Install Cisco IOS XR7 on NCS 540 Series Routers

This section describes the concepts and procedures for upgrading or downgrading your system, installing optional packages, and obtaining bug fixes for the Cisco NCS 540 series routers.

Cisco NCS 540 series routers use the Cisco IOS XR7 framework. This framework refers to a set of architectural enhancements to the Cisco IOS XR software around the capabilities of modularity, simplified platform infrastructure, and programmability at various software layers.

The Cisco IOS XR software is composed of a base image (ISO) that provides the XR infrastructure, and a TAR file. The TAR file is made up of a set of packages (also called RPMs). These packages comprise mandatory and optional RPMs that can be deployed based on specific requirements. This software modularity approach provides a flexible consumption model that allows you to install a subset of IOS XR packages on devices based on your individual requirements. All critical components are modularized as packages so that you can select the features that you want to run on your router. For example, components like CDP and Telnet are modularized as packages and separated from the base image. These packages can be individually installed, upgraded or removed based on your requirements.

Cisco IOS XR7 install is Dandified Yum- or DNF-based software package manager that is used to install, update, and remove packages on the RPM-based Linux distributions. The package manager is used to automatically compute dependencies and determine the actions required to install packages.

Note For information on how to download the system upgrade procedures document, see the *About Cisco IOS XR Software Upgrade and Downgrade Guide*.

The Cisco NCS 540 router variants that support XR7 in Cisco IOS XR Release 7.0.1 are:

- N540-28Z4C-SYS-A
- N540-28Z4C-SYS-D
- N540X-16Z4G8Q2C-A
- N540X-16Z4G8Q2C-D
- N540-12Z20G-SYS-A
- N540-12Z20G-SYS-D
- N540X-12Z16G-SYS-A
- N540X-12Z16G-SYS-D

The Cisco NCS 540 router variants that support XR7 in Cisco IOS XR Release 7.3.1 are:

- N540X-6Z18G-SYS-A
- N540X-6Z18G-SYS-D
- N540X-8Z16G-SYS - A
- N540X-8Z16G-SYS - D

Supported Packages

The base ISO image is contained within a `.tar` file. Additional optional packages (RPMs) are provided as modular software deliverables to align with diverse use cases and their deployments across the network.

Note You can create a golden ISO (GISO) with optional packages and bug fixes based on your requirement. Contact Cisco Support to build a GISO.

The software deliverables include:

- ISO image containing the base install image - `ncs540l-x64-7.0.1.iso`
- Tar file containing optional RPMs - `NCS540l-iosxr-7.0.1.tar`
- ZIP file for USB boot - `ncs540l-usb_boot-7.0.1.zip`

The software deliverables can be downloaded from Cisco Software Download center.

Optional Package	Included in ISO by Default
ncs540l-netflow	Yes
ncs540l-mcast	Yes
BGP	Yes
CDP	No
EIGRP	No
IPSLA	Yes
IS-IS	Yes
LLDP	Yes
MCAST	Yes
MPLS-OAM	Yes

Optional Package	Included in ISO by Default
Netflow	Yes
OSPF	Yes
Perfmgmt	Yes
RIP	No
Telnet	No
Track	Yes

Note The telnet package is not part of the ISO image. You must manually install the telnet optional package to use telnet for client or server. This applies to all packages that are not part of the ISO image.

SSH is part of the ISO image.

Install operation over IPv6 is not supported.

Supported Packages for NCS 540 Small-Density Routers

Effective Cisco IOS XR Release 7.3.1, the following variants of the Cisco NCS 540 routers form the small-density routers:

- N540X-6Z18G-SYS-A
- N540X-6Z18G-SYS-D
- N540X-8Z16G-SYS-A
- N540X-8Z16G-SYS-D

The software deliverables include:

- ISO image containing the base install image —`ncs540l-aarch64-7.3.1.iso`
- Tar file containing optional RPMs—`NCS540l-iosxr-7.3.1.tar`
- ZIP file for USB boot—`ncs540l-usb_boot-7.3.1.zip`

Software Deliverables and Terminologies

This section provides an understanding of the terms that are associated with installing the software.

- **Package:** The primary mechanism for changing the install image on a system. A package, also known as an RPM, contains the software and metadata. A package is in `.rpm` format. A package can be mandatory or optional. Mandatory packages are part of the install image and cannot be removed. Optional packages are not required for the software to work, but can be installed to provide additional functionalities, and can be installed or removed based on requirement.

- **ISO image:** A bootable image that contains the installable files of the base operating system (OS). The image contains the IOS XR (XR7) infrastructure for fixed and distributed platforms in the form of base ISO image, mandatory RPMs. An ISO image is in `.iso` format.
- **Golden ISO (GISO):** A customizable ISO image that is built to contain preferable packages to suit diverse installation requirements. GISO can be customized to include a standard base image with the basic functional components, additional RPMs, bug fixes, and configuration files based on your requirement. GISO can also include a custom image version. From IOS XR Release 7.5.x and later, you can build your GISO image without support from Cisco by using the Build a Golden ISO feature.
- **Source:** A location where packages can be installed from. The source can be a repository, local directory or a local tar file.
- **Repository:** A directory of RPMs and their metadata that a package manager uses to query the packages.
- **Active package:** A package whose software is currently running on the system.
- **Committed package:** A package that is committed and remains active following a system reload.
- **Atomic Change:** Every packaging operation is contained within an atomic change. Atomic changes may contain multiple packaging operations. During an atomic change, any changes to install IOS XR software will not be visible to the system. To make the changes visible to the system, the atomic change must be applied.
- **Top-level package:** Each block of software has a top-level package and various partition-level packages. The top-level package can be installed or upgraded directly, whereas the partition-level packages cannot be changed directly. The partition-level packages are installed or upgraded automatically as dependencies of the top-level package. The top-level package has the name format `xr-<feature>-<release>.x86_64.rpm`, whereas the dependent partition-level packages have the longer name format containing information about the partition. You can also use the standard RPM commands to check the summary or description metadata of the package, which will identify whether it is a top-level or a partition-level package.
- **Package manager:** An entity that handles the semantics to resolve dependencies in packaging operations.
- **Packaging operations:** The actions performed to change the packages that are installed on the system. The semantics are inherited from the underlying package manager. Examples of packaging operations are upgrade, downgrade, replace, add, or remove packages.
- **Synchronous action:** Synchronous action requests are supported for install actions using CLI command. Specify `synchronous` keyword in the install commands, and the prompt will only be returned when either the request has completed, `Ctrl + C` keys are pressed or a reload occurs. Pressing `Ctrl + C` keys during a synchronous action request will return the prompt to the user but will not halt the install operation. During the synchronous action request, the user is updated with the status of the request whenever it changes.
- **Transaction:** All atomic changes occur within a transaction. If the system reloads during an install transaction, the running software will be reverted to its previous state before the transaction was started. To maintain the software changes carried out during a transaction, you must commit the transaction.
- A complete install operation to modify the system’s software requires three phases:
  - Packaging operation
  - **Apply:** This is required to complete an atomic change and make the software change visible to the system.

- **Commit:** This is required to end a transaction and ensure that all software changes will still be present on router reload.

Note If you perform a manual or automatic system reload without completing the transaction with the **install commit** command, the action will revert the system to the point before the install transaction commenced, including any configuration changes. Only the log is preserved for debugging.

Note In a multinode system, any node reloads that occur during a transaction that are not initiated as part of the install 'apply by reload' phase can result in the reloaded node being in BOOT HOLD state. The node continues to be in the BOOT HOLD state until the transaction is either committed or cancelled.

Workflow for Installing Cisco IOS XR7 Software

The router is shipped with a pre-installed version of the Cisco IOS XR (XR7) software. When the router is powered ON for the first time, the pre-installed software starts functioning automatically. You configure the router for network capabilities. When a new version of the software is available, you can upgrade the system using these tasks:

Note For instructions to upgrade image-specific software, navigate to the CCO Software Download portal, select the product and refer to the `ncs540-x64-<version>.docs.tar` file for the release.

Obtain Data Models for Install Operation

You can use YANG data models to install and upgrade XR7 software. The data models are packaged with the release image in the `/pkg/yang` directory.

The models are in the `.yang` format. Each data model can be identified as one of the following functionalities:

- `-oper` in the model name indicates an operational model. For example, `Cisco-IOS-XR-install-oper.yang` and `Cisco-IOS-XR-install-augmented-oper.yang` are operational models for the install operation.
- `-cfg` indicates a configuration model. For example, `Cisco-IOS-XR-install-cfg.yang` is a configuration model for the install operation.
- `-act` indicates an action model. For example, `Cisco-IOS-XR-install-augmented-act.yang` and `Cisco-IOS-XR-install-act.yang` are action models for the install operation.

Procedure

Step 1 View the install-related data models on the router. You can also access the supported data models to install Cisco IOS XR software from the Github repository.

Example:

```
node0_RP0_CPU0:/pkg/yang]$ls -ltr *install*
-rw-r--r--. 1 root root  8646 Jul  2 01:59 Cisco-IOS-XR-install-act.yang
-rw-r--r--. 1 root root  7267 Jul  2 01:59 Cisco-IOS-XR-install-search-act.yang
-rw-r--r--. 1 root root 10664 Jul  2 01:59 Cisco-IOS-XR-install-augmented-act.yang
-rw-r--r--. 1 root root  2511 Jul  2 02:00 Cisco-IOS-XR-um-install-cfg.yang
-rw-r--r--. 1 root root  2270 Jul  2 02:04 Cisco-IOS-XR-install-cfg.yang
-rw-r--r--. 1 root root  6222 Jul  2 02:04 Cisco-IOS-XR-install-oper.yang
-rw-r--r--. 1 root root 14009 Jul  2 02:04 Cisco-IOS-XR-install-augmented-oper.yang
-rw-r--r--. 1 root root 13726 Jul  2 02:04 Cisco-IOS-XR-install-oper-sub1.yang
-rw-r--r--. 1 root root  2440 Jul  2 02:04 Cisco-IOS-XR-install-augmented-oper-sub2.yang
-rw-r--r--. 1 root root 59866 Jul  2 02:04 Cisco-IOS-XR-install-augmented-oper-sub1.yang
```

The following table describes the function of the install-related data models:

Data Model	Description
Cisco-IOS-XR-install-oper	Operational data model to view details that are related to basic package information, active and committed packages, and fixes
Cisco-IOS-XR-install-cfg	Configuration data model to specify the location of the install source
Cisco-IOS-XR-install-act	Action model to perform basic install operations and software upgrade
Cisco-IOS-XR-install-search-act	Action model that contains a collection of YANG definitions for install actions related to searching for package information
Cisco-IOS-XR-install-augmented-oper	Augmented operational model that displays information about packaging, atomic changes, and history of the install operation on the router
Cisco-IOS-XR-install-augmented-act	Action model to perform flexible install operations, including controlling the exact timing of system reloads and rolling back to a previous commit
Cisco-IOS-XR-shellutil-copy-act	Action model to copy files on the router from a source location

Step 2 Use a manageability agent like NETCONF or gRPC to connect and communicate with the router. You can send Remote Procedure Calls (RPC) requests to configure or retrieve operational data from the router. The router processes the request and responds to the request through an RPC response. You use the RPCs to send requests to install the software by populating the relevant container and leaf in the data model.

For more information about understanding the data model structure and using data models, see the *Programmability Configuration Guide for Cisco NCS 540 Series Routers*.

Create Repository to Access Files for Installing IOS XR Software

Note If only Golden ISO (GISO) is used, you do not need to create a repository.

To install packages (RPM), code upgrades, and updates in XR7, you need a repository of RPMs for the router to download the RPMs for installation. The repository can be local to the router, or accessed remotely through FTP, HTTP, or HTTPS.

Important The repository must be created specific to each platform and release. Do not create repositories with a mix of platforms and releases.

When the repository is accessed remotely, you must provide a repository URL from where the install files are fetched. The URL contains:

- IP address of the server
- Port number of the server
- (Optional) Virtual Routing and Forwarding (VRF) name

The repository can be configured to be reachable using a non-default VRF table. If the repository is reachable through an address in a VRF, specify the name of the VRF.

The format of the repository URL is one of the following:

- FTP: `ftp://<server>[;<vrf>]/<path-to-repository>`
- HTTP: `http://<server>[;<vrf>]/<path-to-repository>`
- HTTPS: `https://<server>[;<vrf>]/<path-to-repository>`
- Local: `file:///<path-to-repository>`. The path to the repository must be under /harddisk:/ location.

For example, the URL for HTTP server is http://172.16.0.0:3333/.

Note Username and password are not supported for HTTP and FTP repositories.

Create and Configure a Local Repository

The router can serve as repository to host the RPMs. You must be a `root-lr` user with access to the router shell. Remote repository is the recommended method to access the RPMs. However, if remote repository is not your preferred option, then you can use the router as a repository to host the RPMs.

Using a local repository removes the need to setup an external server for software installation. In this method, the image files are copied directly to the router, and used to create a repository locally. However, on the downside, the files for future updates must be copied to each router individually.

This section provides the procedure for setting up a local RPM repository on the router.

Procedure

Step 1 Create a directory locally on the router's `/harddisk:`. Copy the required RPMs and ISO files (using copy or scp command) from the server to the local directory on the router.

Step 2 Access the shell of the router using `run` command and untar the RPMs.

Example:

```
Router#run
[node:~]$cd <directory-with-rpms>
[node:~]$tar -xvzf <rpm-name>.tgz
```

Step 3 Exit from the shell.

Step 4 Configure the local repository.

Example:

```
Router#config
Router(config)#install repository local-repo url file:///harddisk:/<directory-with-rpms>
Router(config)#commit
<data and time stamp> UTC: config[67543]: Configuration committed by user.
Router(config)#end
```

where, `local-repo` is the repository name, `file:///harddisk:/<directory-with-rpms>` is the local repository URL.

Step 5 Check the contents of the repository.

Example:

```
Router#show install available
Trying to access repositories...
Package                Architecture          Version          Repository
--------------------  ---------------  ------------------ ---------------

xr-ncs540l-core       x86_64        7.0.1v1.0.1-1      local-repo

xr-core               x86_64        7.0.1v1.0.1-1      local-repo
```

Note Only the top-level packages are displayed. The contents of the repository is displayed only when the configured repository is valid and the RPMs are present in the repository. It displays only the packages that are available in the repository and not part of active system.

Create and Configure an External Repository

To create an external repository, use a server that can be reached over HTTP, HTTPS or FTP. The following instructions are applicable to Linux distribution systems.

Using an external repository provides a central common repository to be used across devices. This eliminates the need to copy files for future updates to each router individually. It also serves as a single source when new RPMs (bug fixes, packages, updates) are made available. This is the recommended method to setup a repository.

Note For release 7.0.1, 7.0.2, and 7.1.x, the external repository is available only through the Management Ethernet interface.

Before you begin

Ensure that you have completed the following tasks:

- Set up your HTTP, HTTPS or FTP server. Ensure that the server is reachable as specified in the note above.
- Install `createrepo` utility on the Linux distribution system (if not installed already).

Procedure

Step 1 Create a directory on the server and copy all the RPMs to a directory. This directory hosts the repository and must be accessible to the HTTP, HTTPS or FTP server that the router will use to access the repository. For example, `/var/www/html`, is the directory where the repository will be created.

If the RPM files are archived (.tar format) or compressed (.tgz or .gz format), extract the files. The files hierarchically arrange in sub directories under the main directory that is used as a repository.

Step 2 Convert the directory to a repository using `createrepo` utility on the Linux server. This creates a directory named `repodata` with the metadata of all the RPMs.

Example:

```
[node]$createrepo --database /var/www/html/
Saving Primary metadata
Saving file lists metadata
Saving other metadata
Generating sqlite DBs
Sqlite DBs complete

[node]$cd /var/www/html/
[node]$ls
repodata
```

If you add new packages to the repository, change or remove packages from the repository, you must run `createrepo` command again to update the metadata. This ensures that the package manager chooses the correct packages.

Step 3 Configure the external repository.

Example:

```
Router#config
Router(config)#install repository remote-repo url http://10.194.88.104/<directory-with-rpms>

Router(config)#commit
<data and time stamp> UTC: config[67542]: Configuration committed by user 'cisco'.
Router(config)#end
```

For FTP, the repository is configured as follows:

```
Router#config
Router(config)#install repository remote-repo url ftp://10.194.88.104/<directory-with-rpms>
Router(config)#commit
<data and time stamp> UTC: config[67543]: Configuration committed by user 'cisco'.
Router(config)#end
```

where, `remote-repo` is the repository name, `http://10.194.88.104/<directory-with-rpms>` is the HTTP repository URL, and `ftp://10.194.88.104/<directory-with-rpms>` is the FTP repository URL.

Step 4 Verify connectivity to the server, and check the contents of the repository.

Example:

```
Router#show install available
Trying to access repositories...
Package                Architecture          Version          Repository
--------------------  ---------------  ------------------ ---------------

xr-ncs540l-core       x86_64         7.0.1v1.0.1-1      remote-repo

xr-core               x86_64         7.0.1v1.0.1-1      remote-repo
```

Note Only the top-level packages are displayed. The contents of the repository are displayed only when the configured repository is valid and the RPMs with the updated metadata are present in the repository. It displays only the packages that are available in the repository and not part of active system.

Upgrade the Current Active Version of Cisco IOS XR Software

This section shows replacing the current software version with `.iso` image. The instructions in this section also apply to system downgrade.

Upgrade the Current Active Version

In this scenario, you replace the current software with image, apply the changes, and commit the install operation. Committing the changes indicates the end of the current transaction. The updated software is used after the changes are applied, before the install transaction is committed.

A reboot is not always necessary. Bug fixes can be applied using a GISO that contains the current running software and the additional bugfix. These fixes may not require a reboot. Reboots are required for a system version change, if too many processes need restarting, there is configuration in the GISO to apply or if the bugfix is marked as requiring a reload.

From Cisco IOS XR Release 7.5.1, you can use the Automatic Install of Bridging Bug Fix RPMs feature to install any bridging bug fix RPMs that are prerequisite for a system upgrade or a downgrade.

You need to add the required Bridging Bug Fix RPMs into the customized ISO built using Cisco Golden ISO (GISO) build script **gisobuild.py**, by going through the steps in Build a Golden ISO, on page 19. Ensure that you add the required bridging bug fix RPMs into your Golden ISO. The GISO can include bridging Bug Fix RPMs for multiple releases, and installs only the specific bridging Bug Fix RPMs required for the target release. The bridging bug fix RPMs can be used in the following scenarios:

- To resolve a bug that might stop upgrade.
- The latest version has new prerequisite requirements that are not met by the earlier version.

The **install replace** command adds and applies the highest version of any bridging bugfix RPMs for the currently active XR version.

Procedure

Step 1 Copy the ISO (or GISO) image to the `/harddisk:` location on the router.

Step 2 Upgrade the system to replace the current software with the .iso image.

Example:

```
Router#install package replace /harddisk:/ncs540l-x64-x.x.x.iso
```

Step 3 Activate the new .iso image on the router by applying the changes.

Example:

```
Router#install apply {reload | restart} [noprompt]
```

Note You can use a single command to perform both the packaging operation and activating the applying the changes using **install replace /harddisk:/ncs540l-x64-x.x.x.iso noprompt** command.

To identify whether a reload is required or only process restart is needed, use either **show install history last transaction verbose** command or **show install request** command.

Include the keyword `noprompt` in the command to enable the system to bypass your permission to reload the router.

Applying the change gives you the flexibility to test the operation of the new software before committing the changes. If you reload the router, the router reverts the software to its previous software state.

All operations that automatically apply the new software are prohibited when an atomic change is already in progress. You must address the current atomic-change before performing this operation. To address the change, apply the current atomic-change, or cancel it with the **install package abort all-since-apply** command.

Step 4 View the install log.

Example:

```
Router#show install log detail
Fri Nov 12 09:43:49.702 UTC
2021-11-12 09:33:47 UTC    Transaction 1 started
2021-11-12 09:33:47 UTC    Atomic change 1.1 started
2021-11-12 09:33:47 UTC    Packaging operation 1.1.1 started
2021-11-12 09:33:47 UTC    Replace


2021-11-12 09:35:58 UTC    Packaging operation 1.1.1 success
2021-11-12 09:36:04 UTC    Apply by reload started
2021-11-12 09:38:48 UTC    Atomic change 1.1 successfully applied by reload
```

Step 5 Verify that the image is activated successfully.

Example:

```
Router#show install request
```

Step 6 Commit the transaction.

Example:

```
Router#install commit
```

Note Any action requests may be run synchronously from the CLI. During this request, you are updated with the status of the request whenever it changes. The following example shows the output from a synchronous action request:

```
Router#install commit synchronous
Starting:
  install commit
Transaction 1
The install operation will continue in the background
Press Ctrl-C to return to the exec prompt. This will not cancel the install
operation

Current activity: Initializing ....
Current activity: Commit transaction ......

Transaction 4: 'install commit' completed without error
```

Upgrade the System and Install RPMs

In this scenario, you replace the current software with the `.iso` image and have the possibility to install or remove optional RPMs before applying the changes. You can perform this operation while an atomic-change is already in progress. However, all packaging operations before this command are discarded. The installed software is an exact copy of the software in the ISO after this packaging operation is complete. You can perform all additional packaging operations after this operation and before applying and committing the changes.

Procedure

Step 1 Copy the ISO (or GISO) image to the `/harddisk:` directory on the router.

Step 2 Upgrade the system to replace the current software with the .iso image.

Example:

```
Router#install package replace /harddisk:/ncs540l-x64-x-x-x.iso
```

Step 3 Install other RPMs (packages) after the system upgrade operation.

a) Configure a repository on the router. For instructions to create a local or a remote repository, see Create Repository to Access Files for Installing IOS XR Software, on page 7.

b) Check the available packages in the repository.

Example:

```
Router#show install available
```

c) Install the RPMs.

Example:

```
Router#install package add <pkg1> <pkg2> <pkgn>
```

Step 4 Check the status of install operation.

Example:

```
Router#show install request
```

```
User request: install package add xr-bgp

State: In progress since <date and timestamp>

Current activity: Package add or other package operation
Next activity: Await user input
Time started: <date and timestamp>
Timeout in: 35m 8s
Locations responded: 0/1

Location    Packaging operation stage  Notification Phase Clients responded
----------  ------------------------- ------------------- ------------------
0/RP0/CPU0   Package operations         None in progress    N/A
```

Note The operation ID is a unique ID for each user request. This ID is constructed from the transaction ID, atomic change ID and packaging operation ID that was already used in the commands. For example, if the request is `install commit`, the operation ID is the transaction ID. If the request includes applying an atomic change but not committing the transaction (for example, `install replace /harddisk:/ncs540_x64.iso`), the operation ID is the atomic change ID. An operation ID of 4.2 indicates a second atomic change in the fourth transaction.

This operation ID is also returned in the action RPC. If an error occurs while the request is initiated, an empty string is returned instead of an operation ID.

When the `State` changes to `Success`, activate the new image.

```
Router#show install request
Wed Sep 14 02:53:21.525 PDT

User request: install package abort latest
Operation ID: 2.1.2
State:        Failure since 2022-09-14 02:48:15 UTC-07:00
Disk space check failed on nodes: 0/0/CPU0. Query 'show install history id 2.1.2 errors'
for more details and next steps

Current activity:    Await user input
Time started:        2022-09-14 02:48:20 UTC-07:00

The following actions are available:
    install package add
    install package remove
    install package upgrade
    install package downgrade
    install package abort latest
    install package abort all-since-apply
    install apply restart
    install apply reload
    install reimage
```

Note The **install apply restart** method has the least impact.

Step 5 Activate the new .iso image or RPM on the router by applying the changes.

Example:

```
Router#install apply {reload | restart} [noprompt]
```

To identify whether a reload is required or only process restart is needed, use either **show install history last transaction verbose** command or **show install request** command.

Include the keyword `noprompt` in the command to enable the system to bypass your permission to reload the router.

Step 6 Verify the image and packages that are activated as part of `install package add` operation is activated successfully.

Example:

```
Router#show install request
```

Step 7 Commit the transaction.

Example:

```
Router#install commit
```

To perform the same step using data models, use the `install-package-replace` RPC on the Cisco-IOS-XR-install-augmented-act data model.

```
<install-replace>
   <file>iso-name</file>
   <source-type>local</source-type>
   <source>directory-containing-iso</source>
   <commit>true</commit>
</install-replace>
```

Upgrade QDD Optical Modules Through CLI

The QDD optics firmware file needs to be copied to the router manually. Contact Cisco Support to check the QDD firmware version, IOS XR release compatibility, and to obtain the QDD optics firmware file.

Limitation: When ports share a common management interface, IOS XR serializes the firmware upgrade. Serializing and deserializing may delay the upgrade process.

Procedure

Step 1 From the router, copy the QDD firmware file to the hard disk using the following command:

Example: `scp user@10.1.1.1:/home/user/filename harddisk:/`

- When you are using VRF, use the following sample command:

```
scp user@10.1.1.1:/home/user/cl1.bin vrf MGMT harddisk:/

Tue Jan 25 02:57:22.762 UTC
Connecting to 10.1.1.1...
Password:
  Transferred 1484800 Bytes
  1484800 bytes copied in 0 sec (22161194)bytes/sec

RP/0/RP0/CPU0:8808#dir harddisk:/cl1.bin
Tue Jan 25 03:00:47.835 UTC

Directory of harddisk:/cl1.bin
35 -rw-r--r--. 1 1484800 Jan 25 02:57 dp04qsdd_dp04sfp8_161_10_01.ackit

53461500 kbytes total (42983204 kbytes free)
```

- When you are not using VRF, remove the `vrf MGMT` command:

```
scp user@10.1.1.1:/home/user/cl1.bin harddisk:/
```

Step 2 Run the following commands to upgrade the FPD for QDD optical modules:

Multiport upgrade:`upgrade optics port 0,1,2,3,4 filename /harddisk:/cl1.bin location 0/1/CPU0`

Single port upgrade: `upgrade optics port 0 filename /harddisk:/cl1.bin location 0/1/CPU0`

You can check the firmware upgrade progress using the following command: `show optics firmware upgrade port 0,1,1,2,3,4 location 0/1/CPU0`

Install Optional Packages to Provide Additional Functionality

You can install one or more packages (RPM) that are not already present on the system. The packages are not mandatory for the software to function, but provide additional functionality. Based on your requirement, you can install or remove these optional packages. The source file can be a repository name, repository url, local filepath, or path to a tar file.

You must specify only the top-level package name that you want to install. The associated dependencies of this package, in the form of card and partition-specific packages, are included automatically. By default, the latest available version of each package is installed. You can also explicitly install a specific version of a package.

Note All Cisco IOS XR images are signed to ensure the authenticity of the software.

This example shows the options to install the optional package `xr-telnet-7.0.1v1.0.1-1.x86_64.rpm`.

Before you begin

If you are installing the packages from a local directory, ensure that the TAR file `ncs540l-iosxr-7.0.1.tar` is copied to the `harddisk:/` on the router. If you are installing the packages from an RPM repository, ensure you have configured the repository. For more information, see Create Repository to Access Files for Installing IOS XR Software, on page 7.

Procedure

Step 1 Install one or more optional packages using one of the following options:

- **Option 1:** Install the package from the local directory:

  ```
  Router# install source /harddisk:/files xr-telnet-7.0.1
  v1.0.1-1.x86_64.rpm
  ```

  Note The `install source` command automatically applies the changes. Use this command to install optional packages. To upgrade existing packages, see Upgrade the System to Obtain Bug Fixes, on page 20.

- **Option 2:** Install the package from a configured remote repository:

  ```
  Router#install source install-repo xr-telnet
  ```

  Here, `install-repo` is the name of the repository. For repository configuration, see Create Repository to Access Files for Installing IOS XR Software, on page 7.

- **Option 3:** Install the package from a repository URL:

```
Router#install source http://72.16.0.0:3333/remote-repo xr-telnet
```

- **Option 4:** Add the package and apply the change. The package must be available in the repository.

```
Router#install package add xr-telnet-7.0.1v1.0.1-1.x86_64.rpm
Router#install apply {restart | reload}
```

More than one package can be installed using a single packaging operation. Use the following command:

```
Router#install source <path-to-source> <package 1> <package 2> … <package n>
```

For example,

```
Router#install source /harddisk:/files xr-telnet-7.0.1v1.0.0-1.x86_64.rpm
xr-mcast-7.0.1v1.0.0-1.x86_64.rpm
```

To perform this task using data models, use the `install` RPC on the Cisco-IOS-XR-install-act data model. Here is an example with an HTTP repository:

```
<install>
   <packages>
     <packagename>pkg1</packagename>
     <packagename>pkg2</packagename>
     …
     <packagename>pkgn</packagename>
   </packages>
   <source-type>http</source-type>
   <source><path-to-source></source>
</install>
```

Step 2 Commit the operation.

Example:

```
Router#install commit
```

Step 3 Check the status of install operation.

Example:

Delete Optional Packages

You can remove optional packages that you no longer require. An optional package is not mandatory for the operating system to function, and based on your requirement, it can be installed or removed.

Procedure

Step 1 Remove the optional package.

Example:

```
Router#install package remove <optional-package-name>
```

Step 2 Apply the changes to make the change active.

Example:

```
Router#install apply [reload | restart]
```

Attention To identify whether to reload or restart the system after applying the changes, use either **show install history last transaction verbose** command or **show install request** command.

Step 3 Commit the changes to make the change persistent after a reload operation.

Example:

```
Router#install commit
```

Additional Install Operations

After you upgrade your system, based on your requirement, you can perform additional install operations:

View the Version of Installed Packages

The router is shipped with a pre-installed operating system. You can view the version of the installed software and the active packages. If you have upgraded your system, installed additional packages or bug fixes, you can view the version of the committed packages.

Review the software version information:

- Package name and version
- User who built the package
- Time the package was built
- Build workspace
- Build host
- ISO label:
  - Label is present if GISO boots using PXE boot
  - Label is present if GISO is installed using the `install replace` method
  - Label reverts to default (only release version) if there is any change since the time the image with the label was installed.
  - Label is nullified and reverts to default if an RPM is added or removed on top of an existing GISO.
  - Label is repopulated if an RPM from the GISO is added or removed and a rollback operation is performed.
- Copyright information
- Hardware information

Procedure

Step 1 View the version of the Cisco IOS XR software, and its various software components that are installed on the router.

Example:

The following example shows the version information for a non-GISO image:

```
Router#show version
Cisco IOS XR Software, Version 7.0.1 LNT
Copyright (c) 2013-2019 by Cisco Systems, Inc.

Build Information:
 Built By     : xyz
 Built On     : Sat Jun 29 22:45:27 2019
 Build Host   : iox-lnx-064
 Workspace    : ../7.0.1
                7.3.1/
                NCS540L/ws/
 Version      : 7.0.1
 Label        : 7.0.1

cisco NCS540L
System uptime is 41 minutes
```

The following example shows the version information for a GISO image. The customer label is appended to the `Label` field in the GISO image:

```
Router#show version
Cisco IOS XR Software, Version 7.0.1 LNT
Copyright (c) 2013-2019 by Cisco Systems, Inc.

Build Information:
 Built By     : xyz
 Built On     : Sat Jun 29 22:45:27 2019
 Build Host   : iox-lnx-064
 Workspace    : ../7.0.1
                /NCS540L/ws/
 Version      : 7.0.1
 Label        : 7.0.1-CUSTOMER_LABEL

cisco NCS540L
System uptime is 41 minutes
```

You can also use the `get` RPC on the `install.version` data model.

Step 2 View the active packages.

Example:

```
Router#show install active [summary]
Active Packages:    XR: 112    All: 1088
Label:              7.0.1

Optional Packages                          Version
--------------------------           ----------------------
xr-ncs540l-mcast                         7.0.1v1.0.0-1
xr-ncs540l-netflow                       7.0.1v1.0.0-1
xr-bgp                                   7.0.1v1.0.0-1
xr-ipsla                                 7.0.1v1.0.0-1
xr-is-is                                 7.0.1v1.0.0-1
xr-lldp                                  7.0.1v1.0.0-1
xr-mcast                                 7.0.1v1.0.0-1
```

```
xr-mpls-oam                             7.0.1v1.0.0-1
xr-netflow                              7.0.1v1.0.0-1
xr-ospf                                 7.0.1v1.0.0-1
xr-perfmgmt                             7.0.1v1.0.0-1
xr-track                                7.0.1v1.0.0-1
```

You can also use the `get` RPC on the `install.packages.active.node` and the `install.packages.active.node.summary` data models.

To understand the data model structure and its arguments, see the Obtain Data Models for Install Operation, on page 5 topic.

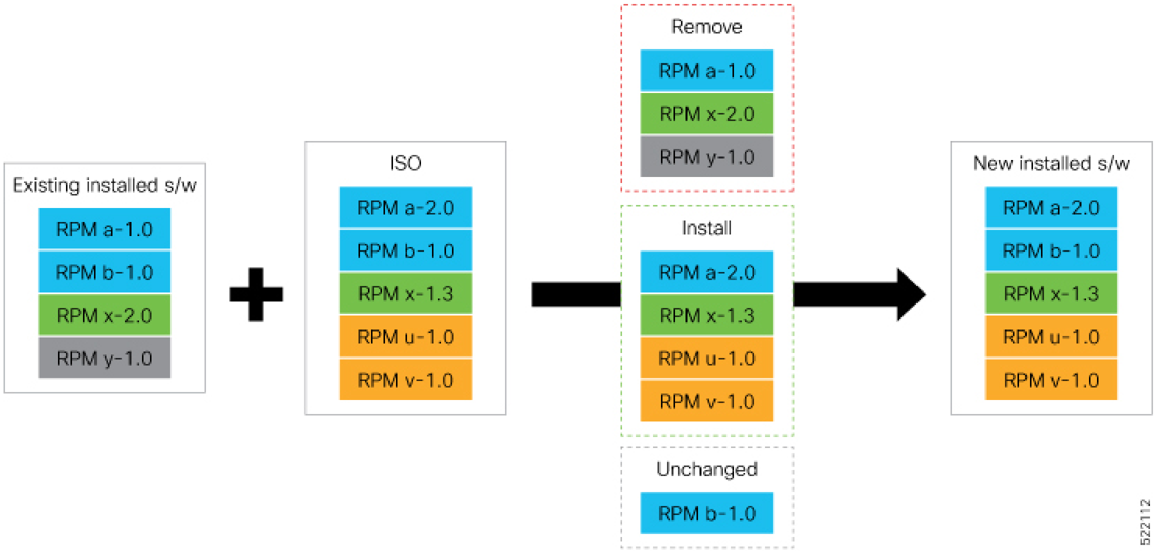
Build a Golden ISO

Golden ISO (ISO) upgrades the router to a version that has a predefined set of RPMs with a single operation. For example, you can create a customized ISO with the base OS package and specific optional RPMs based on your network requirements.

GISO supports automatic dependency management, and provides these functionalities:

- Builds RPM database of all the packages present in package repository.
- Skips and removes Cisco RPMs that do not match the base ISO version.
- Skips and removes third-party RPMs that are not part of already existing third-party base package in the base ISO.

Note Install operation over IPv6 is not supported.



Procedure

Step 1 Contact Cisco Support to build the GISO image with the set of packages based on your requirement.

Step 2 Copy the GISO image to the `/harddisk:` location on the router.

Step 3 Upgrade the system to replace the current software with the <*platform-architecture*>.iso image, and install the RPMs.

Example:

```
Router#install replace <source location> <giso name.iso>
```

Step 4 View the version information for the GISO image. You can include a label to indicate the runing software version on the router. For example, create a label v1 for the current GISO version. When you rebuild GISO with additional RPMs, you can create a label v2 to distinguish the builds.

Example:

```
Router#show version
Cisco IOS XR Software, Version 7.0.1 LNT
Copyright (c) 2013-2019 by Cisco Systems, Inc.

Build Information:
 Built By     : xyz
 Built On     : Sat Jun 29 22:45:27 2019
 Build Host   : iox-lnx-064
 Workspace    : ../7.0.1
                /NCS540L/ws/
 Version      : 7.0.1
 Label        : 7.0.1-CUSTOMER_LABEL

cisco NCS540L
System uptime is 41 minutes
```

Upgrade the System to Obtain Bug Fixes

Table 1: Feature History Table

Feature Name	Release Information	Description
Install Cisco RPM Directly from TAR File	Release 7.3.1	Cisco RPMs can be installed from one of these sources - repository name, repository URL or a local file path. Previously, to install RPMs from a TAR file, you had to manually extract the TAR file and specify the path to the locally extracted file to install the RPM. This feature extends support to install the RPM directly from the TAR file. Bug fix RPMs are available as TAR files on the Software Download page. The RPMs can be installed from the TAR file using CLI or Yang data model.

You can upgrade the system to obtain all available bug fixes or choose specific bug fix using bug ID.

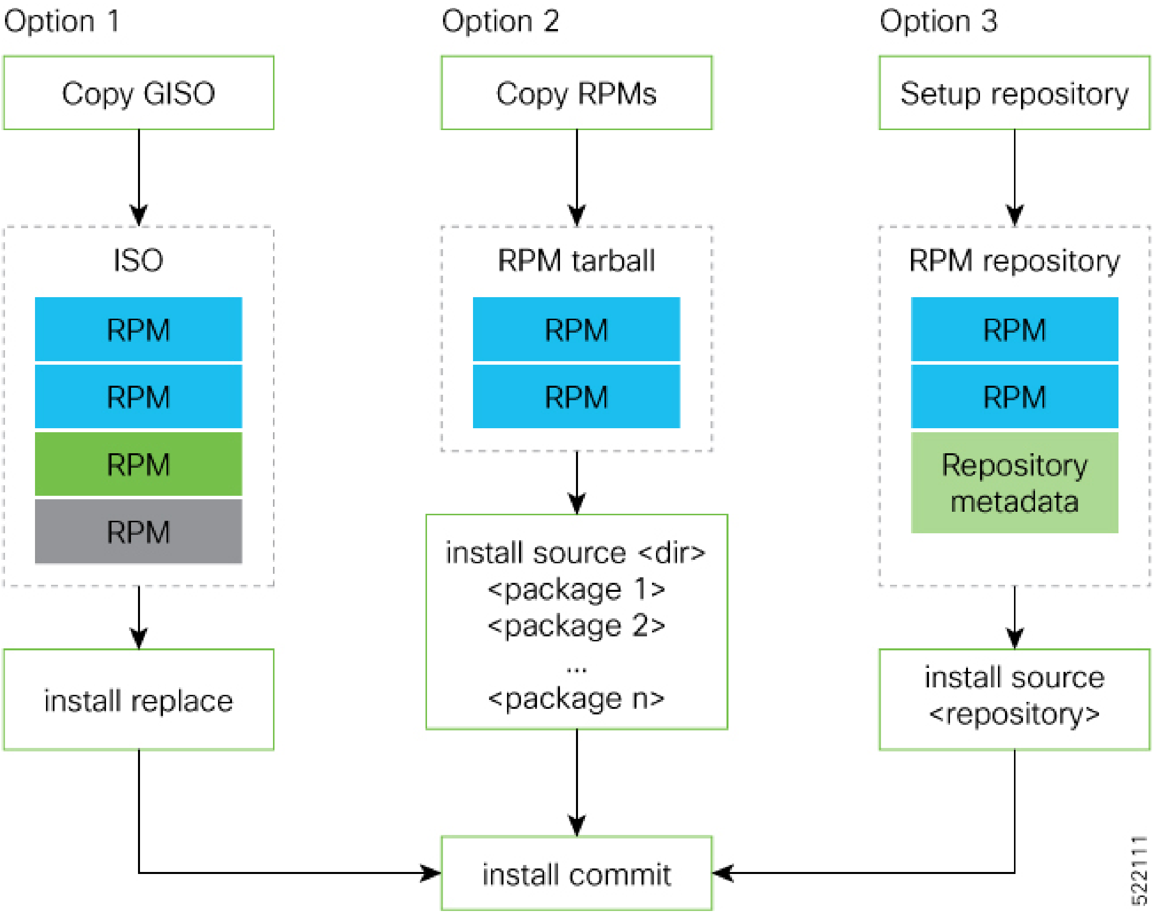
Bug fixes are available as optional RPMs. The bug fixes replace packages in the base ISO without adding up to the image size. For example, even if you add 20 RPMs to the GISO, the GISO file size will remain the same as the initial ISO.

You can download the bug fix RPMs from the Cisco Software Download portal .

From this page, download the latest bug fix RPMs as tarballs to the install repository. Untar the tarball into RPMs.

The `README` file provides the relevant information about the bug fix and also identifies the dependencies, if any, where other bug fix RPMs may be required for a complete fix.

The following image shows the options to install the bug fix RPMs.



The software is split into modular blocks and the package manager infrastructure computes the dependencies between the blocks. Each block of software has a top-level package and various partition-level packages. Bug fixes that span multiple blocks may lead to creating multiple dependent packages that are built as part of earlier bug fixes.

Note We recommend that you leverage the GISO workflow. Contact Cisco Support to build a new GISO with the required bug fixes. The RPMs are present in the initrd, which is the initial RAM disk for the boot loader, and this requires that the package is signed by Cisco. You can install GISO using a single `install replace` operation. For more information about GISO, see the *Build a Golden GISO* section.

However, if you do not prefer using the GISO, here are a few alternative ways to install bug fixes:

- Create a bug fix tarball to contain all the dependent packages. The tarball may be reasonably large for bug fixes that span mulitple blocks, but you can use this single tarball file directly to install the bug fixes without the need to check the individual packages within the file. You can also create a tarball containing all the dependent packages manually, but this method does not scale well.
- Create tarballs to install one or more bug fixes. For example, if you are installing bug fixes CSCxx11111, CSCyy22222 and CSCzz33333, you can use the individual tarball files and create a single tarball file.
- Use a Dandified Yum- or DNF repository to install, update, or remove relevant bug fixes. See, Create Repository to Access Files for Installing IOS XR Software, on page 7.

Note The RPMs can be installed from the TAR file using CLI or Yang data model.

- CLI—
  - Packaging operation: `install package add source /harddisk:/ncs540-<version>.tgz synchronous`
  - Packaging operation and atomic change: `install source /harddisk:/ncs540-<version>.tgz synchronous`
- Yang Data Model—

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:
base:1.0" message-id="101">
<install-package-add xmlns=
"http://cisco.com/ns/yang/Cisco-IOS-XR-install-augmented-act">
<source-type>tar</source-type>
<source>/misc/disk1/ncs540-<version>.tgz</source>
</install-package-add>
</rpc>
```

Note Use the RPM repository to harvest the benefits of package manager. The package manager queries the available packages, and downloads only those packages and their dependencies that are needed for installation.

Procedure

Step 1 View the list of available bug fixes.

Example:

```
Router#show install fixes available
Bug Id             Packages                       Repository
-----------    -----------------------------  ----------------
CSCxx12345     xr-540l-core-7.0.1v1.0.1-1       <repository-name>

               xr-core-7.0.1v1.0.1-1            <repository-name>
```

Step 2 Install the bug fix or package using one of the following options:

- Install the package where the bug fix is applied.

```
Router#install package upgrade xr-540l-core-7.0.1v1.0.1-1 xr-core-7.0.1v1.0.1-1
Packaging operation 1.1.1 started - xr-540l-core-7.0.1v1.0.1-1 xr-core-7.0.1v1.0.1-1
```

This task can also be accomplished using Cisco-IOS-XR-install-augmented-oper data model.

Apply the changes.

```
Router#install apply [reload | restart]
```

Note To identify if you must reload or restart the system while applying the changes, use one of these two methods:

- History of last transaction

  ```
  Router#show install history last transaction verbose
  2019-09-11 17:01:46 UTC    Transaction 3 started
  2019-09-11 17:01:46 UTC      Atomic change 3.1 started
  2019-09-11 17:01:46 UTC      Packaging operation 3.1.1 started
  2019-09-11 17:16:46 UTC    Transaction 3 complete

  Least impactful apply method: process restart
  ```

  The command also displays the information about the changes to files and processes because of the install operation, and the package operations carried out on each node.

- Show install request

  Here, both `install apply restart` and `install apply reload` options are available. In this case, use `install apply restart` command because the impact on the system is the least. But when only an `install apply reload` option is available, then reload is the only option to apply the change.

- Install the optional package. Changes are applied automatically.

  Attention Automatic change may trigger a reload of the router depending on the package that is installed.

  ```
  Router#install source /harddisk:/files xr-540l-core-7.0.1v1.0.1-1.x86_64.rpm
  ```

  Note Packages can also be installed using the package name.

  ```
  Router#install source /harddisk:/files  xr-540l-core
  ```

- This task can also be performed using YANG data models. Use `install` RPC on the Cisco-IOS-XR-install-act data model. Here is an example usage with an HTTP repository:

  ```
  <install>
     <packages>
       <packagename>pkg1</packagename>
     </packages>
     <source-type>http</source-type>
     <source><path-to-source></source>
  </install>
  ```

Step 3 View the state of the packaging operation.

Example:

```
Router#show install request
User request: install package upgrade xr-<platform>-core-<version> xr-core-<version>
Operation ID: 2.1.2
State:        In progress since

Current activity:    Initiate operation
```

```
Next activity:       Begin transaction
Time started:        2019-06-25 07:41:06

No per-location information.
```

Step 4 View the log to ensure that the installation is successful.

Example:

```
Router#show install log
2019-06-25 07:41:06 UTC    Transaction 1 started
2019-06-25 07:45:08 UTC    Upgrade (Success)
2019-06-25 07:45:08 UTC    xr-<platform>-core-<version>
2019-06-25 07:45:08 UTC    xr-core-<version>
2019-06-25 07:57:02 UTC    Atomic change 1.1 successfully applied by reload
```

Step 5 View the history of the install operation.

Example:

```
Router#show install history table
  Transaction             Atomic Change          Packaging Operations
---------------------  --------------------------  -----------------------------------
Id   Status          Id  Method   Status      Id  Operation   Inputs Status
---------------------  --------------------------  -----------------------------------
 1   In progress     1   Reload   Success      1   Upgrade        1  Success
```

The command can also be used to view more details if there is a failed operation.

Use **show install history id <operation-id>** command to filter the history of install information by ID. IDs are of the form `<transaction id>.<atomic id>.<packaging id>`.

```
Router#show install history id ?
  WORD Specify an operation ID (e.g. 1, 1.2, 1.2.3)
```

Use **show install history last** command to view the last packaging operation, atomic change, or transaction.

```
Router#show install history last ?
     atomic-change  Show the last atomic change
     package        Show the last packaging operation
     transaction    Show the last transaction
```

Step 6 After the operation is complete, verify that the packages `xr-540l-core-7.0.1v1.0.1-1` and `xr-core-7.0.1v1.0.1-1` are installed and active.

Example:

```
Router#show install active summary
xr-ncs540l-bfd                                               7.0.1v1.0.0-1
xr-ncs540l-bmc                                               7.0.1v1.0.0-1
xr-ncs540l-bundles                                           7.0.1v1.0.0-1
xr-ncs540l-card-support                                      7.0.1v1.0.0-1
xr-ncs540l-core                                              7.0.1v1.0.1-1
xr-ncs540l-x64-core                                          7.0.1v1.0.1-1
xr-core                                                      7.0.1v1.0.1-1
xr-core-calv                                                 7.0.1v1.0.0-1
xr-host-core                                                 7.0.1v1.0.0-1
xr-ip-core                                                   7.0.1v1.0.0-1
xr-spi-core                                                  7.0.1v1.0.0-1
```

Example:

Example:

```
Router#show install active summary
```

The version has changed. The version `1.0.1-1` indicates that the bug fix is installed.

This task can also be accomplished using data models. Use the `get` RPC for `install.fixes.active` operation using Cisco-IOS-XR-install-augmented-oper data model.

Step 7 Commit the changes for the changes to persist after a reload operation.

Example:

```
Router#install commit
```

Step 8 View the list of bug IDs for which fixes are committed.

Example:

```
Router#show install fixes committed
```

This task can also be accomplished using data models. Use the `get` RPC for `install.fixes.committed` operation using Cisco-IOS-XR-install-augmented-oper data model.

Step 9 View the list of active bug fix RPMs.

Example:

```
Router#show install fixes active
```

This task can also be accomplished using data models. Use the `get` RPC for `install.fixes.active` operation using Cisco-IOS-XR-install-augmented-oper data model.

Downgrade to a Previously Installed Package

You can downgrade a package to a previously installed version. By default, the subsequent previous version (version previous to the current version) is installed. Also, you can downgrade the software to a specific version of interest. To remove a bug fix RPM from the installed packages, downgrade the package to a version where the fix was not applied.

Note While downgrading, you can choose any previous version, including the base version of the RPM. However, when downgrading a bug fix RPMs, ensure that you also consider all dependencies of the current version.

Bug fix RPM is an upgrade to the existing package. The action of removing a bug fix RPM either removes the entire feature, or fails if the package is mandatory.

Before you begin

Ensure you have access to the previously installed package and its source.

Procedure

Step 1 Downgrade the package using one of the following options:

- Downgrade the package where the fix was applied. When multiple older versions of the package are present in the configured repositories, the immediate previous version of the package is installed. Use caution when using this command as the current version of the package is removed completely.

```
Router#install package downgrade xr-telnet
```

Apply the changes.

```
Router#install apply [reload | restart]
```

Attention To identify whether to reload the router or restart the affected processes as part of the apply operation, use either **show install history last transaction verbose** command or **show install request** command.

- Install a specific earlier version of the optional package. The changes are applied automatically.

Attention An automatic change may trigger a reload of the router depending on the package being downgraded.

```
Router#install source <path-to-source> xr-telnet-7.0.1v1.0.0
```

- Use `install` RPC on the Cisco-IOS-XR-install-act data model. Here is an example usage with a local repository:

```
<install>
 <packages>
   <packagename>xr-telnet-7.0.1v1.0.0


</packagename>
 </packages>
   <source>file://<path-to-source>/</source>
</install>
```

The package version `xr-telnet-7.0.1v1.0.1` is downgraded to `xr-telnet-7.0.1v1.0.0`.

Step 2 Commit the operation.

Example:

```
Router#install commit
```

Roll Back Software to a Previously Saved Installation Point

Note This section does not apply to the following variants of the Cisco NCS 540 routers:

- N540X-6Z18G-SYS-A
- N540X-6Z18G-SYS-D
- N540X-8Z16G-SYS-A
- N540X-8Z16G-SYS-D

You can roll your system software back to a previous version. This could be used to discard an ongoing install operation, or to undo an install operation that has already been committed. After each commit operation, the system saves a record of the committed software packages. Each record is a restoration point, and is assigned a unique ID. This ID is known as a transaction ID. You can use the transaction ID to roll back the software to a restoration point associated with this ID. Up to 900MB of space is allowed for rollback points, instead of a specific number of rollback points.

Note

- Use transaction ID 0 to roll back to the software that was present after the system booted for the first time.
- If you commit an install transaction using **install commit** command, the GISO ZTP configuration is saved along with the rest of the software changes. This means that if you use the **install rollback** or **install package rollback** command to revert the software to the state of a previous transaction, the GISO ZTP configuration is also reverted to its previous state. To undo this install operation, as well as the change in GISO ZTP configuration, use **install package abort** command. If there is no GISO ZTP configuration saved at the end of the install transaction, the existing GISO ZTP configuration is reverted to the previous state when the rollback operation of that transaction is applied.

Procedure

Step 1 View the list of available transaction IDs.

Example:

```
Router# show install rollback list-ids
```

Step 2 Explore the main packages that can be installed if you roll the software back to the specific transaction ID.

Example:

```
Router# show install rollback id <id>
```

Step 3 View the relative changes that are made to the currently installed software if it is rolled back to a transaction ID.

Example:

```
Router# show install rollback id <id> changes
```

To perform these tasks using data models, use the `get` RPC on the Cisco-IOS-XR-install-augmented-oper data model.

```
<rpc>
  <get>
   <filter type="subtree">
      <install xmlns="http://cisco.com/ns/yang/Cisco-IOS-XR-install-augmented-oper">
      <rollback/>
     </install>
   </filter>
  </get>
</rpc>
```

Step 4 Roll back to the software associated with the specific transaction ID.

Example:

```
Router# install rollback <id> [commit]
```

If you want to apply the change and roll back to the associated transaction ID, commit the change. You can also include the keyword `noprompt` in the command to enable the system to bypass your permission to reload the router.

Attention This roll back operation installs the previous software and also applies the change automatically. This may reload the router depending on the package that is rolled back.

Alternatively, use the **install package rollback** command to only roll back the package but not apply the changes. You can check whether the router will reload or restart if you apply the change using the **show install history last transaction verbose** command or **show install request** command. Based on the command output, you can take the appropriate action using **install apply reload | restart** command to either reload or restart the system. Use the **install commit** command to commit the transaction.

To perform this task using data models, use the `install-rollback` RPC on the Cisco-IOS-XR-install-augmented-oper data model.

```
<rpc>
 <install-rollback xmlns="http://cisco.com/ns/yang/Cisco-IOS-XR-install-augmented-act">
  <commit>true</commit>
   <transaction-id>0</transaction-id>
 </install-rollback>
</rpc>
```

To understand the data model structure and its arguments, see the Access the Install-Related Data Model.

Step 5 Commit the operation.

Example:

```
Router#install commit
```