [Create ZTP Device Entries Using Import, on page 47](#).

Note that, if you are preparing the import file to correct device entries you have already made, the device entries must be in the **Unprovisioned** status. For instructions on how to reset the device entry's status, see [XREF](#)

- 
- Step 1** From the main menu, choose **Device Management > Devices**. Crosswork displays the **Devices** list.
- Step 2** Click the **Zero Touch Devices** tab.
- Step 3** Click  to open the **Import Devices** dialog box.
- Step 4** Click the **Download 'Devices import' template (.csv) file** link and save the CSV file template to a local storage resource. Then click **Cancel** to exit the **Import Devices** dialog.
- Step 5** Open the template using your preferred tool. Begin adding rows to the file, one row for each device. As you do so, observe the following guidelines:
- Use two semicolons with no space between them to indicate that you are leaving a field blank.
  - Use a semicolon to separate multiple entries in the same field.



When you separate multiple entries with semicolons, remember that the order in which you enter values in each field is important. For example, if you enter **SSH ; SNMP ; NETCONF** in the **Connectivity Type** field and you enter **22 ; 161 ; 830** in the **Connectivity Port** field, the mapping between the two fields will be as follows:

- SSH: 22
- SNMP: 161
- NETCONF: 830

For a list of the fields and the values you can enter, see the "Add ZTP Device Fields" table in [Create ZTP Device Entries Using the UI, on page 44](#).

Be sure to delete the sample data rows before saving the file, or they will be imported along with the data you want. The column header row can stay, as it is ignored during import.

If you notice errors next to your device entries after the import, download the ZTP device entries as explained in [Export ZTP Devices, on page 49](#). Correct the errors in the exported CSV file. Before re-importing it, make sure the device entries with errors have their **Status** set to **Unprovisioned**.

---

## Export ZTP Devices


When you export the ZTP device list, all of the ZTP device information is exported to a CSV file. Export is a handy way to keep a record of all the ZTP devices in the system at one time. You can also edit the CSV file as needed, and re-import it to overwrite existing device data (this works only for ZTP device entries with a **Status** of **Unprovisioned**).



---

**Note** The exported ZTP device CSV file will contain only the name of the credential profile for each device, not the credentials themselves.

---


- 
- Step 1** From the main menu, choose **Device Management > Devices**. Crosswork displays the **Devices** list.
- Step 2** Click the **Zero Touch Devices** tab.
- Step 3** Click . Your browser will prompt you to select a path and file name to use when saving the CSV file, or to open it immediately.
- 

## Edit ZTP Devices

Follow the steps below to update a ZTP device entry. You can select and edit only one ZTP device entry at a time.

Before editing any device, it is always good practice to export a CSV backup of the devices you want to change (see [Export ZTP Devices, on page 49](#)).


- 
- Step 1** From the main menu, choose **Device Management > Devices**. Crosswork displays the **Devices** list.
- Step 2** Click the **Zero Touch Devices** tab.

- Step 3** (Optional) Filter the list of ZTP devices by filtering specific columns (see [Set, Sort and Filter Table Data](#)).
- Step 4** Check the check box of the device entry you want to change, then click . The **Edit Device** page appears.
- Step 5** Edit the values configured for the device entry, as needed.
- For a description of the fields you can edit, see [Create ZTP Device Entries Using the UI, on page 44](#). Some fields will be disabled, depending on the **Status** of the device entry.
- If the device entry **Status** displays an **Onboarding Error** or **Provisioning Error**, you must reset the **Status** to **Unprovisioned** before attempting to retry onboarding or importing a device entry CSV file.
- Step 6** Click **Save**. The Save button is disabled until all required fields are completed.

## Delete ZTP Devices

Follow the steps below to delete an unprovisioned ZTP device. Deleting ZTP devices from the **Zero Touch Devices** tab deletes them from the ZTP repository only. Onboarded ZTP devices must be deleted from the **Network Devices** tab.

Before deleting any device, it is always good practice to export a CSV backup (see [Export ZTP Devices, on page 49](#)). Note that deleting a device that has successfully completed ZTP processing has no impact on the number of ZTP licenses that have been used.

- Step 1** From the main menu, choose **Device Management > Devices**. Crosswork displays the **Devices** list.
- Step 2** Click the **Zero Touch Devices** tab.
- Step 3** (Optional) Filter the list of ZTP devices by filtering specific columns (see [Set, Sort and Filter Table Data](#)).
- Step 4** Check the check box for the ZTP devices you want to delete.
- Step 5** Click .
- Step 6** In the confirmation dialog box, click **Delete**.

## DHCP Setup for Crosswork ZTP

Once you have uploaded your ZTP image and configuration files, (optionally) created ZTP profiles, and created your device entries, you must update your organization's DHCP server configuration file with the IDs for these device entries and the paths to the image and configuration files stored in the Crosswork ZTP repository. These entries identify each ZTP host and the corresponding file paths and UUIDs of the associated image and configuration files. This step is necessary to allow Crosswork and DHCP to identify these ZTP devices and to respond correctly to each device's requests for connection to the network, and image and configuration file downloads.

The following topics discuss how to update common DHCP server configurations to meet this requirement. Please refer to the following note on support for HTTP and HTTPS downloads.

### Crosswork ZTP Device Management Support for HTTP and HTTPS

Cisco strongly recommends that you deploy ZTP over secure network domains.

As of today, Cisco devices supported by Crosswork 3.2.0 (that is, those running IOS-XR versions 6.6.3, 7.0.1, 7.0.2, and 7.0.12) allow iPXE software image downloads via HTTP only. These same devices support download of configuration files via either HTTP or HTTPS. These options require entry of DHCP bootfile URLs in your organization's DHCP server configuration.

If you want to use HTTP for both image and configuration file downloads, these URLs must specify the HTTP protocol and port 30604, as shown in Example 1, below.

If you want to use HTTPS for configuration file downloads only, the URL must specify the HTTPS protocol and port 30603. You must also specify the `-k` option before the HTTPS protocol specification of the URL. See Example 2, below.

**Figure 6: Example 1: HTTP Image and Configuration File Download URLs**

```
if exists user-class and option user-class = "iPXE" {
filename =
"http://<CW_HOST_IP>:30604/crosswork/imagesvc/v1/device/files/cw-image-uuid-...853a3210c581";
} else if exists user-class and option user-class = "exr-config" {
filename =
"http://<CW_HOST_IP>:30604/crosswork/configsvc/v1/configs/device/files/...3b2c07b94cee";
}
```

**Figure 7: Example 2: HTTP Image and HTTPS Configuration File Download URLs**

```
if exists user-class and option user-class = "iPXE" {
filename =
"http://<CW_HOST_IP>:30604/crosswork/imagesvc/v1/device/files/cw-image-uuid-...853a3210c581";
} else if exists user-class and option user-class = "exr-config" {
filename = "-k
https://<CW_HOST_IP>:30603/crosswork/configsvc/v1/configs/device/files/...3b2c07b94cee";
}
```

## Cisco Prime Network Registrar DHCP Setup

Below are two sets of scripts that allow you to add ZTP device, image and configuration file entries to the Cisco Prime Network Registrar (CPNR) DHCP server configuration file. There is one set of three scripts for IPv4, and a separate set of five scripts for IPv6. To use these scripts:

1. Copy and paste the contents of the scripts into local text files with the names given here.
2. Modify the device, image and configuration entries in the `ztp-v4-setup-vi-nrcmd.txt` or `ztp-v6-setup-vi-nrcmd.txt` script to fit your needs, as explained in the script's comments.
3. Copy all of the script files you want to use to the root folder of your local CPNR server.
4. Execute the scripts on the CPNR server using the following command:

```
[root@cpnr-local ~]#/opt/nwreg2/local/usrbin/nrcmd -N username -P password
<ztp-IPVersion-setup-via-nrcmd.txt
```

Where:

- `username` is the name of a user ID with administrator privileges on the CPNR server.
- `password` is the password for the corresponding CPNR admin user ID.
- `IPVersion` is either `v4` for the IPv4 version of the scripts, or `v6` for the IPv6 version of the scripts.

Cisco recommends that you deploy Crosswork ZTP over secure networks only. Please see the additional requirements in [#unique\\_123 unique\\_123\\_Connect\\_42\\_ZTPSupport4HTTPS](#).

**IPv4 Script 1 of 3: ztp-v4-setup-vi-nrcmd.txt**

```

#
# Create the scope
#
scope ztp-ncs-5501-mgmt create 192.0.20.0/24

# Add the dynamic range
scope ztp-ncs-5501-mgmt addrange 200 225

# Default the routers option. Note: No need to do subnet-mask. It is automatically provided.
scope-policy ztp-ncs-5501-mgmt setoption routers 10.10.10.1

# Set the lease time for clients on this scope
scope-policy ztp-ncs-5501-mgmt setoption dhcp-lease-time 216000
#
# Load the option 43 definitions
import option-set ztp-v4-option-set.txt
#
# Set the client classing expression and enable use of client-class
dhcp set client-class-lookup-id=@ztp-v4-client-class-expr.txt
dhcp enable client-class
#
# Load the client classes - these are used to lookup the correct client details
# depending on whether an iso or script is requested by the client.
client-class ztp-iso create
client-class ztp-iso set client-lookup-id="(or (try (concat (as-string
(request get option 61)) \"-iso\")) (request macaddress-string))"
#
client-class ztp-script create
client-class ztp-script set client-lookup-id="(or (try (concat (as-string
(request get option 61)) \"-script\") (request macaddress-string))"
#
# Clients that are not ztp will fall into the ztp-none class
# and should not be offered service so they are excluded.
#
client-class ztp-none create
client-class ztp-none set action=exclude
#
# Create a default client that will prevent service to unknown clients.
client default create
client default set action=exclude
#
# Create some ZTP clients
#
# For each ZTP client we create two clients based on their serial number.
# (See above for the client-lookup-id expressions.)
# One has "-iso" added to the end that will be used when the client's
# request includes "iPXE" in option 77.
# The other has "-script" added to the end that will be used when the
# client's request includes "exr-config" in option 77.
#

### Device-1 Settings ####
client <device-1-serial-num>-iso create
client-policy <device-1-serial-num>-iso set packet-file-name=
"http://<cw-ipv4-address>:30604/crosswork/imagesvc/v1/device/files/cw-image-uuid-d3930e13-b081-4905-b2e5-051249d9b0cb"

client <device-1-serial-num>-script create
client-policy <device-1-serial-num>-script set packet-file-name=
"http://<cw-ipv4-address>:30604/crosswork/configsvc/v1/configs/device/files/d1d7b441-3a27-47d1-aef0-39c3087d34c1"

```

```

client-policy <device-1-serial-num>-script setvendoroption 43 Cisco-ZTP "(1 exr-config) (2
0)"

### Device-2 Settings ###
client <device-2-serial-num>--iso create
client-policy <device-2-serial-num>-iso set packet-file-name=

"http://<cw-ipv4-address>:30604/crosswork/imagesvc/v1/device/files/cw-image-uuid-d3930e13-b081-4905-b2e5-051249d9b0cb"

client <device-2-serial-num>-script create
client-policy <device-2-serial-num>-script set packet-file-name=

"http://<cw-ipv4-address>:30604/crosswork/configsvc/v1/configs/device/files/d1640deb-8252-47b6-aab1-a843c0c7757b"
client-policy <device-2-serial-num>-script setvendoroption 43 Cisco-ZTP "(1 exr-config) (2
0)"

#
# Create more as needed using the above as models.
# Note: For those that need option 67 (boot file), you can use:
#   client-policy <name> setoption boot-file "<file-url>"
#
# The next line is optional. Uncomment it if you want to log what the script is doing.
# dhcp set log-settings+=incoming-packet-detail,outgoing-packet-detail,client-detail

# Assure that the server is up-to-date with this configuration
dhcp reload

```

### IPv4 Script 2 of 3: ztp-v4-option-set.txt

```

#
#
# Option Definition Set Export/Import Utility
# Version: 1
#
{
  ( name = Cisco-ZTP )
  ( id-range = 1 )
  ( vendor-option-regex = PXEClient:Arch:.* )
  ( tenant-id = 0 )
  ( desc = Cisco ZTP Suboption Definitions )
  ( option-list = [
    {
      ( id = 43 )
      ( name = Cisco-ZTP )
      ( base-type = AT_BLOB )
      ( desc = Cisco Zero Touch Provision )
      ( flags = )
      ( option-list = [
        {
          ( id = 1 )
          ( name = clientId )
          ( base-type = AT_NSTRING )
          ( desc = )
          ( flags = )
        }
        {
          ( id = 2 )
          ( name = authCode )
          ( base-type = AT_INT8 )
          ( desc = )
          ( flags = )
        }
      ]
    }
  ]
}

```

```

        ( id = 3 )
        ( name = md5sum )
        ( base-type = AT_NSTRING )
        ( desc = )
        ( flags = )
    }
] )
}
] )
}

```

### IPv4 Script 3 of 3: ztp-v4-client-class-expr.txt

```

(or
  (if (equal (as-string (request get-blob option 77)) "iPXE") "ztp-iso")
    (if (equal (as-string (request get-blob option 77)) "exr-config") "ztp-script")
      "ztp-none"
    )
)

```

### IPv6 Script 1 of 5: ztp-v6-setup-vi-nrcmd.txt

```

#
# create prefix for mgmt
prefix prefix-for-mgmt create 2001:DB8:10e:201a::/64
#
# Set the client classing expression and enable use
# of client-class
#
dhcp set v6-client-class-lookup-id=@ztp-v6-client-class-expr.txt
dhcp enable client-class
#
# Load the client classes - these are used to lookup the correct
# client details depending on whether an iso or script is requested
# by the client.
#
client-class ztp-iso create
client-class ztp-iso set v6-client-lookup-id=@ztp-v6-iso-lookup-expr.txt
#
client-class ztp-script create
client-class ztp-script set v6-client-lookup-id=@ztp-v6-script-lookup-expr.txt
client-class-policy ztp-script set v6-reply-options=17
#
# Delete option set (may not exist and ok if fails)
#
option-set dhcp6-cisco-custom delete
#
import option-set ztp-v6-options.txt
#
# Clients that are not ztp will fall into the ztp-none class
# and should not be offered service so they are excluded.
#
client-class ztp-none create action=exclude
#
# Create a default client that will prevent service to
# unknown clients.
#
client default create
client default set action=exclude
#
# Create some ZTP clients
#

```

```

# For each ZTP client we create two clients based on their mac-address.
# One has "-iso" added to the end that will be used when the client's
# request does not include the "exr-config" in option 77.
# The other has "-script" added to the end that will be used when the
# client's request does include "exr-config" in option 77.
#
client <device-serial-no>-iso create
# Set the vendor options using blob format as option definitions are for different data
client-policy <device-serial-no>-iso setV6VendorOption 17 dhcp6-cisco-custom "(1 exr-config) (2
0)"
# Escape the [ and ] as nrcmd (which uses tcl interpreter) will otherwise fail command
client-policy <device-serial-no>-iso setv6option bootfile-url
"http://\[cw-ipv6-address\]:30604/crosswork/imagesvc/v1/device/files/cw-image-uuid-aec596

a1-7847-4254-966a-2456aa5"
#
client <device-serial-no>-script create
# Set the vendor options using blob format as option definitions are for different data
client-policy <device-serial-no>-script setV6VendorOption 17 dhcp6-cisco-custom "(1
exr-config) (2 0)"
# Escape the [ and ] as nrcmd (which uses tcl interpreter) will otherwise fail command
client-policy <device-serial-no>-script setv6option bootfile-url
"http://\[cw-ipv6-address\]:30604/crosswork/configsvc/v1/configs/device/files/8eb6b7e1
-bd54-40bb-84e0-89f11a60128b"
#
# Assure the server is up-to-date with this configuration
dhcp reload

```

### IPv6 Script 2 of 5: ztp-v6-client-class-expr.txt

```

(or (try (if (equal (as-string (request get option 15)) "exr-config") "ztp-script"))
    (try (if (equal (as-string (request get option 15)) "iPXE") "ztp-iso")))
    "ztp-none"
)

```

### IPv6 Script 3 of 5: ztp-v6-iso-lookup-expr.txt

```

(let (id)
  (setq id (request get option 1))
  (or
    # First try extracting the serial number from DUID
    (try (if (equali (substring id 0 6) 00:02:00:00:00:09)
            (concat (as-string (substring id 6 128)) "-script")
          )
    )
    # If that fails, use normal client-id (DUID) lookup
    (concat (to-string id) "-iso")
  )
)

```

### IPv6 Script 4 of 5: ztp-v6-script-lookup-expr.txt

```

(let (id)
  (setq id (request get option 1))
  (or
    # First try extracting the serial number from DUID
    (try (if (equali (substring id 0 6) 00:02:00:00:00:09)

```

```

        (concat (as-string (substring id 6 128)) "-script")
    )
)
# If that fails, use normal client-id (DUID) lookup
(concat (to-string id) "-script")
)
)

```

### IPv6 Script 5 of 5: ztp-v6-options.txt

```

# Option Definition Set Export/Import Utility
# Version: 1
#
{
  ( name = dhcp6-cisco-custom )
  ( desc = Cisco Systems, Inc. )
  ( vendor-option-enterprise-id = 9 )
  ( id-range = 2 )
  ( option-list = [
    {
      ( name = cisco-17 )
      ( id = 17 )
      ( base-type = AT_VENDOR_OPTS )
      ( flags = AF_IMMUTABLE )
      ( sepstr = , )
      ( option-list = [
        {
          ( name = clientID )
          ( id = 1 )
          ( base-type = AT_NSTRING )
          ( sepstr = , )
          ( desc = ZTP - clientID )
        }
        {
          ( name = authCode )
          ( id = 2 )
          ( base-type = AT_INT8 )
          ( sepstr = , )
          ( desc = ZTP - authCode )
        }
        {
          ( id = 3 )
          ( name = md5sum )
          ( base-type = AT_NSTRING )
          ( desc = ZTP - md5sum )
        }
      ]
    }
    {
      ( name = cnr-leasequery )
      ( id = 13 )
      ( base-type = AT_BLOB )
      ( flags = AF_IMMUTABLE )
      ( sepstr = , )
      ( option-list = [
        {
          ( name = oro )
          ( id = 1 )
          ( base-type = AT_SHORT )
          ( flags = AF_IMMUTABLE )
          ( repeat = ZERO_OR_MORE )
          ( sepstr = , )
        }
      ]
    }
    {
      ( name = dhcp-state )
    }
  ]
)

```



```
( id = 2 )
( base-type = AT_INT8 )
( flags = AF_IMMUTABLE )
( sepstr = , )
}
{
( name = data-source )
( id = 3 )
( base-type = AT_INT8 )
( flags = AF_IMMUTABLE )
( sepstr = , )
}
{
( name = start-time-of-state )
( id = 4 )
( base-type = AT_TIME )
( flags = AF_IMMUTABLE )
( sepstr = , )
}
{
( name = base-time )
( id = 5 )
( base-type = AT_DATE )
( flags = AF_IMMUTABLE )
( sepstr = , )
}
{
( name = query-start-time )
( id = 6 )
( base-type = AT_DATE )
( flags = AF_IMMUTABLE )
( sepstr = , )
}
{
( name = query-end-time )
( id = 7 )
( base-type = AT_DATE )
( flags = AF_IMMUTABLE )
( sepstr = , )
}
{
( name = client-class-name )
( id = 8 )
( base-type = AT_NSTRING )
( flags = AF_IMMUTABLE )
( sepstr = , )
}
{
( name = partner-last-transaction-time )
( id = 9 )
( base-type = AT_TIME )
( flags = AF_IMMUTABLE )
( sepstr = , )
}
{
( name = client-creation-time )
( id = 10 )
( base-type = AT_TIME )
( flags = AF_IMMUTABLE )
( sepstr = , )
}
{
( name = limitation-id )
( id = 11 )
```

```

    ( base-type = AT_BLOB )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = binding-start-time )
    ( id = 12 )
    ( base-type = AT_TIME )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = binding-end-time )
    ( id = 13 )
    ( base-type = AT_STIME )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = fwd-dns-config-name )
    ( id = 14 )
    ( base-type = AT_NSTRING )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = rev-dns-config-name )
    ( id = 15 )
    ( base-type = AT_NSTRING )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = lookup-key )
    ( id = 16 )
    ( base-type = AT_BLOB )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = user-defined-data )
    ( id = 17 )
    ( base-type = AT_NSTRING )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = prefix-name )
    ( id = 18 )
    ( base-type = AT_NSTRING )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = failover-state-serial-number )
    ( id = 19 )
    ( base-type = AT_INT )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = reservation-key )
    ( id = 20 )
    ( base-type = AT_BLOB )

```

```

        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = failover-partner-lifetime )
        ( id = 21 )
        ( base-type = AT_STIME )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = failover-next-partner-lifetime )
        ( id = 22 )
        ( base-type = AT_STIME )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = failover-expiration-time )
        ( id = 23 )
        ( base-type = AT_STIME )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = client-oro )
        ( id = 24 )
        ( base-type = AT_SHORT )
        ( flags = AF_IMMUTABLE )
        ( repeat = ZERO_OR_MORE )
        ( sepstr = , )
    }
] )
}
{
    ( name = failover )
    ( id = 21 )
    ( base-type = AT_BLOB )
    ( flags = AF_NO_CONFIG_OPTION,AF_SUPPORTS_ENCAP_OPTION,AF_IMMUTABLE )
    ( sepstr = , )
    ( option-list = [
        {
            ( name = server-state )
            ( id = 1 )
            ( base-type = AT_INT8 )
            ( flags = AF_IMMUTABLE )
            ( sepstr = , )
        }
        {
            ( name = server-flags )
            ( id = 2 )
            ( base-type = AT_INT8 )
            ( flags = AF_IMMUTABLE )
            ( sepstr = , )
        }
        {
            ( name = binding-status )
            ( id = 3 )
            ( base-type = AT_INT8 )
            ( flags = AF_IMMUTABLE )
            ( sepstr = , )
        }
        {
            ( name = binding-flags )

```

```

    ( id = 4 )
    ( base-type = AT_INT8 )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = start-time-of-state )
    ( id = 5 )
    ( base-type = AT_DATE )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = state-expiration-time )
    ( id = 6 )
    ( base-type = AT_DATE )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = failover-expiration-time )
    ( id = 7 )
    ( base-type = AT_DATE )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = bndupd-serial )
    ( id = 8 )
    ( base-type = AT_INT )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = bndack-serial )
    ( id = 9 )
    ( base-type = AT_INT )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = client-flags )
    ( id = 10 )
    ( base-type = AT_INT )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = vpn-id )
    ( id = 11 )
    ( base-type = AT_INT )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
  }
  {
    ( name = lookup-key )
    ( id = 12 )
    ( base-type = AT_BLOB )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
    ( option-list = [
      {
        ( name = type )
        ( id = 0 )
      }
    ] )
  }

```

```

        ( base-type = AT_INT8 )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = data )
        ( id = 0 )
        ( base-type = AT_BLOB )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
] )
}
{
    ( name = user-defined-data )
    ( id = 13 )
    ( base-type = AT_BLOB )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = reconfigure-data )
    ( id = 14 )
    ( base-type = AT_BLOB )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
    ( option-list = [
        {
            ( name = time )
            ( id = 0 )
            ( base-type = AT_DATE )
            ( flags = AF_IMMUTABLE )
            ( sepstr = , )
        }
        {
            ( name = key )
            ( id = 0 )
            ( base-type = AT_BLOB )
            ( flags = AF_IMMUTABLE )
            ( sepstr = , )
        }
    ] )
}
{
    ( name = requested-fqdn )
    ( id = 15 )
    ( base-type = AT_BLOB )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
    ( option-list = [
        {
            ( name = flags )
            ( id = 0 )
            ( base-type = AT_INT8 )
            ( flags = AF_IMMUTABLE )
            ( sepstr = , )
        }
        {
            ( name = domain-name )
            ( id = 0 )
            ( base-type = AT_DNSNAME )
            ( flags = AF_IMMUTABLE )
            ( sepstr = , )
        }
    ] )
}

```

```

] )
}
{
  ( name = forward-dnsupdate )
  ( id = 16 )
  ( base-type = AT_NSTRING )
  ( flags = AF_IMMUTABLE )
  ( sepstr = , )
}
{
  ( name = reverse-dnsupdate )
  ( id = 17 )
  ( base-type = AT_NSTRING )
  ( flags = AF_IMMUTABLE )
  ( sepstr = , )
}
{
  ( name = partner-raw-cltt )
  ( id = 18 )
  ( base-type = AT_DATE )
  ( flags = AF_IMMUTABLE )
  ( sepstr = , )
}
{
  ( name = client-class )
  ( id = 19 )
  ( base-type = AT_NSTRING )
  ( flags = AF_IMMUTABLE )
  ( sepstr = , )
}
{
  ( name = status-code )
  ( id = 20 )
  ( base-type = AT_BLOB )
  ( flags = AF_IMMUTABLE )
  ( sepstr = , )
  ( option-list = [
    {
      ( name = status-code )
      ( id = 0 )
      ( base-type = AT_SHORT )
      ( flags = AF_IMMUTABLE )
      ( sepstr = , )
    }
    {
      ( name = status-message )
      ( id = 0 )
      ( base-type = AT_NSTRING )
      ( flags = AF_IMMUTABLE )
      ( sepstr = , )
    }
  ] )
}
{
  ( name = dns-info )
  ( id = 21 )
  ( base-type = AT_BLOB )
  ( flags = AF_IMMUTABLE )
  ( sepstr = , )
  ( option-list = [
    {
      ( name = flags )
      ( id = 0 )
      ( base-type = AT_SHORT )

```

```

        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = host-label-count )
        ( id = 0 )
        ( base-type = AT_INT8 )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = name-number )
        ( id = 0 )
        ( base-type = AT_INT8 )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
] )
}
{
    ( name = base-time )
    ( id = 22 )
    ( base-type = AT_DATE )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = relationship-name )
    ( id = 23 )
    ( base-type = AT_NSTRING )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = protocol-version )
    ( id = 24 )
    ( base-type = AT_INT )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = mclt )
    ( id = 25 )
    ( base-type = AT_INT )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = dns-removal-info )
    ( id = 26 )
    ( base-type = AT_BLOB )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
    ( option-list = [
        {
            ( name = host-name )
            ( id = 1 )
            ( base-type = AT_RDNSNAME )
            ( flags = AF_IMMUTABLE )
            ( sepstr = , )
        }
        {
            ( name = zone-name )
            ( id = 2 )

```

```

        ( base-type = AT_DNSNAME )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = flags )
        ( id = 3 )
        ( base-type = AT_SHORT )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = forward-dnsupdate )
        ( id = 4 )
        ( base-type = AT_NSTRING )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = reverse-dnsupdate )
        ( id = 5 )
        ( base-type = AT_NSTRING )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
] )
}
{
    ( name = max-unacked-bndupd )
    ( id = 27 )
    ( base-type = AT_INT )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = receive-timer )
    ( id = 28 )
    ( base-type = AT_INT )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = hash-bucket-assignment )
    ( id = 29 )
    ( base-type = AT_BLOB )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = partner-down-time )
    ( id = 30 )
    ( base-type = AT_DATE )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = next-partner-lifetime )
    ( id = 31 )
    ( base-type = AT_DATE )
    ( flags = AF_IMMUTABLE )
    ( sepstr = , )
}
{
    ( name = next-partner-lifetime-sent )

```



```

        ( id = 32 )
        ( base-type = AT_DATE )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    {
        ( name = client-oro )
        ( id = 33 )
        ( base-type = AT_SHORT )
        ( flags = AF_IMMUTABLE )
        ( repeat = ZERO_OR_MORE )
        ( sepstr = , )
    }
    {
        ( name = requested-prefix-length )
        ( id = 34 )
        ( base-type = AT_INT8 )
        ( flags = AF_IMMUTABLE )
        ( sepstr = , )
    }
    ] )
}
] )
}
] )
}

```

## Generic ISC DHCP Setup

Below is a sample of the type of host entry you would make for a ZTP device in the `/etc/dhcp/dhcp.conf` configuration file of an [Internet Systems Consortium \(ISC\) DHCP server](#).

While DHCP servers differ in overall implementation, most open-source DHCP servers use options and formats similar to the following ISC examples for IPv4 and IPv6.

Cisco recommends that you deploy Crosswork ZTP over secure networks only. Please see the additional requirements in [#unique\\_123 unique\\_123\\_Connect\\_42\\_ZTPSupport4HTTPS](#).

Be sure to reload or restart the ISC DHCP server once you have finished creating these new entries.

### ISC IPv4 DHCP Configuration Example

```

host NCS5k-1
{
    option dhcp-client-identifier "FOC2302R09H";
    hardware ethernet 00:cc:fc:bb:be:6a;
    fixed-address 105.1.1.16;
    if exists user-class and option user-class = "iPXE" {
        filename = "http://105.11.1.2.1:30604/crosswork/imagesvc/v1/device/files/
        cw-image-uuid-2b66f2ce-21ff-44c1-9801-d649db2a5581
    } else if exists user-class and option user-class = "exr-config" {
        filename = "http://105.1.2.1:30604/crosswork/configsvc/v1/configs/device/files/
        9cclea36-f53f-4306-959f-0fd804b32f01";
    }
}

```

## ISC IPv6 DHCP Configuration Example

```

host 5501
{
    host-identifier option dhcp6.client-id
00:02:00:00:00:09:46:4f:43:32:33:30:38:52:30:53:33:00;
    fixed-address6 fc00:15:2::36;
    if exists dhcp6.user-class and substring(option dhcp6.user-class, 2, 4) = "iPXE" {
        option dhcp6.bootfile-url
"http://[fc00:15:2::2]:30604/crosswork/imagesvc/v1/device/files/
    cw-image-uuid-94dc3788-e0d4-4bb0-9c17-721b23c30007";
    } else {if exists dhcp6.user-class and substring(option dhcp6.user-class, 0, 10) =
"exr-config" {
        option dhcp6.bootfile-url
"http://[fc00:15:2::2]:30604/crosswork/configsvc/v1/configs/device/files/
    2dde1691-bb9c-4e1e-919c-08fffa89611a";
    }
}
}

```

## IPv4 DHCP Configuration Entries and Values

The following table describes each line in the IPv4 example DHCP device entries and the source of the values used. The IPv6 entries are similar.

**Table 8: IPv4 DHCP Configuration Host Entries and Values**


IPv4 Entry	Description
host NCS5k-1	The device entry host name. This can be the same as the actual assigned host name, but need not be.
option dhcp-client-identifier	The unique ID of the device entry. The value "FOC2302R09H" is the serial number of the device, which can be found on the device chassis. If you do not have physical access to the device, the IOS-XR <code>show inventory</code> command will provide the serial number.
hardware ethernet 00:cc:fc:bb:be:6a	The MAC address of the device's Ethernet NIC on which you trigger the zero-touch provisioning process. This can be a management or data port, as long as it is reachable from Crosswork.
fixed-address 105.1.1.16	The IP address to be assigned to the device during configuration. This example is for a static IP, but you can also use standard DHCP IP pool assignment commands.
option user-class = "iPXE" and filename =	This line checks that the incoming ZTP request contains the "iPXE" option, which is used to image (or re-image) the device. If the request includes this option, then the device will download from the ZTP repository the image file corresponding to the UUID and on the path specified in the <code>filename =</code> parameter. To copy the complete image file path and/or UUID into your DHCP device entry, follow the steps in <a href="#">Copy Image File Paths and UUIDs, on page 36</a> .

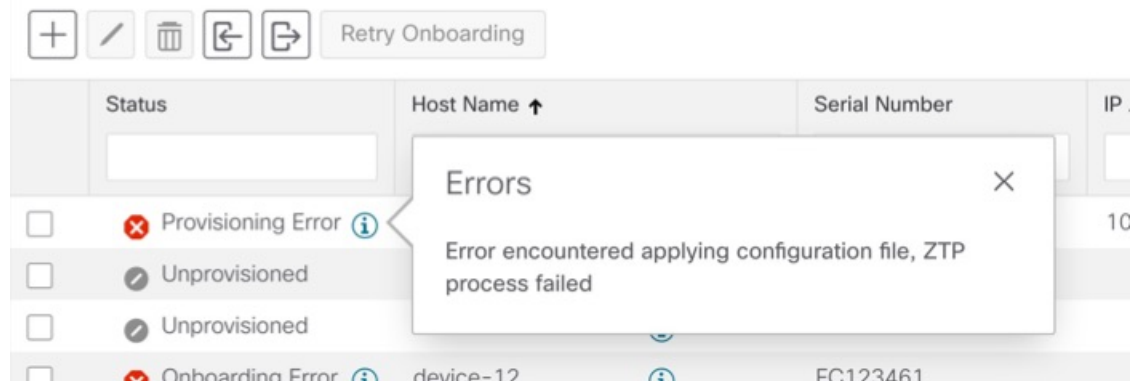
IPv4 Entry	Description
<pre>option user-class = "exr-config" and ffl filename =</pre>	<p>This line checks that the incoming ZTP request contains the "exr-config" option, which is used to configure the device. If the request includes this option, then the device will download from the Crosswork repository the configuration file corresponding to the UUID and on the path specified in the <code>filename =</code> parameter. To copy the complete configuration file path and/or UUID into your DHCP device entry, follow the steps in <a href="#">Copy Configuration File Paths and UUIDs</a>, on page 41.</p>

## Troubleshoot ZTP Issues

Crosswork ZTP provisioning and onboarding happen quickly and automatically, but errors and problems do occur. The following topics discuss how to remedy common problems.

### Inspect Status Errors

As explained in [Use the Zero Touch Devices Window to Work with Devices](#), on page 29, the **Status** column displays the  next to every device entry whose ZTP processing finished with a **Provisioning Error** or **Onboarding Error**. Click on the icon to display a popup window with information about the error, as in the example shown below. When you are finished viewing the popup window, click **X** to close it.



### Errors while uploading image files

Make sure that the image file's MD5 checksum was entered correctly. If all the information was entered correctly, image uploads to the Crosswork repository can still fail due to slow network connections. If you are running into this problem, retry the upload.

### Uploaded images and configuration files are not in the drop down menu when creating ZTP device entries or ZTP profiles

The drop down menu selects images and configuration files based on the device family and release number you specify in your device entry or profile. Make sure that the release and the device family for the image or configuration files matches the release and device family specified for the device entry or profile you are creating.

### Errors during import of devices

If there are any devices already present in Crosswork that have the same serial numbers as the devices you are importing, make sure these existing devices are in the **Unprovisioned** state before the import (all the devices imported using CSV files have their status set to **Unprovisioned** on import). Before importing the devices, make sure the configuration files, software images, and ZTP profiles mentioned in the CSV file are already present in Crosswork. If you are importing a previously exported CSV file in which you have made changes, and want to ensure they are associated with new image or configuration files you have uploaded, make sure to edit the UUIDs of the associated image and configuration files in the CSV file before importing.

### Image file download fails

Check that there is network connectivity between Crosswork and the device. Make sure that the device is getting its IP address from the DHCP server. Ensure that the UUID of the software image given in the DHCP server's configuration file is correct. If you must correct the image UUID specified in the DHCP server's configuration file, make sure you restart the DHCP server before initiating ZTP processing again.

### Configuration file download fails

Check that there is network connectivity between Crosswork and the device. Make sure that the device is getting its IP address from the DHCP server. Ensure that the UUID of the software image given in the DHCP server's configuration file is correct. If you must correct the image UUID specified in the DHCP server's configuration file, make sure you restart the DHCP server before initiating ZTP processing again. Make sure that the device serial number entered in Crosswork is correct and matches the serial number on the device's chassis. Ensure that the device's status in Crosswork is either **Unprovisioned** or **In Progress** before initiating ZTP processing. If the device is in any other state, the configuration download will fail again.

### Device state is showing Onboarded and not Provisioned

This is expected behavior, as **Provisioned** is an intermediate state. As soon as the device state is changed to **Provisioned**, Crosswork will attempt to onboard the device immediately, and the status will change to **Onboarded** or **Onboarding Error**, depending on whether the onboard to DLM was successful or not.

### Onboarding Error

The default Crosswork device life-cycle management (DLM) policy for identifying devices uniquely is the IP address. If your Crosswork installation is using the default DLM policy and if there is already a device in inventory with the same IP address as the ZTP device entry being processed, the device status will change first to **Provisioned**, then to **Onboarding Error**. You will get the same result if the IP address field is not populated in the device entry. These same issues apply if your Crosswork installation uses an OSPF ID, ISIS ID, or other DLM policy. All the DLM policy fields must be populated and their values must be unique for onboarding to succeed. If onboarding fails, inspect the popup error message, update the corresponding fields and retry onboarding.