Cisco NSO T-SDN Function Pack Bundle

Installation Guide

Version 5.0.0

Contents

Preface

Abstract

This **Cisco Network Service Orchestrator Transport-SDN Function Pack Bundle Installation Guide** includes information to help you to install Cisco NSO Transport SDN Function Pack (T-SDN FP) Bundle v5.0.0.

Audience

This document is intended for Cisco Advanced Services developers, network engineers, and system engineers to install the T-SDN automation functionalities to Cisco customers.

Additional Documentation

This documentation requires the reader to have a good understanding of NSO and its usage as described in the NSO documentation.

Sl. No.	Documentation
1.	Cisco Transport SDN Function Pack Bundle User Guide
2.	NSO Installation Guide
3.	NSO User Guide

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Installation Methods

You can perform T-SDN FP Bundle installation on NSO in two ways:

- System Installation
- Local Installation

The system installation is for a real time production environment and is the preferred installation method.

The local installation is the demo version of the installation.

You must have **sudo** user privileges to perform the installation and run the installation commands. You can perform T-SDN FP Bundle system installation on a single machine or multiple machines at a given time. System installation is used for installation of NSO on multiple hosts/VMs from a Single Controller host.

This documentation describes how to perform the T-SDN FP Bundle system installation. For information on local installation, contact your Cisco representative.

Installation - Overview

The NSO T-SDN FP Bundle system installation allows you to install the SR-TE CFP services and the Example Function Packs.

The Cisco SR-TE CFP-IOSXR CLI, which is a productized and supported implementation of SR-TE automation, comprises the Cisco SR-ODN, Cisco SR-Policy, Circuit-style policy services, and IETF-L3VPN-NM services.

The Example Function Packs for IETF-L2VPN-NM and IETF – Traffic Engineering (IETF-TE) services are intended to be customized for specific requirements.

For a detailed overview of this product, see the ***Cisco NSO T-SDN FP Bundle User Guide***.

Perform the NSO T-SDN FP Bundle system installation by using the Layered Service Architecture (LSA) deployment model or on a single NSO instance. The following topics in this documentation discuss each of these installation procedures in detail.

For information on how to install T-SDN FP Bundle on a single NSO instance, see **Installing and Uninstalling Cisco NSO T-SDN Function Pack Bundle on a Single NSO Instance**.

For information on how to install T-SDN FP Bundle in the LSA Model, see **Installing and Uninstalling T-SDN FP Bundle in the LSA Model**.

You can install the Example Function Packs (flavors) on top of the base flavor SR-TE CFP-IOSXR CLI.
To install a flavor, copy the required packages for the flavor either during or after the SR-TE CFP-IOSXR CLI installation. For more information on how to install the different flavors, see **Installing Example Function Packs on a Single NSO Instance**.

This chapter discusses the required package categories for each flavor and the procedure to install the base flavor (SR-TE CFP-IOSXR CLI).

Installation Requirements

This topic discusses the system requirements, NSO versions, and the NED versions required to install T-SDN FP Bundle.

System Requirements

This section outlines the hardware requirements, software requirements, and platform dependencies to successfully install Cisco NSO T-SDN FP Bundle v5.0.0 on NSO v6.1.0.

Item	Requirement
Operating systems	NSO and T-SDN FP Bundle are available for all Linux distributions and supported on the following operating systems: Ubuntu 22.04 LTS or later Rocky Linux v8.6 or later RedHat Linux v8.7 or later
Software	Open JDK v11 or higher Python v3.8 or higher
ulimit value for NSO	64000 (minimum)

Cisco NSO and Cisco NED Requirements

Software/Driver	Versions
Cisco NSO	6.1.0
IOSXR CLI NED (default)	7.46
IOSXE CLI NED (for Multi-Vendor Extension Example)	6.86

The IOSXR CLI NED is the default NED. The IOSXR CLI and IOSXE CLI NEDs are packaged with the installation tar file. The following IOSXR Netconf NEDs are downloadable from the Cisco website.

IOSXR Netconf NED (for Multi-Vendor Extension Example)	7.3, 7.315, 7.4. 7.5, 7.6, 7.7, 7.8, 7.9

Preparing the NSO Environment to Install the Cisco T-SDN FP Bundle

To install T-SDN FP Bundle on NSO 6.1.0, you must first prepare the NSO environment. The information in this section is applicable to install Cisco T-SDN FP Bundle on a single NSO instance and in the LSA model.

To prepare the NSO environment, do the following:

1. Obtain the NSO 6.1.0 installation bin file and follow the steps described in the ***NSO Installation Guide – System Installation Guide*** to install NSO.
2. Verify NSO version.
   ```
   $ ncs --version
   6.1.0
   ```
3. Make sure the version for Python and Python 3 installed is 3.8 or higher. See Python documentation for more information about how to install Python.
   ```
   $ python --version
   3.8
   ```
   The default Python should point to Python 3. If you cannot change the default Python to Python 3, change the Python startup command configuration. For more information, see **Appendix A: Changing Python Startup Command Configuration**.
4. Verify OpenJDK 11 or higher is installed.
   ```
   $ Java --version
   openjdk 11.0.7
   ```
5. Set the overcommit memory settings to the default value 0.
   ```
   $ cat /proc/sys/vm/overcommit_memory
   0
   ```
6. Make sure to have **sudo** user privileges to perform the CFP installation. This user must also be part of the **ncsadmin** group.
7. (For LSA installation only) Configure Network Time Protocol (NTP).
8. Add the ulimit level value for NSO and the operating system in **/etc/init.d/ncs** as follows:
   ```
   ...
   ncsdir=/opt/ncs/current
   confdir=/etc/ncs
   rundir=/var/opt/ncs
   logdir=/var/log/ncs

   ncs=${ncsdir}/bin/ncs
   ulimit -n 65535
   prog=ncs
   conf="-c ${confdir}/ncs.conf"
   ```

```
heart="--heart"
...
```

9. Add the ulimit value for the operating system. The following is an example.
   a. Edit the **/etc/security/limits.conf** file and add the following lines:

      ```
      * soft nproc 65535
      * hard nproc 65535
      * soft nofile 65535
      * hard nofile 65535
      * hard memlock 65535
      * soft memlock 65535
      ```

   b. Run the **sysctl -p** script to set the parameters.
   c. Log out of the system and log in again to apply the new values.
10. Verify the ulimit values are applied.

```
[admin@cnso-60-52 ~]$ ulimit -a
core file size          (blocks, -c) 0
data seg size           (kbytes, -d) unlimited
scheduling priority             (-e) 0
file size               (blocks, -f) unlimited
pending signals                 (-i) 95697
max locked memory       (kbytes, -l) 65536
max memory size         (kbytes, -m) unlimited
open files                      (-n) 65535
pipe size            (512 bytes, -p) 8
POSIX message queues     (bytes, -q) 819200
real-time priority              (-r) 0
stack size              (kbytes, -s) 8192
cpu time               (seconds, -t) unlimited
max user processes              (-u) 4096
virtual memory          (kbytes, -v) unlimited
file locks                      (-x) unlimited
```

11. Set the timeout value for the ncs services, if required. The default timeout value for the ncs services is 300 seconds.

```
sudo mkdir /etc/systemd/system/ncs.service.d
echo -e "[Service]\nTimeoutStartSec=<timeout_in_seconds>" | sudo tee
/etc/systemd/system/ncs.service.d/startup-timeout.conf
sudo systemctl daemon-reload
```

12. Verify the timeout value is set.

```
sudo systemctl show ncs | grep ^Timeout
```

Installing and Uninstalling Cisco NSO T-SDN Function Pack Bundle on a Single NSO Instance

This topic discusses the packages required to install the NSO -T-SDN FP Bundle on a single NSO instance and the information to prepare the NSO environment for such an installation.

Package Categories and Packages on a Single NSO Instance

This section discusses the required package categories and the associated packages. These packages are extracted either during or after SR-TE CFP-IOSXR CLI installation.

For more information on SR-TE CFP-IOSXR CLI installation, see **Installing SR-TE CFP-IOSXR CLI**.

The following tables shows the packages in the Core Function Pack category and the Example Packages category.

The IOSXR CLI NED is the default NED and is packaged with the installation tar file. The IOSXR Netconf NEDs are downloadable from the Cisco website.

The Core Function Pack packages are required to install SR-TE CFP. The Example packages comprises the packages for the Example function packs (such as L2VPN) you choose to install.

Note: The cs-sr-te-cfp package in SR-TE CFP-IOSXR CLI is supported only on IOSXR CLI 7.46 NED, IOSXR NC 7.8 NED, and IOSXR NC 7.9 NED.

Core Function Pack	
Package Category	**Packages**
T-SDN FP Bundle packages	ncs-6.1-cisco-sr-te-cfp-5.0.0.tar.gz ncs-6.1-cisco-sr-te-cfp-internal-5.0.0.tar.gz ncs-6.1-cisco-cs-sr-te-cfp-5.0.0.tar.gz
T-SDN FP Bundle L3NM Packages	ncs-6.1-cisco-flat-L3vpn-fp-internal-5.0.0.tar.gz ncs-6.1-ietf-l3vpn-nm-5.0.0.tar.gz
T-SDN FP Bundle common packages	ncs-6.1-core-fp-plan-notif-generator-1.0.10.tar.gz ncs-6.1-custom-template-utils-2.0.13.tar.gz ncs-6.1-lsa-utils-1.0.4.tar.gz ncs-6.1-core-fp-common-1.33.0.tar.gz ncs-6.1-cisco-tsdn-core-fp-common-5.0.0.tar.gz ncs-6.1-core-fp-delete-tag-service-1.0.6.tar.gz

T-SDN FP Bundle Multi-Vendor for IOSXE	ncs-6.1-sr-te-multi-vendors-5.0.0.tar.gz ncs-6.1-flat-l3vpn-multi-vendors-5.0.0.tar.gz
NEDs	**IOSXR CLI NED:** ncs-6.1-cisco-iosxr-7.46.3.tar.gz **IOSXE CLI NED:** ncs-6.1-cisco-ios-6.86.6.tar.gz

Example Packages	
Package Category	**Package Name**
Automated assurance package for L2NM,L3NM	ncs-6.1-cisco-aa-service-assurance-EXAMPLE-5.0.0.tar.gz
L2VPN example package with IOSXR CLI NED	ncs-6.1-cisco-flat-L2vpn-fp-internal-EXAMPLE-5.0.0.tar.gz
L2VPN multi-vendor example with IOSXE CLI NED	ncs-6.1-flat-l2vpn-multi-vendors-EXAMPLE-5.0.0.tar.gz
Northbound/External service package for handling T-SDN Flat L2VPN service creation via IETF L2NM interface	ncs-6.1-ietf-l2vpn-nm-EXAMPLE-5.0.0.tar.gz
IETF-TE example package with IOSXR CLI NED	ncs-6.1-ietf-te-fp-EXAMPLE-5.0.0.tar.gz ncs-6.1-cisco-rsvp-te-fp-EXAMPLE-5.0.0.tar.gz
RSVP-TE multi-vendor example IOSXE CLI NED	ncs-6.1-rsvp-te-multi-vendors-EXAMPLE-5.0.0.tar.gz

Editing the NCS Configuration File on a Single NSO Instance

Edit the NCS configuration file to add or update configurations for Cisco NSO T-SDN Function Pack Bundle. For more information about the ncs.conf file, see the **nso_man-<*version*>.pdf** documentation in **volume5**.

Edit the /etc/ncs/ncs.conf file as follows:

1. Back up the current ncs.conf file before editing the file.
2. Add **service-state-changes under <stream>** to generate notifications for any changes in the service state.

```
<notifications>
    <event-streams>
        <stream>
```

```
            <name>service-state-changes</name>
            <description>Plan state transitions according to
      tailf-ncs-plan.yang</description>
            <replay-support>true</replay-support>
            <builtin-replay-store>
                <enabled>true</enabled>
                <dir>./state</dir>
                <max-size>S10M</max-size>
                <max-files>50</max-files>
            </builtin-replay-store>
        </stream>
```

3. If you choose to install Automated Assurance (AA), add AA notifications under **<notifications> -> <event streams>** to notify any AA configuration changes.

```
<stream>
  <name>service-aa-changes</name>
  <description>Notifications relating to the service aa configuration
change</description>
  <replay-support>true</replay-support>
  <builtin-replay-store>
    <enabled>true</enabled>
    <dir>./state</dir>
    <max-size>S10M</max-size>
    <max-files>50</max-files>
  </builtin-replay-store>
</stream>
```

4. Append the **<hide-group>** information as follows.

```
<hide-group>
    <name>debug</name>
</hide-group>
<hide-group>
    <name>tsdn</name>
</hide-group>
<hide-group>
    <name>fastmap-private</name>
</hide-group>
<hide-group>
    <name>lsa</name>
  </hide-group>
</ncs-config>
```

5. The SSH port configuration is optional for CLI, webui, and netconf northbound parameters. You can choose to either enable or disable the SSH port configuration, as required, for these parameters.
   By default, the SSH port configuration for these parameters is disabled. For more information on these parameters, see the ***NSO documentation***.
   The following shows how to enable the SSH port configuration, if required. Provide the port numbers as per your requirement.

   SSH port for CLI

```
<cli>
  <enabled>true</enabled>
  <!-- Use the builtin SSH server -->
  <ssh>
         <enabled>true</enabled>
         <ip>0.0.0.0</ip>
         <port>${North_Bound_CLI_SSH_Port}</port>
  </ssh>
```

   webui

   Enable webui in either TCP or SSL.

```
  <webui>
  <enabled>true</enabled>
    <transport>
      <tcp>
         <enabled>true</enabled>
          <ip>0.0.0.0</ip>
          <port>${North_Bound_Web_UI_Port}</port>
      </tcp>

         <ssl>
  <enabled>true</enabled>
             <ip>0.0.0.0</ip>
             <port>${SSL_port}</port>
             <key-file>${NCS_CONFIG_DIR}/ssl/cert/host.key</key-file>
             <cert-file>${NCS_CONFIG_DIR}/ssl/cert/host.cert</cert-file>
         </ssl>
       </transport>
```

   netconf northbound

```
  <netconf-north-bound>
      <enabled>true</enabled>
```

```
        <transport>
    <ssh>
    <enabled>true</enabled>
    <ip>0.0.0.0</ip>
    <port>${Netconf_North_Bound_port}</port>
     </ssh>
```

6. Add/update start-timeout in **ncs.conf** under **<python-vm>**.

```
<python-vm>
  <start-timeout>PT300S</start-timeout>
</python-vm>
```

Installing Core Function Packs on a Single NSO Instance

To install Cisco NSO T-SDN FP Bundle, you must install SR-TE CFP-IOSXR CLI. The SR-TE CFP-IOSXR CLI is the primary CFP or the main component in T-SDN FP Bundle and includes the cs-sr-te-cfp package. This is the base flavor on which the other CFPs (SR-TE CFP-IOSXR NC and SR-TE CFP IETF-TE) and Example Function Packs are installed.

Note: The cs-sr-te-cfp package in SR-TE CFP-IOSXR CLI is supported only on IOSXR CLI 7.46 NED, IOSXR NC 7.8 NED, and IOSXR NC 7.9 NED.

This topic discusses the procedure to install the Core Function Packs. For information on how to install the Example Function Packs, see **Installing Example Function Packs on a Single NSO Instance**.

Installing SR-TE CFP-IOSXR CLI

Use the information in this section to install SR-TE CFP-IOSXR CLI. This installation is the base for all other flavors.

To install SR-TE CFP-IOSXR CLI:

1. Make sure to have performed the tasks described in the following sections:
   - **Preparing the NSO Environment to Install the Cisco T-SDN FP Bundle**
   - **Editing the NCS Configuration File on a Single NSO Instance**

2. Log in to the host machine as the **sudo** user, who is also part of the **ncsadmin** user group.
3. Obtain and download the signed bin file **nso-<*version*>-tsdn-<*version*>.signed.bin** package from Cisco website and copy it to the host server.

   For example, obtain and download the **nso-6.1.0-tsdn-5.0.0.signed.bin** package from Cisco website and copy it to the host server.
4. Extract the content of the bin file to the current directory.

   ```
   $ sh nso-<version>-tsdn-<version>.signed.bin
   ```

   This verifies the authenticity of the product. If you encounter any network connectivity issues, run the following command to skip this verification.

   ```
   $ sh nso-<version>-tsdn-<version>.signed.bin --skip-verification
   ```
5. Untar the T-SDN FP Bundle installer **tar.gz** file to the current directory. If the folder already exists, make sure to create a backup of the existing folder.

   ```
   $ tar -xvf nso-<version>-tsdn-<version>.tar.gz
   ```
6. Go to the packages directory.

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/core-fp-packages/
   ```
7. Copy and link the following packages to install SR-TE CFP-IOSXR CLI. The other packages are for the different installation flavors.

   ```
   sudo cp ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz
   /var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz

   sudo cp ncs-<version>-cisco-sr-te-cfp-internal-<version>.tar.gz
   /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-
   internal-<version>.tar.gz

   sudo cp ncs-<version>-cisco-cs-sr-te-cfp-<version>.tar.gz /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-
   <version>.tar.gz var/opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-
   <version>.tar.gz

   sudo cp ncs-<version>-custom-template-utils-<version>.tar.gz
   /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-custom-template-utils-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-custom-template-utils-
   <version>.tar.gz

   sudo cp ncs-<version>-cisco-tsdn-core-fp-common-<version>.tar.gz
   /opt/ncs/packages/
   ```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-
common-<version>.tar.gz

sudo cp ncs-<version>-core-fp-common-<version>.tar.gz /opt/ncs/packages/

sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz

sudo cp ncs-<version>-cisco-iosxr-<version>.tar.gz /opt/ncs/packages/

sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz

sudo cp ncs-<version>-core-fp-plan-notif-generator-<version>.tar.gz
/opt/ncs/packages/

sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-
generator-<version>.tar.gz

sudo cp ncs-<version>-resource-manager-<version>.tar.gz /opt/ncs/packages/

sudo ln -s /opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz

sudo cp ncs-<version>-lsa-utils-<version>.tar.gz /opt/ncs/packages/

sudo ln -s /opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
```

Note: To install one or more installation flavors, copy and link the required packages for the flavor from the **EXAMPLE** folder. For more information on the flavors and the required packages, see **Package Categories and Packages on a Single NSO Instance**.

8. (*Optional*) Change the default timeout for ncs services if the ncs services fail after the default timeout of 300 seconds.

```
sudo mkdir /etc/systemd/system/ncs.service.d

echo -e "[Service]\nTimeoutStartSec=<timeout_in_seconds>" | sudo tee
/etc/systemd/system/ncs.service.d/startup-timeout.conf

sudo systemctl daemon-reload
```

Verify the new timeout is applied.

```
sudo systemctl show ncs | grep ^Timeout
```

9. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart

Restarting ncs (via systemctl):

                      [  OK  ]
```

The T-SDN FP Bundle installation is complete and SR-TE CFP-IOSXR CLI is now installed on your system.

10. Verify the installation and make sure the packages are up and running.

```
admin@ncs> show packages package package-version | select build-info ncs
version | select build-info file | select build-info package sha1 | select
oper-status error-info | select oper-status up | tab
```

11. The SR-TE CFP-IOSXR CLI installation is now complete. Perform the post installation tasks.

Performing Post Installation Tasks for SR-TE CFP-IOSXR CLI

Do the following after installing SR-TE CFP-IOSXR CLI:

1. Change the current directory to:

```
$ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
$ ncs_cli -u admin
admin@ncs> configure
unhide debug
```

2. Load-merge the following plan notification files to activate notifications.

```
admin@ncs% load merge SR-plan-notification-settings.xml
admin@ncs% load merge CS-SR-plan-notification-settings.xml
admin@ncs% commit
```

3. Load-merge the following files to activate status-codes.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge SR-status-codes.xml
admin@ncs% load merge CS-SR-status-codes.xml
admin@ncs% commit
```

4. Load-merge the following files to activate kickers.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge SR-internal-plan-kicker.xml
admin@ncs% load merge SR-cfp-configuration-kicker.xml
admin@ncs% load merge CS-SR-internal-plan-kicker.xml
admin@ncs% commit
```

5. Configure resource-pools.

```
load merge xr-bidirectional-association-id-resource-pool.xml
load merge xr-color-resource-pool.xml
load merge xr-disjoint-group-id-resource-pool.xml
commit
```

6. Configure the following common bootstrap data.
   a. Commit queue settings

```
admin@ncs% load merge commit-queue-settings.xml
admin@ncs% commit
```

   b. Sync dispatch-map.

```
admin@ncs% unhide debug
load merge dispatch-map-settings.xml
commit request devices lsa dispatch-map sync
show devices lsa dispatch-map
```

   c. Set NACM rules for the user.

      The user must be a **sudo** user, who is also part of the **ncsadmin** group.

```
admin@ncs% set nacm groups group ncsadmin user-name [ <user-name>
private ]
admin@ncs% commit
```

   d. Configure ssh-rsa algorithms public key. You can configure this either at the global level or for a specific device that will be onboarded.

      Setting the algorithm globally

```
% show devices global-settings ssh-algorithms public-key
public-key [ ssh-ed25519 ecdsa-sha2-nistp256 ecdsa-sha2-nistp384 ecdsa-
sha2-nistp521 rsa-sha2-512 rsa-sha2-256 ];

% set devices global-settings ssh-algorithms public-key [ ssh-ed25519
ecdsa-sha2-nistp256 ecdsa-sha2-nistp384 ecdsa-sha2-nistp521 rsa-sha2-512
rsa-sha2-256 ssh-rsa ]
% commit

% show device global-settings ssh-algorithms public-key
public-key [ ssh-ed25519 ecdsa-sha2-nistp256 ecdsa-sha2-nistp384 ecdsa-
sha2-nistp521 rsa-sha2-512 rsa-sha2-256 ssh-rsa ];
```

      Setting the algorithm for a specific device

```
% set devices device <DEVICE_NAME> ssh-algorithms public-key [ ssh-rsa ]
% commit

% show device device <DEVICE_NAME> ssh-algorithms public-key
public-key [ ssh-rsa ];
```

Verifying the Post Installation Tasks for SR-TE CFP-IOSXR CLI

Verify the post installation tasks you performed are correct.

Do the following:

1. Verify the kickers configuration.

```
admin@ncs% unhide debug
admin@ncs% show kickers
data-kicker sr-te-cfp-configuration-kicker {
    monitor     /cisco-sr-te-cfp:cfp-configurations;
    kick-node   /cisco-sr-te-cfp:sr-te;
    action-name update-internal-cfp-configurations;
}
data-kicker sr-te-odn-internal-plan-kicker {
    monitor     /cisco-sr-te-cfp-internal:sr-te/cisco-sr-te-cfp-sr-odn-
internal:odn/cisco-sr-te-cfp-sr-odn-internal:odn-template-plan;
    kick-node   /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-odn:odn/cisco-sr-
te-cfp-sr-odn:actions;
    action-name internal-plan-change-handler;
}
data-kicker sr-te-policy-internal-plan-kicker {
    monitor     /cisco-sr-te-cfp-internal:sr-te/cisco-sr-te-cfp-sr-policies-
internal:policies/cisco-sr-te-cfp-sr-policies-internal:policy-plan;
    kick-node   /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-
policies:policies/cisco-sr-te-cfp-sr-policies:actions;
    action-name internal-plan-change-handler;
}
data-kicker cs-sr-te-internal-plan-kicker {
    monitor     /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-
policies:policies/policy-plan;
    kick-node   /cisco-cs-sr-te-cfp:cs-sr-te-actions;
    action-name internal-plan-change-handler;
```

2. Verify the status-codes.

```
admin@ncs% show status-codes
core-function-pack SR {
    status-code-enum-path cisco-tsdn-core-fp-
common/python/cisco_tsdn_core_fp_common/status_codes/sr_te_status_codes;
    status-code 301 {
        reason              "Device unreachable";
        category            device;
        severity            ERROR;
```

```
        recommended-actions "Check device connectivity from NSO and perform
recovery steps.";
    }
    status-code 302 {
        reason              "Device out of sync";
        category            device;
        severity            ERROR;
        recommended-actions "Check sync between device and NSO, and perform
recovery steps.";
    }
…
…
    }
core-function-pack CS-SR {
    status-code 400 {
        reason              "Status code mapping has not been loaded for
function pack during install";
        category            user;
        severity            ERROR;
        recommended-actions "Bootstrap status code mapping";
    }
}
[ok]
```

3. Verify the plan-notifications.

```
admin@ncs% run show configuration services plan-notifications
subscription cs-sr-te-notif {
    service-type /cisco-cs-sr-te-cfp:cs-sr-te-policy;
}
subscription sr-odn-notif {
    service-type /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-odn:odn/cisco-sr-
te-cfp-sr-odn:odn-template;
}
subscription sr-policy-notif {
    service-type /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-
policies:policies/cisco-sr-te-cfp-sr-policies:policy;
}
[ok]
admin@ncs% run show configuration plan-path-for-notification
plan-path-for-notification /cisco-cs-sr-te-cfp:cs-sr-te-plan {
    service-path         /cisco-cs-sr-te-cfp:cs-sr-te-policy;
    service-key-elements [ name ];
}
plan-path-for-notification /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-
odn:odn/odn-template-plan {
```

```
    service-path         /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-
odn:odn/odn-template;
    service-key-elements [ name ];
}
plan-path-for-notification /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-
policies:policies/policy-plan {
    service-path         /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-
policies:policies/policy;
    service-key-elements [ name ];
}
```

4. Check the device list. The list displays the devices configured. The devices in this list must also be populated in the dispatch-map. If no devices are configured, the list is empty.

```
admin@ncs> show devices list
```

5. Verify the bootstrap data is successfully loaded.

   Verify the dispatch-map. The dispatch-map is populated with the devices from the device list. If there are no devices in the device list, the dispatch-map is empty.

   The following is a sample output for a correctly configured dispatch-map for two PIOSXR devices.

```
admin@ncs% show devices lsa dispatch-map PIOSXR-0 {
    ned-id cisco-iosxr-cli-7.33:cisco-iosxr-cli-7.33;
}
dispatch-map PIOSXR-1 {
    ned-id cisco-iosxr-cli-7.33:cisco-iosxr-cli-7.33;
}
```

6. Verify the commit-queue setting configuration.

```
admin@ncs% show devices global-settings commit-queue
enabled-by-default false;
async;
atomic             false;
retry-attempts     0;
retry-timeout      30;
error-option       stop-on-error;
[ok]
```

Installing SR-TE CFP-IOSXR NC

This section discusses the packages you must copy to install and verify SR-TE CFP-IOSXR NC.

Note: The IOSXR CLI NED is the default NED and is bundled with T-SDN FP Bundle. The IOSXR NC NED is downloadable from the Cisco website. For information on supported Netconf NEDs, see **Cisco NSO and Cisco NED Requirements**.

SR-TE CFP-IOSXR NC requires SR-TE CFP-IOSXR CLI to be installed. For more information on how to install SR-TE CFP-IOSXR CLI, see **Installing SR-TE CFP-IOSXR CLI**.

To install SR-TE CFP-IOSXR NC:

1. Obtain and load the NETCONF NED into NCS.
2. Go to the packages directory.

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/core-fp-packages/
   ```

3. Copy and link the following packages to install SR-TE CFP-IOSXR NC.

   ```
   sudo cp ncs-<version>-sr-te-multi-vendors-<version>.tar.gz /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
   <version>.tar.gz

   sudo cp ncs-<version>-cisco-iosxr_netconf-<version>.tar.gz /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-iosxr_netconf-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-iosxr_netconf-
   <version>.tar.gz
   ```

4. Restart NSO with package reload.

   ```
   $ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
   Restarting ncs (via systemctl):
                        [  OK  ]
   ```

5. Verify the installation. Make sure the packages are up and running and perform the post installation tasks.

   ```
   admin@ncs% run show packages package package-version | select build-info ncs
   version | select build-info file | select build-info package sha1 | select
   oper-status error-info | select oper-status up | tab
   ```

Performing Post Installation Tasks for SR-TE CFP- IOSXR NC Installation

Do the following after installing SR-TE CFP-IOSXR NC:

1. Change the current directory to:

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
   ```

2. Load-merge the **SR-multi-vendor-iosxr-netconf.xml** file to configure the dynamic-mapping.

   ```
   $ /opt/ncs/current/bin/ncs_cli -u admin
   admin@ncs> configure
   admin@ncs% load merge SR-multi-vendor-iosxr-netconf.xml
   admin@ncs% commit
   ```

Verifying the Post Installation Tasks for SR-TE CFP-IOSXR NC

Verify the dynamic-mapping as follows:

```
admin@ncs% show cisco-sr-te-cfp:cfp-configurations
dynamic-device-mapping cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3 {
    python-impl-class-name sr_te_multi_vendors.NativeXR;
}
dynamic-device-mapping cisco-iosxr-nc-7.4:cisco-iosxr-nc-7.4 {
    python-impl-class-name sr_te_multi_vendors.NativeXR;
}
…
[ok]
```

Installing SR-TE CFP-IOSXE CLI

This section discusses the procedure to copy the required packages to install and verify SR-TE CFP-IOSXE CLI.

Before you install SR-TE CFP-IOSXE CLI, make sure SR-TE CFP-IOSXR CLI is installed and then continue to perform the tasks mentioned in this topic. For more information on how to install SR-TE CFP-IOSXR CLI, see **Installing SR-TE CFP-IOSXR CLI**.

Note: CS-SR-TE CFP is not supported on IOSXE CLI.

To install SR-TE CFP-IOSXE CLI:

1. Obtain and load the IOSXE CLI 6.86 NED into NCS.
2. Go to the packages directory.

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/core-fp-packages/
   ```

3. Copy and link the following packages to install SR-TE CFP-IOSXE CLI.

   ```
   sudo cp ncs-<version>-sr-te-multi-vendors-<version>.tar.gz /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
   <version>.tar.gz
   sudo cp ncs-<version>-cisco-ios-<version>.tar.gz /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
   /var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
   ```

4. Restart NSO with package reload.

   ```
   $ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
   Restarting ncs (via systemctl):
                          [  OK  ]
   ```

   The SR-TE CFP-IOSXE CLI is now complete.

5. Verify the installation and make sure the packages are up and running.

   ```
   admin@ncs% run show packages package package-version | select build-info ncs
   version | select build-info file | select build-info package sha1 | select
   oper-status error-info | select oper-status up | tab
   ```

6. SR-TE CFP-IOSXE CLI installation is now complete. Perform the post installation tasks.

Performing Post Installation Tasks for SR-TE CFP-IOSXE CLI

Do the following after installing SR-TE CFP-IOSXE CLI:

1. Change the current directory to:

```
$ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
```

2. Load-merge the **SR-multi-vendor-iosxe-cli.xml** file to configure dynamic-mapping.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% load merge SR-multi-vendor-iosxe-cli.xml
admin@ncs% commit
```

Verifying the Post Installation Tasks for SR-TE CFP-IOSXE CLI

Verify the dynamic-mapping as follows:

```
admin@ncs% show cisco-sr-te-cfp:cfp-configurations
dynamic-device-mapping cisco-ios-cli-6.86:cisco-ios-cli-6.86 {
    python-impl-class-name sr_te_multi_vendors.IosXE;
}
[ok]
```

Installing IETF-L3VPN-NM Services

This section discusses the packages you must copy to install the L3NM service either on SR-TE CFP-IOSXR CLI or as a standalone flavor and the procedure to verify the same. For more information on how to install SR-TE CFP-IOSXR CLI, see **Installing SR-TE CFP-IOSXR CLI**.

To install IETF-L3VPN-NM-IOSXR CLI as a standalone flavor, perform the tasks from **step 1** to **step 5** in section **Installing SR-TE CFP-IOSXR CLI** and then continue to perform the tasks mentioned in this topic.

Installing IETF-L3VPN-NM-IOSXR CLI

L3NM picks up the standardized IETF version of L3VPN implementation. This section discusses the packages you must copy to install and verify the L3VPN-NM-IOSXR CLI service.

1. Go to the packages directory.

```
$ cd nso-<version>-tsdn-<version>/tsdn/
```

2. Do one of the following.

   a. Copy and link the following packages to install IETF-L3VPN-NM-IOSXR CLI on SR-TE CFP-IOSXR CLI.

   ```
   sudo cp core-fp-packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
   /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-
   <version>.tar.gz
   ```

   ```
   sudo cp core-fp-packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-
   <version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-
   fp-internal-<version>.tar.gz
   ```

   ```
   sudo cp core-fp-packages/ncs-<version>-core-fp-delete-tag-service-
   <version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-delete-tag-
   service-<version>.tar.gz
   ```

   ```
   sudo cp example-packages/ncs-<version>-cisco-aa-service-assurance-
   EXAMPLE-<version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-
   EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-aa-
   service-assurance-EXAMPLE-<version>.tar.gz
   ```

   b. Copy and link the following packages to install L3NM-IOSXR CLI as a standalone flavor.

   ```
   sudo cp core-fp-packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
   /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-
   <version>.tar.gz
   ```

   ```
   sudo cp core-fp-packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-
   core-fp-<version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-
   fp-internal-<version>.tar.gz
   ```

   ```
   sudo cp core-fp-packages/ncs-<version>-core-fp-common-<version>.tar.gz
   /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-common-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-common-
   <version>.tar.gz
   ```

   ```
   sudo cp core-fp-packages/ncs-<version>-core-fp-plan-notif-generator-
   <version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-
   generator-<version>.tar.gz
   ```

```
sudo cp core-fp-packages/ncs-<version>-custom-template-utils-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-custom-template-
utils-<version>.tar.gz

sudo cp core-fp-packages/ncs-<version>-core-fp-delete-tag-service-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-delete-tag-
service-ncs-<version>-cisco-iosxr-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /var/opt/ncs/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz
sudo cp example-packages/ncs-<version>-cisco-aa-service-assurance-
EXAMPLE-<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-
EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-aa-
service-assurance-EXAMPLE-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-lsa-utils-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-resource-manager-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-resource-manager-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-resource-manager-
<version>.tar.gz
```

3. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
                      [  OK  ]
```

The L3VPN-NM-IOSXR CLI installation is now complete.

4. Verify the installation and make sure the packages are up and running.

```
admin@ncs% run show packages package package-version | select build-info ncs
version | select build-info file | select build-info package sha1 | select
oper-status error-info | select oper-status up | tab
```

Note: For standalone installation, the cisco-sr-te-cfp package is not displayed in the output.

5. Perform the post installation tasks.

Performing Post Installation Tasks for IETF-L3VPN-NM-IOSXR CLI

Do the following after installing L3NM-IOSXR CLI:

1. Change the current directory to:

```
$ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
```

2. Load-merge the **IETF-L3NM-plan-notification-settings.xml** file to activate notifications.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% load merge IETF-L3NM-plan-notification-settings.xml
admin@ncs% commit
```

3. Load-merge the **IETF-L3NM-status-codes.xml** file to activate status-codes.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-L3NM-status-codes.xml
admin@ncs% commit
```

4. Load-merge the **IETF-L3NM-internal-plan-kicker.xml** file to activate kicker settings.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-L3NM-internal-plan-kicker.xml
admin@ncs% load merge IETF-L3NM-cfp-configuration-kicker.xml
admin@ncs% load merge IETF-L3NM-route-policy-kicker.xml
admin@ncs% commit
```

5. If AA is installed, load merge the **IETF-L3NM-AA-notification-settings.xml** file to configure AA notifications.

```
/opt/ncs/current/bin/ncs_cli -u admin
unhide tsdn
configure
load merge IETF-L3NM-AA-notification-settings.xml
commit
```

Verifying the Post Installation Tasks for IETF-L3VPN-NM-IOSXR CLI

Do the following:

1. Verify the kickers configuration.

```
unhide debug
admin@ncs% show kickers data-kicker ietf-l3nm-cfp-configuration-kicker {
    monitor     /l3nm:l3vpn-ntw/cisco-l3nm:cfp-configurations;
    kick-node   /l3nm:l3vpn-ntw/cisco-l3nm:l3nm-actions;
    action-name update-internal-cfp-configurations;
}
data-kicker l3nm-internal-plan-kicker {
    monitor     /cisco-flat-L3vpn-fp-internal:flat-L3vpn-internal/cisco-flat-
L3vpn-fp-internal:flat-L3vpn-plan;
    kick-node   /l3nm:l3vpn-ntw/cisco-l3nm:l3nm-actions;
    action-name internal-plan-change-handler;
}
data-kicker l3nm-policy-definition-kicker {
    monitor     /cisco-l3vpn-routing-policy:l3vpn-routing-policy/policy-
definitions/cisco-l3vpn-routing-policy:policy-definition;
    kick-node   /cisco-l3vpn-routing-policy:l3vpn-routing-policy/cisco-l3vpn-
routing-policy:policy-definitions;
    action-name internal-policy-defs-change-handler;
}

data-kicker l3nm-defined-set-kicker {
    monitor     /cisco-l3vpn-routing-policy:l3vpn-routing-policy/cisco-l3vpn-
routing-policy:defined-sets;
    kick-node   /cisco-l3vpn-routing-policy:l3vpn-routing-policy/cisco-l3vpn-
routing-policy:policy-definitions;
    action-name internal-defined-sets-change-handler;
}
```

2. Verify the status-codes.

```
admin@ncs% show status-codes
core-function-pack IETF-L3NM {
    status-code-enum-path cisco-tsdn-core-fp-
common/python/cisco_tsdn_core_fp_common/status_codes/ietf_l3vpn_nm_status_cod
es;
    status-code 400 {
        reason              "Status code mapping has not been loaded for
function pack during install";
        category            user;
```

```
        severity            ERROR;
        recommended-actions "Bootstrap status code mapping";
    }
    status-code 404 {
        reason              "Input element's value is not supported";
        category            validation;
        severity            ERROR;
        recommended-actions "Verify that input element's value is supported
in the payload";
    }
…
…
    }
}
[ok]
```

3. Verify the plan-notifications. The plan-notifications display AA models only if the AA package is installed.

```
admin@ncs% run show configuration services plan-notifications
subscription l3nm-notif {
    service-type /l3vpn-ntw:l3vpn-ntw/l3vpn-ntw:vpn-services/l3vpn-ntw:vpn-
service;
}
[ok]

admin@ncs% show plan-path-for-notification
plan-path-for-notification /l3vpn-ntw:l3vpn-ntw/vpn-services/vpn-service-plan
{
    service-path         /l3vpn-ntw:l3vpn-ntw/vpn-services/vpn-service;
    service-key-elements [ vpn-id ];
}
[ok]
```

4. If you have installed AA, verify the bootstrap data is successfully loaded for AA notification settings.

```
admin@ncs% unhide tsdn
admin@ncs% run show service-path-for-subscription

                                          LSA                     LSA      DEVICE  CUSTOMER  PLAN                          CONFIG
SERVICE PATH                           DEVICES  SERVICES  SERVICES  DEVICES  SERVICES  SERVICES  LIST    SERVICE   LOCATION  ID  STATUS  NAME  TIME  DATA    ERROR  WHEN  TYPE  LEVEL  MESSAGE
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
/l3vpn-ntw:l3vpn-ntw/vpn-services/vpn-service  -      -      -      -      -      -      -      -      -

[ok]

admin@ncs% hide tsdn
```

Installing IETF-L3VPN-NM-IOSXR NC

L3NM picks up the standardized IETF version of L3VPN implementation. This section discusses the packages you must copy to install and verify the L3NM-IOSXR NC service.

Note: The IOSXR CLI NED is the default NED and is bundled with T-SDN FP Bundle. The IOSXR NC NED is downloadable from the Cisco website. For information on the supported Netconf NEDs, see **Cisco NSO and Cisco NED Requirements**.

L3VPN-NM-IOSXE CLI installation requires L3VPN-NM-IOSXR CLI to be installed. For more information, see **Installing IETF-L3VPN-NM-IOSXR CLI**.

To install L3VPN-NM-IOSXR NC:

1. Go to the packages directory.

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/core-fp-packages
   ```

2. Copy and link the following packages to install L3NM-IOSXR NC:

   ```
   sudo cp ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
   /var/opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
   ```

3. Restart NSO with package reload.

   ```
   $ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
   Restarting ncs (via systemctl):
                          [  OK  ]
   ```

   The L3NM-IOSXR NC installation is now complete.

4. Verify the installation and make sure the packages are up and running.

   ```
   admin@ncs% run show packages package package-version | select build-info ncs
   version | select build-info file | select build-info package sha1 | select
   oper-status error-info | select oper-status up | tab
   ```

5. Perform the post installation tasks.

Performing Post Installation Tasks for IETF-L3VPN-NM-IOSXR NC

Do the following after installing L3NM-IOSXR NC:

1. Change the current directory to:

   ```
   $ cd nso-<version>-tsdn-<release>/tsdn/bootstrap-data
   ```

2. Load-merge the **IETF-L3NM-plan-notification-settings.xml** file to activate notifications.

   ```
   $ ncs_cli -u admin
   admin@ncs> configure
   admin@ncs% load merge IETF-L3NM-plan-notification-settings.xml
   admin@ncs% commit
   ```

3. Load-merge the **IETF-L3NM-status-codes.xml** file to activate status-codes.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-L3NM-status-codes.xml
admin@ncs% commit
```

4. Load-merge the **IETF-L3NM-internal-plan-kicker.xml** file to activate the kickers.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-L3NM-internal-plan-kicker.xml
admin@ncs% load merge IETF-L3NM-route-policy-kicker.xml
admin@ncs% commit
```

Verifying the Post Installation Tasks for IETF-L3VPN-NM-IOSXR NC

Verify the post installation tasks as follows:

Verify the plan-notifications.

```
admin@ncs% run show configuration services plan-notifications
subscription l3nm-notif {
    service-type /l3vpn-ntw:l3vpn-ntw/l3vpn-ntw:vpn-services/l3vpn-ntw:vpn-
service;
}
[ok]

admin@ncs% run show configuration plan-path-for-notification
plan-path-for-notification /l3vpn-ntw:l3vpn-ntw/vpn-services/vpn-service-plan
{
    service-path         /l3vpn-ntw:l3vpn-ntw/vpn-services/vpn-service;
    service-key-elements [ vpn-id ];
}
[ok]
```

Installing IETF-L3VPN-NM-IOSXE CLI

L3NM picks up the standardized IETF version of L3VPN implementation. This section discusses the packages you must copy to install and verify the L3NM-IOSXE CLI service.

L3NM-IOSXE CLI installation requires L3NM-IOSXR CLI to be installed. For more information, see **Installing IETF-L3VPN-NM-IOSXR CLI**.

To install L3NM-IOSXE CLI:

1. Go to the packages directory.

```
$ cd nso-<version>-tsdn-<version>/tsdn/
```

2. Copy and link the following packages to install L3NM-IOSXE CLI:

```
sudo cp example-packages/cp ncs-<version>-flat-l3vpn-multi-vendors-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-flat-l3vpn-multi-vendors-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-flat-l3vpn-multi-
vendors-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-cisco-ios-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
```

3. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
                      [  OK  ]
```

The L3NM-IOSXE CLI installation is now complete.

4. Verify the installation and make sure the packages are up and running.

```
admin@ncs% run show packages package package-version | select build-info ncs
version | select build-info file | select build-info package sha1 | select
oper-status error-info | select oper-status up | tab
```

5. Perform the post installation tasks.

Performing Post Installation Tasks for L3NM-IOSXE CLI

Do the following after installing L3NM-IOSXE CLI:

1. Change the current directory to:

```
$ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
```

2. Load-merge the **L3VPN-multi-vendor-iosxe-cli.xml** file to configure dynamic mapping.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% load merge IETF-L3NM-multi-vendor-iosxe-cli.xml
admin@ncs% commit
```

Verifying the Post Installation Tasks for L3NM-IOSXE CLI

Verify the dynamic-mapping as follows:

```
unhide tsdn
admin@ncs% show l3vpn-ntw cfp-configurations
dynamic-device-mapping cisco-ios-cli-6.86:cisco-ios-cli-6.86 {
    python-impl-class-name flat_l3vpn_multi_vendors.IosXE;
}
```

Installing Example Function Packs on a Single NSO Instance

The SR-TE CFP-IOSXR-CLI is the base flavor and is the pre-requisite to install the Example Function Packs (flavors), except for standalone services.

You can choose to install one or more flavors on top of the base flavor SR-TE CFP-IOSXR CLI. To install a flavor, copy the packages for the flavor either during or after the SR-TE CFP-IOSXR CLI installation.

Additionally, the IOSXR-NC flavor or the IOSXE-CLI flavor for a service (L2NM/IETF-TE) requires the IOSXR-CLI flavor for the service. For example, to install the L2NM-IOSXE flavor, you must:

1. Install the base flavor (SR-TE CFP-IOSXR CLI).
2. Install the L2NM-IOSXR CLI flavor on the base flavor .
3. Install the L2NM-IOSXE flavor.

This topic discusses the procedure to install the following flavors:

- IETF-L2VPN-NM service with IOSXR-CLI/IOSXR-NC/IOSXE-CLI
- IETF-TE service with IOSXR-CLI/IOSXR-NC/IOSXE-CLI

Note: L2NM uses the standardized IETF version of L2VPN.

Standalone Flavors

To perform standalone installations, do not copy the **cisco-sr-te-cfp** packages during the SR-TE CFP-IOSXR CLI installation. You can install the L2NM service and the IETF-TE service with IOSXR-CLI, IOSXR-NC, or IOSXE-CLI as standalone services.

The standalone installation for the service with IOSXR-CLI is the base and is a pre-requisite to perform the standalone installations for the services with IOSXR-NC or IOSXE-CLI flavors.

For example, to install L2NM-IOSXR NC as a standalone service, you must first install L2NM-IOSXR CLI as a standalone service and then install the L2NM-IOSXR NC service.

Installing Automated Assurance Services

The Automated Assurance feature is an optional feature and is applicable only to IETF-L2VPN-L2NM,
IETF-L3VPN-L3NM. This feature is installed if the **ncs-<*version*>-cisco-aa-service-assurance-EXAMPLE-<*version*>.tar.gz** package is extracted and copied along with the packages to install the Example services.

Installing IETF-L2VPN-NM Services

This section discusses the packages required to install the L2NM service either on SR-TE CFP-IOSXR CLI or as a standalone flavor, and the procedure to verify the same.

Before you install L2NM service, make sure SR-TE CFP-IOSXR CLI is installed and then continue to perform the tasks mentioned in this topic. For more information on how to install SR-TE CFP-IOSXR CLI, see **Installing SR-TE CFP-IOSXR CLI**.

To install IETF-L2VPN-NM-IOSXR CLI as a standalone flavor, perform the tasks from **step 1** to **step 5** in section **Installing SR-TE CFP-IOSXR CLI** and then continue to perform the tasks mentioned in this topic.

Installing IETF-L2VPN-NM-IOSXR CLI

L2NM uses the standardized IETF version of L2VPN. This section discusses the packages you must copy to install and verify the L2NM-IOSXR CLI service.

Note: To install the AA feature, copy and link the AA package. It is, however, optional to load the AA packages.

To install L2NM-IOSXR CLI:

1. Go to the packages directory.

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/
   ```

2. Do one of the following:

   a. Copy and link the following packages to install L2NM-IOSXR CLI on SR-TE CFP-IOSXR CLI.

   ```
   sudo cp example-packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
   <version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-
   EXAMPLE-<version>.tar.gz
   ```

   ```
   sudo cp example-packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-
   EXAMPLE-<version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-
   EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-
   L2vpn-fp-internal-EXAMPLE-<version>.tar.gz
   ```

   ```
   sudo cp core-fp-packages/ncs-<version>-core-fp-delete-tag-service-
   <version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-delete-tag-
   service-<version>.tar.gz
   ```

   ```
   sudo cp example-packages/ncs-<version>-cisco-aa-service-assurance-
   EXAMPLE-<version>.tar.gz /opt/ncs/packages/
   ```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-
EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-aa-
service-assurance-EXAMPLE-<version>.tar.gz
```

b. Copy and link the following packages to install L2NM-IOSXR CLI as a standalone flavor.

```
sudo cp example-packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
<version>.tar.gz
sudo cp example-packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-
EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-
L2vpn-fp-internal-EXAMPLE-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-core-fp-common-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-
generator-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-custom-template-utils-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-core-fp-delete-tag-service-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-delete-tag-
service-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /var/opt/ncs/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-lsa-utils-<version>.tar.gz
/opt/ncs/packages/
```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
```

3. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
                      [  OK  ]
```

The IETF-L2VPN-NM-IOSXR CLI installation is now complete.

4. Verify the installation and make sure the packages are up and running.

```
admin@ncs% run show packages package package-version | select build-info ncs
version | select build-info file | select build-info package sha1 | select
oper-status error-info | select oper-status up | tab
```

5. Perform the post installation tasks.

Performing Post Installation Tasks for IETF-L2VPN-NM-IOSXR CLI

Do the following after installing L2NM-IOSXR CLI service:

1. Change the current directory to:

```
$ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
```

2. Load-merge the **IETF-L2NM-plan-notification-settings.xml** file to activate notifications.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% load merge IETF-L2NM-plan-notification-settings.xml
admin@ncs% commit
```

3. Load-merge the **IETF-L2NM-status-codes.xml** file to activate status-codes.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-L2NM-status-codes.xml
admin@ncs% commit
```

4. Load-merge the following xml files to activate kicker settings.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-L2NM-internal-plan-kicker.xml
admin@ncs% load merge IETF-L2NM-cfp-configuration-kicker.xml
admin@ncs% commit
admin@ncs% load merge IETF-L2NM-route-policy-kicker.xml
admin@ncs% commit
```

5. If you have installed AA, load merge the **IETF-L2NM-AA-notification-settings.xml** to activate AA notifications.

```
$ ncs_cli -u admin
configure
unhide tsdn
load merge IETF-L2NM-AA-notification-settings.xml
commit
```

6. Configure SMAN ID resource pool for Y1731.

```
$ ncs_cli -u admin
configure
load merge xr-sman-id-resource-pool.xml
commit
```

Verifying the Post Installation Tasks for L2NM-IOSXR CLI

Verify the post installation tasks as follows:

1. Verify the kickers configuration.

```
unhide debug
admin@ncs% show kickers
data-kicker flat-L2vpn-internal-remote-site-plan-kicker {
    monitor     /cisco-flat-L2vpn-fp-internal-remote-site:flat-L2vpn-
internal-remote-site/cisco-flat-L2vpn-fp-internal-remote-site:flat-L2vpn-
plan;
    kick-node   /l2vpn-ntw:l2vpn-ntw/cisco-l2vpn-ntw:l2nm-actions;
    action-name internal-plan-change-handler;
}
data-kicker flat-L2vpn-internal-site-plan-kicker {
    monitor     /cisco-flat-L2vpn-fp-internal-site:flat-L2vpn-internal-
site/cisco-flat-L2vpn-fp-internal-site:flat-L2vpn-plan;
    kick-node   /l2vpn-ntw:l2vpn-ntw/cisco-l2vpn-ntw:l2nm-actions;
    action-name internal-plan-change-handler;
}
data-kicker flat-L2vpn-internal-local-site-plan-kicker {
    monitor     /cisco-flat-L2vpn-fp-internal-local-site:flat-L2vpn-internal-
local-site/cisco-flat-L2vpn-fp-internal-local-site:flat-L2vpn-plan;
    kick-node   /l2vpn-ntw:l2vpn-ntw/cisco-l2vpn-ntw:l2nm-actions;
    action-name internal-plan-change-handler;
}
data-kicker plan-notification-kicker-/l2vpn-ntw:l2vpn-ntw/vpn-services/cisco-
l2vpn-ntw:vpn-service-plan {
```

```
    monitor     /l2vpn-ntw:l2vpn-ntw/vpn-services/cisco-l2vpn-ntw:vpn-
service-plan;
    kick-node   /action;
    action-name generate-plan-notifications;
data-kicker l2nm-defined-set-kicker {
    monitor     /cisco-l2vpn-routing-policy:l2vpn-routing-policy/cisco-l2vpn-
routing-policy:defined-sets;
    kick-node   /cisco-l2vpn-routing-policy:l2vpn-routing-policy/cisco-l2vpn-
routing-policy:policy-definitions;
    action-name internal-defined-sets-change-handler;
}
data-kicker l2nm-route-policy-kicker {
    monitor     /cisco-l2vpn-routing-policy:l2vpn-routing-policy/cisco-l2vpn-
routing-policy:policy-definitions/cisco-l2vpn-routing-policy:policy-
definition;
    kick-node   /l2vpn-ntw:l2vpn-ntw/l2vpn-ntw:vpn-services/l2vpn-ntw:vpn-
service[vpn-nodes/vpn-node/te-service-mapping/te-mapping/odn/route-
policy=current()/name];
    action-name reactive-re-deploy;
}
data-kicker service-assurance-subsciption-kicker-/l2vpn-ntw:l2vpn-ntw/vpn-
services/vpn-service {
    monitor     /l2vpn-ntw:l2vpn-ntw/vpn-services/vpn-service;
    kick-node   /service-assurance;
    action-name service-assurance-action;
}
```

2. Verify the status-codes.

```
admin@ncs% show status-codes core-function-pack IETF-L2NM
status-code-enum-path cisco-tsdn-core-fp-
common/python/cisco_tsdn_core_fp_common/status_codes/ietf_l2vpn_nm_status_cod
es;
    status-code 400 {
        reason              "Status code mapping has not been loaded for
function pack during install";
        category            user;
        severity            ERROR;
        recommended-actions "Bootstrap status code mapping";
    }
    status-code 404 {
        reason              " The value for the input element is not
supported ";
        category            validation;
```

```
        severity            ERROR;
        recommended-actions "Verify that input element's value is supported
in the payload";
    }
...
    }
}
[ok]
```

3. Verify the plan-notifications. Plan-notifications display AA models only if the AA packages are installed.

```
admin@ncs% run show configuration services plan-notifications
subscription l2nm-notif {
    service-type /l2vpn-ntw:l2vpn-ntw/l2vpn-ntw:vpn-services/l2vpn-ntw:vpn-
service;
}
[ok]
admin@ncs% run show plan-path-for-notification
plan-path-for-notification /l2vpn-ntw:l2vpn-ntw/vpn-services/vpn-service-plan
{
    service-path         /l2vpn-ntw:l2vpn-ntw/vpn-services/vpn-service;
    service-key-elements [ vpn-id ];
}
[ok]
```

4. Verify SMAN ID configuration for Y1731.

```
admin@ncs% show resource-pools id-pool sman-id-pool
range {
    start 1;
    end   65535;
}
```

5. If you have installed AA, verify the bootstrap data is successfully loaded for AA notification settings.

```
admin@ncs% unhide tsdn
admin@ncs% run show service-path-for-subscription

                                          LSA                    LSA      DEVICE  CUSTOMER  PLAN                          CONFIG
SERVICE PATH                           DEVICES  SERVICES  SERVICES  DEVICES  SERVICES  SERVICES  LIST    SERVICE   LOCATION  ID  STATUS  NAME  TIME  DATA    ERROR  WHEN  TYPE  LEVEL  MESSAGE
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
/l2vpn-ntw:l2vpn-ntw/vpn-services/vpn-service  -       -       -       -       -       -       -       -       -
[ok]

admin@ncs% hide tsdn
```

Installing L2VPN-NM-IOSXR NC

L2NM picks up the standardized IETF version of L2VPN implementation. This section discusses the packages you must copy to install and verify the L2NM-IOSXR NC service.

L2NM-IOSXR NC installation requires L2VPN-NM-IOSXR CLI to be installed. For more information, see **Installing IETF-L2VPN-NM-IOSXR CLI**.

To install L2NM-IOSXR NC:

1. Go to the packages directory.

   ```
   $ cd nso-<version>-tsdn-<release>/tsdn/
   ```

2. Copy and link the following packages to install L2NM-IOSXR NC:

   ```
   sudo cp example-packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-<version>.tar.gz
   /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
   <version>.tar.gz
   sudo cp core-fp-packages/ncs-<version>-resource-manager-<version>.tar.gz
   /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz
   /var/opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz
   ```

3. Restart NSO with package reload.

   ```
   $ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
   Restarting ncs (via systemctl):
                        [  OK  ]
   ```

   The L2NM-IOSXR NC installation is now complete.

4. Verify the installation and make sure the packages are up and running.

   ```
   admin@ncs% run show packages package package-version | select build-info ncs
   version | select build-info file | select build-info package sha1 | select
   oper-status error-info | select oper-status up | tab
   ```

5. Perform the post installation tasks.

Performing Post Installation Tasks for L2NM-IOSXR NC

Do the following after installing L2NM-IOSXR NC:

1. Change the current directory to:

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
   ```

2. Load-merge the **IETF-L2NM-plan-notification-settings.xml** file to activate notifications.

   ```
   $ /opt/ncs/current/bin/ncs_cli -u admin
   admin@ncs> configure
   admin@ncs% load merge IETF-L2NM-plan-notification-settings.xml
   admin@ncs% commit
   ```

3. Load-merge the **IETF-L2NM-status-codes.xml** file to activate status-codes.

   ```
   $ /opt/ncs/current/bin/ncs_cli -u admin
   ```

```
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-L2NM-status-codes.xml
admin@ncs% commit
```

4. Load-merge the **IETF-L2NM-internal-plan-kicker.xml** file to activate kicker settings.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-L2NM-internal-plan-kicker.xml
admin@ncs% commit
admin@ncs% load merge IETF-L2NM-route-policy-kicker.xml
```

Verifying the Post Installation Tasks for L2NM-IOSXR NC

Do the following:

1. Verify the kickers configuration.

```
unhide debug
data-kicker flat-L2vpn-internal-local-site-plan-kicker {
    monitor     /cisco-flat-L2vpn-fp-internal-local-site:flat-L2vpn-internal-
local-site/cisco-flat-L2vpn-fp-internal-local-site:flat-L2vpn-plan;
    kick-node   /l2vpn-ntw:l2vpn-ntw/cisco-l2vpn-ntw:l2nm-actions;
    action-name internal-plan-change-handler;
}
data-kicker flat-L2vpn-internal-remote-site-plan-kicker {
    monitor     /cisco-flat-L2vpn-fp-internal-remote-site:flat-L2vpn-
internal-remote-site/cisco-flat-L2vpn-fp-internal-remote-site:flat-L2vpn-
plan;
    kick-node   /l2vpn-ntw:l2vpn-ntw/cisco-l2vpn-ntw:l2nm-actions;
    action-name internal-plan-change-handler;
}
data-kicker flat-L2vpn-internal-site-plan-kicker {
    monitor     /cisco-flat-L2vpn-fp-internal-site:flat-L2vpn-internal-
site/cisco-flat-L2vpn-fp-internal-site:flat-L2vpn-plan;
    kick-node   /l2vpn-ntw:l2vpn-ntw/cisco-l2vpn-ntw:l2nm-actions;
    action-name internal-plan-change-handler;
}
data-kicker l2nm-defined-set-kicker {
    monitor     /cisco-l2vpn-routing-policy:l2vpn-routing-policy/cisco-l2vpn-
routing-policy:defined-sets;
```

```
    kick-node   /cisco-l2vpn-routing-policy:l2vpn-routing-policy/cisco-l2vpn-
routing-policy:policy-definitions;
    action-name internal-defined-sets-change-handler;
}
data-kicker l2nm-route-policy-kicker {
    monitor     /cisco-l2vpn-routing-policy:l2vpn-routing-policy/cisco-l2vpn-
routing-policy:policy-definitions/cisco-l2vpn-routing-policy:policy-
definition;
    kick-node   /l2vpn-ntw:l2vpn-ntw/l2vpn-ntw:vpn-services/l2vpn-ntw:vpn-
service[vpn-nodes/vpn-node/te-service-mapping/te-mapping/odn/route-
policy=current()/name];
    action-name reactive-re-deploy;
}
```

2. Verify the status-codes.

```
admin@ncs% show status-codes
core-function-pack IETF-L2NM {
    status-code-enum-path cisco-tsdn-core-fp-
common/python/cisco_tsdn_core_fp_common/status_codes/ietf_l2vpn_nm_status_cod
es;
    status-code 400 {
        reason              "Status code mapping has not been loaded for
function pack during install";
        category            user;
        severity            ERROR;
        recommended-actions "Bootstrap status code mapping";
    }
    status-code 404 {
        reason              "Input element's value is not supported";
        category            validation;
        severity            ERROR;
        recommended-actions "Verify that input element's value is supported
in the payload";
    }
…
    }
}
[ok]
```

3. Verify the plan-notifications.

```
admin@ncs% run show configuration services plan-notifications
subscription l2nm-notif {
    service-type /l2vpn-ntw:l2vpn-ntw/l2vpn-ntw:vpn-services/l2vpn-ntw:vpn-
service;
}
[ok]

admin@ncs% show plan-path-for-notification
```

```
plan-path-for-notification /l2vpn-ntw:l2vpn-ntw/vpn-services/vpn-service-plan
{
    service-path         /l2vpn-ntw:l2vpn-ntw/vpn-services/vpn-service;
    service-key-elements [ vpn-id ];
}
[ok]
```

Installing L2VPN-NM-IOSXE CLI

L2NM picks up the standardized IETF version of L2VPN implementation. This section discusses the packages you must copy to install and verify the L2NM-IOSXE CLI service.

L2NM-IOSXE CLI installation requires L2VPN-NM-IOSXR CLI to be installed. For more information, see **Installing IETF-L2VPN-NM-IOSXR CLI**.

To install L2NM-IOSXE CLI:

1. Go to the packages directory.

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/
   ```

2. Copy and link the following packages to install L2NM-IOSXE CLI:

   ```
   sudo cp example-packages/ncs-<version>-flat-l2vpn-multi-vendors-EXAMPLE-
   <version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-flat-l2vpn-multi-vendors-EXAMPLE-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-flat-l2vpn-multi-
   vendors-EXAMPLE-<version>.tar.gz
   ```

   ```
   sudo cp core-fp-packages/ncs-<version>-cisco-ios-<version>.tar.gz
   /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
   /var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
   ```

3. Restart NSO with package reload.

   ```
   $ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
   Restarting ncs (via systemctl):
                          [  OK  ]
   ```

   The L2NM-IOSXE CLI installation is now complete.

4. Verify the installation and make sure the packages are up and running.

   ```
   admin@ncs% run show packages package package-version | select build-info ncs
   version | select build-info file | select build-info package sha1 | select
   oper-status error-info | select oper-status up | tab
   ```

5. Perform the post installation tasks.

Performing Post Installation Tasks for L2NM-IOSXE CLI

Do the following after installing L2NM-IOSXE CLI:

1. Change the current directory to:

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
   ```

2. Load-merge the **L2VPN-multi-vendor-iosxe-cli.xml** file to configure dynamic mapping.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% load merge IETF-L2NM-multi-vendor-iosxe-cli.xml
admin@ncs% commit
```

Verifying the Post Installation Tasks for L2NM-IOSXE CLI

Verify the dynamic-mapping.

```
unhide tsdn
admin@ncs% show l2vpn-ntw cfp-configurations
dynamic-device-mapping cisco-ios-cli-6.86:cisco-ios-cli-6.86 {
    python-impl-class-name flat_l2vpn_multi_vendors.IosXE;
}
```

Installing IETF-TE Services

This section discusses the procedure to copy the packages to install and verify the IETF-TE-IOSXR CLI service either on SR-TE CFP-IOSXR CLI or as a standalone flavor.

Installing IETF TE-IOSXR CLI

To install IETF-TE-IOSXR CLI on the base flavor, make sure to have installed SR-TE CFP-IOSXR CLI and then continue to perform the tasks mentioned in this topic. For more information on how to install SR-TE CFP-IOSXR CLI, see **Installing SR-TE CFP-IOSXR CLI**.

To install IETF-TE-IOSXR CLI as a standalone flavor, perform the tasks from **step 1** to **step 5** in section **Installing SR-TE CFP-IOSXR CLI** and then continue to perform the tasks mentioned in this topic.

To install and verify IETF TE-IOSXR CLI:

1. Go to the packages directory.

```
$ cd nso-<version>-tsdn-<version>/tsdn/
```

2. Do one of the following as required.

   a. Copy and link the following packages to install IETF TE-IOSXR CLI on SR-TE CFP-IOSXR CLI:

```
sudo cp example-packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-
EXAMPLE-<version>.tar.gz

sudo cp example-packages/ncs-<version>-ietf-te-fp-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/

sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-
```

```
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-
<version>.tar.gz
```

b. Copy and link the following packages to install IETF-TE-IOSXR CLI as a standalone flavor.

```
sudo cp example-packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-
EXAMPLE-<version>.tar.gz
sudo cp example-packages/ncs-<version>-ietf-te-fp-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-
<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-core-fp-delete-tag-service-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-delete-tag-
service-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-core-fp-common-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-common-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-common-
<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-
generator-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-custom-template-utils-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-custom-template-
utils-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
sudo cp core-fp-packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /var/opt/ncs/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz
```

3. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
```

```
Restarting ncs (via systemctl):
                      [  OK  ]
```

The IETF TE-IOSXR CLI installation is now complete.

4. Verify the installation and make sure the packages are up and running.

```
admin@ncs% run show packages package package-version | select build-info ncs
version | select build-info file | select build-info package sha1 | select
oper-status error-info | select oper-status up | tab
```

Note: The cisco-sr-te-cfp package is not displayed for the standalone installation.

5. Perform the post installation tasks.

Performing Post Installation Tasks for IETF TE-IOSXR CLI

Do the following after installing IETF TE-IOSXR CLI:

1. Change the current directory to:

```
$ cd nso-<version>-tsdn-<version>/tsdn/example-packages
```

2. (*For standalone installation only*) Make sure to configure the common bootstrap data as described in section **Performing Post Installation Tasks for SR-TE CFP-IOSXR CLI**.

3. Load-merge the **IETF-TE-plan-notification-settings.xml** file to configure plan notifications.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% load merge IETF-TE-plan-notification-settings.xml
admin@ncs% commit
```

4. Load-merge the following xml files to configure the status-codes.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge RSVP-TE-status-codes.xml
load merge IETF-TE-status-codes.xml
admin@ncs% commit
```

5. Load-merge the following xml files to configure kickers.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-TE-internal-plan-kicker.xml
admin@ncs% load merge IETF-TE-cfp-configuration-kicker.xml
admin@ncs% commit
```

Verifying the Post Installation Tasks for IETF-TE IOSXR CLI

Do the following:

1. Verify the kickers configuration.

```
admin@ncs% show kickers
data-kicker ietf-te-fp-configuration-kicker {
    monitor     /te:cfp-configurations;
    kick-node   /te:ietf-te-actions;
    action-name update-internal-fp-configurations;
}
data-kicker ietf-te-internal-plan-kicker {
    monitor     /cisco-rsvp-te-fp:rsvp-te/cisco-rsvp-te-fp:tunnel-te-plan;
    kick-node   /te:ietf-te-actions;
    action-name internal-plan-change-handler;
}
[ok]
```

2. Verify the status-codes.

```
admin@ncs% show status-codes
core-function-pack IETF-TE {
    status-code-enum-path cisco-tsdn-core-fp-
common/python/cisco_tsdn_core_fp_common/status_codes/ietf_te_status_codes;
    status-code 301 {
        reason              "Device unreachable";
        category            device;
        severity            ERROR;
        recommended-actions "Check device connectivity from NSO and perform
recovery steps.";
    }
    status-code 302 {
        reason              "Device out of sync";
        category            device;
        severity            ERROR;
        recommended-actions "Check sync between device and NSO, and perform
recovery steps.";
    }
…
…   }
}
core-function-pack RSVP-TE {
    status-code-enum-path cisco-tsdn-core-fp-
common/python/cisco_tsdn_core_fp_common/status_codes/rsvp_te_status_codes;
    status-code 301 {
        reason              "Device unreachable";
        category            device;
        severity            ERROR;
```

```
        recommended-actions "Check device connectivity from NSO and perform
recovery steps.";
    }
    status-code 302 {
        reason              "Device out of sync";
        category            device;
        severity            ERROR;
        recommended-actions "Check sync between device and NSO, and perform
recovery steps.";
    }
…
…   }
}
[ok]
```

3. Verify plan-notifications.

```
admin@ncs% run show configuration services plan-notifications
subscription ietf-te-notif {
    service-type /te:te/te:tunnels/te:tunnel;
}
[ok]
admin@ncs% run show configuration plan-path-for-notification

plan-path-for-notification /te:te/tunnels/tunnel-plan {
    service-path         /te:te/tunnels/tunnel;
    service-key-elements [ name ];
}
[ok]
```

Installing IETF TE-IOSXR NC

IETF-TE-IOSXR NC installation requires IETF-TE-IOSXR CLI to be installed. For more information on how to install IETF-TE-IOSXR CLI, see **Installing IETF TE-IOSXR CLI**.

To install IETF TE-IOSXR NC:

1. Go to the packages directory.

```
$ cd nso-<version>-tsdn-<version>/tsdn/
```

2. Copy and link the following packages to install IETF TE-IOSXR NC:

```
sudo cp core-fp-packages/ncs-<version>-cisco-iosxr-netconf-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-iosxr-netconf-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-iosxr-netconf-
<version>.tar.gz

sudo cp example-packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/
```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-
EXAMPLE-<version>.tar.gz
```

3. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
                        [  OK  ]
```

The IETF TE-IOSXR NC installation is now complete.

4. Verify the installation and make sure the packages are up and running.

```
admin@ncs% run show packages package package-version | select build-info ncs
version | select build-info file | select build-info package sha1 | select
oper-status error-info | select oper-status up | tab
```

5. Perform the post installation tasks.

Performing Post Installation Tasks for IETF TE-IOSXR NC

Do the following after installing IETF TE-IOSXR NC:

1. Change the current directory to:

```
$ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
```

2. Load-merge the **IETF-TE-multi-vendor-iosxr-netconf.xml** file to configure dynamic-mapping.

```
$ ncs_cli -u admin
configure
unhide debug
admin@ncs% load merge IETF-TE-multi-vendor-iosxr-netconf.xml
admin@ncs% commit
```

Verifying the Post Installation Tasks for IETF TE-IOSXR NC

Verify the dynamic-mapping as follows:

```
unhide tsdn
admin@ncs% show cisco-rsvp-te-fp:cfp-configurations
dynamic-device-mapping cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3 {
    python-impl-class-name rsvp_te_multi_vendors.NativeXR;
}
dynamic-device-mapping cisco-iosxr-nc-7.4:cisco-iosxr-nc-7.4 {
    python-impl-class-name rsvp_te_multi_vendors.NativeXR;
}
```

Installing IETF-TE-IOSXE CLI

IETF-TE-IOSXE CLI installation requires IETF-TE-IOSXR CLI to be installed. For more information on how to install IETF-TE-IOSXR CLI, see **Installing IETF TE-IOSXR CLI**.

To install IETF-TE-IOSXE CLI:

1. Go to the packages directory.

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/
   ```

2. Copy and link the following packages to install IETF-TE-IOSXE CLI:

   ```
   sudo cp example-packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-
   <version>.tar.gz /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-
   EXAMPLE-<version>.tar.gz
   ```

   ```
   sudo cp core-fp-packages/ncs-<version>-cisco-ios-<version>.tar.gz
   /opt/ncs/packages/
   ```

   ```
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
   /var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
   ```

3. Restart NSO with package reload.

   ```
   $ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
   Restarting ncs (via systemctl):
                          [  OK  ]
   ```

   The IETF-TE-IOSXE CLI installation is now complete.

4. Verify the installation and make sure the packages are up and running.

   ```
   admin@ncs% run show packages package package-version | select build-info ncs
   version | select build-info file | select build-info package sha1 | select
   oper-status error-info | select oper-status up | tab
   ```

5. Perform the post installation tasks.

Performing Post Installation Tasks for IETF-TE-IOSXE CLI

Do the following after installing IETF-TE-IOSXE CLI:

1. Change the current directory to:

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn/bootstrap-data
   ```

2. Load-merge the **IETF-TE-multi-vendor-iosxe-cli.xml** file to configure dynamic-mapping.

   ```
   $ ncs_cli -u admin
   admin@ncs> configure
   admin@ncs% load merge IETF-TE-multi-vendor-iosxe-cli.xml
   admin@ncs% commit
   ```

Verifying the Post Installation Tasks for IETF-TE-IOSXE CLI

Verify the dynamic-mapping as follows:

```
unhide tsdn
admin@ncs% show cisco-rsvp-te-fp:cfp-configurations
dynamic-device-mapping cisco-ios-cli-6.86:cisco-ios-cli-6.86 {
    python-impl-class-name rsvp_te_multi_vendors.IosXE;
}
```

Uninstalling Cisco T-SDN FP Bundle on a Single NSO Instance

To uninstall Cisco NSO T-SDN FP Bundle, you must first remove the associated services and any associated devices from the system. Make sure no zombie services are running for the services and all the devices are removed from the device tree.

If you uninstall a service (flavor) installed on SR-TE CFP-IOSXR CLI, the system continues to render the
SR-TE CFP-IOSXR CLI services. However, if you uninstall SR-TE CFP-IOSXR CLI without uninstalling the flavor, only the services rendered by the flavor are available. In such cases, the flavor functions as a standalone service only if the common packages and the required packages for the services are available.

Note: Do not remove the T-SDN FP Bundle common packages or the CLI NEDs if you continue to use the Example Function Packs (services) as standalone flavors after uninstalling T-SDN FP Bundle.

This section discusses the procedure to uninstall the Example Function Packs (flavors) and the Core Function Packs.

Reverting Changes to the NCS Configuration File on a Single NSO Instance

Revert the changes to the **ncs.config** file before you uninstall the flavors and the Cisco NSO T-SDN FP Bundle.

To revert the changes to the NCS configuration file:

1. Stop NCS.
2. Edit the **/etc/ncs/ncs.conf** as follows:
    a. Update the python **<start-command>** configuration.

```
 <python-vm>
<start-command>DEFAULT</start-command>
<run-in-terminal>
  <terminal-command>DEFAULT</terminal-command>
```

```
</run-in-terminal>
<logging>
  <log-file-prefix>${NCS_LOG_DIR}/ncs-python-vm</log-file-prefix>
</logging>
  </python-vm>
```

b. Under **<notifications> <event-streams>** group, set **<replay-support>** and **<builtin-replay-store>** parameters to false as follows.

```
<notifications>
   <event-streams>
       <stream>
           <name>service-state-changes</name>
           <description>Plan state transitions according to
      tailf-ncs-plan.yang</description>
           <replay-support>false</replay-support>
           <builtin-replay-store>
               <enabled>false</enabled>
               <dir>./state</dir>
               <max-size>S10M</max-size>
               <max-files>50</max-files>
           </builtin-replay-store>
       </stream>
```

c. Remove **<hide-group>** section at the end of the file.

```
<hide-group>
   <name>debug</name>
</hide-group>
<hide-group>
   <name>tsdn</name>
</hide-group>
<hide-group>
   <name>fastmap-private</name>
</hide-group>
<hide-group>
   <name>lsa</name>
</hide-group>
```

d. If you enabled the SSH port configuration for the CLI, webui, and the northbound notifications, it is optional to revert the configuration.

Uninstalling Example Function Packs

If you uninstall a flavor that is installed on SR-TE CFP-IOSXR CLI, the system continues to render the SR-TE CFP-IOSXR CLI services. Delete all the services for the flavor before uninstalling the flavor.

Note: Do not remove the T-SDN FP Bundle common packages or the CLI NEDs if you continue to use the Example Function Packs (services) as standalone flavors after uninstalling T-SDN FP Bundle.

Uninstalling IETF-L2VPN-NM Services

Use the information in this section to uninstall L2NM services with IOSXR CLI/IOSXR NC/IOSXE CLI.

Uninstalling IETF-L2VPN-NM-IOSXR CLI

Before you uninstall L2NM-IOSXR CLI flavor, be sure to delete all the related services and the devices from the device tree.

Uninstalling L2NM-IOSXR CLI reverts the system to SR-TE CFP-IOSXR CLI flavor. For more information on how to uninstall SR-TE CFP-IOSXR CLI, see **Uninstalling SR-TE CFP-IOSXR CLI**.

To uninstall L2NM-IOSXR CLI:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File**.
2. Delete plan-notifications.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete services plan-notifications subscription l2nm-notif
admin@ncs% delete plan-path-for-notification /l2vpn-ntw:l2vpn-ntw/vpn-services/vpn-service-plan
admin@ncs% commit
```

3. Delete status-codes.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% delete status-codes core-function-pack IETF-L2NM
admin@ncs% delete status-code-cfp IETF-L2NM
admin@ncs% commit
```

4. Delete kickers.

```
$ ncs_cli -u admin
admin@ncs> configure
```

```
admin@ncs% unhide debug
admin@ncs% delete kickers data-kicker flat-L2vpn-internal-local-site-plan-kicker
admin@ncs% delete kickers data-kicker flat-L2vpn-internal-remote-site-plan-kicker
admin@ncs% delete kickers data-kicker l2nm-route-policy-kicker
admin@ncs% delete kickers data-kicker l2nm-defined-set-kicker
admin@ncs% delete kickers data-kicker flat-L2vpn-internal-site-plan-kicker
admin@ncs% delete kickers data-kicker l2nm-cfp-configuration-kickeradmin@ncs%
admin@ncs% commit
```

5. If AA is installed, delete notifications for the AA module.

```
unhide debug
/opt/ncs/current/bin/ncs_cli -u admin
configure
delete service-path-for-subscription /l2vpn-ntw:l2vpn-ntw/vpn-services/vpn-service
commit
```

6. Unlink the following packages in **/var/opt/ncs/packages** and delete the packages from **/opt/ncs/packages/** directory.

```
sudo rm -f /opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-EXAMPLE-<version>.tar.gz
sudo rm -f /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-<version>.tar.gz
sudo rm -f /opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-<version>.tar.gz
sudo rm -f /opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz
```

7. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show zombies
sudo /etc/init.d/ncs stop
```

8. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
                [  OK  ]
```

Uninstalling L2NM-IOSXR NC

To uninstall the L2NM-IOSXR NC flavor, you must first delete the L2NM services with NC NED.

Uninstalling this flavor reverts the system to SR-TE CFP-IOSXR CLI flavor.

Before you uninstall L2NM-IOSXR NC flavor, be sure to delete all the related services and the devices from the device tree.

To uninstall L2NM-IOSXR NC:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File**.
2. Delete plan-notifications.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete services plan-notifications subscription l2nm-notif
admin@ncs% delete plan-path-for-notification /l2vpn-ntw:l2vpn-ntw/vpn-services/vpn-service-plan
admin@ncs% commit
```

3. Delete status-codes for L2NM.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% delete status-codes core-function-pack IETF-L2NM
admin@ncs% delete status-code-cfp IETF-L2NM
admin@ncs% commit
```

4. Delete kickers.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% commit
```

5. Unlink the following packages in **/var/opt/ncs/packages** and delete the packages from **/opt/ncs/packages/** directory.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-<version>.tar.gz
sudo rm -f /var/opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz /opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz
```

6. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies
sudo /etc/init.d/ncs stop
```

7. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
               [  OK  ]
```

Uninstalling L2NM-IOSXE CLI

Uninstalling the L2NM-IOSXE CLI flavor reverts the system to SR-TE CFP IOSXR-CLI flavor.

Before uninstalling L2NM-IOSXE CLI flavor, be sure to delete all the related services and the devices from the device tree.

To uninstall L2NM-IOSXE CLI:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File**.
2. Delete the dynamic-mapping for the flavor.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete cisco-flat-L2vpn-fp:cfp-configurations dynamic-device-
mapping cisco-ios-cli-<version>:cisco-ios-cli-<version>
admin@ncs% commit
```

3. Unlink the following package in **/var/opt/ncs/packages** and delete the package from **/opt/ncs/packages/** directory.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-flat-l2vpn-multi-vendors-
EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-flat-l2vpn-multi-
vendors-EXAMPLE-<version>.tar.gz
```

4. Remove the CLI NED.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
```

5. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies
sudo /etc/init.d/ncs stop
```

6. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
```

```
Restarting ncs (via systemctl):
               [  OK  ]
```

Uninstalling IETF-TE Services

Use the information in this section to uninstall the IETE-TF services with IOSXR CLI/IOSXR NC/IOSXE CLI.

Uninstalling IETF-TE-IOSXR-CLI

Uninstalling this flavor reverts the system to SR-TE CFP-IOSXR CLI. For more information on how to uninstall SR-TE CFP-IOSXR CLI, see **Uninstalling SR-TE CFP-IOSXR CLI**.

To uninstall IETF-TE with IOSXR-CLI:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File**.
2. Delete plan-notifications.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete services plan-notifications subscription ietf-te-notif
admin@ncs% delete plan-path-for-notification /te:te/tunnels/tunnel-plan
admin@ncs% commit
```

3. Delete status-codes for IETF-TE.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% delete status-codes core-function-pack IETF-TE
admin@ncs% delete status-code-cfp IETF-TE
admin@ncs% delete status-codes core-function-pack RSVP-TE
admin@ncs% delete status-code-cfp RSVP-TE
admin@ncs% commit
```

4. Delete kickers.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% delete kickers data-kicker ietf-te-fp-configuration-kicker
admin@ncs% delete kickers data-kicker ietf-te-internal-plan-kicker
admin@ncs% commit
```

5. Unlink the following packages in **/var/opt/ncs/packages** and delete the packages from **/opt/ncs/packages/** directory.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-<version>.tar.gz
```

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-<version>.tar.gz
```

6. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show zombies
sudo /etc/init.d/ncs stop
```

7. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
               [   OK  ]
```

Uninstalling IETF-TE-IOSXR NC

Uninstalling this flavor reverts the system to IETF-TE IOSXR CLI. For information on how to uninstall IETF-TE IOSXR CLI, see **Uninstalling IETF-TE-IOSXR-CLI**.

To uninstall IETF-TE-IOSXR NC:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.

2. Delete dynamic-mapping for IETF-TE.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete cisco-rsvp-te-fp:cfp-configurations dynamic-device-mapping cisco-iosxr-nc-<version>:cisco-iosxr-nc-<version>
admin@ncs% delete te:cfp-configurations dynamic-device-mapping cisco-iosxr-nc-<version>:cisco-iosxr-nc-<version>
admin@ncs% commit
```

3. Unlink the following package in **/var/opt/ncs/packages** and delete the package from **/opt/ncs/packages/** directory.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-<version>.tar.gz
```

4. Remove the Netconf NED if they are not used in other services.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-iosxr-nc-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-iosxr-nc-
<version>.tar.gz
```

5. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies
sudo /etc/init.d/ncs stop
```

6. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
               [   OK  ]
```

Uninstalling IETF-TE-IOSXE-CLI

Uninstalling this flavor reverts the system to IETF-TE IOSXR CLI. For information on how to uninstall
IETF-TE IOSXR CLI, see **Uninstalling IETF-TE-IOSXR-CLI**.

To uninstall IETF-TE-IOSXE-CLI:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.

2. Delete dynamic-mapping.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete cisco-rsvp-te-fp:cfp-configurations dynamic-device-mapping
cisco-ios-cli-<version>:cisco-ios-cli-<version>
admin@ncs% commit
```

3. Unlink the following package in **/var/opt/ncs/packages** and delete the package from **/opt/ncs/packages/** directory.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-
EXAMPLE-<version>.tar.gz
```

4. Remove the XE CLI NED if it is not used in other services.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
```

5. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
```

```
### Make sure there are no zombie services by running the command: show
zombies
sudo /etc/init.d/ncs stop
```

6. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
               [   OK  ]
```

Uninstalling Core Function Packs

Use the information in this section to uninstall the SR-TE CFPs with IOSXE CLI/IOSXR NC/IOSXR-CLI.

Note: Do not remove the T-SDN FP Bundle common packages or the CLI NEDs if you continue to use the Example Function Packs (services) as standalone flavors after uninstalling T-SDN FP Bundle.

Uninstalling SR-TE CFP IOSXR CLI uninstalls the Cisco T-SDN FP Bundle.

Uninstalling SR-TE CFP-IOSXE CLI

Uninstalling this flavor reverts the system to SR-TE CFP-IOSXR CLI.

To uninstall SR-TE CFP-IOSXE CLI:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.
2. Delete dynamic-mapping for the flavor.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete cisco-sr-te-cfp:cfp-configurations dynamic-device-mapping
cisco-ios-cli-<version>:cisco-ios-cli-<version>
admin@ncs% commit
```

3. Unlink the following packages in **/var/opt/ncs/packages** and delete the packages from **/opt/ncs/packages/** directory. Remove the IOSXE CLI NEDs installed with the multi-vendor package.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
<version>.tar.gz

sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
```

4. Delete all the services and devices.
5. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
```

```
### Make sure there are no zombie services by running the command: show
zombies
sudo /etc/init.d/ncs stop
```

6. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
               [   OK  ]
```

Uninstalling SR-TE CFP-IOSXR NC

Uninstalling SR-TE CFP-IOSXR NC reverts the system to SR-TE CFP-IOSXR CLI.

To uninstall SR-TE CFP-IOSXR NC:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.
2. Delete dynamic-mapping for the flavor.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete cisco-sr-te-cfp:cfp-configurations dynamic-device-mapping
cisco-iosxr-nc-<version>:cisco-iosxr-nc-<version>
admin@ncs% commit
```

3. Unlink the following package in **/var/opt/ncs/packages** and delete the package from **/opt/ncs/packages/** directory.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
<version>.tar.gz
```

4. Remove the Netconf NED installed along with the multi-vendors package.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-iosxr-nc-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-iosxr-nc-
<version>.tar.gz
```

5. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies
sudo /etc/init.d/ncs stop
```

6. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
                 [ OK  ]
```

Uninstalling IETF-L3VPN-NM Services

Use the information in this section to uninstall L3NM services with IOSXR CLI/IOSXR NC/IOSXE CLI.

Uninstalling IETF-L3VPN-NM-IOSXR CLI

Uninstalling this flavor, reverts the system to SR-TE CFP-IOSXR CLI.

Before you uninstall L3NM-IOSXR CLI flavor, be sure to delete all the related services and the devices from the device tree.

To uninstall L3NM-IOSXR CLI:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.
2. Delete plan-notifications.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete services plan-notifications subscription l3nm-notif
admin@ncs% delete plan-path-for-notification /l3vpn-ntw:l3vpn-ntw/vpn-services/vpn-service-plan
admin@ncs% commit
```

3. Delete status-codes.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% delete status-codes core-function-pack IETF-L3NM
admin@ncs% delete status-code-cfp IETF-L3NM
admin@ncs% commit
```

4. Delete kickers for the L3NM IOSXR-CLI service.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% delete kickers data-kicker service-assurance-subsciption-kicker-/l3nm:l3vpn-ntw/vpn-services/vpn-service
admin@ncs% delete kickers data-kicker l3nm-policy-definition-kicker
admin@ncs% delete kickers data-kicker l3nm-defined-set-kicker
admin@ncs% delete kickers data-kicker l3nm-internal-plan-kicker
admin@ncs% delete kickers data-kicker ietf-l3nm-cfp-configuration-kicker
admin@ncs% commit
```

5. Unlink the following packages in **/var/opt/ncs/packages** and delete the package from **/opt/ncs/packages/** directory.

```
sudo rm -f /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-<version>.tar.gz
```

```
sudo rm -f /opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-<version>.tar.gz
```

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz /opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
```

6. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
```

```
### Make sure there are no zombie services by running the command: show zombies
```

```
sudo /etc/init.d/ncs stop
```

7. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
```

```
Restarting ncs (via systemctl):
                  [ OK ]
```

Uninstalling IETF-L3VPN-NM-IOSXR NC

Uninstalling this flavor reverts the system to SR-TE CFP-IOSXR NC flavor.

Before uninstalling L3NM-IOSXR NC flavor, be sure to delete all the related services and the devices from the device tree.

To uninstall L3NM-IOSXR NC:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.

2. Delete plan-notifications.

```
$ ncs_cli -u admin
```

```
admin@ncs> configure
```

```
admin@ncs% delete services plan-notifications subscription l3nm-notif
```

```
admin@ncs% delete plan-path-for-notification /l3vpn-ntw:l3vpn-ntw/vpn-services/vpn-service-plan
```

```
admin@ncs% commit
```

3. Delete status-codes for L3NM.

```
$ ncs_cli -u admin
```

```
admin@ncs> configure
```

```
admin@ncs% unhide debug
```

```
admin@ncs% delete status-codes core-function-pack IETF-L3NM
admin@ncs% delete status-code-cfp IETF-L3NM
admin@ncs% commit
```

4. Delete kickers.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% delete kickers data-kicker l3nm-internal-plan-kicker
admin@ncs% commit
```

5. Unlink the following package in **/var/opt/ncs/packages** and delete the package from **/opt/ncs/packages/** directory.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
```

6. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies
sudo /etc/init.d/ncs stop
```

7. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
                  [ OK  ]
```

Uninstalling IETF-L3VPN-NM-IOSXE CLI

Uninstalling the L3NM-IOSXE CLI flavor reverts the system to L3NM-IOSXR CLI flavor. For information on how to uninstall L3VPN-IOSXE CLI, see **Installing IETF-L3VPN-NM-IOSXR CLI**.

Before uninstalling L3NM-IOSXE CLI flavor, be sure to delete all the related services and the devices from the device tree.

To uninstall L3NM-IOSXE CLI:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.

2. Delete dynamic-mapping for the flavor.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete cisco-flat-L3vpn-fp:cfp-configurations dynamic-device-
mapping cisco-ios-cli-<version>:cisco-ios-cli-<version>
admin@ncs% commit
```

3. Unlink the following packages in **/var/opt/ncs/packages** and delete the packages from **/opt/ncs/packages/** directory.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-flat-l3vpn-multi-vendors-<version>.tar.gz /opt/ncs/packages/ncs-<version>-flat-l3vpn-multi-vendors-<version>.tar.gz
```

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
```

4. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show zombies
sudo /etc/init.d/ncs stop
```

5. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
                [  OK  ]
```

Uninstalling SR-TE CFP-IOSXR CLI

SR-TE CFP-IOSXR CLI is the main component in Cisco NSO T-SDN FP Bundle. Uninstalling SR-TE CFP-IOSXR CLI and the associated packages from the system removes the Cisco NSO T-SDN FP Bundle. Only a user who has **sudo** privileges and is part of **ncsadmin** user group can perform this uninstallation.

Before uninstalling T-SDN FP Bundle, you must first remove the T-SDN FP Bundle services and any devices from the system. Make sure no zombie services are running for the services. For more information on how to remove the services, see chapter ***Deleting Services*** in the ***Cisco NSO T-SDN FP Bundle User Guide***.

Note: Do not remove the T-SDN FP Bundle common packages or the CLI NEDs if you continue to use the Example Function Packs (services) as standalone flavors after uninstalling T-SDN FP Bundle.

To uninstall Cisco NSO T-SDN Function Pack Bundle:

1. Revert the **ncs.conf** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.

2. Delete plan notifications.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% delete services plan-notifications subscription cs-sr-te-notif
admin@ncs% delete services plan-notifications subscription sr-policy-notif
```

```
admin@ncs% delete plan-path-for-notification /cisco-cs-sr-te-cfp:cs-sr-te-plan
admin@ncs% delete services plan-notifications subscription sr-odn-notif
admin@ncs% delete plan-path-for-notification /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-odn:odn/odn-template-plan
admin@ncs% delete plan-path-for-notification /cisco-sr-te-cfp:sr-te/cisco-sr-te-cfp-sr-policies:policies/policy-plan
admin@ncs% commit
```

3. Delete status-codes.

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% delete status-code-cfp CS-SR
admin@ncs% delete status-codes core-function-pack CS-SR
admin@ncs% delete status-code-cfp SR
admin@ncs% delete status-codes core-function-pack SR
admin@ncs% commit
```

4. Delete kickers.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% delete kickers data-kicker cs-sr-te-internal-plan-kicker
admin@ncs% delete kickers data-kicker sr-te-cfp-configuration-kicker
admin@ncs% delete kickers data-kicker sr-te-odn-internal-plan-kicker
admin@ncs% delete kickers data-kicker sr-te-policy-internal-plan-kicker
admin@ncs% commit
```

5. Unlink the packages in **/var/opt/ncs/packages** and delete the packages from **/opt/ncs/packages/** directory.

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
sudo rm -f /var/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-<version>.tar.gz
sudo rm -f /var/opt/ncs/packages/ncs-<version>-custom-template-utils-<version>.tar.gz /opt/ncs/packages/ncs-<version>-custom-template-utils-<version>.tar.gz
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz
```

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-
<version>.tar.gz
```

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-
<version>.tar.gz
```

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
```

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz
```

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
```

```
sudo rm -f /var/opt/ncs/packages/ncs-<version>-resource-manager-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-resource-manager-
<version>.tar.gz
```

6. Stop NSO.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies
sudo /etc/init.d/ncs stop
```

7. Restart NSO with package reload.

```
$ sudo NCS_RELOAD_PACKAGES=force
```

```
Restarting ncs (via systemctl):
            [OK]
```

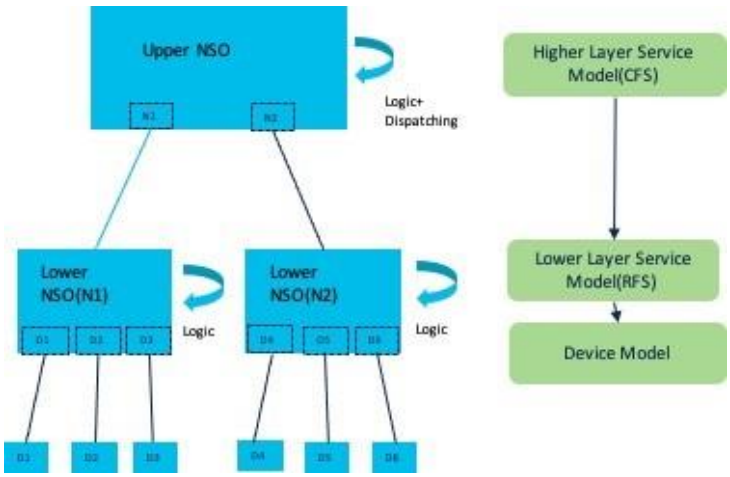
The Cisco NSO T-SDN FP Bundle uninstallation is now complete.

Installing and Uninstalling T-SDN FP Bundle in the LSA Model

The LSA model splits the T-SDN FP Bundle into two parts – one upper-level customer-facing service (CFS) part and two lower-level resource-facing service (RFS) parts.

The lower-level node layer (RFS node) comprises the managed devices mounted on their /devices tree. The lower-level node pushes the configurations to the devices in the network. These lower-level nodes are added as devices in the upper-level node on their /devices tree. The upper-level node does not contain any devices, except the lower-level device nodes. The upper-level node and the lower-level node communicate with each other by using Netconf.

The following diagram shows the T-SDN FP Bundle installation by using the LSA deployment model.



The upper-level node comprises the CFS packages for the T-SDN FP Bundle, the RFS NEDs, and other common packages and corresponding NEDs (such as core-fp-common and core-fp-common-ned).

The lower-level node has the RFS package for the T-SDN FP Bundle, other common packages, and the required device NEDs.

In the LSA model, install the upper-level node and each lower-level node (for each CFP) on separate NSO instances. The upper-level node is one common node to both the lower-level nodes. It is recommended to install the lower- level node for the CFP first and then the upper-level node. This is because you must add the lower-level nodes as devices on the upper-level node.

Installing T-SDN FP Bundle on the Lower-Level Nodes

This section discusses the required packages and configurations required to install the FP bundle on the lower-level node(s) in the LSA model.

Package Categories and Packages – Lower-Level Nodes

The following table shows the package categories and the packages extracted on the lower-level nodes.

The IOSXR CLI NED is the default NED and is packaged with the installation tar file. The IOSXR Netconf NEDs are downloadable from the Cisco website.

RFS Node Packages	
Package Category	**Packages**
T-SDN FP Bundle packages	ncs-6.1-cisco-sr-te-cfp-internal-5.0.0.tar.gz ncs-6.1-sr-te-multi-vendors-5.0.0.tar.gz ncs-6.1-flat-l3vpn-multi-vendors-5.0.0.tar.gz ncs-6.1-cisco-flat-L3vpn-fp-internal-5.0.0.tar.gz
T-SDN FP Bundle common packages	ncs-6.1-core-fp-plan-notif-generator-1.0.10.tar.gz ncs-6.1-core-fp-common-1.33.0.tar.gz ncs-6.1-custom-template-utils-2.0.13.tar.gz ncs-6.1-lsa-utils-1.0.4.tar.gz ncs-6.1-core-fp-delete-tag-service-1.0.6.tar.gz ncs-6.1.cisco-tsdn-core-fp-common-5.0.0.tar.gz
LSA NED packages	**IOSXR CLI NED:** ncs-6.1-cisco-iosxr-7.46.3.tar.gz **IOSXE CLI NED:** ncs-6.1-cisco-ios-6.86.6.tar.gz
Example packages	ncs-6.1-cisco-flat-L2vpn-fp-internal-EXAMPLE-5.0.0.tar.gz ncs-6.1-cisco-rsvp-te-fp-EXAMPLE-5.0.0.tar.gz ncs-6.1-flat-l2vpn-multi-vendors-EXAMPLE-5.0.0.tar.gz ncs-6.1-rsvp-te-multi-vendors-EXAMPLE-5.0.0.tar.gz

Modifying the NCS Configuration File on the Lower-Level Nodes

Back up the **/etc/ncs/ncs.conf** file and then modify the file for each lower-level node of the CFPs. Use this backup file to restore the configurations while uninstalling the CFPs.

For more information about the ncs.conf file, see the **nso_man-<*version*>.pdf** documentation in **volume5**.

To modify the NCS configuration file on the lower-level nodes:

1. (*Optional*) Configure the SSH port for CLI, webui, and netconf northbound parameters. You can choose to either enable or disable the SSH port configuration, as required, for these parameters. By default, the SSH port configuration for these parameters is disabled. For more information on these parameters, see the ***NSO documentation***.

   The following shows how to enable the SSH port configuration, if required. Provide the port numbers as per your requirement.

   SSH port for CLI

```
<cli>
  <enabled>true</enabled>
  <!-- Use the builtin SSH server -->
  <ssh>
         <enabled>true</enabled>
         <ip>0.0.0.0</ip>
         <port>${North_Bound_CLI_SSH_Port}</port>
  </ssh>
```

   webui

   You can enable webui in either TCP or SSL.

```
<webui>
<enabled>true</enabled>
  <transport>
    <tcp>
       <enabled>true</enabled>
        <ip>0.0.0.0</ip>
        <port>${North_Bound_Web_UI_Port}</port>
    </tcp>

       <ssl>
<enabled>true</enabled>
           <ip>0.0.0.0</ip>
           <port>${SSL_port}</port>
           <key-file>${NCS_CONFIG_DIR}/ssl/cert/host.key</key-file>
           <cert-file>${NCS_CONFIG_DIR}/ssl/cert/host.cert</cert-file>
       </ssl>
     </transport>
```

netconf northbound

```
<netconf-north-bound>
    <enabled>true</enabled>
        <transport>
<ssh>
<enabled>true</enabled>
<ip>0.0.0.0</ip>
<port>${Netconf_North_Bound_port}</port>
</ssh>
```

2. Add the following under notifications/event-streams.

   Dispatch map

```
<stream>
   <name>dispatch-map-update</name>
    <description>Device addition/removal on RFS notified to
CFS</description>
     <replay-support>true</replay-support>
      <builtin-replay-store>
         <enabled>true</enabled>
         <dir>${NCS_RUN_DIR}/state</dir>
         <max-size>S10M</max-size>
         <max-files>50</max-files>
      </builtin-replay-store>
 </stream>
```

   Custom-template events

```
<stream>
   <name>custom-template-events</name>
    <description>Custom Template updates on RFS notified to
CFS</description>
     <replay-support>true</replay-support>
      <builtin-replay-store>
      <enabled>true</enabled>
      <dir>${NCS_RUN_DIR}/state</dir>
      <max-size>S10M</max-size>
      <max-files>50</max-files>
      </builtin-replay-store>
</stream>
```

3. Configure the following under /logs.

   netconf-trace-log

```
<netconf-trace-log>
    <enabled>true</enabled>
    <filename>${NCS_LOG_DIR}/netconf-north.trace</filename>
    <format>pretty</format>
</netconf-trace-log>
```

webui-browser-log

```
<webui-browser-log>
      <enabled>true</enabled>
      <filename>${NCS_LOG_DIR}/webui-browser.log</filename>
</webui-browser-log>
```

4. Configure ssh algorithms.

```
<ssh>
   <algorithms>
     <kex>diffie-hellman-group14-sha1</kex>
     <mac>hmac-sha2-512,hmac-sha2-256,hmac-sha1</mac>
     <encryption>aes128-ctr,aes192-ctr,aes256-ctr</encryption>
   </algorithms>
 </ssh>
```

5. Append the **<hide-group>** information to the file.

```
<hide-group>
    <name>tsdn</name>
  </hide-group>
  <hide-group>
    <name>debug</name>
 </hide-group>
 <hide-group>
    <name>lsa</name>
  </hide-group>
```

6. Add and set **<commit-message>** parameter to **false** under suppress-commit-message-context.

```
<commit-message>false</commit-message>
```

7. Configure Java-API parameters.

```
<japi>
  <new-session-timeout>PT3600S</new-session-timeout>
  <query-timeout>PT3600S</query-timeout>
  <connect-timeout>PT3600S</connect-timeout>
  <event-reply-timeout>PT3600S</event-reply-timeout>
</japi>
```

Installing T-SDN FP Bundle on the Lower-Level Nodes

To install T-SDN FP Bundle on the lower-level nodes:

1. Make sure you have completed the tasks described in sections **Preparing the NSO Environment to Install the Cisco T-SDN FP Bundle** and **Modifying the NCS Configuration File on the Lower-Level Nodes**.
2. Log in to the host machine as a **sudo** user, who is also part of the **ncsadmin** user group.
3. Obtain and download the **nso-<*version*>-tsdn-<*version*>.signed.bin** file from Cisco website and copy it to the lower-level node.
4. Extract the content of the bin file to the current directory. If the folder already exists, back up the existing folder.

   ```
   $ sh nso-<version>-tsdn-<version>.signed.bin
   ```

   This verifies the authenticity of the product. However, if you encounter any network connectivity issues, run the following command to skip this verification.

   ```
   $ sh nso-<version>-tsdn-<version>.signed.bin --skip-verification
   ```

5. Untar the installer tar.gz file to the current directory to extract the T-SDN FP Bundle packages. If the folder already exists, be sure to create a backup of the existing folder.

   ```
   $tar -xf nso-<version>-tsdn-<version>.tar.gz
   ```

6. Go to the lower-level node packages directory and change the current directory as follows:

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn-lsa/tsdn-lsa-rfs/core-fp-packages
   ```

7. Copy the T-SDN FP Bundle packages to the **/opt/ncs/packages/** directory and create symbolic links from **/var/opt/ncs/packages**.

   ```
   sudo cp ncs-<version>-cisco-tsdn-core-fp-common-<version>.tar.gz
   /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-<version>.tar.gz
   ```

   ```
   sudo cp ncs-<version>-cisco-sr-te-cfp-internal-<version>.tar.gz
   /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-<version>.tar.gz
   ```

   ```
   sudo cp ncs-<version>-sr-te-multi-vendors-<version>.tar.gz
   /opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-<version>.tar.gz
   ```

   ```
   sudo cp ncs-<version>-cisco-iosxr-<version>.tar.gz /opt/ncs/packages/ncs-
   <version>-cisco-iosxr-<version>.tar.gz
   ```

   ```
   sudo cp ncs-<version>-cisco-ios-<version>.tar.gz /opt/ncs/packages/ncs-
   <version>-cisco-ios-<version>.tar.gz
   ```

   ```
   sudo cp ncs-<version>-custom-template-utils-<version>.tar.gz
   /opt/ncs/packages/ncs-<version>-custom-template-utils-<version>.tar.gz
   ```

   ```
   sudo cp ncs-<version>-core-fp-common-<version>.tar.gz /opt/ncs/packages/ncs-
   <version>-core-fp-common-<version>.tar.gz
   ```

   ```
   sudo cp ncs-<version>-core-fp-plan-notif-generator-<version>.tar.gz
   /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-<version>.tar.gz
   ```

   ```
   sudo cp ncs-<version>-core-fp-delete-tag-service-<version>.tar.gz
   /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-<version>.tar.gz
   ```

```
sudo cp ncs-<version>-lsa-utils-<version>.tar.gz /opt/ncs/packages/ncs-
<version>-lsa-utils-<version>.tar.gz
sudo cp ncs-<version>-cisco-flat-L3vpn-fp-internal-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-<version>.tar.gz
sudo cp ncs-<version>-flat-l3vpn-multi-vendors-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-flat-l3vpn-multi-vendors-<version>.tar.gz

sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-
common-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-
internal-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-
<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-
generator-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-delete-tag-
service-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-
internal-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-flat-l3vpn-multi-vendors-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-flat-l3vpn-multi-
vendors-<version>.tar.gz
```

8. Go to the example-packages directory.

```
$ cd nso-<version>-tsdn-<version>/tsdn-lsa/tsdn-lsa-rfs/example-packages
```

9. Copy the packages for the required example function packs to the **/opt/ncs/packages/** directory and create symbolic links from **/var/opt/ncs/packages**.

```
sudo cp ncs-<version>-cisco-flat-L2vpn-fp-internal-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-EXAMPLE-
<version>.tar.gz
sudo cp ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-<version>.tar.gz
sudo cp ncs-<version>-flat-l2vpn-multi-vendors-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-flat-l2vpn-multi-vendors-EXAMPLE-
<version>.tar.gz
sudo cp ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-
<version>.tar.gz


sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-
EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-
L2vpn-fp-internal-EXAMPLE-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-
EXAMPLE-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-flat-l2vpn-multi-vendors-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-flat-l2vpn-multi-
vendors-EXAMPLE-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-
EXAMPLE-<version>.tar.gz
```

10. Restart NSO with package-reload.

```
$ sudo /etc/init.d/ncs restart-with-package-reload
```

T-SDN FP Bundle is now installed on the lower-level node.

Performing Post Installation Tasks on the Lower-Level Nodes

Do the following:

1. Load the following bootstrap data.

```
cd nso-<version>-tsdn-<version>/tsdn-lsa/tsdn-lsa-rfs/bootstrap-data
ncs_cli -u <user>
configure
unhide debug
load merge SR-status-codes.xml
load merge SR-internal-plan-monitor.xml
load merge RSVP-TE-status-codes.xml
load merge RSVP-TE-internal-plan-monitor.xml
```

```
load merge rfs-custom-template-settings.xml
load merge L3VPN-status-codes.xml
load merge L3VPN-internal-plan-monitor.xml
load merge L2VPN-status-codes.xml
load merge L2VPN-internal-plan-monitor.xml
load merge rfs-dispatch-map-settings.xml
load merge commit-queue-settings.xml
load merge bootstrap-autopopulate-dispatch.xml
commit
```

2. Set NACM rules. In the following example, the ncs-admin user ID is admin.

```
% set nacm groups group ncsadmin user-name admin
% commit
Commit complete.
```

3. Configure the local **ncsadmin** user as a **cfp-local-user** for the CFP to identify the user to push the configurations.

```
% configure
% set cfp-local-user admin
% commit
```

4. Set the public key for ssh algorithms.

```
# Global settings method
------------------------
% show devices global-settings ssh-algorithms public-key
public-key [ ssh-ed25519 ecdsa-sha2-nistp256 ecdsa-sha2-nistp384 ecdsa-sha2-
nistp521 rsa-sha2-512 rsa-sha2-256 ];
% set devices global-settings ssh-algorithms public-key [ ssh-ed25519 ecdsa-
sha2-nistp256 ecdsa-sha2-nistp384 ecdsa-sha2-nistp521 rsa-sha2-512 rsa-sha2-
256 ssh-rsa ]
% commit

% show device global-settings ssh-algorithms public-key
public-key [ ssh-ed25519 ecdsa-sha2-nistp256 ecdsa-sha2-nistp384 ecdsa-sha2-
nistp521 rsa-sha2-512 rsa-sha2-256 ssh-rsa ];
# Device-specific method
------------------------
% show devices device PE1 ssh-algorithms public-key
No entries found.

% set devices device <DEVICE_NAME> ssh-algorithms public-key [ ssh-rsa ]
% commit
```

```
% show device device <DEVICE_NAME> ssh-algorithms public-key
public-key [ ssh-rsa ];
```

5. Add the global settings for timeout.

```
configure
set devices global-settings connect-timeout 300
set devices global-settings read-timeout 300
set devices global-settings write-timeout 300
```

Verifying the Installation on the Lower-Level Nodes

Do the following:

1. Verify the packages are installed and their status is UP.

```
admin@ncs> show packages package oper-status | tab
```

2. Verify the package information.

```
admin@ncs> show packages package package-version | select build-info ncs
version | select build-info file | select build-info package sha1 | select
oper-status error-info | select oper-status up | tab
```

3. Verify bootstrap configuration.

```
% show devices global-settings commit-queue
enabled-by-default false;
async;
atomic             false;
retry-attempts     0;
retry-timeout      30;
error-option       stop-on-error;
% show status-code-cfp
status-code-cfp L2VPN;
status-code-cfp L3VPN;
status-code-cfp RSVP-TE;
status-code-cfp SR;
% show rfs-monitor-path
rfs-monitor-path /cisco-flat-L2vpn-fp-internal-local-site:flat-L2vpn-
internal-local-site/cisco-flat-L2vpn-fp-internal-local-site:flat-L2vpn-plan;
rfs-monitor-path /cisco-flat-L2vpn-fp-internal-remote-site:flat-L2vpn-
internal-remote-site/cisco-flat-L2vpn-fp-internal-remote-site:flat-L2vpn-
plan;
rfs-monitor-path /cisco-flat-L2vpn-fp-internal-site:flat-L2vpn-internal-
site/cisco-flat-L2vpn-fp-internal-site:flat-L2vpn-plan;
rfs-monitor-path /cisco-flat-L3vpn-fp-internal:flat-L3vpn-internal/cisco-
flat-L3vpn-fp-internal:flat-L3vpn-plan;
```

```
rfs-monitor-path /cisco-rsvp-te-fp:rsvp-te/tunnel-te-plan;
rfs-monitor-path /cisco-sr-te-cfp-internal:sr-te/cisco-sr-te-cfp-sr-odn-
internal:odn/cisco-sr-te-cfp-sr-odn-internal:odn-template-plan;
rfs-monitor-path /cisco-sr-te-cfp-internal:sr-te/cisco-sr-te-cfp-sr-policies-
internal:policies/cisco-sr-te-cfp-sr-policies-internal:policy-plan;

% show auto-populate-dispatch-map
auto-populate-dispatch-map true;

% show ct-event-stream-enabled
ct-event-stream-enabled true;

% show status-codes | nomore
core-function-pack L2VPN {
    status-code-enum-path cisco-tsdn-core-fp-
common/python/cisco_tsdn_core_fp_common/status_codes/flat_L2vpn_status_codes;
    status-code 301 {
        reason              "Device unreachable";
        category            device;
        severity            ERROR;
        recommended-actions "Check device connectivity from NSO and perform
recovery steps.";
    }
    status-code 302 {
        reason              "Device out of sync";
        category            device;
        severity            ERROR;
        recommended-actions "Check sync between device and NSO, and perform
recovery steps.";
    }
…
```

4. Verify the NACM rules.

```
% show nacm
read-default     deny;
write-default    deny;
exec-default     deny;
groups {
    group ncsadmin {
        user-name [ admin private ];
    }
    group ncsoper {
```

```
        user-name [ public ];
    }
}
...
```

5. Verify cfp-local-user.

```
% show cfp-local-user
  cfp-local-user admin;
```

6. Verify lsa role is set for the lower-level node.

```
% show lsa role
role lower-layer;
```

Installing T-SDN FP Bundle on the Upper-Level Node

This section discusses the required packages and configurations required to install the FP bundle on the lower-level node(s) in the LSA model.

Package Categories and Packages – Upper-Level Node

The following table shows the package categories and the packages extracted on the upper-level node.

Note: The cs-sr-te-cfp package in SR-TE CFP-IOSXR CLI is supported only on IOSXR CLI 7.46 NED, IOSXR NC 7.8 NED, and IOSXR NC 7.9 NED.

CFS Node Packages	
Package Category	**Packages**
T-SDN FP Bundle packages	ncs-6.1-cisco-sr-te-cfp-5.0.0.tar.gz ncs-6.1-cisco-cs-sr-te-cfp-5.0.0.tar.gz ncs-6.1-ietf-l3vpn-nm-5.0.0.tar.gz
T-SDN FP Bundle common packages	ncs-6.1-core-fp-plan-notif-generator-1.0.10.tar.gz ncs-6.1-custom-template-utils-2.0.13.tar.gz ncs-6.1-core-fp-common-1.33.0.tar.gz ncs-6.1-lsa-utils-1.0.4.tar.gz ncs-6.1-cisco-tsdn-core-fp-common-5.0.0.tar.gz ncs-6.1-resource-manager-4.2.0.tar.gz
LSA NED packages	ncs-6.1-cisco-flat-L2vpn-fp-internal-ned-EXAMPLE-5.0.0.tar.gz ncs-6.1-cisco-flat-L3vpn-fp-internal-ned-5.0.0.tar.gz ncs-6.1-cisco-rsvp-te-fp-internal-ned-EXAMPLE-5.0.0.tar.gz ncs-6.1-lsa-utils-ned-1.0.tar.gz ncs-6.1-custom-template-utils-ned-1.0.tar.gz ncs-6.1-core-fp-common-ned-1.0.tar.gz

	ncs-6.1-cisco-sr-te-cfp-internal-ned-5.0.0.tar.gz ncs-6.1-cisco-nso-nc-6.1.tar.gz
Example packages	ncs-6.1-cisco-aa-service-assurance-EXAMPLE-5.0.0.tar.gz ncs-6.1-ietf-l2vpn-nm-EXAMPLE-5.0.0.tar.gz ncs-6.1-ietf-te-fp-EXAMPLE-5.0.0.tar.gz

Modifying the NCS Configuration File on the Upper-Level Node

Back up the **/etc/ncs/ncs.conf** file and then modify the file for the upper-level node. Use the backup file to restore the configurations while uninstalling the CFPs.

For more information about the ncs.conf file, see the **nso_man-<*version*>.pdf** documentation in **volume5**.

To modify the NCS configuration file on the upper-level node:

1. It is optional to configure the SSH port for CLI, webui, and netconf northbound parameters. You can choose to either enable or disable the SSH port configuration, as required, for these parameters. By default, the SSH port configuration for these parameters is disabled. For more information on these parameters, see the ***NSO documentation***.

   The following shows how to enable the SSH port configuration, if required. Provide the port numbers as per your requirement.

   SSH port for CLI

```
<cli>
  <enabled>true</enabled>
  <!-- Use the builtin SSH server -->
  <ssh>
         <enabled>true</enabled>
         <ip>0.0.0.0</ip>
         <port>${North_Bound_CLI_SSH_Port}</port>
  </ssh>
```

   webui

   You can enable webui in either TCP or SSL.

```
<webui>
<enabled>true</enabled>
  <transport>
    <tcp>
       <enabled>true</enabled>
        <ip>0.0.0.0</ip>
        <port>${North_Bound_Web_UI_Port}</port>
    </tcp>
```

```
        <ssl>
              <enabled>true</enabled>
            <ip>0.0.0.0</ip>
            <port>${SSL_port}</port>
            <key-file>${NCS_CONFIG_DIR}/ssl/cert/host.key</key-file>
            <cert-file>${NCS_CONFIG_DIR}/ssl/cert/host.cert</cert-file>
        </ssl>
      </transport>
```

netconf northbound

```
<netconf-north-bound>
    <enabled>true</enabled>
        <transport>
<ssh>
<enabled>true</enabled>
<ip>0.0.0.0</ip>
<port>${Netconf_North_Bound_port}</port>
</ssh>
```

2. Add the stream service-state-changes as follows.

```
<notifications>
<event-streams>
  <stream>
    <name>service-state-changes< /name >
    <description>Plan state transitions according to
    tailf-ncs-plan.yang< /description >
    <replay-support> true < /replay-support >
    < builtin -replay-store>
      <enabled> true < /enabled >
      < dir >${NCS_RUN_DIR}/state < /dir >
      <max-size>S10M< /max-size >
      <max-files>50< /max-files >
    < /builtin-replay-store >
  < /stream >
```

3. If AA is installed, add AA notification streams to generate AA configuration change notifications.

```
<stream>
   <name>service-aa-changes< /name >
   <description>Notifications relating to the service aa configuration
change< /description >
   <replay-support> true < /replay-support >
   < builtin -replay-store>
```

```
      <enabled> true < /enabled >
      < dir >${NCS_RUN_DIR} /state < /dir >
      <max-size>S10M< /max-size >
      <max-files>50< /max-files >
    < /builtin-replay-store >
< /stream >
```

4. Append the **<hide-group>** information to the file.

```
<hide-group>
    <name>tsdn</name>
</hide-group>
  <hide-group>
    <name>debug</name>
  </hide-group>
<hide-group>
   <name>fastmap-private</name>
   </hide-group>
   <hide-group>
       <name>lsa</name>
   </hide-group>
```

5. Add or update **<start-timeout>** parameter under <python-vm>.

```
<python-vm>
   <start-timeout>PT300S</start-timeout >
</python-vm >
```

Installing T-SDN FP Bundle on the Upper-Level Node

To install T-SDN FP Bundle on the upper-level node:

1. Be sure to have installed T-SDN FP Bundle on the lower-level node. This is because you must add the lower-level node devices as devices on the upper-level node, configure the lower-

level node, and sync it to the upper-level node. For more information, see **Installing T-SDN FP Bundle on the Lower-Level Nodes**.

2. Make sure to have performed the tasks mentioned in section **Modifying the NCS Configuration File on the Upper-Level Node**.
3. Log in to the host machine as a sudo user, who is also part of the ncsadmin user group.
4. Obtain and download the required **nso-<*version*>-tsdn-<*version*>.signed.bin** file from Cisco website and copy it to the upper-level node.
5. Extract the content of the bin file to the current directory. If the folder already exists, back up the existing folder.

   ```
   $ sh nso-<version>-tsdn-<version>.signed.bin
   ```

   This verifies the authenticity of the product. However, if you encounter any network connectivity issues, run the following command to skip this verification.

   ```
   $ sh nso-<version>-tsdn-<version>.signed.bin --skip-verification
   ```

6. Untar the installer tar.gz file to the current directory to extract the T-SDN FP Bundle packages. If the folder already exists, be sure to create a backup of the existing folder.

   ```
   $tar -xf nso-<version>-tsdn-<version>.tar.gz
   ```

7. Go to the upper-level node packages directory and change the current directory as follows:

   ```
   $ cd nso-<version>-tsdn-<version>/tsdn-lsa/tsdn-lsa-cfs/core-fp-packages
   ```

8. Copy the T-SDN FP Bundle packages to the **/opt/ncs/packages/** directory and create symbolic links from **/var/opt/ncs/packages**.

   ```
   sudo cp ncs-<version>-lsa-utils-ned-<version>.tar.gz /opt/ncs/packages/ncs-<version>-lsa-utils-ned-<version>.tar.gz
   sudo cp ncs-<version>-custom-template-utils-ned-<version>.tar.gz /opt/ncs/packages/ncs-<version>-custom-template-utils-ned-<version>.tar.gz
   sudo cp ncs-<version>-core-fp-common-ned-<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-common-ned-<version>.tar.gz
   sudo cp ncs-<version>-cisco-tsdn-core-fp-common-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-<version>.tar.gz
   sudo cp ncs-<version>-cisco-sr-te-cfp-internal-ned-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-ned-<version>.tar.gz
   sudo cp ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz
   sudo cp ncs-<version>-cisco-cs-sr-te-cfp-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-<version>.tar.gz
   sudo cp ncs-<version>-cisco-nso-nc-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-nso-nc-<version>.tar.gz
   sudo cp ncs-<version>-core-fp-common-<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
   ```

```
sudo cp ncs-<version>-lsa-utils-<version>.tar.gz /opt/ncs/packages/ncs-
<version>-lsa-utils-<version>.tar.gz
sudo cp ncs-<version>-custom-template-utils-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-custom-template-utils-<version>.tar.gz
sudo cp ncs-<version>-core-fp-plan-notif-generator-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-<version>.tar.gz
sudo cp ncs-<version>-resource-manager-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz
sudo cp ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz /opt/ncs/packages/ncs-
<version>-ietf-l3vpn-nm-<version>.tar.gz

sudo ln -s /opt/ncs/packages/ncs-<version>-lsa-utils-ned-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-lsa-utils-ned-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-custom-template-utils-ned-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-custom-template-utils-
ned-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-common-ned-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-common-ned-
<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-
common-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-ned-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-
internal-ned-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-
<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-nso-nc-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-nso-nc-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-
generator-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz
```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
```

9. Go to the example-packages directory.

```
$ cd nso-<version>-tsdn-<version>/tsdn-lsa/tsdn-lsa-cfs/example-packages
```

10. Copy the packages for the required example function packs to the **/opt/ncs/packages/** directory and create symbolic links from **/var/opt/ncs/packages**.

```
sudo cp ncs-<version>-ietf-te-fp-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-<version>.tar.gz
```

```
sudo cp ncs-<version>-ietf-l2vpn-nm-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-<version>.tar.gz
```

```
sudo cp ncs-<version>-cisco-aa-service-assurance-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-EXAMPLE-
<version>.tar.gz
```

```
sudo cp ncs-<version>-cisco-rsvp-te-fp-internal-ned-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-internal-ned-EXAMPLE-
<version>.tar.gz
```

```
sudo cp ncs-<version>-cisco-flat-L3vpn-fp-internal-ned-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-ned-
<version>.tar.gz
```

```
sudo cp ncs-<version>-cisco-flat-L2vpn-fp-internal-ned-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-
internal-ned-EXAMPLE-<version>.tar.gz
```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-
<version>.tar.gz
```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
<version>.tar.gz
```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-
EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-aa-
service-assurance-EXAMPLE-<version>.tar.gz
```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-internal-ned-
EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-rsvp-te-
fp-internal-ned-EXAMPLE-<version>.tar.gz
```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-ned-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-
internal-ned-<version>.tar.gz
```

```
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-ned-
EXAMPLE-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-
L2vpn-fp-internal-ned-EXAMPLE-<version>.tar.gz
```

11. Restart NSO with package-reload.

```
$ sudo /etc/init.d/ncs restart-with-package-reload
```

T-SDN FP Bundle is now installed on the upper-level node.

Performing Post Installation Tasks on the Upper-Level Node

Do the following:

1. Load the following bootstrap data. Make sure the LSA cluster is up and the Netconf notifications is running.

```
cd nso-<version>-tsdn-<version>/tsdn-lsa/tsdn-lsa-cfs/bootstrap-data
ncs_cli -u <user>
configure
unhide tsdn
load merge IETF-L2NM-AA-notification-settings.xml
load merge IETF-L3NM-AA-notification-settings.xml
commit

unhide debug
load merge CS-SR-status-codes.xml
load merge SR-status-codes.xml
load merge RSVP-TE-status-codes.xml
load merge L3VPN-status-codes.xml
load merge L2VPN-status-codes.xml
load merge IETF-TE-status-codes.xml
load merge IETF-L3NM-status-codes.xml
load merge IETF-L2NM-status-codes.xml
commit

load merge CS-SR-internal-plan-kicker.xml
load merge SR-cfp-configuration-kicker.xml
load merge IETF-TE-cfp-configuration-kicker.xml
load merge IETF-L2NM-cfp-configuration-kicker.xml
load merge IETF-L2NM-route-policy-kicker.xml
load merge IETF-L3NM-cfp-configuration-kicker.xml
load merge IETF-L3NM-route-policy-kicker.xml
load merge cfs-dispatch-map-settings.xml
load merge cfs-netconf-notification-kicker.xml
commit

load merge CS-SR-plan-notification-settings.xml
load merge SR-plan-notification-settings.xml
load merge IETF-TE-plan-notification-settings.xml
```

```
load merge IETF-L3NM-plan-notification-settings.xml
load merge IETF-L2NM-plan-notification-settings.xml
commit

load merge SR-multi-vendor-iosxe-cli.xml
load merge IETF-TE-multi-vendor-iosxe-cli.xml
load merge IETF-L2NM-multi-vendor-iosxe-cli.xml
load merge IETF-L3NM-multi-vendor-iosxe-cli.xml
commit

load merge commit-queue-settings.xml
load merge IETF-L3NM-resource-pools.xml
load merge xr-color-resource-pool.xml
load merge xr-bidirectional-association-id-resource-pool.xml
load merge xr-disjoint-group-id-resource-pool.xml
load merge xr-sman-id-resource-pool.xml
commit
```

2. Set NACM rules. In the following example, the ncs-admin user ID is admin.

```
% set nacm groups group ncsadmin user-name admin
% commit
Commit complete.
```

3. Configure the local **ncsadmin** user as a **cfp-local-user** for the CFP to identify the user to push the configurations.

```
% configure
% set cfp-local-user admin
% commit
```

4. Configure the authgroups for the lower-level nodes. Provide the password for the user when prompted.

```
% configure
admin@ncs% set devices authgroups group cnc-rfs-auth default-map remote-name
admin remote-password
(<AES256 encrypted string>): *********
[ok]
admin@ncs% commit
Commit complete.
```

5. Onboard the lower-level node as a device to the upper-level node device tree.

```
% configure
```

```
set devices device rfs-1 address 10.10.10.10 port 2022 authgroup cnc-rfs-auth
out-of-sync-commit-behaviour accept
set devices device rfs-1 device-type netconf ned-id cisco-nso-nc-5.7
set devices device rfs-1 use-lsa
set devices device rfs-1 state admin-state unlocked
set devices device rfs-1 connect-timeout 300 read-timeout 300 write-timeout
300 connect-retries attempts 2 timeout 300
admin@ncs% commit
Commit complete
```

6. Run the following command to ensure receive notification setting.

```
set devices device rfs-1 netconf-notifications received-notifications max-
size 500000
admin@ncs% commit
Commit complete
```

Note: The timestamp on both the RFS node and the CFS node must be the same. It is recommended to use the same NTP server for time synchronization.

7. Configure the Netconf notification subscription for each lower-level node. You must append the lower-level node name for all notification streams. In the following example, the user admin is the local user, who is a part of the ncsadmin group.

```
set devices device rfs-1 netconf-notifications subscription rfs-cisco-custom-
template-events stream custom-template-events local-user admin store-in-cdb
true
set devices device rfs-1 netconf-notifications subscription rfs-dispatch-map-
update stream dispatch-map-update local-user admin store-in-cdb true
set devices device rfs-1 netconf-notifications subscription rfs-kicker-events
stream kicker-events local-user admin store-in-cdb false
```

Note: Ignore any notification alarms you may receive. The following steps help to resolve the issue.

8. Configure cluster. Be sure to use the same authgroup name that you used while onboarding the lower-level node. Provide the IP address and the port number of the lower-level node. The lower-level node device names must be unique. Cluster fetch ssh host keys is also essential for the cluster to form and for its status to be up.

```
set cluster remote-node rfs-1 address 10.10.10.10 port 2022 authgroup cnc-
rfs-auth username cisco

set cluster authgroup cnc-rfs-auth default-map remote-name abc remote-
password xyz
set cluster device-notifications disabled
set cluster commit-queue enabled
set cluster global-settings timeouts connect-timeout 300
```

```
commit

admin@ncs% request cluster remote-node rfs-1 ssh fetch-host-keys
result updated
fingerprint {
    algorithm ssh-ed25519
    value 83:a0:c2:62:85:dd:ee:bd:12:4f:a1:23:ae:47:d7:ca
}

admin@ncs% run show cluster
RECEIVED
NAME  NAME                 STATUS  LAST EVENT                      NOTIFICATIONS
-------------------------------------------------------------------------------
rfs-1 device-notifications  up      0000-01-01T00:00:00-00:00        0
      ncs-events            up      2022-01-27T10:48:25.148393+00:00  630

REMOTE                                LOCAL  REMOTE
NODE    ADDRESS         PORT  CHANNELS  USER   USER    STATUS  TRACE
-----------------------------------------------------------------------
rfs-1   10.10.10.10     2022  -         cisco  abc   up      disabled
```

9. Sync-from the lower-level device node and verify the device tree.

```
admin@ncs% request devices fetch-ssh-host-keys
fetch-result {
    device rfs-1
    result updated
    fingerprint {
        algorithm ssh-ed25519
        value ed:7b:1c:e4:77:80:ab:68:3b:17:40:69:68:9e:56:8d
    }
}
[ok]

admin@ncs% request devices sync-from
sync-result {
    device rfs-1
    result true
}
[ok]
admin@ncs% run show devices list

NAME   ADDRESS         DESCRIPTION  NED ID            ADMIN STATE
-------------------------------------------------------------------
rfs-1  10.10.10.10       -            cisco-nso-nc-6.1  unlocked
```

```
[ok]
```

10. Sync the dispatch-map and verify if the onboarded devices on the RFS node can be seen from the CFS node.

```
% request devices lsa dispatch-map sync
success true
detail Dispatch Map Synced Successfully

% show device lsa dispatch-map
device rfs-1 {
    ned-id cisco-nso-nc-6.1:cisco-nso-nc-6.1;
}
```

11. Verify the Netconf notification subscription is running for the added lower-level node device. This shows the upper-level and the lower-level nodes are connected, and communication is up and running.

```
admin@ncs% run show devices device rfs-1 netconf-notifications subscription

                                                  FAILURE  ERROR
NAME                                   STATUS     REASON   INFO
-----------------------------------------------------------------
rfs-cisco-custom-template-events       running    -        -
rfs-dispatch-map-update                running    -        -
rfs-kicker-events                      running    -        -
```

Once the installation is complete, onboard the devices only from the lower-level node.

Verifying the Installation on the Upper-Level Node

Do the following:

1. Verify the packages are installed and their status is UP.

```
admin@ncs> show packages package oper-status | tab
```

2. Verify the package information.

```
admin@ncs> show packages package package-version | select build-info ncs version
| select build-info file | select build-info package sha1 | select oper-status
error-info | select oper-status up | tab
```

3. Verify the NACM rules.

```
% show nacm
read-default     deny;
write-default    deny;
exec-default     deny;
groups {
    group ncsadmin {
        user-name [ admin private ];
    }
    group ncsoper {
```

```
        user-name [ public ];
    }
}
...
```

4. Verify cfp-local-user.

```
% show cfp-local-user
  cfp-local-user admin;
```

5. Verify the lsa role is set for the upper-level node.

```
% show lsa role
role upper-layer;
```

Uninstalling T-SDN FP Bundle in the LSA Model

This chapter explains the uninstallation procedure for the NSO T-SDN FP Bundle. To uninstall the T-SDN FP Bundle, you must first uninstall the Bundle from the upper-level node and then from the lower-level node since the lower-level node is added as a device to the upper-level node device tree.

Uninstalling T-SDN FP Bundle removes the CFP and the associated packages from the system. Only a user who has sudo privileges and is part of ncsadmin user group can perform the uninstallation process.

You must delete all the related services, devices from NSO, and any day-1 packages before performing the uninstallation procedure. If a cluster has only one lower-level node, delete the cluster.

Note: Do not delete any common packages if you have installed other CFPs.

Uninstalling T-SDN FP Bundle from the Upper-Level Node

To uninstall T-SDN FP Bundle from the upper-level node:

1. Delete kicker notifications.

```
% unhide debug
% delete kickers notification-kicker remote-dispatch-map-update-notifications
% delete kickers notification-kicker rfs-custom-template-change-notification
% delete kickers notification-kicker tsdn-kicker-events-notifications
% commit
Commit complete.
```

2. Delete the cluster. If the cluster has only one lower-level node, delete the complete cluster.

```
% delete cluster remote-node rfs-1
% commit
Commit complete.
% delete cluster authgroup cluster-rfs-auth
```

```
% delete cluster device-notifications enabled
% commit
Commit complete.
```

3. Remove lower-node devices from the upper-level node device tree.

```
% delete devices device rfs-1
% commit
Commit complete.
```

4. Stop NCS by using the `ncs --stop` command.
5. Restore the backup of the ncs.conf file that you created during installation. For more information, see **Modifying the NCS Configuration File on the Upper-Level Node**.
6. Unlink and remove the packages in the **/var/opt/ncs/packages** directory and delete the packages from the **/opt/ncs/packages/** directory.

```
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-
EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-aa-service-
assurance-EXAMPLE-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-EXAMPLE-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-resource-manager-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-resource-manager-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-core-fp-common-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-common-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz
```

```
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-
generator-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-nso-nc-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-nso-nc-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-
ned-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-flat-
L2vpn-fp-internal-ned-EXAMPLE-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-
ned-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-
internal-ned-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-internal-
ned-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-rsvp-te-
fp-internal-ned-EXAMPLE-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-lsa-utils-ned-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-lsa-utils-ned-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-custom-template-utils-ned-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-custom-template-utils-ned-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-core-fp-common-ned-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-common-ned-
<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-ned-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-
ned-<version>.tar.gz
```

7. Restart NSO with the package-reload option.

```
$ sudo /etc/init.d/ncs restart-with-package-reload
  Restarting ncs (via systemctl):
   [  OK  ]
```

T-SDN FP Bundle is now uninstalled from the upper-level node.

Uninstalling T-SDN FP Bundle from the Lower-Level Node

Delete all the related services. Perform the procedure described in this section for each lower-level node in the cluster.

To uninstall T-SDN FP Bundle from the lower-level node:

1. Delete devices from the lower-level node device tree.

```
% delete devices
% commit
```

```
Commit complete.
```

2. Stop NSO by using the `ncs --stop` command.
3. Restore the backup of the ncs.conf file that you created during installation. For more information, see **Modifying the NCS Configuration File on the Lower-Level Nodes**.
4. Unlink the packages from the **/var/opt/ncs/packages** directory and delete the packages from the **/opt/ncs/packages/** directory.

```
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-internal-EXAMPLE-<version>
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-flat-L3vpn-fp-internal-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-flat-l2vpn-multi-vendors-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-flat-l2vpn-multi-vendors-EXAMPLE-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-flat-l3vpn-multi-vendors-<version>.tar.gz /opt/ncs/packages/ncs-<version>-flat-l3vpn-multi-vendors-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-<version>.tar.gz /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-<version>.tar.gz /opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-custom-template-utils-<version>.tar.gz /opt/ncs/packages/ncs-<version>-custom-template-utils-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-<version>.tar.gz
```

```
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-
generator-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
sudo rm -rf /var/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-ios-<version>.tar.gz
```

5. Restart NSO with the package-reload option.

```
$ sudo /etc/init.d/ncs restart-with-package-reload
  Restarting ncs (via systemctl):
          [  OK  ]
```

Upgrading the NSO T-SDN FP Bundle CFP

This section includes information about how to upgrade the CFPs from version 4.x to version 5.0.0 in the Cisco NSO T-SDN FP Bundle. It is recommended to back up your environment before performing the upgrade.

Note: NSO must be up and running (on both the nodes in the LSA model) before beginning the upgrade procedure.

Before You Begin

Do the following before beginning the upgrade process. In the LSA model, perform these tasks on both the CFS and RFS nodes.

1. Obtain and place the **NSO 6.1.0 installer bin** file and the **nso-6.1.0-tsdn-5.0.0-signed.bin** file in **/home/user/** directory (replace user according to your setup).
2. Create a directory **upgrade-ned** under **/opt/ncs/packages**.
3. Copy the existing NED packages (the IOSXE CLI and other NEDs from any devices) from **/opt/ncs/packages** directory to the **/opt/ncs/packages/upgrade-ned** directory.
4. Back up the current NCS packages and the current **etc/ncs/ncs.conf** file. For more information on how to back up and restore, see the ***NSO Administration Guide***.

   Note: Make sure to copy the backup tar file outside the **/var/opt/ncs** directory to prevent any loss of data.

   ```
   $ mkdir /home/admin/ncsBackup
   $ cp /opt/ncs/packages/* /home/admin/ncsBackup/
   $ echo "Backup current NCS"
   $ sudo /opt/ncs/current/bin/ncs-backup --non-interactive
   ```

5. Remove the old status-codes.

   ```
   admin@ncs% unhide debug
   admin@ncs% delete status-code-cfp
   admin@ncs% delete status-codes
   admin@ncs% commit
   ```

Upgrading NSO T-SDN FP Bundle CFP on a Single NSO Instance

Perform the following tasks to upgrade the CFPs in T-SDN FP Bundle to v5.0.0.

Do the following:

1. Make sure to complete the tasks described in section **Before You Begin**.
2. Stop NSO.

   ```
   sudo /etc/init.d/ncs stop
   ```

3. Upgrade NSO to version 6.1.0 by performing system installation of NSO. For more information about how to upgrade NSO, see the ***NSO Installation Guide***.
4. Copy the configuration from **ncs.conf .install** file to the existing **etc/ncs/ncs.conf** file and edit the **ncs.conf** file to add/append configurations as described in section **Editing the NCS Configuration File on a Single NSO Instance**.
5. Remove the old packages in the **/opt/ncs/packages** directory.

   ```
   cd /opt/ncs/packages/
   sudo rm *.tar.gz
   ```

6. Remove the old symbolic links for the packages in **/var/opt/ncs/packages** directory.

   ```
   cd /var/opt/ncs/packages/
   sudo rm -f *
   ```

7. Change directory to **nso-6.1.0-tsdn-5.0.0**.
8. Extract the content of the T-SDN FP Bundle bin file to the current directory.

   ```
   $ sh nso-6.1.0-tsdn-5.0.0.signed.bin
   ```

   This verifies the authenticity of the product. However, if you encounter any network connectivity issues, run the following command to skip this verification.

   ```
   $ sh nso-6.1.0-tsdn-5.0.0.signed.bin --skip-verification
   ```

9. Untar the T-SDN FP Bundle **tar.gz** file to the current directory. If the folder already exists, be sure to create a backup of the existing folder.

   ```
   $ tar -xvf nso-6.1.0-TSDN-5.0.0.tar.gz
   ```

10. Copy the T-SDN FP Bundle 5.0.0 packages from the TSDN tar file to the **/var/opt/ncs/packages** directory.

    ```
    sudo cp *.tar.gz /opt/ncs/packages/
    ```

11. Recompile the NEDs in the **/opt/ncs/packages/upgrade-ned** directory (such as the IOSXE CLI NED and any other customized NEDs in any devices) with NSO v6.1.0.

    ```
    user$ ncs --version
    6.1
    user$ cd /var/opt/ncs/packages
    ```

```
user$ tar -xzf <OLD_NED_TARBALL>
user$ cd <OLD_NED_PACKAGE>/src
user$ make clean all
```

12. Copy the recompiled NEDs from **/opt/ncs/packages/upgrade-ned** directory to the **/var/opt/ncs/packages** directory. You may also contact your Cisco representative to obtain the recompiled NED packages you require.

    Note: Since the older NEDs are compiled with the prior installed version of NSO, the NEDs still display the old NED version at this stage.

13. Create soft links for all the packages.

```
cd /var/opt/ncs/packages
sudo ln -s /opt/ncs/packages/*.tar.gz
```

14. Set the **ignore-initial-validation** flag and restart ncs with the package-reload option as follows. If you do not set this flag, the upgrade process fails with errors.

    a. Add the ignore-initial-validation flag in the start ( ) function.

```
sudo vi /etc/init.d/ncs
…
…
start() {
        echo -n $"Starting $prog: "
        . $ncsdir/ncsrc
        NCS_CONFIG_DIR=${confdir}
        NCS_RUN_DIR=${rundir}
        NCS_LOG_DIR=${logdir}
        export NCS_CONFIG_DIR NCS_RUN_DIR NCS_LOG_DIR
        $ncs -cd ${rundir}  ${heart} ${conf}
        RETVAL=$?
        Echo
        # [ $RETVAL = 0 ] && touch /var/lock/subsys/ncs
        return $RETVAL
}
…
…
Change it to
…
…
start() {
        echo -n $"Starting $prog: "
        . $ncsdir/ncsrc
        NCS_CONFIG_DIR=${confdir}
        NCS_RUN_DIR=${rundir}
        NCS_LOG_DIR=${logdir}
        export NCS_CONFIG_DIR NCS_RUN_DIR NCS_LOG_DIR
        $ncs -cd ${rundir}  ${heart} ${conf} --ignore-initial-
validation
```

```
        RETVAL=$?
        Echo
        # [ $RETVAL = 0 ] && touch /var/lock/subsys/ncs
        return $RETVAL
}
…
…
```

b. Reload systemd.

```
sudo systemctl daemon-reload
```

c. Restart ncs with package-reload option.

```
sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs start
```

d. Once NSO has started up, revert the start ( ) function script to its original content to remove the **--ignore-initial-validation** flag.

15. Reload systemd.

```
sudo systemctl daemon-reload
```

16. Verify the status of the packages.

```
admin@ncs> show packages package oper-status
```

17. Migrate the IOSXR CLI NED and IOSXE CLI NED.

```
admin@ncs% request devices device <Device_name> migrate new-ned-id cisco-iosxr-cli-7.46 no-networking
admin@ncs% request devices device <Device_name> migrate new-ned-id cisco-ios-cli-6.86 no-networking
```

18. Sync dispatch map to update with new NED ID.

```
admin@ncs% request devices lsa dispatch-map sync
success true
detail Dispatch Map Synced Successfully
[ok]
```

19. Sync the device to pull the new NED capabilities. For example, the IOSXE CLI NED 6.86 may have new capabilities over the IOSXE CLI NED 6.7. These new capabilities may introduce new NSO device configuration from Day0 device configuration. Therefore, you must pull the new changes to bring the device back in-sync with NSO.

Note: When syncing the device configuration northbound to NSO, verify the new configuration is a Day0 configuration only with a dry-run.

```
admin@ncs% request devices device XECLI-0 sync-from dry-run
cli  config {
          interface {
              GigabitEthernet 1 {
                  ip {
```

```
                        dhcp {
                            client {
                                client-id {
+                                   ascii cisco-02bc.9833.b2f9-Gi1;
                                }
                            }
                        }
                    }
                }
            }
            router {
                isis-container {
                    isis 1 {
                        router-id {
+                           Loopback 0;
                        }
                    }
                }
            }
        }
```

```
admin@ncs% request devices sync-from device [ XECLI-0 XECLI-1 ]
sync-result {
    device XECLI-0
    result true
}
sync-result {
    device XECLI-1
    result true
}
```

20. Clean up the old NED packages for the migrated device and reload the packages to remove the old NEDs from NSO.

```
$ rm /var/opt/ncs/packages/ncs-6.1-cisco-ios-6.77.9.tar.gz
$ rm /var/opt/ncs/packages/ncs-6.1-cisco-iosxr-7.39.5.tar.gz
```

21. Force reload NSO to remove the old NED packages from the NSO running instance.

```
admin@ncs> request packages reload force
```

22. Configure the bootstrap data for the new version, plan-notifications, status-codes, and kickers. For more information, see **Performing Post Installation Tasks for SR-TE CFP-IOSXR CLI.**

23. Sync dispatch-map and verify the map is populated with the NED ID.

```
admin@ncs% request devices lsa dispatch-map sync
success true
detail Dispatch Map Synced Successfully
admin@ncs% show devices lsa dispatch-map
```

```
dispatch-map <Device_name> {
    ned-id cisco-ios-cli-6.86:cisco-ios-cli-6.86;
…
…
}
```

24. Verify the device configuration and backpointers are correct.

```
admin@ncs% show devices device <Device_name> config | display service-meta-
data
/* Refcount: 3 */
/* Backpointer: [ /cisco-sr-te-cfp-internal:sr-te/cisco-sr-te-cfp-sr-odn-
internal:odn/cisco-sr-te-cfp-sr-odn-internal:odn-template-plan[cisco-sr-te-
cfp-sr-odn-internal:name='SR-ODN-XR-CLI'][cisco-sr-te-cfp-sr-odn-
internal:head-end='PIOSXR-0']/cisco-sr-te-cfp-sr-odn-internal:plan/cisco-sr-
te-cfp-sr-odn-internal:component[cisco-sr-te-cfp-sr-odn-
internal:type='ncs:self'][cisco-sr-te-cfp-sr-odn-internal:name='self']/cisco-
sr-te-cfp-sr-odn-internal:state[cisco-sr-te-cfp-sr-odn-internal:name='cisco-
sr-te-cfp-sr-odn-nano-services:config-apply'] /cisco-sr-te-cfp-internal:sr-
te/cisco-sr-te-cfp-sr-policies-internal:policies/cisco-sr-te-cfp-sr-policies-
internal:policy-plan[cisco-sr-te-cfp-sr-policies-internal:name='SR-POLICY-XR-
CLI'][cisco-sr-te-cfp-sr-policies-internal:head-end='PIOSXR-0']/cisco-sr-te-
cfp-sr-policies-internal:plan/cisco-sr-te-cfp-sr-policies-
internal:component[cisco-sr-te-cfp-sr-policies-
internal:type='ncs:self'][cisco-sr-te-cfp-sr-policies-
internal:name='self']/cisco-sr-te-cfp-sr-policies-internal:state[cisco-sr-te-
cfp-sr-policies-internal:name='cisco-sr-te-cfp-sr-policies-nano-
services:config-apply'] ] */
segment-routing {
    global-block {
        lower-bound 16000;
        upper-bound 23999;
    }
```

25. Display and verify the external plans for the ODN service and the policy service are in the **reached** state.

```
admin@ncs% run show cisco-sr-te-cfp:sr-te odn odn-template-plan
<ODN_Service_Name> plan
admin@ncs% run show cisco-sr-te-cfp:sr-te policies policy-plan
<Policy_service_Name> plan
```

The Cisco NSO T-SDN FP Bundle upgrade is now complete.

Upgrading NSO T-SDN FP Bundle in the LSA Model

Perform the following tasks to upgrade the CFPs in T-SDN FP Bundle to v5.0.0 in the LSA model.

Do the following:

1. Make sure to complete the tasks described in section **Before You Begin** .
2. Stop NSO on both the CFS and RFS nodes.

   ```
   sudo /etc/init.d/ncs stop
   ```

3. Upgrade CFS node.

   a. Upgrade NSO to version 6.1.0 on the CFS node by performing a system installation of NSO. For more information about how to upgrade NSO, see the ***NSO Installation Guide***.

   b. Copy the configuration from **ncs.conf .install** file to the existing **etc/ncs/ncs.conf** file and edit the **ncs.conf** file to add/append the configuration as described in section **Modifying the NCS Configuration File on the Upper-Level Node**.

   c. Remove the old packages in the **/opt/ncs/packages** directory.

   ```
   cd /opt/ncs/packages/
   sudo rm *.tar.gz
   ```

   d. Remove the old symbolic links for the packages in **/var/opt/ncs/packages** directory.

   ```
   cd /var/opt/ncs/packages/
   sudo rm -f *
   ```

   e. Change directory to **nso-6.1.0-tsdn-5.0.0**.

   f. Extract the content of the T-SDN FP Bundle bin file to the current directory.

   ```
   $ sh nso-6.1.0-tsdn-5.0.0.signed.bin
   ```

   This verifies the authenticity of the product. However, if you encounter any network connectivity issues, run the following command to skip this verification.

   ```
   $ sh nso-6.1.0-tsdn-5.0.0.signed.bin --skip-verification
   ```

   g. Untar the T-SDN FP Bundle **tar.gz** file to the current directory. If the folder already exists, be sure to create a backup of the existing folder.

   ```
   $ tar -xvf nso-6.1.0-TSDN-5.0.0.tar.gz
   ```

   h. Copy the T-SDN FP Bundle 5.0.0 packages for the CFS node from the TSDN tar file to the **/var/opt/ncs/packages** directory.

   ```
   sudo cp *.tar.gz /opt/ncs/packages/
   ```

   i. Recompile the NEDs in the **/opt/ncs/packages/upgrade-ned** directory (such as the IOSXE CLI NED and any other customized NEDs in any devices) with NSO v6.1.0.

   ```
   user$ ncs --version
   ```

```
6.1
user$ cd /var/opt/ncs/packages
user$ tar -xzf <OLD_NED_TARBALL>
user$ cd <OLD_NED_PACKAGE>/src
user$ make clean all
```

j. Copy the new NSO pre-compiled Netconf NED from the NSO root directory to the **/var/opt/ncs/packages** directory.

```
user$ cp -r <NSO_6.1_ROOT>/packages/lsa/cisco-nso-nc-5.7
/var/opt/ncs/packages
```

4. Upgrade RFS node.

a. Upgrade NSO to version 6.1.0 on the RFS node by performing a system installation of NSO. For more information about how to upgrade NSO, see the ***NSO Installation Guide***.

b. Copy the configuration from **ncs.conf .install** file to the existing **etc/ncs/ncs.conf** file and edit the **ncs.conf** file to add/append the configuration as described in section **Modifying the NCS Configuration File on the Lower-Level Nodes**.

c. Remove the old packages in the **/opt/ncs/packages** directory.

```
cd /opt/ncs/packages/
sudo rm *.tar.gz
```

d. Remove the old symbolic links for the packages in **/var/opt/ncs/packages** directory.

```
cd /var/opt/ncs/packages/
sudo rm -f *
```

e. Change directory to **nso-6.1.0-tsdn-5.0.0**.

f. Extract the content of the T-SDN FP Bundle bin file to the current directory.

```
$ sh nso-6.1.0-tsdn-5.0.0.signed.bin
```

This verifies the authenticity of the product. However, if you encounter any network connectivity issues, run the following command to skip this verification.

```
$ sh nso-6.1.0-tsdn-5.0.0.signed.bin --skip-verification
```

g. Untar the T-SDN FP Bundle **tar.gz** file to the current directory. If the folder already exists, be sure to create a backup of the existing folder.

```
$ tar -xvf nso-6.1.0-TSDN-5.0.0.tar.gz
```

h. Copy the T-SDN FP Bundle 5.0.0 packages for the RFS node from the TSDN tar file to the **/var/opt/ncs/packages** directory.

```
sudo cp *.tar.gz /opt/ncs/packages/
```

i. Recompile the NEDs in the **/opt/ncs/packages/upgrade-ned** directory (such as the IOSXE CLI NED and any other customized NEDs in any devices) with NSO v6.1.0.

```
user$ ncs --version
6.1
user$ cd /var/opt/ncs/packages
user$ tar -xzf <OLD_NED_TARBALL>
user$ cd <OLD_NED_PACKAGE>/src
user$ make clean all
```

j. Copy the new NSO pre-compiled Netconf NED from the NSO root directory to the **/var/opt/ncs/packages** directory.

```
user$ cp -r <NSO_6.1_ROOT>/packages/lsa/cisco-nso-nc-5.7
/var/opt/ncs/packages
```

5. Create soft links for all the packages.

```
cd /var/opt/ncs/packages
sudo ln -s /opt/ncs/packages/*.tar.gz
```

6. Set the **ignore-initial-validation** flag. If you do not set this flag, the upgrade process fails with errors.

   a. Add the ignore-initial-validation flag in the start ( ) function.

```
sudo vi /etc/init.d/ncs
…
…
start() {
        echo -n $"Starting $prog: "
        . $ncsdir/ncsrc
        NCS_CONFIG_DIR=${confdir}
        NCS_RUN_DIR=${rundir}
        NCS_LOG_DIR=${logdir}
        export NCS_CONFIG_DIR NCS_RUN_DIR NCS_LOG_DIR
        $ncs -cd ${rundir}  ${heart} ${conf}
        RETVAL=$?
        Echo
        # [ $RETVAL = 0 ] && touch /var/lock/subsys/ncs
        return $RETVAL
}
…
…
Change it to
…
…
start() {
        echo -n $"Starting $prog: "
        . $ncsdir/ncsrc
        NCS_CONFIG_DIR=${confdir}
        NCS_RUN_DIR=${rundir}
```

```
            NCS_LOG_DIR=${logdir}
            export NCS_CONFIG_DIR NCS_RUN_DIR NCS_LOG_DIR
            $ncs -cd ${rundir}  ${heart} ${conf} -ignore-initial-validation
            RETVAL=$?
            Echo
            # [ $RETVAL = 0 ] && touch /var/lock/subsys/ncs
            return $RETVAL
    }
    …
    …
```

b. Reload systemd.

```
sudo systemctl daemon-reload
```

c. Restart ncs with package-reload option on both the CFS node and the RFS node.

```
sudo NCS_RELOAD_PACKAGES=force /etc/init.d/ncs start
```

d. Once NSO has started up, revert the start ( ) function script to its original content.

7. Reload systemd.

```
sudo systemctl daemon-reload
```

8. Verify the status of the packages.

```
admin@ncs> show packages package oper-status
```

9. (*On CFS only*) Update SSH host keys.

```
user@ncs% request devices fetch-ssh-host-keys
```

10. Migrate NEDs first on the CFS node and then on the RFS node.

```
user@ncs% request devices device rfs-node-1 migrate new-ned-id cisco-nso-nc-
6.1 no-networking
user@ncs% request devices device PIOSXR-0 migrate new-ned-id cisco-iosxr-cli-
7.46 no-networking
```

11. Sync the device to pull the new NED capabilities. For example, the IOSXE CLI NED 6.86 may have new capabilities over the IOSXE CLI NED 6.77. These new capabilities may introduce new NSO device configuration from Day0 device configuration. Therefore, you must pull the new changes to bring the device back in-sync with NSO.

    Note: When syncing the device configuration northbound to NSO, verify the new configuration is a Day0 configuration only with a dry-run.

```
user@ncs% request devices device <XR-device> sync-from dry-run
cli  config {
          call-home {
              profile CiscoTAC-1 {
                  destination {
                      transport-method {
```

```
                        email-disable {
                            email {
     +                          disable;
                            }
                        }
                    }
                }
            }
        }
    }

user@ncs> request devices device <XE-device> sync-from dry-run
cli config {
          service {
              conf {
     +            pad false;
              }
          }
      }

user@ncs% request devices sync-from device [ <XR-device> <XE-device> ]
sync-result {
    device <XR-device>
    result true
}
sync-result {
    device <XE-device>
    result true      }
```

12. Clean up the old NED packages for the migrated device and reload the packages to remove the old NEDs from NSO.

```
$ rm /var/opt/ncs/packages/ncs-6.1-cisco-ios-cli-6.77.9.tar.gz
$ rm /var/opt/ncs/packages/ncs-6.1-cisco-iosxr-cli-7.39.5.tar.gz
```

13. Configure the bootstrap data for the new version, plan-notifications, status-codes, and kickers as described in section **Performing Post Installation Tasks for SR-TE CFP-IOSXR CLI.**

14. (*On CFS only*) Sync dispatch-map and verify the map is populated with the NED ID. When syncing the dispatch map, provide the RFS node for the sync to update the dispatch map.

```
admin@ncs% request devices lsa dispatch-map sync remote-nso <rfs_node>
success true
```

```
detail Dispatch Map Synced Successfully
```

15. Perform a service redeploy reconciliation from the CFS node to reconcile the RFS service configuration. This is because the RFS service configuration may sometimes lose its backpointers to the CFS service. A service redeploy reconciliation fixes this issue.

```
user@ncs% request sr-te odn odn-template <Service> re-deploy reconcile
```

Upgrading NSO T-SDN FP Bundle in the LSA High Availability Model

Perform the following tasks to upgrade the CFPs in T-SDN FP Bundle to v5.0.0 in the LSA HA model.

Do the following on the primary nodes, unless specified as secondary:

1. Make sure to complete the tasks described in section **Before You Begin** .
2. Disable and shutdown the secondary HA nodes for both the CFS and RFS nodes.

   Note: You must restore the secondary HA nodes after upgrading the primary HA nodes.

   ```
   user@ncs> request high-availability disable
   result NSO Built-in HA disabled
   ```

   A message indicating a lost connection to slave is displayed. Ignore this message as this connection is re-established at the end of the upgrade procedure.

3. Remove the high-availability nominal role on both CFS and RFS nodes as this has backward incompatible changes in NSO 6.x.

   ```
   user@ncs% set high-availability settings enable-failover false
   user@ncs% delete high-availability ha-node <PRIMARY_HA_NODE> nominal-role.
   user@ncs% delete high-availability ha-node <SECONDARY_HA_NODE> nominal-role
   user@ncs% commit
   ```

4. Stop NSO on both the CFS and RFS nodes.

   ```
   sudo /etc/init.d/ncs stop
   ```

5. Perform the tasks described in section **Upgrading NSO T-SDN FP Bundle in the LSA Model** to upgrade the CFS node and RFS nodes.
6. Reconfigure nominal-role on both the CFS and RFS nodes.

   ```
   user@ncs% set high-availability ha-node <PRIMARY_HA_NODE> nominal-role
   primary
   user@ncs% set high-availability ha-node <SECONDARY_HA_NODE> nominal-role
   secondary
   user@ncs% commit
   ```

7. Back up both the primary CFS and RFS nodes. Use these backup to replicate the secondary CFS and RFS nodes respectively.

```
user$ sudo /opt/ncs/current/bin/ncs-backup
INFO  Backup /var/opt/ncs/backups/<version>.backup.gz created successfully
```

8. Verify the high-availability status on the primary nodes.

```
user@ncs% run show high-availability
high-availability enabled
high-availability status mode primary
high-availability status current-id <PRIMARY_HA_NODE>
high-availability status assigned-role primary
high-availability status read-only-mode false
ID                ADDRESS
------------------------------------
<SECONDARY_HA_NODE_ID> <IP_ADDRESS>
```

9. On the secondary node, do the following:

   a. Upgrade NSO on both the CFS and RFS nodes by performing a system installation of NSO. For more information on how to upgrade NSO, see the ***NSO documentation***.

   b. Export the primary HA nodes backup file from the primary CFS and RFS nodes into the /var/opt/ncs/backups/ directories on secondary CFS and RFS nodes respectively.

```
user$ sudo /opt/ncs/current/bin/ncs-backup --restore <backup.gz>
Restore /etc/ncs from the backup (y/n)? y
Restore /var/opt/ncs from the backup (y/n)? y
INFO  Restore completed successfully
```

   c. Restart NSO on both the secondary CFS and RFS nodes.

```
user$ sudo /etc/init.d/ncs restart-with-package-reload
Stopping ncs: Starting ncs: .
```

   d. Verify the high-availability status on the secondary nodes.

```
user$ ncs_cli
user@ncs> show high-availability
high-availability enabled
high-availability status mode secondary
high-availability status current-id <SECONDARY_HA_NODE>
high-availability status assigned-role secondary
high-availability status be-secondary-result initialized
high-availability status primary-id <PRIMARY_HA_NODE>
high-availability status read-only-mode false
```

Appendix A: Changing Python Startup Command Configuration

Use the information in this section only if you are unable to change the default Python to Python 3. Change the Python startup command configuration after extracting the T-SDN FP Bundle packages during the T-SDN FP Bundle installation. For more information on how to extract the T-SDN FP Bundle packages, see installation instructions in this documentation.

To change the Python startup command configuration:

1. Navigate to the extracted TSDN package directory.

   ```
   $ cd nso-<version>-tsdn-<version>
   ```

2. Copy the **start-vm** file.

   ```
   $ mkdir -p /opt/cisco/nso/tsdn
   $ cp init_data/scripts/ncs-start-python-vm-tsdn /opt/cisco/nso/tsdn/ncs-start-python-vm-tsdn
   ```

3. Configure the **<start-command>** in **/etc/ncs/ncs.conf** file as follows:

   ```
   </java-vm>
   <python-vm>
    <start-command>/opt/cisco/nso/tsdn/ncs-start-python-vm- tsdn</start-command>
    <run-in-terminal>
        <terminal-command>DEFAULT</terminal-command>
    </run-in-terminal>
    <logging>
        <log-file-prefix>${NCS_LOG_DIR}/ncs-python-vm</log-file-prefix>
    </logging>
   </python-vm>
   ```

   Note: If you make any changes to the ncs.conf file, restart ncs to apply the changes.

Appendix B: Passing the commit-queue async Flag

The **async** flag is an API constraint used in commit-queue. Set the **async** flag to commit a Create, Read, Update, Delete (CRUD) operation through commit-queue.

The following commands show how to set the **async** flag in different APIs.

NSO CLI

```
admin@ncs% load merge payload/IETF-TE.xml
[ok]
[edit]
admin@ncs% commit commit-queue async
commit-queue {
    id 1616809621834
    status async
}
Commit complete.
[ok]
```

JSON-RPC

JSON-RPC commit invocation with commit-queue async flag. For more information, see the ***NSO WebUI*** documentation.

```
{"jsonrpc":"2.0","id":497,"method":"validate_commit","params":{"th":3,"flags":[
"commit-queue=async"]}}
{jsonrpc: "2.0", id: 86, method: "commit", params: {th: 3, flags: ["commit-
queue=async"]}}
```

RESTCONF

With RESTCONF, the POST, PUT and DELETE calls can be sent with an additional parameter for commit-queue async. There is no change to GET calls.

```
http://<NSO-IP>:8080/restconf/data/sr-te?async-commit-queue=true
```

Python

Python API commit invocation with commit-queue async flag.

```
with ncs.maapi.single_write_trans(uinfo.username, "system", db=ncs.RUNNING) as
trans:
            root = ncs.maagic.get_root(trans)
            root.ncs__devices.device[input.device].config.asa__banner.login =
input.message
            commit_params = ncs.maapi.CommitParams()
            commit_params.commit_queue_async()
            res = trans.apply_params(False, commit_params)
```