Cisco NSO T-SDN Function Pack Bundle

Installation Guide

Version 7.0

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Preface

Abstract

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

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 the **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 time. System installation is used to install 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 Core Function Packs and the Example Function Packs.

The Core Function Packs are productized and supported implementation of Cisco SR-ODN, Cisco SR-Policy, Circuit-style policy services, IETF-L2VPN-NM, and IETF-L3VPN-NM services.

The services in the Example Function Packs are 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. This documentation discusses each installation method.

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**.

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 different flavors, see **Installing Example Function Packs on a Single NSO Instance**.

Installation Requirements

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

System Requirements

The following table outlines the hardware requirements, software requirements, and platform dependencies to install Cisco NSO T-SDN FP Bundle v7.0 on NSO v6.1.11.

Item	Requirement
Operating systems	NSO and T-SDN FP Bundle are available for all Linux distributions and are 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 v17 or higher Python v3.8 or higher
ulimit value for NSO	64000 (minimum)

Cisco NSO and Cisco NED Requirements

Software/Driver	Versions
Cisco NSO	6.1.11
IOS XR CLI NED (default)	7.46, 7.52
IOS XE CLI NED (for Multi-Vendor Extension Example)	6.86, 6.106

The IOS XR CLI NED is the default NED. The IOS XR CLI NED and the IOS XE CLI NED are packaged with the installation tar file.

Note: T-SDN FP Bundle v7.0.0 supports two versions of IOS XR CLI and IOS XE CLI NEDs.

- The IOS XR CLI v7.46 and IOS XE CLI v6.86 NEDs support only T-SDN FP Bundle v5.0.0 features.
- The IOS XR CLI v7.52 and IOS XE CLI v6.106, NEDS support all T-SDN Bundle v7.0 features.

You can choose to upgrade to IOS XR CLI v7.52 and IOS XE CLI v6.106, as required, to get ~~avail~~ the latest features. It is recommended to use the latest NED versions while onboarding new devices to NSO.

The following IOS XR NETCONF NEDs are downloadable from the Cisco website.

IOS XR Netconf NED (for Multi-Vendor Extension Example)	7.3.2, 7.4.2. 7.5.2, 7.6.2, 7.7.2, 7.8.2, 7.9.2, 7.10.2, 7.11.2, 24.1.2, 24.2.1

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

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

To prepare the NSO environment:

1. Obtain the NSO 6.1.11 installation bin file and follow the steps described in the ***NSO Installation Guide – System Installation Guide*** to install NSO.
2. Verify the NSO version.
   ```
   $ ncs --version
   6.1.11
   ```
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 17 or higher is installed.
   ```
   $ java --version
   openjdk 17
   ```
5. Ensure that you have the **sudo** user privileges to perform the CFP installation. You must also be part of the **ncsadmin** group.
   ```
   $ groups
   cisco wheel ncsadmin
   ```
6. Network Time Protocol (NTP) is recommended, and it is required on LSA installations.
7. Add the ulimit level value for NSO in **/etc/init.d/ncs**:
   ```
   ...
   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"
   ...
   ```

8. Add the ulimit values for the Linux operating system before the commented line “#End of file” if it’s not already there. The following is an example.
   a. Check **/etc/security/limits.conf** file
      ```
      $ grep hard /etc/security/limits.conf
      $ grep soft /etc/security/limits.conf
      ```
   b. If not configured, edit the **/etc/security/limits.conf** file and add the following lines:
      ```
      * soft nproc 65535
      * hard nproc 65535
      * soft nofile 65535
      * hard nofile 65535
      * soft memlock 65535
      * hard 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.

9. Verify the ulimit values for the Linux operating system are applied.
   ```
   $ 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) 65535
   virtual memory          (kbytes, -v) unlimited
   file locks                      (-x) unlimited
   ```

10. Set the timeout value for the ncs services, if required. The default timeout value for the ncs services is 300 seconds. The service startup time ~~is depending~~ depends on system load, performance, number, and type of installed NSO packages. We have observed in testing that it can take up to 30 minutes.
    ```
    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
    ```

11. Verify the timeout value is set.
    ```
    sudo systemctl show ncs | grep ^Timeout

    Example on Ubuntu:
    $ sudo systemctl show ncs | grep ^Timeout
    ```

```
TimeoutStartUSec=30min
TimeoutStopUSec=5min
TimeoutAbortUSec=5min
TimeoutStartFailureMode=terminate
TimeoutStopFailureMode=terminate
TimeoutCleanUSec=infinity
```

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.

Installing on a Single NSO Instance

This section discusses the packages required and the installation procedure to install T-SDN FP Bundle and the Example function packs on a single NSO instance.

Package Categories and Packages on a Single NSO Instance

This section discusses the required package categories, and the associated packages. The following tables show the packages in the Core Function Pack category and the Example Packages category.

IOS XR CLI NED is the default NED and is packaged with the installation tar file. IOS XR NETCONF NEDs are downloadable from the Cisco website.

IOS XE CLI NED is the only NED required for IOS-XE type devices and is packaged with the installation tar file. IOS XR NETCONF NEDs are downloadable from the Cisco website.

Core Function Pack packages are required to install SR-TE CFP. Example packages comprise the packages for the Example function packs you choose to install and can be extracted either during or after SR-TE CFP-IOSXR CLI installation.

Note: The Circuit-Style-Segment Routing-Traffic Engineering-Core Function Pack (**cs-sr-te-cfp)** package in SR-TE CFP-IOSXR CLI is supported only on IOS XR CLI 7.46 NED, IOS XR CLI 7.52, IOS XR NC 7.8 (or later) NED.

Core Function Pack	
Package Category	**Packages**
T-SDN FP Bundle packages	ncs-6.1.11-cisco-sr-te-cfp-7.0.0.tar.gz ncs-6.1.11-cisco-sr-te-cfp-internal-7.0.0.tar.gz ncs-6.1.11-cisco-cs-sr-te-cfp-7.0.0.tar.gz
T-SDN FP Bundle L2NM packages	ncs-6.1.11-cisco-L2vpn-fp-internal-7.0.0.tar.gz ncs-6.1.11-ietf-l2vpn-nm-7.0.0.tar.gz
T-SDN FP Bundle L3NM packages	ncs-6.1.11-cisco-L3vpn-fp-internal-7.0.0.tar.gz ncs-6.1.11-ietf-l3vpn-nm-7.0.0.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-6.1.11-cisco-tsdn-core-fp-common-7.0.0.tar.gz

	ncs-6.1.8-resource-manager-4.2.5.tar.gz ncs-6.1-core-fp-delete-tag-service-1.0.6.tar.gz ncs-6.1.3-cisco-cfp-jwt-auth-1.0.0.tar.gz (RBAC PAM package) ncs-6.1.6-phased-provisioning-1.1.0.tar.gz
T-SDN FP Bundle Multi-Vendor for IOS XE	ncs-6.1.11-sr-te-multi-vendors-7.0.0.tar.gz ncs-6.1.11-l2vpn-multi-vendors-7.0.0.tar.gz ncs-6.1.11-l3vpn-multi-vendors-7.0.0.tar.gz ncs-6.1.11-rsvp-te-multi-vendors-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-pm-multi-vendors-EXAMPLE-7.0.0.tar.gz
CNC specific packages	ncs-6.1.11-dlm-svc-7.0.0.tar.gz ncs-6.1.11-cw-device-auth-7.0.0.tar.gz ncs-6.1.11-cisco-tm-tc-fp-7.0.0.tar.gz
NEDs	**IOS XR CLI NED:** ncs-6.1.4-cisco-iosxr-7.52.2.tar.gz ncs-6.0.3-cisco-iosxr-7.46.3.tar.gz **IOS XE CLI NED:** ncs-6.1.5-cisco-ios-6.106.9.tar.gz ncs-6.1-cisco-ios-6.86.6.tar.gz

Example Packages	
Package Category	**Package Name**
Automated Assurance Example package for L2NM, L3NM	ncs-6.1.11-cisco-aa-service-assurance-7.0.0.tar.gz
IETF Network Slice Service Example package	ncs-6.1.11-ietf-network-slice-service-EXAMPLE-7.0.0.tar.gz
IETF-TE Example package with IOS XR CLI NED	ncs-6.1.11-ietf-te-fp-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-cisco-rsvp-te-fp-EXAMPLE-7.0.0.tar.gz
Performance Measurement Example package	ncs-6.1.11-cisco-pm-fp-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-cisco-pm-fp-internal-EXAMPLE-7.0.0.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>${NCS_RUN_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>${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 as follows.

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

5. The SSH port configuration is optional for CLI, Web UI, 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>${North_Bound_CLI_SSH_Port}</port>
          <extra-listen>
         <ip>::</ip>
         <port>${North_Bound_CLI_SSH_Port}</port>
       </extra-listen>
  </ssh>
```

Web UI

Enable Web UI 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. (*RBAC PAM installation only*) Set **<package-authentication>** to true under **<aaa>** to use the RBAC PAM feature.

```
<aaa>
   <package-authentication>
     <enabled>true</enabled>
     <packages>
       <package>cisco-cfp-jwt-auth</package>
     </packages>
   </package-authentication>
 </aaa>
```

7. 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-IOS XR 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 (such as SR-TE CFP-IOS XR 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 IOS XR CLI 7.46/7.52 NED and IOS XR NC 7.8 (and later) NED.

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

For information on how to install the Core Function Packs using NETCONF NED, see **Appendix C: Using NETCONF NED in T-SDN FP Bundle**.

Installing SR-TE CFP

Use the information in this section to install SR-TE CFP with IOS XR CLI NED and IOS XE CLI NED. SR-TE CFP with IOS XR CLI NED installation is the base for all other installation flavors. You must install SR-TE CFP-IOSXR CLI first and then install SR-TE CFP IOSXE CLI.

Note: **cs-sr-te-cfp** is not supported by IOS XE CLI.

Do the following to install SR-TE CFP:

Steps 1 to 8 describe the SR-TE CFP – IOSXR CLI installation procedure. If it is already installed, skip to **Step 9** for the SR-TE CFP-IOSXE CLI installation procedure.

1. Ensure that you 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 **tsdn-<*version*>-nso-<*version*>.signed.bin** package from the Cisco website and copy it to the host server.

   For example, obtain and download the **tsdn-7.0.0-nso-6.1.10.signed.bin** package from the Cisco website and copy it to the host server.
4. Extract the content of the bin file to the current directory:

   ```
   $ sh tsdn-<version>-nso-<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 tsdn-<version>-nso-<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, create a backup of the existing folder.

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

   ```
   $ cd tsdn-<version>-nso-<version>/standalone/packages
   ```
7. Copy and link the following packages to install SR-TE CFP-IOSXR CLI. The remaining packages are intended for various installation options.

   ```
   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

sudo cp 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>-lsa-utils-<version>.tar.gz

sudo cp ncs-<version>-phased-provisioning-<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-phased-provisioning-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-phased-provisioning-
<version>.tar.gz

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

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

8. (*Optional*) If the ncs services fail after the default timeout of 300 seconds, change the default timeout for the ncs services.

```
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. To install SR-TE CFP-IOS XE CLI, continue with Step 10, or ~~else~~ skip to Step 13 to complete the SR-TE CFP IOSXR CLI installation.

   Note: Ensure that you have completed Steps 1-8 (SR-TE CFP-IOSXR CLI installation) before installing SR-TE CFP-IOSXE CLI.

10. Obtain and load the required IOS XE CLI NEDs into NCS. For more information, see **Cisco NSO and Cisco NED Requirements**.

11. Navigate to the directory where the packages are located.

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

12. Copy and link the following packages to install SR-TE CFP-IOS XE 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
```

13. Restart NSO with package reload.

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

14. Verify that the installation is complete and the packages are up and running before performing the post installation tasks.

```
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
```

Performing Post Installation Tasks for SR-TE CFP

Do the following:

To perform the post installation tasks for SR-TE CFP – IOSXR CLI and SR-TE CFP – IOS XE CLI, change the current directory:

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

1. ~~Perform~~ Do the following post installation tasks for SR-TE CFP – IOSXR CLI installation. If you have already installed and performed the post installation tasks for SR-TE CFP-IOSXR CLI CFP, skip to Step 2 for the post installation tasks of SR-TE CFP – IOS XE CLI installation.
   a. 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
```

b. 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
```

c. 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 1_SR-cfp-configuration-kicker.xml
admin@ncs% load merge CS-SR-internal-plan-kicker.xml
admin@ncs% commit
```

d. 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
```

e. Configure the following common bootstrap data.

a. Commit the 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 ];
```

e. If you installed RBAC PAM, configure the bootstrap information for RBAC PAM:

```
set jwt-auth cnc-host <ip-address/FQDN>
set jwt-auth port 30603
set jwt-auth pem-key-path /home/cisco/cert.pem
commit
```

where cnc-host is the IP address of the Authentication Provider, port is the port number used for the Authentication Provider, and pem-key-path is the file path to the certificate file key used for authentication.

2. (*SR-TE CFP – IOS XE CLI only*) Load-merge the **2_SR-multi-vendor-iosxe-cli.xml** file to configure dynamic-mapping.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% load merge 2_SR-multi-vendor-iosxe-cli.xml
     admin@ncs% commit
```

Verifying the Post Installation Tasks for SR-TE CFP

Verify the post installation tasks you performed are correct.

Do the following:

1. Verify SR-TE CFP-IOSXR CLI installation as follows. If you have already verified SR-TE CFP-IOSXR CLI installation, skip to **Step 2** to verify SR-TE CFP-IOSXE CLI installation.
   a. 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;
```

b. Verify the status-codes configuration.

```
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]
```

c. Verify the plan-notifications configuration.

```
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 ];
}
```

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

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

e. 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 on 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-7.52:cisco-iosxr-cli-7.52;
        }
        dispatch-map PIOSXR-1 {
            ned-id cisco-iosxr-cli-7.52:cisco-iosxr-cli-7.52;
        }
```

f. 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]
```

2. (*SR-TE CFP-IOSXE CLI only*) Verify the dynamic-mapping for the IOS XE CLI NEDs installed.

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

Installing IETF-L2VPN-NM Services

L2VPN-NM (or L2NM) uses the standardized IETF version of L2VPN. This section discusses the procedure, and the packages required to install the L2NM service either on SR-TE CFP or as a standalone flavor, and the procedure to verify the same.

Note: To install L2VPN-NM-IOS XE CLI, you must first install L2VPN-NM-IOSXR CLI.

To install L2NM service on SR-TE CFP, make sure SR-TE CFP-IOSXR CLI is installed and then continue to perform the tasks mentioned in this topic. 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** and then continue to perform the tasks mentioned in this topic.

To install IETF-L2VPN-NM CFP:

1. Navigate to the directory where the packages are stored.

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

2. Do one of the following to install L2NM-IOSXR CLI. If L2NM-IOSXR CLI is already installed, skip to **Step 4** to install L2NM-IOS XE CLI.

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

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

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

(*Optional*) To install the AA feature, copy and link the AA package.

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

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

```
sudo cp ncs-<version>-ietf-l2vpn-nm-<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-<version>.tar.gz
sudo cp ncs-<version>-cisco-L2vpn-fp-internal-<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-L2vpn-fp-internal-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-L2vpn-fp-internal-
<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>-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>-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>-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 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>-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 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 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>-cisco-cfp-jwt-auth-<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-cfp-jwt-auth-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-cfp-jwt-auth-<version>.tar.gz
```

3. To install L2NM-IOS XE CLI service, continue with **Step 4**, ~~else~~ or skip to Step 5 to complete installing L2NM-IOSXR CLI service.

4. Copy and link the following packages to install L2NM-IOS XE CLI:

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

5. Restart NSO with package reload.

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

   The L2NM installation is now complete.

6. Verify that the installation is complete, and the packages are up and running before performing 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
```

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

Performing Post Installation Tasks for IETF-L2VPN-NM Service

Do the following after installing L2NM service:

1. Change the current directory to:

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

2. Do the following post installation tasks for L2NM-IOSXR CLI installation. If you have already installed and performed the post installation tasks for L2NM-IOSXR CLI, skip to **Step 3** to perform post installation tasks for L2NM-IOS XE CLI.

   a. 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
```

   b. 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
```

c. 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 1_IETF-L2NM-cfp-configuration-kicker.xml
admin@ncs% commit
admin@ncs% load merge IETF-L2NM-route-policy-kicker.xml
admin@ncs% commit
```

d. Load-merge the following xml files for interface mapping (skip if IETF-L3VPN-NM is already installed).

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge interface-mapping-xr-cli-7.46.xml
admin@ncs% load merge interface-mapping-xr-cli-7.52.xml
admin@ncs% commit
```

e. 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
```

e. Configure the SMAN ID resource pool for Y1731.

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

3. *L2NM-IOS XE CLI only*

a. 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 2_IETF-L2NM-multi-vendor-iosxe-cli.xml
admin@ncs% commit
```

b. Load-merge the following xml files for interface mapping (skip if IETF-L3VPN-NM is already installed).

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
```

```
admin@ncs% unhide debug
admin@ncs% load merge interface-mapping-xe-cli-6.106.xml
admin@ncs% load merge interface-mapping-xe-cli-6.86.xml
admin@ncs% commit
```

Verifying the Post Installation Tasks for L2NM Service

Verify the post installation tasks:

1. Verify the L2NM-IOSXR CLI installation as follows. If you have already verified L2NM-IOSXR CLI installation, skip to **Step 2** to verify the L2NM–IOS XE CLI installation.
   a. 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;
}
```

b. Verify the status-codes configuration.

```
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_co
des;
    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]
```

c. Verify the plan-notifications configurations. Plan-notifications display AA models only when 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]
```

d. Verify the SMAN ID configuration for Y1731.

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

e. If you have installed AA, verify if the bootstrap data is successfully loaded for the 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
```

2. (*L2NM-IOS XE CLI only)* Verify the dynamic mapping for the IOS XE CLI NEDs you installed are listed. The following shows an example of IOS XE CLI 6.106:

```
unhide tsdn
admin@ncs% show l2vpn-ntw cfp-configurations
dynamic-device-mapping cisco-ios-cli-6.106:cisco-ios-cli-6.106 {
python-impl-class-name flat_l3vpn_multi_vendors.IosXE;
}
dynamic-device-mapping cisco-ios-cli-6.106:cisco-ios-cli-6.106 {
    python-impl-class-name flat_l2vpn_multi_vendors.IosXE;
}
dynamic-device-mapping cisco-ios-cli-6.86:cisco-ios-cli-6.86 {
    python-impl-class-name flat_l2vpn_multi_vendors.IosXE;
}
```

Installing IETF-L3VPN-NM Services

L3VPN-NM (L3NM) utilizes the standardized IETF version of L3VPN implementation. This section covers the steps and files required to install the L3NM service on either SR-TE CFP or as a standalone option, as well as the process for verifying the installation.

Note: To install L3VPN-NM-IOS XE CLI service, you must first install L3VPN-NM-IOSXR CLI service.

To install L3NM service on SR-TE CFP, make sure SR-TE CFP-IOSXR CLI is installed and then continue to perform the tasks mentioned in this topic. To install the IETF-L3VPN-NM-IOSXR CLI as a standalone flavor, follow the steps outlined in the Installing SR-TE CFP section from Step 1 to Step 5, and then proceed with the tasks mentioned in this topic.

To install IETF-L3VPN-NM CFP:

1. Navigate to the directory where the packages are located.

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

2. To install the L3NM-IOSXR CLI service, choose one of the following options. If you have already completed the installation of L3NM-IOSXR CLI, proceed to **Step 4** for the installation of L3NM-IOS XE CLI service.

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

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

   (*Optional*) To install the AA feature, copy and link the AA package.

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

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

   ```
   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
   sudo cp ncs-<version>-cisco-L3vpn-fp-internal-core-fp-<version>.tar.gz
   /opt/ncs/packages/
   sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-L3vpn-fp-internal-
   <version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-L3vpn-fp-
   internal-<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>-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>-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>-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 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>-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 ncs-<version>-cisco-aa-service-assurance-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-aa-service-
assurance-<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
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
```

3. To install the L3NM IOS XE CLI service, continue with **Step 4**, or ~~else~~ skip to **Step 5** to complete installing the IETF-L3VPN-NM-IOSXR CLI service.

4. Copy and link the following packages to install L3NM-IOS XE CLI:

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

5. Restart NSO with package reload.

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

The L3NM installation is now complete.

6. Verify the installation and make sure the packages are up and running and then run ~~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
```

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

Performing Post Installation Tasks for IETF-L3VPN-NM Service

Do the following after installing the L3NM service:

1. Change the current directory to:

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

2. Complete the post-installation tasks for L3NM-IOSXR CLI installation. If you have already installed L3NM-IOSXR CLI and completed the post-installation tasks, you can proceed to **Step 3** to perform the post-installation tasks for L3NM-IOS XE CLI.
   a. 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
```

   b. 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
```

   c. 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 1_IETF-L3NM-cfp-configuration-kicker.xml
admin@ncs% load merge IETF-L3NM-route-policy-kicker.xml
admin@ncs% load merge IETF-L3NM-vpn-node-plan-kicker.xml
admin@ncs% load merge IETF-L3NM-vpn-service-delete-kicker.xml
admin@ncs% load merge IETF-L3NM-vpn-service-update-kicker.xml
admin@ncs% commit
```

   d. Load-merge the following xml files for interface mapping (skip if IETF-L2VPN-NM is already installed).

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge interface-mapping-xr-cli-7.46.xml
admin@ncs% load merge interface-mapping-xr-cli-7.52.xml
```

```
admin@ncs% commit
```

e. 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
```

3. *L3NM-IOS XE CLI installation only*

a. Load-merge the L3VPN multi vendor iosxe cli file to configure dynamic mapping.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% load merge 2_IETF-L3NM-multi-vendor-iosxe-cli.xml
admin@ncs% commit
```

b. Load-merge the following xml files for interface mapping (skip if IETF-L2VPN-NM is already installed).

```
$ /opt/ncs/current/bin/ncs_cli -u admin
admin@ncs> configure
admin@ncs% unhide debug
admin@ncs% load merge interface-mapping-xe-cli-6.106.xml
admin@ncs% load merge interface-mapping-xe-cli-6.86.xml
admin@ncs% commit
```

Verifying the Post-Installation Tasks for the IETF-L3VPN-NM Service

Verify the post installation tasks:

1. Verify the installation of L3NM-IOSXR CLI using the following steps. If you have already verified the installation of L3NM-IOSXR CLI, proceed to **Step 2** to verify the installation of L3NM-IOS XE CLI.

a. 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;
}
```

b. Verify the status-codes configuration.

```
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_co
des;
    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]
```

c. Verify the plan-notifications configuration. The plan-notifications display the 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]
```

d. If you have installed AA, verify that the bootstrap data is successfully loaded for the 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
```

2. (*L3NM-IOS XE CLI only*) Verify that the dynamic-mapping configured for IOS XE CLI NED. The following is an example of IOS XE CLI 6.86 NED.

```
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;
}
```

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

Installing Automated Assurance Services

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

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.

The IOSXR-NC flavor or the IOS XE-CLI flavor for a service (IETF-TE) requires the IOSXR-CLI flavor for the service. For example, to install the IETF-TE-IOS XE flavor, you must do the following:

1. Install the base flavor (SR-TE CFP-IOSXR CLI).
2. Install the IETF-TE-IOSXR CLI flavor on the base flavor.
3. Install the IETF-TE-IOS XE flavor.

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/L3NM/IETF-TE services with IOSXR-CLI, IOSXR-NC, or IOS XE-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 IOS XE-CLI flavors.

For example, to install the IETF-TE-IOS XE CLI as a standalone service, you must first install the IETF-TE-IOSXR CLI as a standalone service and then install the IETF-TE-IOS XE CLI service.

Installing IETF-TE Services

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

Before you install IETF-TE service, make sure SR-TE CFP-IOSXR CLI is installed and then continue to perform the tasks mentioned in this topic. To install IETF-TE-IOSXR CLI as a standalone flavor, perform the tasks from **Step 1** to **Step 5** in the **Installing SR-TE CFP** section and then continue to perform the tasks mentioned in this topic.

Note: To install the IETF-TE-IOS XE CLI service, you must first install IETF-TE-IOSXR CLI service.

To install IETF-TE service:

1. Navigate to the directory where the packages are stored.

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

2. Do one of the following as required to install the IETF-TE-IOSXR CLI service. If the service is already installed, skip to **Step 3** to install IETF-TE-IOS XE CLI service.
   a. Copy and link the following packages to install IETF TE-IOSXR CLI on SR-TE CFP-IOSXR CLI:

   ```
   sudo cp 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 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 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 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 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 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>-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>-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-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>-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. To install IETF-TE-IOS XE CLI, continue with **Step 4**, or ~~else~~ skip to **Step 5** to complete the IETF-TE-IOSXR CLI installation.

4. Copy and link the following packages to install IETF-TE-IOS XE CLI:

```
sudo cp 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 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
```

5. Restart NSO with package reload.

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

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

The IETF TE service installation is now complete.

6. Verify the installation and ensure that 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 standalone installation.

7. Perform the post installation tasks.

Performing Post Installation Tasks for IETF-TE Service

Do the following after installing the IETF-TE service:

1. Change the current directory to:

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

2. (*Standalone installation only*) Configure the common bootstrap data as described in section **Performing Post Installation Tasks for SR-TE CFP**.

3. Do the following post installation tasks for IETF-TE-IOSXR CLI installation. If you have already performed the post installation tasks for the installation, skip to **Step 4** to perform the post installation tasks for IETF-TE-IOS XE CLI installation.

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

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

   b. 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-example.xml
load merge IETF-TE-status-codes-example.xml
admin@ncs% commit
```

   c. 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-example.xml
admin@ncs% load merge 1_IETF-TE-cfp-configuration-kicker-example.xml
admin@ncs% commit
```

4. (*IETF-TE-IOS XE CLI only*) Load-merge the **2_IETF-TE-multi-vendor-iosxe-cli-example.xml** file to configure dynamic-mapping.

```
$ ncs_cli -u admin
admin@ncs> configure
admin@ncs% load merge 2_IETF-TE-multi-vendor-iosxe-cli-example.xml
admin@ncs% commit
```

Verifying the Post Installation Tasks for IETF-TE Service

Do the following:

1. Verify the IETF-TE-IOSXR CLI installation as follows. If the installation is verified, skip to **Step 2** to verify the IETF-TE-IOS XE CLI installation.
   a. 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]
```

   b. Verify the status-codes configuration.

```
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]
```

c. Verify the plan-notifications configuration.

```
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]
```

2. (*IETF-TE-IOS XE CLI only*) Verify that the dynamic-mapping for the IOS XE CLI NEDs installed. Following is an example for IOS XE CLI 6.86 NED.

```
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;
}
```

Installing Performance Measurement Services

This section discusses the procedure to copy the packages to install and verify the Performance Measurement service on SR-TE CFP-IOSXR CLI / SR-TE CFP-IOS XE CLI.
The Performance Measurement service additionally requires L2NM and L3NM services to be installed.

For more information about how to install these services, see **Installing Core Function Packs on a Single NSO Instance**.

Note: To install PM-IOS XE CLI service, you must first install PM-IOSXR CLI service.

To install Performance Measurement service:

1. Navigate to the directory where the packages are stored.

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

2. Copy and link the following packages to install SR PM-IOSXR CLI service. If the service is already installed, skip to **Step 4** to install the SR PM-IOS XE CLI service.

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

3. To install the SR PM-IOS XE CLI service continue with **Step 4**, or ~~else~~ skip to **Step 5** to complete the SR PM-IOSXR CLI service installation.

4. Copy and link the following packages to install L3NM-IOS XE CLI:

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

5. Restart NSO with package reload.

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

   The SR PM-IOSXR CLI installation is now complete.

6. 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
   ```

7. Perform the post installation tasks.

Performing Post Installation Tasks for PM Services

Do the following after installing the SR PM service:

1. Change the current directory to:
   ```
   $ cd tsdn-<version>-nso-<version>/standalone/bootstrap-data
   ```
2. Do the following post installation tasks for SR PM-IOSXR CLI installation. If the tasks are already performed for the installation, skip to **Step 3** to perform the post installation tasks for SR PM-IOS XE CLI installation.
   a. Load-merge the following kickers xml files to configure dynamic-mapping.
      ```
      $ ncs_cli -u admin
      admin@ncs> configure
      unhide debug
      admin@ncs% load merge 1_PM-cfp-configuration-kicker.xml
      admin@ncs% load merge PM-internal-plan-kicker-example.xml
      admin@ncs% load merge PM-profiles-kicker-example.xml
      admin@ncs% commit
      ```
   b. Load-merge the following status codes files to activate status codes for the service.
      ```
      admin@ncs% ncs_cli -u admin
      admin@ncs% configure
      admin@ncs% unhide debug
      admin@ncs% load merge PM-status-codes-example.xml
      admin@ncs% commit
      ```
   c. Load-merge the following plan notifications to activate notifications for the service.
      ```
      admin@ncs% ncs_cli -u admin
      admin@ncs% configure
      admin@ncs% load merge PM-plan-notification-settings-example.xml
      admin@ncs% commit
      ```
3. (*SR PM-IOS XE CLI only*) Load-merge the following file to add dynamic-mapping.
   ```
   $ ncs_cli -u admin
   admin@ncs% configure
   unhide debug
   load merge 2_PM-multi-vendor-iosxe-cli-example.xml
   commit
   ```

Verifying the Post Installation Tasks for PM Services

Do the following to verify the PM services:

1. Verify the kickers configuration.

```
unhide debug
admin@ncs% show kickers
data-kicker plan-notification-kicker-/cisco-pm-fp:pm/pm-plan {
    monitor     /cisco-pm-fp:pm/pm-plan;
    kick-node   /action;
    action-name generate-plan-notifications;
}
data-kicker pm-cfp-configuration-kicker {
    monitor     /cisco-pm-fp:cfp-configurations;
    kick-node   /cisco-pm-fp:pm/pm-actions;
    action-name update-internal-cfp-configurations;
}
data-kicker pm-internal-plan-kicker {
    monitor     /cisco-pm-fp-internal:pm-internal/pm-internal-plan;
    kick-node   /cisco-pm-fp:pm/pm-actions;
    action-name internal-plan-change-handler;
}
data-kicker pm-internal-profiles-change-kicker {
    monitor     /cisco-pm-fp:pm/cisco-pm-fp:pm-profiles;
    kick-node   /cisco-pm-fp:pm/cisco-pm-fp:pm-profiles/pm-profiles-actions;
    action-name profiles-change-handler;
}
```

2. Verify the status-codes configuration.

```
admin@ncs% show status-codes
core-function-pack PM {
    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.";
    }
}
```

3. Verify the plan-notifications configuration.

```
admin@ncs% run show configuration services plan-notifications
subscription pm-notif {
    service-type /cisco-pm-fp:pm/cisco-pm-fp:svc-profiles;
}
admin@ncs% run show configuration plan-path-for-notification
plan-path-for-notification /cisco-pm-fp:pm/pm-plan {
    service-path         /cisco-pm-fp:pm/svc-profiles;
    service-key-elements [ name ];
}
```

4. (*SR PM-IOS XE CLI only*) Verify the dynamic-mapping configuration.

```
admin@ncs% show cisco-pm-fp:cfp-configurations
dynamic-device-mapping cisco-ios-cli-6.86:cisco-ios-cli-6.86 {
python-impl-class-name pm_multi_vendors.IosXE;
}
```

Installing IETF Network Slice Services – IOSXR CLI

This section discusses the procedure to copy the packages to install and verify the IETF NSS-IOSXR CLI service on SR-TE CFP IOSXR CLI.

IETF NSS-IOSXR CLI additionally requires L2NM-IOSXR CLI, L3NM-IOSXR CLI, and Performance Management services to be installed.

For more information about installing these services, see **Installing and Uninstalling Cisco NSO T-SDN Function Pack Bundle on a Single NSO Instance**.

To install and verify IETF NSS - IOSXR CLI:

1. Go to the packages directory and copy and link the required packages.

```
$ cd tsdn-<version>-nso-<version>/standalone/packages
cp ncs-<version>-ietf-network-slice-service-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-network-slice-service-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-network-slice-service-
EXAMPLE-<version>.tar.gz
cp ncs-<version>-cisco-pm-fp-EXAMPLE-<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-pm-fp-EXAMPLE-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-pm-fp-EXAMPLE-<version>.tar.gz
cp ncs-<version>.cisco-pm-fp-internal-EXAMPLE-<version>.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages//ncs-<version>.cisco-pm-fp-internal-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages//ncs-<version>.cisco-pm-fp-internal-
EXAMPLE-<version>.tar.gz
```

2. Restart NSO with package reload.

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

The IETF NSS-IOSXR CLI installation is now complete.

3. 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
```

4. Perform the post installation tasks.

Performing Post Installation Tasks for IETF NSS-IOSXR CLI

Do the following after installing IETF NSS-IOSXR CLI:

1. Change the current directory to:

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

2. Load-merge the following kickers xml files to configure dynamic-mapping.

```
$ ncs_cli -u admin
admin@ncs> configure
unhide debug
admin@ncs% load merge IETF-NSS-internal-plan-kicker-example.xml
admin@ncs% load merge 1_PM-cfp-configuration-kicker-example.xml
admin@ncs% load merge PM-internal-plan-kicker-example.xml
admin@ncs% load merge PM-profiles-kicker-example.xml
admin@ncs% commit
```

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

```
admin@ncs% ncs_cli -u admin
admin@ncs% configure
admin@ncs% unhide debug
admin@ncs% load merge IETF-NSS-status-codes-example.xml
admin@ncs% load merge PM-status-codes-example.xml
admin@ncs% commit
```

4. Load-merge the following plan notifications to activate notifications for the service.

```
admin@ncs% ncs_cli -u admin
admin@ncs% configure
admin@ncs% load merge IETF-NSS-plan-notification-settings-example.xml
admin@ncs% load merge PM-plan-notification-settings-example.xml
admin@ncs% commit
```

5. Load-merge the following xml file to configure the resource pool.

```
admin@ncs% ncs_cli -u admin
admin@ncs% configure
admin@ncs% load merge IETF-NSS-resource-pools-example.xml
```

```
admin@ncs% commit
```

Verifying the Post Installation Tasks for IETF NSS-IOSXR CLI

Verify the post installation tasks as follows:

1. Verify the kickers configuration.

```
unhide debug
admin@ncs% show kickers
data-kicker ietf-nss-internal-l2nm-plan-kicker {
    monitor     /l2vpn-ntw:l2vpn-ntw/l2vpn-ntw:vpn-services/l2vpn-ntw-
cisco:vpn-service-plan;
    kick-node   /ietf-nss:network-slice-services/ietf-nss-cisco:actions;
    action-name internal-plan-change-handler;
}
data-kicker ietf-nss-internal-l3nm-plan-kicker {
    monitor     /l3vpn-ntw:l3vpn-ntw/l3vpn-ntw:vpn-services/l3vpn-ntw:vpn-
service-plan;
    kick-node   /ietf-nss:network-slice-services/ietf-nss-cisco:actions;
    action-name internal-plan-change-handler;
}
data-kicker plan-notification-kicker-/ietf-nss:network-slice-services/ietf-
nss-cisco:slice-service-plan {
    monitor     /ietf-nss:network-slice-services/ietf-nss-cisco:slice-
service-plan;
    kick-node   /action;
    action-name generate-plan-notifications;
}
```

2. Verify the status-codes configuration.

```
admin@ncs% show status-codes
core-function-pack IETF-NSS {
    status-code-enum-path cisco-tsdn-core-fp-
common/python/cisco_tsdn_core_fp_common/status_codes/ietf_nss_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.";
    }
```

3. Verify the plan-notifications configuration.

```
admin@ncs% run show configuration services plan-notifications
subscription ietf-nss-notif {
    service-type /ietf-nss:network-slice-services/ietf-nss:slice-service;
}
admin@ncs% run show configuration plan-path-for-notification
plan-path-for-notification /ietf-nss:network-slice-services/ietf-nss-
cisco:slice-service-plan {
    service-path         /ietf-nss:network-slice-services/slice-service;
    service-key-elements [ service-id ];
}
```

4. Verify the resource pools configuration.

```
admin@ncs% show resource-pools id-pool
id-pool mep-id-pool {
    range {
        start 1;
        end   8191;
    }
}
admin@ncs% show network-slice-services cfp-configurations mep-id-pool-name
mep-id-pool-name mep-id-pool;
```

Uninstalling 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.

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.

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.

This section discusses the procedure for uninstalling 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 NCS configuration file:

1. Stop NCS.
2. Edit the **/etc/ncs/ncs.conf**:
   a. Remove **service-state-changes** information under **<stream>**.

```
<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>
```

   b. 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>
```

   c. If you enabled the SSH port configuration for the CLI, Web UI, and the northbound notifications, it is optional to revert the configuration.

Uninstalling Example Function Packs

Uninstalling a flavor installed on SR-TE CFP-IOSXR CLI continues to render the SR-TE CFP-IOSXR CLI services on the system. Delete all the services for the flavor before uninstalling the flavor.

Uninstalling IETF-TE Services

Use the information in this section to uninstall IETE-TF services. Uninstalling the IETF-TE service reverts the system to SR-TE CFP-IOSXR CLI. For more information on how to uninstall SR-TE CFP-IOSXR CLI, see Error! Reference source not found.

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 IETF-TE service:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.
2. To uninstall IETF-TE-IOSXR CLI, do the following. To uninstall IETF-TE-IOSXR CLI, skip to **Step 4**.
   a. 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
```

   b. 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
```

   c. 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
```

   b. 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
```

3. Continue with **Step 4** to uninstall IETF-TE-IOS XE CLI service, or ~~else~~ skip to **Step 6** to complete uninstalling IETF-TE-IOSXR CLI service.

4. (*IETF-TE-IOS XE CLI only*) 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
   ```

5. 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
   ```

6. Restart NSO with package reload.

   ```
   ### Make sure user delete all services and devices from TSDN
   ### Make sure there are no zombie services by running the command: show
   zombies

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

Uninstalling IETF Network-Slice-Services – IOSXR CLI

Use the information in this section to uninstall the IETE-NSS service with IOSXR CLI. Be sure to delete all the IETF NSS services with CLI NED before uninstalling IETF NSS.

To uninstall IETF-TE-IOS XE-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.

   ```
   $ /opt/ncs/current/bin/ncs_cli -u admin
   admin@ncs> configure
   admin@ncs% delete services plan-notifications subscription ietf-nss-notif
   admin@ncs% delete plan-path-for-notification /ietf-nss:network-slice-
   services/ietf-nss-cisco:slice-service-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-NSS
   admin@ncs% delete status-code-cfp IETF-NSS
   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-nss-internal-l2nm-plan-kicker
admin@ncs% delete kickers data-kicker ietf-nss-internal-l3nm-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 /opt/ncs/packages/ncs-<version>-ietf-network-slice-service-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-network-slice-service-
EXAMPLE-<version>.tar.gz
```

6. Remove 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
```

7. Restart NSO with package reload.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies


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

Uninstalling Performance Measurement Service

Uninstall the PM packages to uninstall PM services with IOSXR CLI/IOS XE CLI NED. Removing PM service reverts the system to L2NM/L3NM/SR-TE CFP flavors with the corresponding NEDs. This section provides the procedure to uninstall the Performance Measurement service.

Note: Do not remove the CLI NEDs if you continue to use the Core Function Packs (services) after uninstalling the PM service.

To uninstall the Performance Measurement service:

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

2. To uninstall SR PM (IOSXR CLI/IOS XE CLI) service, do the following.
   a. Delete plan-notifications.

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

```
admin@ncs% delete plan-path-for-notification /cisco-pm-fp:pm/pm-plan
admin@ncs% commit
```

b. Delete status-codes for PM.

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

c. 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 pm-cfp-configuration-kicker
admin@ncs% delete kickers data-kicker pm-internal-plan-kicker
admin@ncs% data-kicker pm-internal-profiles-change-kicker
admin@ncs% commit
```

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

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

3. To uninstall PM-IOSXR CLI only, skip to **Step 5**; or ~~else~~ continue with **Step 4**.

4. (SR PM-IOS XE CLI service only) Remove dynamic-mapping for the PM-IOS XE CLI service.

```
ncs_cli -u admin
configure
delete cisco-pm-fp:cfp-configurations dynamic-device-mapping cisco-ios-cli-
<version>:cisco-ios-cli-<version>
commit
```

5. Restart NSO with package reload.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies

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

Uninstalling Core Function Packs

This section provides the procedure for uninstalling the SR-TE CFPs with IOS XE CLI/IOSXR-CLI. Uninstalling SR-TE CFP IOSXR CLI uninstalls the Cisco T-SDN FP Bundle.

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

This section provides the procedure for uninstalling the L2NM services with IOS XR CLI/IOS XE CLI. Before you uninstall L2NM service, delete all the related services and the devices from the device tree.

Uninstalling L2NM-IOSXR CLI service reverts the system to SR-TE CFP-IOSXR CLI flavor and uninstalling the L2NM-IOS XE CLI service reverts the system to SR-TE CFP IOS XE-CLI flavor. For more information on how to uninstall CFP services, see **Uninstalling Core Function Packs**.

To uninstall L2NM service:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File**.
2. Do the following to uninstall L2NM-IOSXR CLI installation. (To uninstall L2NM-IOS XE CLI installation, skip to **Step 3**).
   a. 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
```

   b. 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
```

   c. 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-kicker
admin@ncs% commit
```

d. 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
```

e. 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-L2vpn-fp-internal-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-L2vpn-fp-internal-<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-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-<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
```

3. To uninstall the L2NM-IOS XE CLI flavor, follow these steps. If you want to complete the uninstallation of the L2NM-IOSXR CLI flavor, skip to **Step** 4.

a. Delete all the dynamic-mappings configured for the IOS XE CLI NED 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
```

b. Unlink the following packages 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-<version>.tar.gz /opt/ncs/packages/ncs-<version>-flat-l2vpn-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. Restart NSO with package reload.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show zombies

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

Uninstalling IETF-L3VPN-NM Services

This section provides the procedure for uninstalling the L3NM services with IOS XR CLI/IOS XE CLI NEDs. Before you uninstall the L3NM service, delete all the related services and the devices from the device tree.

Uninstalling L3NM-IOS XR CLI flavor reverts the system to SR-TE CFP-IOS XR CLI and uninstalling L3NM-IOS XE CLI flavor reverts the system to L3NM IOS XR-CLI. For more information on how to uninstall SR-TE CFP-IOS XR CLI, see **Uninstalling Core Function Packs**.

To uninstall L3NM service:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.
2. Uninstall L3NM-IOSXR CLI. (To uninstall L3NM-IOS XE CLI installation, skip to **Step 3**).
   a. 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
```

   b. 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
```

   c. Delete kickers.

```
$ 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-internal-plan-kicker
admin@ncs% delete kickers data-kicker ietf-l3nm-cfp-configuration-kicker
admin@ncs% delete kickers data-kicker l3nm-defined-set-kicker
admin@ncs% delete kickers data-kicker l3nm-policy-definition-kicker
admin@ncs% delete kickers data-kicker l3nm-service-delete-kicker
admin@ncs% delete kickers data-kicker l3nm-service-update-kicker
admin@ncs% delete kickers data-kicker l3nm-vpn-node-plan-kicker
admin@ncs% commit
```

   d. 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 /l3vpn-ntw:l3vpn-ntw/vpn-services/vpn-service
commit
```

e. 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>-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-L3vpn-fp-internal-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-L3vpn-fp-internal-<version>.tar.gz
sudo rm -f /opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
```

3. Uninstall L3NM-IOS XE CLI flavor, or ~~else~~ skip to Step 4 to complete uninstalling the L3NM-IOSXR CLI flavor.

a. Delete all the dynamic-mappings configured for the IOS XE CLI NED 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
```

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

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show zombies

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

Uninstalling SR-TE CFP Services

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

Uninstalling SR-TE CFP-IOSXE CLI reverts the system to SR-TE CFP-IOSXR CLI.SR-TE CFP-IOSXR CLI is the main component of Cisco NSO T-SDN FP Bundle. Uninstalling SR-TE CFP-IOSXR CLI and the associated

packages from the system remove the Cisco NSO T-SDN FP Bundle. Only a user who has the **sudo** privileges and is part of **ncsadmin** user group can perform this uninstallation.

To uninstall SR-TE CFP services:

1. Revert the **ncs.config** file. For more information, see **Reverting Changes to the NCS Configuration File on a Single NSO Instance**.
2. The following procedure uninstalls SR-TE CFP-IOSXE CLI service.
   a. Delete dynamic-mapping for the installed IOSXR CLI NED versions.

```
$ /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
```

   b. Unlink the following packages in **/var/opt/ncs/packages** and delete the packages from **/opt/ncs/packages/** directory. Remove the IOS XE 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
```

   c. Delete all the services and devices.
3. The following procedure uninstalls SR-TE CFP-IOSXR CLI. Uninstalling SR-TE CFP-IOSXR CLI and the associated packages from the system remove the Cisco NSO T-SDN FP Bundle.
   a. 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
```

   b. 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
```

c. 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
```

d. 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
```

4. Restart NSO with package reload.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies

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

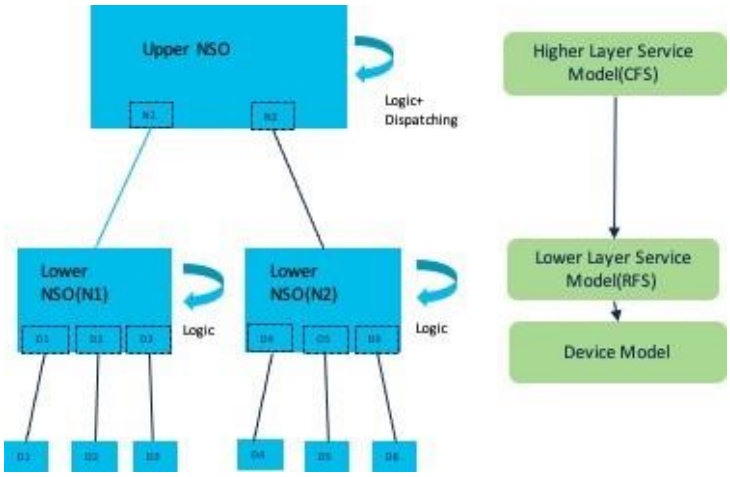
```
Restarting ncs (via systemctl):
                [   OK  ]
```

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 one or more 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. Cisco recommends installing 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-6.1.11-cisco-sr-te-cfp-internal-7.0.0.tar.gz ncs-6.1.11-sr-te-multi-vendors-7.0.0.tar.gz ncs-6.1.11-cisco-L2vpn-fp-internal-7.0.0.tar.gz ncs-6.1.11-l2vpn-multi-vendors-7.0.0.tar.gz ncs-6.1.11-l3vpn-multi-vendors-7.0.0.tar.gz ncs-6.1.11-cisco-L3vpn-fp-internal-7.0.0.tar.gz
T-SDN FP Bundle common packages	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-core-fp-delete-tag-service-1.0.6.tar.gz ncs-6.1-core-fp-plan-notif-generator-1.0.10.tar.gz ncs-6.1-lsa-utils-1.0.4.tar.gz ncs-6.1.11-cisco-tsdn-core-fp-common-7.0.0.tar.gz ncs-6.1.6-phased-provisioning-1.1.0.tar.gz
LSA NED packages	**IOS XR CLI NED:** ncs-6.1.4-cisco-iosxr-7.52.2.tar.gz ncs-6.10.3-cisco-iosxr-7.46.3.tar.gz **IOS XE CLI NED:** ncs-6.1-cisco-ios-6.86.6.tar.gz ncs-6.1.5-cisco-ios-6.106.9.tar.gz
CNC User Specific Packages	ncs-6.1.11-cisco-tm-tc-fp-7.0.0.tar.gz ncs-6.1.11-dlm-svc-7.0.0.tar.gz ncs-6.1.11-cw-device-auth-7.0.0.tar.gz
Example packages	ncs-6.1.11-cisco-rsvp-te-fp-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-rsvp-te-multi-vendors-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-cisco-pm-fp-internal-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-pm-multi-vendors-EXAMPLE-7.0.0.tar.gz

Modifying the NCS Configuration File on the Lower-Level Nodes

Back up the **/etc/ncs/ncs.conf** file and 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, Web UI, 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***.

   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>${North_Bound_CLI_SSH_Port}</port>
         <extra-listen>
          <ip>::</ip>
          <port>${North_Bound_CLI_SSH_Port}</port>
           </extra-listen>
  </ssh>
```

   Web UI

   Enable Web UI either in 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. 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>
```

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

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

6. 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 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 **tsdn-<*version*>-nso-<*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 tsdn-<version>-nso-<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 tsdn-<version>-nso-<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 tsdn-<version>-nso-<version>.tar.gz
   ```

6. Go to the lower-level node packages directory and change the current directory÷.

   ```
   $ cd tsdn-<version>-nso-<version>/LSA/RFS/packages
   ```

   Note: If you are installing DLM, TM-TC, and/or NCA user-specific packages, download the packages and create the symbolic links for these packages before proceeding to **Step 7**.

7. Copy the following 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-L2vpn-fp-internal-<version>.tar.gz
   /opt/ncs/packages/ncs-<version>-cisco-l2vpn-fp-internal-<version>.tar.gz

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

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

   sudo cp ncs-<version>-l3vpn-multi-vendors-<version>.tar.gz /opt/ncs/packages/ncs-
   <version>-l3vpn-multi-vendors-<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>-rsvp-te-multi-vendors-EXAMPLE-<version>.tar.gz
   /opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-<version>.tar.gz
   ```

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

sudo cp ncs-<version>-pm-multi-vendors-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-pm-multi-vendors-EXAMPLE-<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-L2vpn-fp-internal-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-L2vpn-fp-internal-
<version>.tar.gz

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

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

sudo ln -s /opt/ncs/packages/ncs-<version>-l3vpn-multi-vendors-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-l3vpn-multi-vendors-<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>-rsvp-te-multi-vendors-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-
EXAMPLE-<version>.tar.gz

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

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

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

8. 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 tsdn-<version>-nso-<version>/LSA/RFS/bootstrap-data
   ncs_cli -u <user>
   configure
   unhide debug
   load merge bootstrap-autopopulate-dispatch.xml
   load merge commit-queue-settings.xml
   load merge L2VPN-internal-plan-monitor.xml
   load merge L2VPN-status-codes.xml
   load merge L3VPN-internal-plan-monitor.xml
   load merge L3VPN-status-codes.xml
   load merge PM-internal-plan-monitor-example.xml
   load merge PM-status-codes-example.xml
   load merge rfs-custom-template-settings.xml
   load merge rfs-dispatch-map-settings.xml
   load merge RSVP-TE-internal-plan-monitor-example.xml
   load merge RSVP-TE-status-codes-example.xml
   load merge SR-internal-plan-monitor.xml
   load merge SR-status-codes.xml
   commit
   ```

2. Set the 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 the 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
```

Note: If no NETCONF NEDs are loaded, the package oper-status displays warning messages. Ignore these messages.

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 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 that the 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 upper-level node 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, IOS XR CLI 7.52, IOS XR NC 7.8 (or later) NED.

CFS Node Packages	
Package Category	**Packages**
T-SDN FP Bundle packages	ncs-6.1.11-cisco-sr-te-cfp-7.0.0.tar.gz ncs-6.1.11-cisco-cs-sr-te-cfp-7.0.0.tar.gz ncs-6.1.11-ietf-l2vpn-nm-7.0.0.tar.gz ncs-6.1.11-ietf-l3vpn-nm-7.0.0.tar.gz ncs-6.1.3-cisco-cfp-jwt-auth-1.0.0.tar.gz

T-SDN FP Bundle common packages	ncs-6.1-core-fp-plan-notif-generator-1.0.10.tar.gz ncs-6.1.11-custom-template-utils-ned-1.0.tar.gz ncs-6.1-core-fp-common-1.33.0.tar.gz ncs-6.1-lsa-utils-1.0.4.tar.gz ncs-6.1.11-cisco-tsdn-core-fp-common-7.0.0.tar.gz ncs-6.1.8-resource-manager-4.2.5.tar.gz ncs-6.1.6-phased-provisioning-1.1.0.tar.gz
LSA NED packages	ncs-6.1.11-cisco-L2vpn-fp-internal-ned-7.0.0.tar.gz ncs-6.1.11-cisco-L3vpn-fp-internal-ned-7.0.0.tar.gz ncs-6.1.11-cisco-pm-fp-internal-ned-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-cisco-rsvp-te-fp-internal-ned-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-lsa-utils-ned-1.0.tar.gz ncs-6.1.11-custom-template-utils-ned-1.0.tar.gz ncs-6.1.11-core-fp-common-ned-1.0.tar.gz ncs-6.1.11-cisco-sr-te-cfp-internal-ned-7.0.0.tar.gz ncs-6.1.11-cisco-nso-nc-6.1.tar.gz
Example packages	ncs-6.1.11-cisco-aa-service-assurance-7.0.0.tar.gz ncs-6.1.11-cisco-pm-fp-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-ietf-network-slice-service-EXAMPLE-7.0.0.tar.gz ncs-6.1.11-ietf-te-fp-EXAMPLE-7.0.0.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, Web UI, 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~~ about 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>${North_Bound_CLI_SSH_Port}</port>
          <extra-listen>
          <ip>::</ip>
          <port>${North_Bound_CLI_SSH_Port}</port>
```

```
          </extra-listen>

  </ssh>
```

Web UI

You can enable Web UI 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.

```
<notifications>
<event-streams>
  <stream>
    <name>service-state-changes</name>
    <description> Service state changes according to
     tailf-ncs-plan.yang and tailf-ncs-services.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 the AA notification streams to generate the 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. If you have installed the jwt-auth package, enable the package authentication under <aaa>.

```
<aaa>
       <package-authentication>
         <enabled>true</enabled>
         <packages>
           <package>cisco-cfp-jwt-auth</package>
         </packages>
       </package-authentication>
     </aaa>
```

Note: If you do not want to use this authentication feature, set the package authentication to **false**.

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

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

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

Installing 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 **tsdn-<*version*>-nso-<*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 tsdn-<version>-nso-<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 tsdn-<version>-nso-<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 tsdn-<version>-nso-<version>.tar.gz
   ```

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

   ```
   $ cd tsdn-<version>-nso-<version>/LSA/CFS/packages
   ```

Note: If you are installing DLM, TM-TC, and/or NCA user-specific packages, download the packages and create the symbolic links for these packages before proceeding to **Step 8**.

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-l2vpn-nm-<version>.tar.gz /opt/ncs/packages/ncs-
<version>-ietf-l2vpn-nm-<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 cp ncs-<version>-cisco-pm-fp-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-
<version>-cisco-pm-fp-EXAMPLE-<version>.tar.gz

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>-cisco-aa-service-assurance-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-<version>.tar.gz

sudo cp ncs-<version>-ietf-network-slice-service-EXAMPLE-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-ietf-network-slice-service-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-L3vpn-fp-internal-ned-<version>.tar.gz
/opt/ncs/packages/ncs-<version>-cisco-L3vpn-fp-internal-ned-<version>.tar.gz

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

sudo cp ncs-<version>-phased-provisioning-<version>.tar.gz /opt/ncs/packages/ncs-
<version>-phased-provisioning-<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-l2vpn-nm-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-<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
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>-cisco-aa-service-assurance-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-
<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-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-L2vpn-fp-internal-ned-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-cisco-flat-L2vpn-fp-
internal-ned-EXAMPLE-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-cisco-pm-fp-EXAMPLE-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-cisco-pm-fp-EXAMPLE-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-ietf-network-slice-service-EXAMPLE-
<version>.tar.gz /var/opt/ncs/packages/ncs-<version>-ietf-network-slice-service-
EXAMPLE-<version>.tar.gz
sudo ln -s /opt/ncs/packages/ncs-<version>-phased-provisioning-<version>.tar.gz
/var/opt/ncs/packages/ncs-<version>-phased-provisioning-<version>.tar.gz
```

9. 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 are running.

```
cd tsdn-<version>-nso-<version>/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-example.xml
load merge IETF-TE-status-codes-example.xml
load merge IETF-L3NM-status-codes.xml
load merge IETF-L2NM-status-codes.xml
load merge IETF-NSS-status-codes-example.xml
load merge PM-status-codes-example.xml
commit

load merge CS-SR-internal-plan-kicker.xml
load merge 1_SR-cfp-configuration-kicker.xml
load merge 1_IETF-TE-cfp-configuration-kicker-example.xml
load merge 1_IETF-L2NM-cfp-configuration-kicker.xml
load merge IETF-L2NM-route-policy-kicker.xml
load merge 1_IETF-L3NM-cfp-configuration-kicker.xml
load merge IETF-L3NM-route-policy-kicker.xml
load merge IETF-L3NM-vpn-node-plan-kicker.xml
load merge IETF-L3NM-vpn-service-delete-kicker.xml
load merge IETF-L3NM-vpn-service-update-kicker.xml
load merge IETF-NSS-internal-plan-kicker-example.xml
load merge 1_PM-cfp-configuration-kicker-example.xml
load merge PM-profiles-kicker-example.xml
load merge cfs-dispatch-map-settings.xml
commit

load merge CS-SR-plan-notification-settings.xml
load merge SR-plan-notification-settings.xml
load merge IETF-TE-plan-notification-settings-example.xml
load merge IETF-L3NM-plan-notification-settings.xml
```

```
load merge IETF-L2NM-plan-notification-settings.xml
load merge IETF-NSS-plan-notification-settings-example.xml
load merge PM-plan-notification-settings-example.xml
commit

load merge 2_SR-multi-vendor-iosxe-cli.xml
load merge 2_IETF-TE-multi-vendor-iosxe-cli-example.xml
load merge 2_IETF-L2NM-multi-vendor-iosxe-cli.xml
load merge 2_IETF-L3NM-multi-vendor-iosxe-cli.xml
load merge 2_PM-multi-vendor-iosxe-cli-example.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
load merge IETF-NSS-resource-pools-example.xml
commit
## Required for UI interface mapping ##
=======================================
load merge interface-mapping-xe-cli-6.86.xml
load merge interface-mapping-xr-cli-7.46.xml
load merge interface-mapping-xe-cli-6.106.xml
load merge interface-mapping-xr-cli-7.52.xml
 commit

## LSA netconf notification kicker ##

## For TSDN bundle image ##
load merge cfs-netconf-notification-kicker.xml
commit

## For TSDN CLI image. ##
cd <TSDN_build>/netconf_data
load merge cfs-netconf-notification-kicker.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-6.1
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 receive the notification settings.

```
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. Ensure 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~~ are 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 <name> remote-password <password>
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 that 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 and common kickers files 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. If you have other packages installed, skip to **Step 5**.
3. 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.
```

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

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

5. Stop NCS by using the `ncs --stop` command.
6. 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**.
7. 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 /opt/ncs/packages/ncs-<version>-cisco-aa-service-assurance-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-cs-sr-te-cfp-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-L2vpn-fp-internal-ned-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-L3vpn-fp-internal-ned-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-nso-nc-6.1.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-pm-fp-EXAMPLE-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-pm-fp-internal-ned-EXAMPLE-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-internal-ned-EXAMPLE-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-ned-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-core-fp-common-ned-1.0.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-custom-template-utils-ned-1.0.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-ietf-l2vpn-nm-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-ietf-l3vpn-nm-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-ietf-network-slice-service-EXAMPLE-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-ietf-te-fp-EXAMPLE-<version>.tar.gz
```

```
sudo rm -rf /opt/ncs/packages/ncs-<version>-lsa-utils-ned-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-resource-manager-<version>.tar.gz
```

8. 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** ~~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 /opt/ncs/packages/ncs-<version>-cisco-rsvp-te-fp-EXAMPLE-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-rsvp-te-multi-vendors-EXAMPLE-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-sr-te-cfp-internal-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-tsdn-core-fp-common-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-sr-te-multi-vendors-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-l2vpn-multi-vendors-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-l3vpn-multi-vendors-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-L2vpn-fp-internal-
<version>.tar.gz
```

```
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-L3vpn-fp-internal-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-pm-fp-internal-EXAMPLE-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-pm-multi-vendors-EXAMPLE-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-custom-template-utils-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-core-fp-common-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-core-fp-delete-tag-service-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-core-fp-plan-notif-generator-
<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-lsa-utils-<version>.tar.gz
sudo rm -rf /opt/ncs/packages/ncs-<version>-cisco-iosxr-<version>.tar.gz
sudo rm -rf /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 T-SDN FP Bundle CFPs from version 6.0.0 to version 7.0.0. Use cases covered in here are Standalone, LSA, LSA with HA configurations and NSO installed in system mode.

It is strongly recommended to back up your environment before performing the upgrade.

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

Prefix Legend:
user$ - User mode in Unix shell on host machine where NSO is installed
user# - Elevated privilege mode (root) in Unix shell on host machine where NSO is installed
user@ncs% - NSO CLI Configuration Mode
user@ncs> - NSO CLI Operation Mode

Before You Begin

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

1. Obtain and place the **NSO 6.1.11 installer bin** file and the **tsdn-7.0.0-nso-6.1.11-signed.bin** file in **/home/user/** directory (replace user directory according to your setup).
2. Making backup using **ncs_backup**.

   ```
   user$ sudo /opt/ncs/current/bin/ncs-backup
   ```

   Backup filename format: **ncs-<NSO version>@<date-time stamp>.backup.gz**

   Example:
   ```
   user$ sudo /opt/ncs/current/bin/ncs-backup
   INFO  Backup /var/opt/ncs/backups/ncs-6.1.11@2024-05-25T11:24:31.backup.gz
   created successfully
   ```

   For more information on backup and restore, see the *NSO Administration Guide,* **Chapter 2: NSO System Management → Backup and Restore**.
3. Back up the current NCS packages.

   ```
   user$ sudo cp -r /var/opt/ncs/packages /<sample_dir>/
   ```
4. Back up the current **/etc/ncs/ncs.conf** file.

   ```
   user$ sudo cp /etc/ncs/ncs.conf /<sample_dir>/ncs.conf_BKUP
   ```
5. Remove the old status-codes.

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

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

Upgrade NSO to version 6.1.11

1. Stop NSO.
   ```
   user$ sudo /etc/init.d/ncs stop
   ```
2. Upgrade NSO to version 6.1.11 by performing system installation of NSO. For more information about how to upgrade NSO, see the ***NSO Installation Guide***.
   ```
   user$ sudo sh nso-6.1.11<OS>.x86_64.installer.bin --system-install
   user$ sudo -s
   user# cd /opt/ncs
   user# rm -f current
   user# ln -s ncs-<NEWVERSION> current
   ```
3. Updat~~ing~~ **ncs.conf**.
   a. By default, there is a new ncs.conf.install in /opt/ncs/ncs-6.1.11/etc/ncs; make a copy of this file for the next step below:
      ```
      user$ sudo cp /opt/ncs/ncs-6.1.11/etc/ncs/ncs.conf.install
      /<sample_dir>/ncs.conf_NEW
      ```
   b. Modify the copy of /opt/ncs/ncs-6.1.11/etc/ncs/ncs.conf.install and add/append configurations as described in section **Editing the NCS Configuration File on a Single NSO Instance**
      ```
      user$ sudo vi /<sample_dir>/ncs.conf_NEW
      ```
   c. Replace /etc/ncs/ncs.conf with the modified **/<sample_dir>/ncs.conf_NEW** from previous step:
      ```
      user$ sudo cp /<sample_dir>/ncs.conf_NEW /etc/ncs/ncs.conf
      ```

Upgrade the T-SDN FP Bundle CFP to version 7.0.0 and start NSO

Do the following:

1. Remove the old packages in the **/opt/ncs/packages** directory. **Do not remove any old NEDs** that you want to migrate to the new version or customized NED(s) installed by customer.
   ```
   user$ cd /opt/ncs/packages/
   user$ sudo rm <old packages>.tar.gz
   ```
2. Remove the old symbolic links for the packages in **/var/opt/ncs/packages** directory.
   ```
   user$ cd /var/opt/ncs/packages/
   user$ sudo rm -f *
   ```
3. Extract the content of the T-SDN FP Bundle bin file to the current directory.
   ```
   user$ sh tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee.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.

```
user$ sh tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee.signed.bin --skip-verification
```

4. 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.

```
user$ tar -xvf tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee.tar.gz
```

5. Change to package directory.

```
user$ cd tsdn-7.0.0-nso-6.1.10.20240402.5c0a6ee/standalone/packages
```

6. Copy the T-SDN FP Bundle 7.0.0 packages from the T-SDN tar file to the **/opt/ncs/packages** directory.

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

7. Create soft links to runtime directory for all the packages.

```
user$ cd /var/opt/ncs/packages
user$ sudo ln -s /opt/ncs/packages/*.tar.gz .
```

8. 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.

```
user$ 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.

```
user$ sudo systemctl daemon-reload
```

c. Restart ncs with package-reload option.

```
user$ 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.

9. Verify the status of the packages.

```
user$ ncs_cli -u user
user@ncs> show packages package oper-status
```

10. Migrate device NED only if NED version was upgraded (Optional).

```
user@ncs> config
user@ncs% request devices device <Device_name> migrate new-ned-id cisco- iosxr-cli-<new_NED_version> no-networking
user@ncs% request devices device <Device_name> migrate new-ned-id cisco-ios-cli-<new_NED_version> no-networking
```

11. Sync dispatch map to update with new NED ID (Optional).

```
user@ncs% request devices lsa dispatch-map sync
success true
detail Dispatch Map Synced Successfully
[ok]
```

12. Sync the device to pull the new NED capabilities. For example, the IOS XE CLI NED 6.106 ~~may~~ might have new capabilities ~~over~~ than the earlier version of IOS XE CLI NED. These new capabilities ~~may~~ can introduce a new NSO device configuration from Day0 device configuration. Therefore, you must pull the new changes to bring the device back in-sync with NSO (Optional).

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 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;
                        }
                    }
                }
            }
        }
user@ncs% request devices sync-from device [ XECLI-0 XECLI-1 ]
sync-result {
    device XECLI-0
    result true
}
sync-result {
    device XECLI-1
    result true
}
```

13. *(Optional)* Clean up the old/customized NED packages for the migrated device and reload the packages to remove the old/customized NEDs from NSO only if NED version was upgraded ~~(Optional)~~.

```
user$ rm /var/opt/ncs/packages/ncs-6.1-cisco-ios-6.86.3.tar.gz
user$ rm /var/opt/ncs/packages/ncs-6.1-cisco-iosxr-7.46.3.tar.gz
user$ ncs_cli -u user
user@ncs> request packages reload force
```

14. 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 and other relevant installed TSDN features.**

15. Sync **dispatch-map** and verify the map is populated with the NED ID.

```
user@ncs% request devices lsa dispatch-map sync
success true
detail Dispatch Map Synced Successfully
user@ncs% show devices lsa dispatch-map
dispatch-map <Device_name> {
   ned-id cisco-ios-cli-6.106:cisco-ios-cli-6.106;
…
…
}
```

16. Verify the device configuration and backpointers are correct.

```
user@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;
   }
```

17. Service Reconciliation for IETF-L3VPN-NM only.

Note: This step is only applicable if TSDN 6.0 L3NM service instances have been upgraded

a. Manual Service Re-deploy
   If phased provisioning package is not accessible or the generated phased provisioning task fails, L3 services can be manually re-deployed to generate new L3 plan structure and reconcile internal L3 services. No-networking is advised to prevent additional delay from southbound interactions. Reconcile flag is required for internal L3 services to regain ownership of device config.

   ```
   admin@ncs% request l3vpn-ntw vpn-services vpn-service L3-TEST-SERVICE re-
   deploy no-networking true reconcile
   ```

b. Phased Provisioning Task (for large number of IETF-L3VPN-NM services)
   TSDN 7.0 L3 upgrade component will use the Phase Provisioning feature to automatically configure a task that will automate service re-deploy. **No-networking true** is configured to prevent additional delay from southbound interactions.

   Run Phased Provisioning Task

   ```
   admin@ncs% request phased-provisioning task tsdn_7_0_upgrade_re_deploy run
   result true
   info Task successfully processed.
   ```

   Check Status of Task

   ```
   admin@ncs% run show phased-provisioning task-status
   tsdn_7_0_upgrade_re_deploy
   phased-provisioning task-status tsdn_7_0_upgrade_re_deploy
     state                   in-progress
     current-error-budget    0
     allocated-error-budget 0
     last-runtime            2024-04-15T14:28:36.569897-08:00
     in-progress-nodes /l3nm:l3vpn-ntw/vpn-services/vpn-service{L3-1}
   ```

```
in-progress-nodes /l3nm:l3vpn-ntw/vpn-services/vpn-service{L3NM-PROBES}
completed-nodes /l3nm:l3vpn-ntw/vpn-services/vpn-service{L3-1}
completed-nodes /l3nm:l3vpn-ntw/vpn-services/vpn-service{L3NM-PROBES}.
```

If your phased provisioning task fails due to some error such as **unreachable device**, you can retry the task with the following commands:

Resume Phased Provisioning Task

```
admin@ncs% request phased-provisioning task tsdn_7_0_upgrade_re_deploy
resume
```

OR

Resume Phased Provisioning Task

```
admin@ncs% request phased-provisioning task tsdn_7_0_upgrade_re_deploy
retry-failures
```

Because a phased provisioning task cannot be modified once defined, if subsequent runs of phased provisioning task fail, you ~~may~~ can recreate the phased provisioning task using the following commands

Create a new Phased Provisioning Task

```
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
target /l3vpn-ntw/vpn-services/vpn-service
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
action action-name re-deploy
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
action variable no-networking value true
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
action variable reconcile
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
policy tsdn_7_0_upgrade_policy
admin@ncs% commit
```

Run new Phased Provisioning Task

```
admin@ncs% request phased-provisioning task
tsdn_7_0_upgrade_re_deploy_retry run
result true
info Task successfully processed.
```

18. Display and verify the external plans for services that are in the **reached** state.

```
user@ncs% run show cisco-sr-te-cfp:sr-te odn odn-template-plan
<ODN_Service_Name> plan
user@ncs% run show cisco-sr-te-cfp:sr-te policies policy-plan
<Policy_service_Name> plan
user@ncs% run show l2vpn-ntw vpn-services vpn-service-plan <L2VPN_service_Name>
plan
user@ncs% run show l3vpn-ntw vpn-services vpn-service-plan <L3VPN_service_Name>
plan
```

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

Upgrading NSO T-SDN FP Bundle in the LSA Model

LSA architecture involves CFS node (upper layer) and one or more RFS (lower layer) nodes. Upgrade flow would be:

I. Upgrade NSO to version 6.1.11 on all nodes.

II. Upgrade T-SDN Bundle CFP to version 7.0.0 on RFS nodes.

III. Upgrade T-SDN Bundle CFP to version 7.0.0 on CFS node.

I. Upgrade NSO to version 6.1.11 on all nodes.

1. Stop NSO on all the CFS and RFS nodes.

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

2. Upgrade NSO to version 6.1.11 on the CFS node by performing a system installation of NSO. For more information about how to upgrade NSO, see the ***NSO Installation Guide***.

```
user$ sudo sh nso-6.1.11<OS>.x86_64.installer.bin --system-install
user$ sudo -s
user# cd /opt/ncs
user# rm -f current
user# ln -s ncs-<NEWVERSION> current
```

3. Updating **ncs.conf**.

   a. By default, there is a new **ncs.conf.install** in /opt/ncs/ncs-6.1.11/etc/ncs; user needs to make a copy of this file for the next step below:

   ```
   user$ sudo cp /opt/ncs/ncs-6.1.11/etc/ncs/ncs.conf.install
   /<sample_dir>/ncs.conf_NEW
   ```

   b. Modify the copy of **/opt/ncs/ncs-6.1.11/etc/ncs/ncs.conf.install** and add~~/~~ or append configurations as described in section **Modifying the NCS Configuration File on the Upper-Level Node**

   ```
   user$ sudo vi /<sample_dir>/ncs.conf_NEW
   ```

   c. Replace /etc/ncs/ncs.conf with the modified **/<sample_dir>/ncs.conf_NEW** from previous step:

   ```
   user$ sudo cp /<sample_dir>/ncs.conf_NEW /etc/ncs/ncs.conf
   ```

II. Upgrade T-SDN Bundle CFP to version 7.0.0 on **RFS nodes** and start NSO.

1. Remove the old packages in the **/opt/ncs/packages** directory. **Do not remove the old NEDs** you want to migrate to the new version or customized NED(s) installed by customer.

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

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

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

3. Extract the content of the T-SDN FP Bundle bin file to the current directory.

```
user$ sh tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee.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.

```
user$ sh tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee.signed.bin --skip-verification
```

4. 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.

```
user$ tar -xvf tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee.tar.gz
```

5. Change to package directory.

```
user$ cd tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee/LSA/RFS/packages
```

6. Copy T-SDN FP Bundle 7.0.0 packages for CFS node from the T-SDN tar file to **/opt/ncs/packages** directory.

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

7. Create soft links to runtime directory for all the packages.

```
user$ cd /var/opt/ncs/packages
user$ sudo ln -s /opt/ncs/packages/*.tar.gz .
```

8. Set the **ignore-initial-validation** flag and restart ncs with the package-reload option. 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.

```
user$ sudo systemctl daemon-reload
```

c. Restart ncs with package-reload option.

```
user$ 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.

9. Verify the status of the packages.

```
user$ ncs_cli -u user
user@ncs> show packages package oper-status
```

10. *(Optional)* Migrate NEDs on the RFS node only if NED version was upgraded ~~(Optional)~~.

```
user@ncs% request devices device PIOSXR-0 migrate new-ned-id cisco-iosxr-cli-
7.52 no-networking
```

11. Sync the device to pull the new NED capabilities. For example, the IOS XE CLI NED 6.106 may have new capabilities over the earlier IOS XE CLI NED version. 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 (Optional).

    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. *(Optional)* Clean up the old/customized NED packages for the migrated device and reload the packages to remove the old NEDs from NSO only if NED version was upgraded (~~Optional~~).

```
user$ rm /var/opt/ncs/packages/ncs-6.1-cisco-ios-cli-6.86.3.tar.gz
user$ rm /var/opt/ncs/packages/ncs-6.1-cisco-iosxr-cli-7.46.3.tar.gz
user$ ncs_cli -u user
user@ncs> request packages reload force
```

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 and other relevant installed T-SDN features**.

III. Upgrade T-SDN Bundle CFP to version 7.0.0 on **CFS node** and start NSO.

1. Remove the old packages in the **/opt/ncs/packages** directory.

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

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

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

3. Extract the content of the T-SDN FP Bundle bin file to the current directory.

```
user$ sh tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee.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.

```
user$ sh tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee.signed.bin --skip-verification
```

4. 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.

```
user$ tar -xvf tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee.tar.gz
```

5. Change to package directory.

```
user$ cd tsdn-7.0.0-nso-6.1.11.20240402.5c0a6ee/LSA/CFS/packages
```

6. Copy T-SDN FP Bundle 7.0.0 packages for CFS node from the T-SDN tar file to **/opt/ncs/packages** directory.

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

7. Create soft links to runtime directory for all the packages.

```
user$ cd /var/opt/ncs/packages
user$ sudo ln -s /opt/ncs/packages/*.tar.gz .
```

8. 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.

```
user$ 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.

```
user$ sudo systemctl daemon-reload
```

c. Restart ncs with package-reload option.

```
user$ 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.

9. Verify the status of the packages.

```
user$ ncs_cli -u user
user@ncs> show packages package oper-status
```

10. 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.

```
user@ncs> request devices fetch-ssh-host-keys
user@ncs% request devices lsa dispatch-map sync remote-nso <rfs_node>
success true
detail Dispatch Map Synced Successfully
```

11. 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
```

12. Service Reconciliation for IETF-L3VPN-NM only

Note: This step is only applicable if TSDN 6.0 L3NM service instances have been upgraded.

a. Manual Service Re-deploy.
   If phased provisioning package is not accessible or the generated phased provisioning task fails, L3 services can be manually re-deployed to generate new L3 plan structure and reconcile internal L3 services. No-networking is advised to prevent additional delay from southbound interactions. Reconcile flag is required for internal L3 services to regain ownership of device config.

```
admin@ncs% request l3vpn-ntw vpn-services vpn-service L3-TEST-SERVICE
re-deploy no-networking true reconcile
```

b. Phased Provisioning Task (for large number of IETF-L3VPN-NM services)
   TSDN 7.0 L3 upgrade component will use Phase Provisioning feature to automatically configure a task that will automate service re-deploy. No-networking true is configured to prevent additional delay from southbound interactions.

   Run Phased Provisioning Task

```
admin@ncs% request phased-provisioning task tsdn_7_0_upgrade_re_deploy
run
result true
info Task successfully processed.
```

   Check Status of Task

```
admin@ncs% run show phased-provisioning task-status
tsdn_7_0_upgrade_re_deploy
phased-provisioning task-status tsdn_7_0_upgrade_re_deploy
  state                  in-progress
  current-error-budget   0
  allocated-error-budget 0
  last-runtime           2024-04-15T14:28:36.569897-08:00
  in-progress-nodes /l3nm:l3vpn-ntw/vpn-services/vpn-service{L3-1}
  in-progress-nodes /l3nm:l3vpn-ntw/vpn-services/vpn-service{L3NM-PROBES}
  completed-nodes /l3nm:l3vpn-ntw/vpn-services/vpn-service{L3-1}
  completed-nodes /l3nm:l3vpn-ntw/vpn-services/vpn-service{L3NM-PROBES}.
```

   If your phased provisioning task fails due to some error such as unreachable device, you can retry the task with the following commands:

   Resume Phased Provisioning Task

```
admin@ncs% request phased-provisioning task tsdn_7_0_upgrade_re_deploy
resume
```

   OR

   Resume Phased Provisioning Task

```
admin@ncs% request phased-provisioning task tsdn_7_0_upgrade_re_deploy
retry-failures
```

Because a phased provisioning task cannot be modified once defined, if subsequent runs of phased provisioning task fail, you may recreate the phased provisioning task using the following commands:

Create a new Phased Provisioning Task

```
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
target /l3vpn-ntw/vpn-services/vpn-service
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
action action-name re-deploy
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
action variable no-networking value true
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
action variable reconcile
admin@ncs% set phased-provisioning task tsdn_7_0_upgrade_re_deploy_retry
policy tsdn_7_0_upgrade_policy
admin@ncs% commit
```

Run new Phased Provisioning Task

```
admin@ncs% request phased-provisioning task
tsdn_7_0_upgrade_re_deploy_retry run
result true
info Task successfully processed.
```

The Cisco NSO T-SDN FP Bundle upgrade in LSA model is now complete.

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 v7.0.0 in the LSA HA model.

Do the following on the primary nodes, unless specified as secondary:

1. Disable and shutdown the secondary HA nodes for both the CFS and RFS in the LSA model.

   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 the secondary is displayed. Ignore this message, as this connection is re-established at the end of the upgrade procedure.

2. Stop NSO on both the CFS and RFS nodes.

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

3. Perform the tasks described in section **Upgrading NSO T-SDN FP Bundle in the LSA Model** to upgrade the CFS node and RFS nodes.

4. 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
```

5. Back up all primary CFS and RFS nodes using ncs_backup utility. These backups are for replicating data onto the respective secondary CFS and RFS nodes.

```
user$ sudo /opt/ncs/current/bin/ncs-backup
INFO  Backup /var/opt/ncs/backups/<version>.backup.gz created successfully
```

6. On the secondary nodes, do:

   a. Upgrade NSO on all CFS and RFS nodes by performing a system installation of NSO. For more information on how to upgrade NSO, see the ***NSO documentation***.

   b. Transfer backup files from the primary CFS and RFS nodes into the **/var/opt/ncs/backups/** directories on the respective secondary CFS and RFS nodes.

```
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 all 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 cannot 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 T-SDN package directory.

   ```
   $ cd tsdn-<version>-nso-<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 change 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":["com
mit-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)
```

Appendix C: Using NETCONF NED in T-SDN FP Bundle

Installing and Uninstalling Core Function Packs-IOSXR NC

This section discusses the packages required 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**.

Installing SR-TE CFP-IOSXR NC

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 Core Function Packs on a Single NSO Instance**.

To install SR-TE CFP-IOSXR NC:

1. Obtain and load the NETCONF NED into NCS.
2. Navigate to the directory where the packages are stored.

   ```
   $ cd tsdn-<version>-nso-<version>/standalone/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. Ensure 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
   ```

Post Installation Tasks for SR-TE CFP- IOSXR NC

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

1. Change the current directory to:

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

2. Load-merge the **2_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 2_SR-multi-vendor-iosxr-netconf.xml
admin@ncs% commit
```

3. Verify the dynamic-mapping configuration:

```
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 IETF-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 Core Function Packs on a Single NSO Instance**.

To install L2NM-IOSXR NC:

1. Navigate to the directory where the packages are stored.

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

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

```
sudo cp 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 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~~ Do the post installation tasks.

Post Installation Tasks for IETF-L2VPN-NM-IOSXR NC

Do the following after installing L2NM-IOSXR NC:

1. Change the current directory to:

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

2. ~~Perform~~ Do the following post-installation tasks:

   a. 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
   ```

   b. 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
   ```

   c. 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
   ```

3. Verify the post-installation tasks:

   a. 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;
}
```

b. Verify the status-codes configuration.

```
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_co
des;
    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]
```

c. Verify the plan-notifications configuration.

```
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 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-IOS XE CLI installation requires L3VPN-NM-IOSXR CLI to be installed. For more information, see **Installing Core Function Packs on a Single NSO Instance**.

To install L3VPN-NM-IOSXR NC:

1. Navigate to the directory where the packages are located.
   ```
   $ cd tsdn-<version>-nso-<version>/standalone/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 ensure 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~~ Do the post installation tasks.

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

Do the following after installing L3NM-IOSXR NC:

1. Change the current directory to:
   ```
   $ cd tsdn-<version>-nso-<version>/standalone/bootstrap-data
   ```

2. Perform the following post-installation tasks.
   a. 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
```

   b. 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
```

   c. 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
```

3. Verify the plan-notifications configuration.

```
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]
```

Uninstalling IETF-L2VPN-NM-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. Restart NSO with package reload.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show zombies

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

Uninstalling IETF-L3VPN-NM-IOSXR NC

To uninstall the L3NM-IOSXR NC core function pack, you must first delete the L3NM services with NC NED. Uninstalling this core function pack reverts the system to SR-TE CFP-IOSXR NC flavor.

Before you uninstall 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**.
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% 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-l3vpn-nm-EXAMPLE-<version>.tar.gz /opt/ncs/packages/ncs-<version>-ietf-l3vpn-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. Restart NSO with package reload.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show zombies

$ 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. Restart NSO with package reload.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show zombies

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

Installing and Uninstalling Example Function Packs-IOSXR NC

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 Example Function Packs on a Single NSO Instance**.

To install IETF TE-IOSXR NC:

1. Navigate to the directory that contains the packages.

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

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~~ Do the post installation tasks.

Post Installation Tasks for IETF TE-IOSXR NC

Do the following after installing IETF TE-IOSXR NC:

1. Change the current directory to:

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

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

```
$ ncs_cli -u admin
configure
unhide debug
admin@ncs% load merge 2_IETF-TE-multi-vendor-iosxr-netconf.xml
admin@ncs% commit
```

3. 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;
}
```

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 Example Function Packs**.

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. Restart NSO with package reload.

```
### Make sure user delete all services and devices from TSDN
### Make sure there are no zombie services by running the command: show
zombies

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