



Cisco NSO Transport SDN Function Pack Bundle

Installation Guide

Version 1.0.0

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1 Preface

Abstract

This **Cisco NSO Transport SDN Function Pack Bundle Installation Guide** includes information to help you to install Cisco NSO Transport SDN Function Pack (T-SDN FP) Bundle. This document is applicable to T-SDN FP Bundle version 1.0.0.

Audience

This document is intended for Cisco Advanced Services developers, network engineers, and system engineers to install, configure, and deliver 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

2 Prerequisites

This section outlines the hardware requirements, software requirements, and platform dependencies to install the Cisco Network Service Orchestrator Transport SDN (NSO T-SDN) Function Pack Bundle.

2.1 System Requirements

You must install the Cisco NSO T-SDN FP Bundle version 1.0.0 on NSO version 5.2.2. For more information on NSO, see the ***NSO documentation***.

The following table lists the requirements to successfully install T-SDN FP Bundle v1.0.0.

Item	Requirement
Operating systems	NSO and T-SDN FP Bundle are available for all Linux distributions and supported on the following operating systems: <ul style="list-style-type: none"> • Ubuntu <ul style="list-style-type: none"> ○ v18.04 LTS (Bionic) • CentOS v7.4 • RedHat Linux
Software	<ul style="list-style-type: none"> • Open JDK 11 or higher • Python 3.8 or higher
Ulimit value for NSO	<ul style="list-style-type: none"> • 64000 (minimum)

2.2 Preparing to Install Cisco NSO T-SDN Function Pack Bundle

Install the following on your system before installing the T-SDN FP Bundle:

1. Obtain NSO 5.2.2 installation bin file and follow the steps described in the ***NSO Installation Guide – System Installation*** to install NSO 5.2.2.


```
$ sudo sh nso-5.2.2.linux.x86_64.installer.bin --system-install --non-interactive
```
2. If you are running an earlier instance of NSO, make sure to stop the NSO instance.
3. If an older NSO version is installed, uninstall the older version of the NSO and install NSO 5.2.2.
4. Verify the following:
 - NSO version


```
$ ncs --version
5.2.2
```

- Python version
\$python --version
3.8
 - OpenJDK version
\$Java --version
openjdk 11.0.7
5. Make sure to have:
- **sudo** user privileges to perform the installation. This user must also be part of the **ncsadmin** group.
 - OpenJDK 11 or higher is installed.
 - Python 3.8 or higher is installed. 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** in this documentation.
6. Add the Ulimit level value for NSO and the operation system in **/etc/init.d/ncs** as follows:

```
...
...
ncsdir=/opt/ncs/current
confdir=/etc/ncs
rundir=/var/opt/ncs
logdir=/var/log/ncs

ncs=${ncsdir}/bin/ncs
ulimit -n 64000
prog=ncs
conf="-c ${confdir}/ncs.conf"
heart="--heart"
...
...
```

7. Add the Ulimit value for the operating system. The following is an example to add the Ulimit for the CentOS operating system.
- Edit the **/etc/security/limits.conf** file and add the following lines:


```
soft nproc 65535
hard nproc 65535
soft nofile 65535
hard nofile 65535
hard memlock 65536
soft memlock 65536
```
 - Run the `sysctl -p` script to set the parameters.
 - Log out of the system and log in again to apply the new values.

- Verify the Ulimit values are applied.

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

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

- Add `service-state-changes` to generate notifications for service state changes. You must also set the `<replay-support>` parameter and the `<enabled>` parameter to `true`.

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

- Append the `ncs.conf` file with the `<hide-group>` information for T-SDN FP.

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

- Enable the ssh port for CLI.

```
<cli>
  <enabled>true</enabled>
  <!-- Use the builtin SSH server -->
  <ssh>
    <enabled>true</enabled>
    <ip>0.0.0.0</ip>
    <port>2024</port>
  </ssh>
```

- Enable webui and northbound.

```
<webui>  
  <enabled>true</enabled>  
  <transport>  
    <tcp>  
      <enabled>true</enabled>  
      <ip>0.0.0.0</ip>  
      <port>8080</port>  
    </tcp>
```

```
<netconf-north-bound>  
  <enabled>true</enabled>  
  <transport>  
    <ssh>  
      <enabled>true</enabled>  
      <ip>0.0.0.0</ip>  
      <port>2022</port>  
    </ssh>
```


3 Installing Cisco NSO T-SDN Function Pack Bundle

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

- System Installation
- Local Installation

The system installation, which is for a real time production environment, is the preferred method of installation.

The local installation is the demo version of the installation.

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

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

4 Performing Cisco NSO T-SDN Function Pack Bundle System Installation

The NSO T-SDN FP Bundle system installation allows you to install the SR-TE CFP services and the example function packs. The Cisco SR-TE CFP, which is a productized and supported implementation of SR-TE automation, comprises the Cisco SR-ODN and Cisco SR-Policy services. The example function packs for layer 2 and layer 3 VPNs are intended to be customized for specific requirements.

T-SDN FP Bundle installation provides different installation flavors you can install on top of the SR-TE CFP. To install a flavor, you must copy the required packages for the flavor. You can choose to copy these packages either while installing T-SDN FP Bundle or after you have installed T-SDN FP Bundle. For more information on the installation flavors and the required package categories for each flavor, see [Appendix B: Installation Flavors and Package Requirements](#) in this documentation.

To perform the Cisco NSO T-SDN Function Pack Bundle system installation:

1. Make sure to have performed the tasks mentioned in section [Preparing to Install Cisco NSO T-SDN Function Pack Bundle](#) in this documentation.
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 **nso-5.2.2-tdsn-1.0.0.signed.bin** package from Cisco website and copy it to the host server.
4. Execute the following command to extract the content of the bin file to the current directory.

```
$ sh nso-5.2.2-tdsn-1.0.0.signed.bin
```

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

```
$ sh nso-5.2.2-tdsn-1.0.0.signed.bin --skip-verification
```

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

```
$ tar -xvf nso-5.2.2-TSDN-1.0.0.tar.gz
```

For more information on the packages that are extracted during the installation, see **Appendix B: Installation Flavors and Package Requirements** in this documentation.

6. Go to the packages dir.

```
$cd nso-<NSO-VERSION>-tsdn-<tsdn-RELEASE-VERSION>/core-fp-packages/
```

7. Copy and link the following packages to install SR-TE CFP. The remaining package categories are the categories for the different installation flavors.

```
sudo cp core-fp-packages/ncs-xxx-core-fp-common-xxx.tar.gz  
/opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-core-fp-common-xxx.tar.gz  
/var/opt/ncs/packages/ncs-xxx-core-fp-common-xxx.tar.gz  
sudo cp core-fp-packages/ncs-xxx-core-fp-plan-notif-generator-  
xxx.tar.gz /opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-core-fp-plan-notif-generator-  
xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-plan-notif-  
generator-xxx.tar.gz  
sudo cp core-fp-packages/ncs-xxx-custom-template-utils-xxx.tar.gz  
/opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-custom-template-utils-  
xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-custom-template-utils-  
xxx.tar.gz  
sudo cp core-fp-packages/ncs-xxx-cisco-sr-te-cfp-xxx.tar.gz  
/opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-cisco-sr-te-cfp-xxx.tar.gz  
/var/opt/ncs/packages/ncs-xxx-cisco-sr-te-cfp-xxx.tar.gz  
sudo cp core-fp-packages/ncs-xxx-cisco-iosxr-xxx.tar.gz  
/opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-cisco-iosxr-xxx.tar.gz  
/var/opt/ncs/packages/ncs-xxx-cisco-iosxr-xxx.tar.gz
```

8. To install only SR-TE CFP (which offers the base flavor SR-TE with CLI NEDs), skip to **step 10**.
9. To install one or more installation flavors, copy and link the required packages for the flavor from the **EXAMPLE** folder. For more information on the flavors and the required packages, see **Appendix B: Installation Flavors and Package Requirements** in this documentation.
10. Restart NSO with package reload.

```
[admin@nso-1728-73 core-fp-packages]$ sudo /etc/init.d/ncs restart-  
with-package-reload  
Restarting ncs (via systemctl):  
[OK]
```

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

11. Verify the installation and make sure the packages are up and running. For more information, see section **Verifying Cisco NSO T-SDN Function Pack Bundle System Installation** in this documentation.
12. Perform post installation tasks for T-SDN FP Bundle and any installed flavor. For more information, see chapter **Performing Post Installation Tasks** in this documentation.


```

cisco-sr-te-pce-fp          1.0.0
cisco-sr-te-settings-fp    1.0.0
core-fp-common             1.8.0
core-fp-delete-tag-service 1.0.0
core-fp-plan-notif-generator 1.0.0
custom-template-utils      2.0.0
resource-manager           3.4.0

```

4. Set the NACM rules.

```

admin@ncs% set nacm groups group ncsadmin user-name <user_name>
admin@ncs% commit

```

5. Verify the NACM rules.

```

admin@ncs% show nacm groups group ncsadmin
user-name [ <user_name> private];

```

5.2 Verifying the Installation Flavors

1. Verify the installation for the flavor.

Note: If you installed a service as a standalone flavor, the verification does not display the **cisco-sr-te-cfp** package.

Verifying L2vpn with CLI NED

```

admin@ncs> show packages package package-version | select build-info ncs version | select build-info file | select build-info package sha1 |
NAME          PACKAGE VERSION FILE          SHA1    VERSION UP  ERROR
INFO
-----
cisco-flat-L2vpn-fp    1.0.0  ncs-5.2.2-cisco-flat-L2vpn-fp-EXAMPLE-1.0.0.tar.gz  86af776  5.2.2  X  -
cisco-iosxr-cli-7.24  7.24   ncs-5.2.2-cisco-iosxr-7.24.tar.gz                 3acdfad5 5.2.2  X  -
cisco-sr-te-cfp       1.0.0  ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz             86af776  5.2.2  X  -
core-fp-common        1.8.0  -                                                    -        -    X  -
core-fp-delete-tag-service 1.0.0  ncs-5.2.2-core-fp-delete-tag-service-EXAMPLE-1.0.0.tar.gz 86af776  5.2.2  X  -
core-fp-plan-notif-generator 1.0.0  -                                                    -        -    X  -
custom-template-utils 2.0.0  -                                                    -        -    X  -

[ok][2020-05-01 19:38:41]

```

Verifying L3vpn with CLI NED

```

admin@ncs> show packages package package-version | select build-info ncs version | select build-info file | select build-info package sha1 |
NAME          PACKAGE VERSION FILE          SHA1    VERSION UP  ERROR
INFO
-----
cisco-flat-L3vpn-fp    1.0.0  ncs-5.2.2-cisco-flat-L3vpn-fp-EXAMPLE-1.0.0.tar.gz  86af776  5.2.2  X  -
cisco-iosxr-cli-7.24  7.24   ncs-5.2.2-cisco-iosxr-7.24.tar.gz                 3acdfad5 5.2.2  X  -
cisco-sr-te-cfp       1.0.0  ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz             86af776  5.2.2  X  -
core-fp-common        1.8.0  -                                                    -        -    X  -
core-fp-delete-tag-service 1.0.0  ncs-5.2.2-core-fp-delete-tag-service-EXAMPLE-1.0.0.tar.gz 86af776  5.2.2  X  -
core-fp-plan-notif-generator 1.0.0  -                                                    -        -    X  -
custom-template-utils 2.0.0  -                                                    -        -    X  -

[ok][2020-05-01 19:26:58]

```

Verifying SR-PCE with CLI NED

```
admin@ncs> show packages package package-version | select build-info ncs version | select build-info file | select build-info package sha1 |
NAME          PACKAGE          VERSION  FILE          SHA1          VERSION  UP  ERROR
-----
cisco-iosxr-cli-7.24      7.24      ncs-5.2.2-cisco-iosxr-7.24.tar.gz      3acdfad5 5.2.2  X  -
cisco-sr-te-cfp          1.0.0     ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz 86af776 5.2.2  X  -
cisco-sr-te-pce-fp      1.0.0     ncs-5.2.2-cisco-sr-te-pce-fp-EXAMPLE-1.0.0.tar.gz 86af776 5.2.2  X  -
core-fp-common          1.8.0     -          -          -          -      X  -
core-fp-delete-tag-service 1.0.0     ncs-5.2.2-core-fp-delete-tag-service-EXAMPLE-1.0.0.tar.gz 86af776 5.2.2  X  -
core-fp-plan-notif-generator 1.0.0     -          -          -          -      X  -
custom-template-utils    2.0.0     -          -          -          -      X  -
[ok][2020-05-01 19:41:00]
```

Verifying SR-Settings with CLI NED

```
admin@ncs> show packages package package-version | select build-info ncs version | select build-info file | select build-info package sha1 |
NAME          PACKAGE          VERSION  FILE          SHA1          VERSION  UP  ERROR
-----
cisco-iosxr-cli-7.24      7.24      ncs-5.2.2-cisco-iosxr-7.24.tar.gz      3acdfad5 5.2.2  X  -
cisco-sr-te-cfp          1.0.0     ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz 86af776 5.2.2  X  -
cisco-sr-te-settings-fp  1.0.0     ncs-5.2.2-cisco-sr-te-settings-fp-EXAMPLE-1.0.0.tar.gz 86af776 5.2.2  X  -
core-fp-common          1.8.0     -          -          -          -      X  -
core-fp-plan-notif-generator 1.0.0     -          -          -          -      X  -
custom-template-utils    2.0.0     -          -          -          -      X  -
resource-manager         3.4.0     -          -          -          -      X  -
[ok][2020-05-01 19:43:28]
```

6 Performing Post Installation Tasks

As part of post installation tasks, you must configure plan notifications and the status codes for the services.

This section discusses the post installation tasks you must perform after installing T-SDN FP Bundle.

To perform post installation tasks:

1. Configure plan notifications for your installation flavor. Load merge the **<service>-Notifications.xml** file from **<T-SDN FP>/config** in to NSO as follows:

SR-TE CFP:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
load merge SR-Notifications.xml
commit
```

L2vpn with CLI:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
load merge L2VPN-Notifications.xml
commit
```

L3vpn with CLI

```
ncs_cli -u admin
configure
load merge L3VPN-Notifications.xml
commit
```

SR-PCE with CLI

```
ncs_cli -u admin
configure
load merge SR-PCE-Notifications.xml
commit
```

SR-Settings with CLI

```
ncs_cli -u admin
configure
load merge SR-SETTING-Notifications.xml
commit
```

2. Configure the status codes for your installation flavor. Unhide debug and load merge the **<service>-status-codes.xml** file from **<T-SDN FP>/config** in to NSO as follows:

SR-TE CFP:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
unhide debug
load merge SR-status-codes.xml
commit
```

L2vpn with CLI

```
ncs_cli -u admin
configure
unhide debug
load merge L2VPN-status-codes.xml
commit
```

L3vpn with CLI

```
ncs_cli -u admin
configure
unhide debug
load merge L3VPN-status-codes.xml
commit
```

SR-PCE with CLI

```
ncs_cli -u admin
configure
unhide debug
load merge SR-PCE-status-codes.xml
commit
```

SR-Settings with CLI

```
ncs_cli -u admin
configure
unhide debug
load merge SR-SETTING-status-codes.xml
commit
```

7 Uninstalling Flavors

To uninstall T-SDN FP Bundle, you must first remove the T-SDN FP Bundle services and any devices from the system. Make sure no zombie services are running for the services.

7.1 Uninstalling a Flavor

If you uninstall a flavor other than SR-TE CFP (SR-TE with CLI NEDs), the system continues to render the SR-TE CFP services. This is because all the other flavors are installed on top of SR-TE CFP. However, if you uninstall SR-TE CFP without uninstalling any other flavor, the services rendered by SR-TE CFP are no longer available. In such cases, if the common packages and packages for the flavor are still available, the flavor becomes a standalone flavor.

You must delete the service before uninstalling the flavor for the service.

To uninstall a flavor:

1. Delete the plan notifications for the service you want to uninstall.

L2vpn:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
delete services plan-notifications subscription l2vpn-notif
delete plan-path-for-notification /cisco-flat-L2vpn-fp:flat-L2vpn-
plan
commit
```

L3vpn:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
delete services plan-notifications subscription l3vpn-notif
delete plan-path-for-notification /cisco-flat-L3vpn-fp:flat-L3vpn-
plan
commit
```

PCE:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
delete services plan-notifications subscription se-pce-notif
delete plan-path-for-notification /cisco-sr-te-pce-fp:sr-pce-plan
commit
```

Settings:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
delete services plan-notifications subscription sr-setting-notif
delete plan-path-for-notification /cisco-sr-te-settings-fp:sr-
setting-plan
commit
```

2. Delete the status codes for the service you want to uninstall.

L2vpn:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
unhide debug
delete status-code-cfp L2VPN
delete status-codes core-function-pack L2VPN
commit
```

L3vpn:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
unhide debug
delete status-code-cfp L3VPN
delete status-codes core-function-pack L3VPN
commit
```

PCE:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
unhide debug
delete status-code-cfp SR-PCE
delete status-codes core-function-pack SR-PCE
commit
```

Settings:

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
delete status-code-cfp SR-SETTING
delete status-codes core-function-pack SR-SETTING
commit
```

3. Unlink the packages for the installed flavor installed under **/var/opt/ncs/packages** and delete the packages for the flavor from **/opt/ncs/packages/** directory.

L2vpn:

```
sudo rm -f /opt/ncs/packages/ncs-xxx-cisco-flat-L2vpn-fp-EXAMPLE-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-cisco-flat-L2vpn-fp-EXAMPLE-xxx.tar.gz
```

```
sudo rm -f /opt/ncs/packages/ncs-xxx-core-fp-delete-tag-service-EXAMPLE-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-delete-tag-service-EXAMPLE-xxx.tar.gz
```

L3vpn:

```
sudo rm -f /opt/ncs/packages/ncs-xxx-cisco-flat-L3vpn-fp-EXAMPLE-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-cisco-flat-L3vpn-fp-EXAMPLE-xxx.tar.gz
```

```
sudo rm -f /opt/ncs/packages/ncs-xxx-core-fp-delete-tag-service-EXAMPLE-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-delete-tag-service-EXAMPLE-xxx.tar.gz
```

PCE:

```
sudo rm -f /opt/ncs/packages/ncs-xxx-cisco-sr-te-pce-fp-EXAMPLE-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-cisco-sr-te-pce-fp-EXAMPLE-xxx.tar.gz
```

Settings:

```
sudo rm -f /opt/ncs/packages/ncs-xxx-cisco-sr-te-settings-fp-EXAMPLE-xxx.tar /var/opt/ncs/packages/ncs-xxx-cisco-sr-te-settings-fp-EXAMPLE-xxx.tar
```

```
sudo rm -f /opt/ncs/packages/ncs-xxx-resource-manager-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-resource-manager-xxx.tar.gz
```

4. Stop NSO.

```
$ cd ~
$ ncs --stop
```

5. Restart NSO with package reload option.

```
[admin@nso-1728-73 core-fp-packages]$ sudo
NCS_RELOAD_PACKAGES=force /etc/init.d/ncs restart
Restarting ncs (via systemctl):
[OK]
```

7.2 Uninstalling Cisco NSO T-SDN Function Pack Bundle

Uninstalling T-SDN FP Bundle removes the SR-TE 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.

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

To uninstall Cisco NSO T-SDN Function Pack Bundle:

1. Edit the `/etc/ncs/ncs.conf` as follows:
 - a. Update the python <startup-command> configuration.

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

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

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

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

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

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

- d. Disable the ssh port for CLI as follows, webui, and the northbound notifications as follows:

```
<cli>
  <enabled>true</enabled>
  <!-- Use the builtin SSH server -->
  <ssh>
    <enabled>false</enabled>
    <ip>0.0.0.0</ip>
    <port>2024</port>
  </ssh>

<webui>
  <enabled>true</enabled>
  <transport>
    <tcp>
      <enabled>false</enabled>
      <ip>0.0.0.0</ip>
      <port>8080</port>
    </tcp>

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

  <transport>
    <ssh>
      <enabled>false</enabled>
      <ip>0.0.0.0</ip>
      <port>2022</port>
    </ssh>
```

2. Delete the plan notifications for SR-TE.

```
/opt/ncs/current/bin/ncs_cli -u admin
configure
delete services plan-notifications subscription sr-policy-notif
delete services plan-notifications subscription sr-odn-notif
delete plan-path-for-notification /cisco-sr-te-cfp:sr-te/cisco-sr-
te-cfp-sr-odn:odn/odn-template-plan
delete plan-path-for-notification /cisco-sr-te-cfp:sr-te/cisco-sr-
te-cfp-sr-policies:policies/policy-plan
commit
```

3. Delete status codes for SR-TE.

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

4. Unlink the T-SDN FP Bundle packages in **/var/opt/ncs/packages** and delete the packages from **/opt/ncs/packages/** directory. For more information about packages, see section **Package Categories and Packages** in this documentation.

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) after uninstalling T-SDN FP Bundle.

```
sudo rm -f /opt/ncs/packages/ncs-xxx-core-fp-common-xxx.tar.gz
/var/opt/ncs/packages/ncs-xxx-core-fp-common-xxx.tar.gz

sudo rm -f /opt/ncs/packages/ncs-xxx-core-fp-plan-notif-generator-
xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-plan-notif-
generator-xxx.tar.gz

sudo rm -f /opt/ncs/packages/ncs-xxx-custom-template-utils-
xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-custom-template-utils-
xxx.tar.gz

sudo rm -f /opt/ncs/packages/ncs-xxx-cisco-sr-te-cfp-xxx.tar.gz
/var/opt/ncs/packages/ncs-xxx-cisco-sr-te-cfp-xxx.tar.gz

sudo rm -f /opt/ncs/packages/ncs-xxx-cisco-iosxr-xxx.tar.gz
/var/opt/ncs/packages/ncs-xxx-cisco-iosxr-xxx.tar.gz
```

5. Stop NSO.

```
$ cd ~
$ ncs --stop
```

6. Restart NSO with package reload.

```
[admin@nso-1728-73 core-fp-packages]$ sudo NCS_RELOAD_PACKAGES=force
Restarting ncs (via systemctl): [OK]
```

The T-SDN FP Bundle uninstallation is now complete.

8 Appendix A: Changing Python Startup Command Configuration

Use the information in this section only if you are unable to change the default Python to Python 3. Change the Python startup command configuration after extracting the T-SDN FP Bundle packages during the T-SDN FP Bundle installation. For more information on how to extract the T-SDN FP Bundle packages, see chapter **Performing Cisco NSO T-SDN Function Pack Bundle System Installation** in this documentation.

To change the Python startup command configuration:

1. Navigate to the extracted TSDN package directory.

```
$ cd nso-<NSO-VERSION>-tsdn-<tsdn-RELEASE-VERSION>
```

2. Copy the **start-vm** file.

```
$ mkdir -p /opt/cisco/nso/tsdn
```

```
$ cp ncs-start-python-vm-tsdn /opt/cisco/nso/tsdn/ncs-start-python-vm-tsdn
```

3. Configure the **<start-command>** in **/etc/ncs/ncs.conf** file as follows:

```
</java-vm>
<python-vm>
  <start-command>/opt/cisco/nso/tsdn/ncs-start-python-vm-
    tsdn</start-command>
  <run-in-terminal>
  <terminal-command>DEFAULT</terminal-command>
</run-in-terminal>
  <logging>
  <log-file-prefix>${NCS_LOG_DIR}/ncs-python-vm</log-file-prefix>
  </logging>
</python-vm>
```

Note: If you make any changes to the **ncs.conf** file, restart ncs to apply the changes.

9 Appendix B: Installation Flavors and Package Requirements

The base installation flavor is the SR-TE CFP which comprises SR-TE with CLI NEDs. This flavor is obtained when you perform the T-SDN FP Bundle installation. You can choose to install one or more flavors on top of SR-TE CFP. However, a standalone flavor does not require SR-TE CFP to be installed.

The following topics discuss the package categories, packages, and the installation flavors.

9.1 Package Categories and Packages

The following table lists the package categories and the packages in each category. These packages are extracted during T-SDN FP Bundle installation. For more information on T-SDN FP Bundle installation, see chapter [Performing Cisco NSO T-SDN Function Pack Bundle System Installation](#) in this documentation.

The packages in the **Core Function Pack Packages** group and **NEDs** group are required to install SR-TE CFP. The **Example Packages** comprises the packages for the example function packs you can choose to install.

Group	Package Category	Packages
Core Function Pack Packages	SR-TE CFP Packages	ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz
	T-SDN FP Common Packages	ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz ncs-5.2.1-custom-template-utils-2.0.0.tar.gz ncs-5.2.1-core-fp-common-1.8.0.tar.gz
NEDs	CLI NED	ncs-5.2.2-cisco-iosxr-7.24.tar.gz
Example Packages	L2VPN Example Package	ncs-5.2.2-cisco-flat-L2vpn-fp-EXAMPLE-1.0.0.tar.gz
	L3VPN Example Package	ncs-5.2.2-cisco-flat-L3vpn-fp-EXAMPLE-1.0.0.tar.gz
	SR-Settings Example Package	ncs-5.2.2-cisco-sr-te-settings-fp-EXAMPLE-1.0.0.tar.gz

	SR-PCE Example Package	ncs-5.2.2-cisco-sr-te-pce-fp-EXAMPLE-1.0.0.tar.gz
	Resource Manager for SR-Settings	ncs-5.2.1-resource-manager-3.4.0.tar.gz
	Shared Delete Handler Package for L2/L3 Interfaces	ncs-5.2.2-core-fp-delete-tag-service-EXAMPLE-1.0.0.tar.gz

9.2 Installation Flavors

You can choose to copy the packages for the flavor you want to install either during or after the T-SDN FP Bundle installation process.

The following table displays the installation flavors and the required package categories for each flavor. For more information on the packages in each package category, see section **Package Categories and Packages** in this appendix.

Installation	Flavor	Required package categories and packages
SR-TE	With CLI NEDs	<ul style="list-style-type: none"> ➤ SR-TE CFP Packages – IOSXR CLI <ul style="list-style-type: none"> • ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz ➤ T-SDN FP Common Packages <ul style="list-style-type: none"> • ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz • ncs-5.2.1-custom-template-utils-2.0.0.tar.gz • ncs-5.2.1-core-fp-common-1.8.0.tar.gz ➤ CLI NED <ul style="list-style-type: none"> • ncs-5.2.2-cisco-iosxr-7.24.tar.gz
L2vpn	On SR-TE CFP	<ul style="list-style-type: none"> ➤ The package categories required to install the base flavor (SR-TE CFP), SR-TE with CLI NEDs. <ul style="list-style-type: none"> • ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz • ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz • ncs-5.2.1-custom-template-utils-2.0.0.tar.gz • ncs-5.2.1-core-fp-common-1.8.0.tar.gz • ncs-5.2.2-cisco-iosxr-7.24.tar.gz ➤ L2VPN Example Package – IOSXR CLI <ul style="list-style-type: none"> • ncs-5.2.2-cisco-flat-L2vpn-fp-EXAMPLE-1.0.0.tar.gz ➤ Shared Delete Handler Package for L2/L3 Interfaces <ul style="list-style-type: none"> • ncs-5.2.2-core-fp-delete-tag-service-EXAMPLE-1.0.0.tar.gz

	Standalone	<ul style="list-style-type: none"> ➤ T-SDN FP Common Packages <ul style="list-style-type: none"> • ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz • ncs-5.2.1-custom-template-utils-2.0.0.tar.gz • ncs-5.2.1-core-fp-common-1.8.0.tar.gz ➤ CLI NED <ul style="list-style-type: none"> • ncs-5.2.2-cisco-iosxr-7.24.tar.gz ➤ L2VPN Example Package – IOSXR CLI <ul style="list-style-type: none"> • ncs-5.2.2-cisco-flat-L2vpn-fp-EXAMPLE-1.0.0.tar.gz ➤ Shared Delete Handler Package for L2/L3 Interfaces <ul style="list-style-type: none"> • ncs-5.2.2-core-fp-delete-tag-service-EXAMPLE-1.0.0.tar.gz
L3vpn	On SR-TE CFP	<ul style="list-style-type: none"> ➤ The package categories required to install the base flavor (SR-TE CFP), SR-TE with CLI NEDs. <ul style="list-style-type: none"> • ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz • ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz • ncs-5.2.1-custom-template-utils-2.0.0.tar.gz • ncs-5.2.1-core-fp-common-1.8.0.tar.gz • ncs-5.2.2-cisco-iosxr-7.24.tar.gz ➤ L3VPN Example Package – IOSXR CLI <ul style="list-style-type: none"> • ncs-5.2.2-cisco-flat-L3vpn-fp-EXAMPLE-1.0.0.tar.gz ➤ Shared Delete Handler Package for L2/L3 Interfaces <ul style="list-style-type: none"> • ncs-5.2.2-core-fp-delete-tag-service-EXAMPLE-1.0.0.tar.gz
	Standalone	<ul style="list-style-type: none"> ➤ T-SDN FP Common Packages <ul style="list-style-type: none"> • ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz • ncs-5.2.1-custom-template-utils-2.0.0.tar.gz • ncs-5.2.1-core-fp-common-1.8.0.tar.gz ➤ CLI NED <ul style="list-style-type: none"> • ncs-5.2.2-cisco-iosxr-7.24.tar.gz ➤ L3VPN Example Package – IOSXR CLI <ul style="list-style-type: none"> • ncs-5.2.2-cisco-flat-L3vpn-fp-EXAMPLE-1.0.0.tar.gz ➤ Shared Delete Handler Package for L2/L3 Interfaces <ul style="list-style-type: none"> • ncs-5.2.2-core-fp-delete-tag-service-EXAMPLE-1.0.0.tar.gz
SR-Settings	On SR-TE CFP	<ul style="list-style-type: none"> ➤ The package categories required to install the base flavor (SR-TE CFP), SR-TE with CLI NEDs. <ul style="list-style-type: none"> • ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz • ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz • ncs-5.2.1-custom-template-utils-2.0.0.tar.gz • ncs-5.2.1-core-fp-common-1.8.0.tar.gz • ncs-5.2.2-cisco-iosxr-7.24.tar.gz

		<ul style="list-style-type: none"> ➤ SR-Settings Example Package – IOSXR CLI <ul style="list-style-type: none"> • ncs-5.2.2-cisco-sr-te-settings-fp-EXAMPLE-1.0.0.tar.gz ➤ Resource Manager for SR-Settings <ul style="list-style-type: none"> • ncs-5.2.1-resource-manager-3.4.0.tar.gz
	Standalone	<ul style="list-style-type: none"> ➤ T-SDN FP Common Packages <ul style="list-style-type: none"> • ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz • ncs-5.2.1-custom-template-utils-2.0.0.tar.gz • ncs-5.2.1-core-fp-common-1.8.0.tar.gz ➤ CLI NED <ul style="list-style-type: none"> • ncs-5.2.2-cisco-iosxr-7.24.tar.gz ➤ SR-Settings Example Package – IOSXR CLI <ul style="list-style-type: none"> • ncs-5.2.2-cisco-sr-te-settings-fp-EXAMPLE-1.0.0.tar.gz ➤ Resource Manager for SR-Settings <ul style="list-style-type: none"> • ncs-5.2.1-resource-manager-3.4.0.tar.gz
SR-PCE	On SR-TE CFP	<ul style="list-style-type: none"> ➤ The package categories required to install the base flavor (SR-TE CFP), SR-TE with CLI NEDs. <ul style="list-style-type: none"> • ncs-5.2.2-cisco-sr-te-cfp-1.0.0.tar.gz • ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz • ncs-5.2.1-custom-template-utils-2.0.0.tar.gz • ncs-5.2.1-core-fp-common-1.8.0.tar.gz • ncs-5.2.2-cisco-iosxr-7.24.tar.gz ➤ SR-PCE Example Package - IOSXR CLI <ul style="list-style-type: none"> • ncs-5.2.2-cisco-sr-te-pce-fp-EXAMPLE-1.0.0.tar.gz
	Standalone	<ul style="list-style-type: none"> ➤ T-SDN FP Common Packages <ul style="list-style-type: none"> • ncs-5.2.1-core-fp-plan-notif-generator-1.0.0.tar.gz • ncs-5.2.1-custom-template-utils-2.0.0.tar.gz • ncs-5.2.1-core-fp-common-1.8.0.tar.gz ➤ CLI NED <ul style="list-style-type: none"> • ncs-5.2.2-cisco-iosxr-7.24.tar.gz ➤ SR-PCE Example Package - IOSXR CLI <ul style="list-style-type: none"> • ncs-5.2.2-cisco-sr-te-pce-fp-EXAMPLE-1.0.0.tar.gz

The following example details the sequence of tasks to install the L2VPN example service with the CLI NEDs flavor and as a standalone flavor. The procedure is similar for other services/flavors.

Note: After copying the packages, be sure to restart NSO with package reload and to verify the installation. For more information, see chapter **Performing Cisco NSO T-SDN Function Pack Bundle System Installation** in this documentation.

Example: L2VPN example services

To install L2VPN example service on SR-TE CFP

1. Copy the packages required for SR-TE CFP (SR-TE with CLI NEDs) in the **SR-TE CFP Packages – IOSXR CLI, T-SDN FP Common Packages, and CLI NED** package categories.

```
sudo cp core-fp-packages/ncs-xxx-core-fp-common-xxx.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-xxx-core-fp-common-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-common-xxx.tar.gz
sudo cp core-fp-packages/ncs-xxx-core-fp-plan-notif-generator-xxx.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-xxx-core-fp-plan-notif-generator-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-plan-notif-generator-xxx.tar.gz
sudo cp core-fp-packages/ncs-xxx-custom-template-utils-xxx.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-xxx-custom-template-utils-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-custom-template-utils-xxx.tar.gz
sudo cp core-fp-packages/ncs-xxx-cisco-sr-te-cfp-xxx.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-xxx-cisco-sr-te-cfp-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-cisco-sr-te-cfp-xxx.tar.gz
sudo cp core-fp-packages/ncs-xxx-cisco-iosxr-xxx.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-xxx-cisco-iosxr-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-cisco-iosxr-xxx.tar.gz
```

2. Copy the packages for the L2vpn example service in the **L2VPN Example Package – IOSXR CLI** package category.

```
sudo cp example-packages/ncs-xxx-cisco-flat-L2vpn-fp-EXAMPLE-xxx.tar.gz /opt/ncs/packages/
sudo ln -s /opt/ncs/packages/ncs-xxx-cisco-flat-L2vpn-fp-EXAMPLE-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-cisco-flat-L2vpn-fp-EXAMPLE-xxx.tar.gz
```

3. Copy the packages in the **Shared Delete Handler Package for L2/L3 Interfaces** package category.

```
sudo cp example-packages/ncs-xxx-core-fp-delete-tag-service-xxx.tar.gz /opt/ncs/packages/  
  
sudo ln -s /opt/ncs/packages/ncs-xxx-core-fp-delete-tag-service-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-delete-tag-service-xxx.tar.gz
```

To install L2VPN example service as a standalone

1. Copy the packages in the **T-SDN FP Common Packages** package category.

```
sudo cp core-fp-packages/ncs-xxx-core-fp-common-xxx.tar.gz /opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-core-fp-common-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-common-xxx.tar.gz  
sudo cp core-fp-packages/ncs-xxx-core-fp-plan-notif-generator-xxx.tar.gz /opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-core-fp-plan-notif-generator-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-plan-notif-generator-xxx.tar.gz  
sudo cp core-fp-packages/ncs-xxx-custom-template-utils-xxx.tar.gz /opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-custom-template-utils-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-custom-template-utils-xxx.tar.gz
```

2. Copy the packages in the **CLI NED** package category.

```
sudo cp core-fp-packages/ncs-xxx-cisco-iosxr-xxx.tar.gz /opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-cisco-iosxr-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-cisco-iosxr-xxx.tar.gz
```

3. Copy the packages in the **L2VPN Example Package – IOSXR CLI** package category.

```
sudo cp example-packages/ncs-xxx-cisco-flat-L2vpn-fp-EXAMPLE-xxx.tar.gz /opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-cisco-flat-L2vpn-fp-EXAMPLE-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-cisco-flat-L2vpn-fp-EXAMPLE-xxx.tar.gz
```

4. Copy the packages in the **Shared Delete Handler Package for L2/L3 Interfaces** package category.

```
sudo cp example-packages/ncs-xxx-core-fp-delete-tag-service-xxx.tar.gz /opt/ncs/packages/  
sudo ln -s /opt/ncs/packages/ncs-xxx-core-fp-delete-tag-service-xxx.tar.gz /var/opt/ncs/packages/ncs-xxx-core-fp-delete-tag-service-xxx.tar.gz
```

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