Discovery 7: Migrate a CDM Device

Introduction

In this activity, you will learn how to migrate a device and its service data to a new NED ID. After completing this activity, you will be able to:

- Migrate a CDM device to a different NED.
- Update an existing service in order for it to work in a new NED.

Required Resources

The following resources and equipment are required for completing the activities in this lab guide:

- PC or laptop with a web browser
- Access to the Internet

Job Aids

The following job aid is available to help you complete the lab activities:

- This lab guide
- Student guide for general explanations

The following table contains passwords that you might need.

Device	User Name	Password
NSO server	student	1234QWer
NSO application	admin	admin

Command Syntax Reference

This lab guide uses the following conventions for command syntax:

Formatting	Description and Examples
show running config	Commands in steps use this formatting.
Example	Type **show running config**
Example	Use the **name** command.
`show running config`	Commands in CLI outputs and configurations use this formatting.
highlight	CLI output that is important is highlighted.
Example	`student@student-vm:~$ ncs --version` `5.8.2.1`
Example	Save your current configuration as the default **startup config**. `Router Name copy running startup`
brackets ([ ])	Indicates the optional element. You can choose one of the options.
Example:	`(config-if) frame-relay lmi-type {ansi|cisco|q933a}`
italics font	Arguments for which you supply values.
Example	Open file **ip tcp window-size** *bytes*
angle brackets (<>)	In contexts that do not allow italics, arguments for which you supply values are enclosed in angle brackets [<>]. Do not type the brackets when entering the command.
Example	If the command syntax is **ping** <*ip_address*>, you enter ping *192.32.10.12*
string	A non-quoted set of characters. Type the characters as-is.
Example	(config) **hostname MyRouter**
vertical line (|)	Indicates that you enter one of the choices. The vertical line separates choices. Do not type the vertical line when entering the command.
Example	If the command syntax is **show ip route|arp**, you enter either **show ip route** or **show ip arp**, but not both.

Command List

The following are the most common commands that you will need:

Linux Shell:

Command	Comment
source /home/student/nso-5.8/ncsrc	Source NSO environmental variables.
ls|ll	Display contents of the current directory.

Command	Comment
cd	Move directly to user home directory.
cd ..	Exit the current directory.
cd test	Move into folder "test," which is a subfolder of the current directory.
cd /home/student/test	Move into folder "test" by specifying direct path to it, starting from the root of directory system.
ncs_cli -Cu admin	Log in to NSO CLI directly from local server.

NSO CLI:

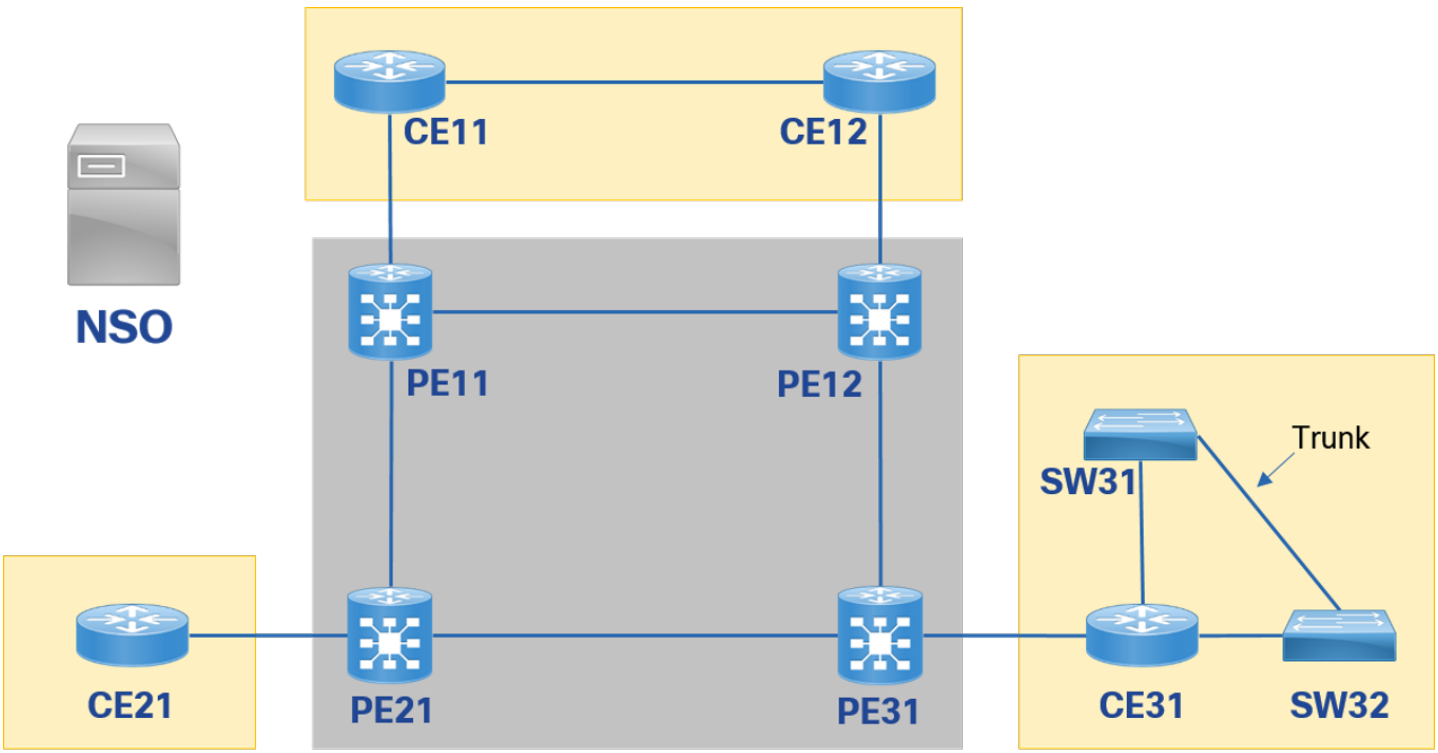
Command	Comment
switch cli	Change CLI style.
show ?	Display all command options for current mode.
configure	Enter configuration mode.
commit	Commit new configuration (configuration mode only command).
show configuration	Display new configuration that has not yet been committed (configuration mode only command).

Lab Topology Information

Your lab session is your own personal sandbox. Whatever you do in your session will not be reflected in anyone else's session. There are two topologies. The general one is your lab environment, and it has your workstation and a Linux server. On the Linux server within that topology is your second topology with your NSO installation, together with numerous netsim routers and switches that are logically grouped into a network topology. This network will be the one that you will orchestrate with your NSO.

- The network topology is designed to cover both the service provider and enterprise use cases. It is a simulated netsim network; devices have no control or data plane. Devices will, however, accept or reject a configuration sent by the NSO, just as real devices would.

Topology



Visual Objective

Task 1: Deploy a NetFlow Service and Migrate a NED

In this task, you will deploy a NetFlow service to a Cisco IOS device and examine the implications of a NED migration.

The final solutions for all labs, including this one, are located in the ~/solutions directory. You can use them for copy-pasting longer pieces of code and as a reference point for troubleshooting your packages.

Activity

Complete these steps:

Step 1

Connect to the NSO Linux server by clicking on the NSO server icon and open the Terminal by clicking the icon on the bottom bar.

```
student@student-vm:~$
```

Step 2

Connect to the NSO CLI.

```
student@student-vm:~$ ncs_cli -Cu admin

admin connected from 127.0.0.1 using console on student-vm
admin@ncs
```

Step 3

Make sure that the device CE40 is using an older version of the Cisco IOS NED – *cisco-ios-cli-6.21*.

```
admin@ncs show devices list
NAME  ADDRESS    DESCRIPTION  NED ID              ADMIN STATE
-----------------------------------------------------------------
CE40  127.0.0.1  -            cisco-ios-cli-6.21  unlocked
```

Step 4

Exit the NSO CLI.

```
admin@ncs exit
student@student-vm:~$
```

Step 5

Copy the *netflow* package from the */packages* directory to NSO running directory and compile the package using the **make** command.

```
student@student-vm:~$ cp -r packages/netflow nso-run/packages
student@student-vm:~$ cd nso-run/packages/netflow/src
student@student-vm:~/nso-run/packages/netflow/src$ make
mkdir -p ../load-dir
/home/student/nso-5.8/bin/ncsc  `ls netflow-ann.yang  > /dev/null 2>&1 && echo "-a netflow-
ann.yang"` \
              -c -o ../load-dir/netflow.fxs yang/netflow.yang
```

Step 6

Open the *netflow.yang* file and inspect the YANG model.

This is how the contents of the file should look when you open it. You can see that the package is used to model a service, that export NetFlow data to a specific destination.

```
student@student-vm:~/nso-run/packages/netflow/src$ cat yang/netflow.yang
module netflow {
  namespace "http://cisco.com/example/netflow";
  prefix netflow;

  import ietf-inet-types {
    prefix inet;
  }
  import tailf-ncs {
    prefix ncs;
  }
  import tailf-common {
    prefix tailf;
  }
```

```
  augment /ncs:services {
    list netflow {
      description "Export NetFlow service";
      key device;

      uses ncs:service-data;
      ncs:servicepoint "netflow";

      leaf device {
        tailf:info "Device to export NetFlow data from";
        type leafref {
          path "/ncs:devices/ncs:device/ncs:name";
        }
      }

      leaf destination {
        tailf:info "Address to export NetFlow data to";
        type inet:ipv4-address;
      }
    }
  }
}
```

Step 7

Connect to the NSO CLI.

```
student@student-vm:~/nso-run/packages/netflow/src $ ncs_cli -Cu admin

admin connected from 127.0.0.1 using console on student-vm
admin@ncs
```

Step 8

Reload the packages.

```
admin@ncs packages reload
>>> System upgrade is starting.
>>> Sessions in configure mode must exit to operational mode.
>>> No configuration changes can be performed until upgrade has completed.
>>> System upgrade has completed successfully.
reload-result {
    package cisco-ios-cli-6.21
    result true
}
reload-result {
    package netflow
    result true
}
admin@ncs
System message at 2022-09-08 14:56:01...
    Subsystem stopped: ncs-dp-7-cisco-ios-cli-6.21:IOSDp
admin@ncs
System message at 2022-09-08 14:56:01...
    Subsystem started: ncs-dp-10-cisco-ios-cli-6.21:IOSDp
admin@ncs
```

Step 9

Deploy the netflow service to device CE40. Use the address 10.100.0.1 as the destination.

```
admin@ncs config
Entering configuration mode terminal
admin@ncs(config) services netflow CE40 destination 10.100.0.1
```

Step 10

Inspect a dry run of the commit for changes.

```
admin@ncs(config-netflow-CE40) commit dry-run
cli {
    local-node {
        data  devices {
                  device CE40 {
                      config {
                          ip {
                              flow-export {
                                  source {
             +                        GigabitEthernet 1/0;
                                  }
             +                    version 5;
                                  destination {
             +                        ip 10.100.0.1;
                                  }
                              }
                          }
                          interface {
             +                GigabitEthernet 1/0 {
             +                }
                          }
                      }
                  }
              }
              services {
             +    netflow CE40 {
             +        destination 10.100.0.1;
             +    }
              }
    }
}
```

Step 11

Commit the changes and exit the NSO CLI.

```
admin@ncs(config-netflow-CE40) commit
Commit complete.
admin@ncs(config-netflow-CE40) end
admin@ncs exit
student@student-vm:~/nso-run/packages/netflow/src$
```

Step 12

You will now migrate the CE40 device from the old NED ID to a new one (cisco-ios-cli-6.85). Copy the NED from the ~/neds directory to the NSO running directory.

```
student@student-vm:~/nso-run/packages/netflow/src$ cp -r $HOME/neds/cisco-ios-cli-6.85 $HOME/
nso-run/packages
student@student-vm:~/nso-run/packages/netflow/src$
```

Step 13

Connect to the NSO CLI and reload the packages.

You will notice that the netflow package cannot be reloaded now. The conflict occurs in the netflow package template, because the new NED apparently handles the netflow configuration differently than the old one.

```
student@student-vm:~/nso-run/packages/netflow/src $ ncs_cli -Cu admin

admin connected from 127.0.0.1 using console on student-vm
admin@ncs packages reload

>>> System upgrade is starting.
>>> Sessions in configure mode must exit to operational mode.
>>> No configuration changes can be performed until upgrade has completed.
>>> System upgrade has completed successfully.
reload-result {
    package cisco-ios-cli-6.21
    result true
}
reload-result {
    package cisco-ios-cli-6.85
    result true
}
reload-result {
    package netflow
    result false
    info netflow-template.xml:12 the tag: version is different for ned-ids: cisco-ios-
cli-6.21:cisco-ios-cli-6.21, cisco-ios-cli-6.85:cisco-ios-cli-6.85
}
admin@ncs
System message at 2022-09-08 15:38:45...
    Subsystem stopped: ncs-dp-15-cisco-ios-cli-6.21:IOSDp
admin@ncs
System message at 2022-09-08 15:38:45...
    Subsystem started: ncs-dp-17-cisco-ios-cli-6.21:IOSDp
admin@ncs
System message at 2022-09-08 15:38:45...
    Subsystem started: ncs-dp-18-cisco-ios-cli-6.85:IOSDp
admin@ncs *** ALARM package-load-failure: netflow-template.xml:12 the tag: version is
different for ned-ids: cisco-ios-cli-6.21:cisco-ios-cli-6.21, cisco-ios-cli-6.85:cisco-ios-
cli-6.85
admin@ncs
```

Step 14

Observe the differences between two NEDs by using the **dry run** of the **migrate** command. Find the changes that happen for the Netflow configuration.

```
admin@ncs devices migrate device [ CE40 ] old-ned-id cisco-ios-cli-6.21 new-ned-id cisco-ios-
cli-6.85 verbose dry-run
migrate-result {
    device CE40
    result true
}
modified-path {
    path /ios:spd/headroom
```

```
    info leaf/leaf-list type has changed
}
modified-path {
    path /ios:transceiver/type/all/monitoring/interval
    info leaf/leaf-list type has changed from uint16 to uint32
}

...
...

modified-path {
    path /ios:platform/punt-policer/rate
    info leaf/leaf-list type has changed
}
modified-path {
    path /ios:foobar
    info sub-tree has been deleted
}
admin@ncs
```

There are many changes between the two device model versions. To find the changes that affect the Netflow configuration, you have to interpret the package reload error message from the previous step first:

```
netflow-template.xml:12 the tag: version is different for ned-ids: cisco-ios-cli-6.21:cisco-
ios-cli-6.21, cisco-ios-cli-6.85:cisco-ios-cli-6.85
```

The error message tells you that there is an error in the line 12 of the configuration template netflow-template.xml. This is related to **flow-export** configuration, so you may select only the lines that are starting with **<flow-export>** XML tag, as defined in the configuration template:

```
01 <?xml version="1.0"?>
02 <config-template xmlns="http://tail-f.com/ns/config/1.0"
         servicepoint="netflow">
03  <devices xmlns="http://tail-f.com/ns/ncs">
04    <device>
05      <name>{/device}</name>
06      <config>
07        <ip xmlns="urn:ios">
08          <flow-export>
09            <source>
10              <GigabitEthernet>1/0</GigabitEthernet>
11            </source>
12            <version>5</version>
13            <destination>
14              <ip>{/destination}</ip>
15            </destination>
16          </flow-export>
17        </ip>
18        <interface xmlns="urn:ios">
19          <GigabitEthernet>
20            <name>1/0</name>
21          </GigabitEthernet>
22        </interface>
23      </config>
24    </device>
25  </devices>
26 </config-template>
```

Step 15

Run the dry-run of the migrate command again, with an additional condition "**begin flow-export**," which will display lines beginning with a line that includes "flow-export" statement.

```
admin@ncs devices migrate device [ CE40 ] old-ned-id cisco-ios-cli-6.21 new-ned-id cisco-ios-
cli-6.85 verbose dry-run | begin flow-export | more
    path /ios:ip/flow-export/destination/ip
    info leaf is now a list key
}
modified-path {
    path /ios:ip/flow-export/destination/port
    info leaf is now a list key
}
modified-path {
    path /ios:ip/flow-export/destination
    info node type has changed from non-presence container to list
}
modified-path {
    path /ios:ip/flow-export/version
    info node type has changed from leaf to non-presence container
}
modified-path {
    path /ios:ip/ssh/client/algorithm/encryption
    info leaf/leaf-list type has changed
}
modified-path {
    path /ios:ip/ssh/client/algorithm/mac
    info leaf/leaf-list type has changed
}
...

modified-path {
    path /ios:ip/icmp/rate-limit/unreachable/DF
    info sub-tree has been deleted
}
modified-path {
--More-- [64]
```

The "destination" node has been changed from a non-presence container to a list and the "version" node has been changed from a leaf to a non-presence container. Also "ip" and "port" nodes have been modified. These changes are usually incompatible with the older configuration.

You can abort further output by issuing the CTRL+C key combination.

Step 16

Display the full device configuration with the addition of service metadata, which shows you the number of backpointers to existing services.

```
admin@ncs show running-config devices device CE40 config ip flow-export | display xml |
display service-meta-data
<config xmlns="http://tail-f.com/ns/config/1.0">
  <devices xmlns="http://tail-f.com/ns/ncs">
    <device>
      <name>CE40</name>
      <config>
        <ip xmlns="urn:ios">
          <flow-export>
            <source>
              <GigabitEthernet refcounter="1" >1/0</GigabitEthernet>
            </source>
```

```
            <version refcounter="1" >5</version>
            <destination>
              <ip refcounter="1" >10.100.0.1</ip>
            </destination>
          </flow-export>
        </ip>
      </config>
    </device>
  </devices>
</config>
admin@ncs
```

Step 17

Migrate the device to the new NED ID. This time without the dry-run parameter. To have the least amount of service downtime as possible, you should also use the no-networking parameter, which prevents any southbound communication to the devices. This means that the CDB and the devices will be out of sync for the time being, until the affected services are fixed, redeployed, and the device configuration is synchronized.

As an alternative approach to the CDM device migration, you can prepare and update the service in advance, to avoid going out of sync. This requires an additional device that already uses the newer version of the NED, which allows you to create the configuration template for the updated service.

```
admin@ncs devices migrate device [ CE40 ] old-ned-id cisco-ios-cli-6.21 new-ned-id cisco-ios-
cli-6.85 no-networking
migrate-result {
    device CE40
    result true
}
modified-path {
    path /ios:spd/headroom
    info leaf/leaf-list type has changed
}
modified-path {
    path /ios:transceiver/type/all/monitoring/interval
    info leaf/leaf-list type has changed from uint16 to uint32
}
modified-path {
    path /ios:platform/punt-policer/rate
    info leaf/leaf-list type has changed
}

...

modified-path {
    path /ios:foobar
    info sub-tree has been deleted
}
admin@ncs
```

Step 18

Verify that the CE40 device is using the cisco-ios-cli-6.85 NED.

```
admin@ncs show devices list
NAME  ADDRESS    DESCRIPTION  NED ID              ADMIN STATE
------------------------------------------------------------
CE40  127.0.0.1  -            cisco-ios-cli-6.85  unlocked
admin@ncs
```

Activity Verification

You have completed this task when you attain the following result:

- The CE40 device is using the cisco-ios-cli-6.85 NED.

Task 2: Update the Service After NED Migration

In this task, you will update the existing service for it to work on both NED versions.

Activity

Complete these steps:

Step 1

Examine the device configuration for service backpointers again.

The configuration elements in which the change occurred are no longer linked back to the service. The only remaining backpointer is the one on the "source" element. The version node was also removed because it has a different structure now, which is not compatible with the previous one.

```
admin@ncs config
Entering configuration mode terminal
admin@ncs(config) show full-configuration devices device CE40 config ip flow-export | display
xml | display service-meta-data
<config xmlns="http://tail-f.com/ns/config/1.0">
  <devices xmlns="http://tail-f.com/ns/ncs">
    <device>
      <name>CE40</name>
      <config>
        <ip xmlns="urn:ios">
          <flow-export>
            <source>
              <GigabitEthernet refcounter="1">1/0</GigabitEthernet>
            </source>
          </flow-export>
        </ip>
      </config>
    </device>
  </devices>
</config> admin@ncs(config)
```

Step 2

Configure the missing configuration for NetFlow data exporting on device CE40, which now uses a new NED. The destination now required a version in a new format, and a destination port. Use the default 2055 port. Display the changes using the dry-run commit parameter.

```
admin@ncs(config) devices device CE40 config ip flow-export destination 10.100.0.1 2055
admin@ncs(config-config) ip flow-export version 5
admin@ncs(config-config) commit dry-run outformat xml
result-xml {
    local-node {
        data <devices xmlns="http://tail-f.com/ns/ncs">
               <device>
                 <name>CE40</name>
                 <config>
                   <ip xmlns="urn:ios">
                     <flow-export>
                       <version>
```

```
                        <version>5</version>
                      </version>
                      <destination>
                        <ip>10.100.0.1</ip>
                        <port>2055</port>
                      </destination>
                    </flow-export>
                  </ip>
                </config>
              </device>
            </devices>
    }
}
admin@ncs(config-config)
```

Step 3

Do not commit the changes and exit the NSO CLI.

```
admin@ncs(config-config) abort
admin@ncs exit
student@student-vm:~/nso-run/packages/netflow/src$
```

Step 4

You will now modify the XML template to support both versions of the NED. Since both versions use the "urn:ios" namespace, you will have to make the distinction as to which version of a NED to use for which part of the configuration. Open the XML template.

```
student@student-vm:~/nso-run/packages/netflow/src$ code ../templates/netflow-template.xml
```

Step 5

You can use the *<?if-ned-id?>* template processing instructions to set the configuration for a specific NED. Add an instruction for the old cisco-ios-cli-6.21 NED for the existing flow-export configuration and add another instruction for the new cisco-ios-cli-6.85 NED configuration, a combination of migrated changes and dry-run.

```
<?xml version="1.0"?>
<config-template xmlns="http://tail-f.com/ns/config/1.0" servicepoint="netflow">
  <devices xmlns="http://tail-f.com/ns/ncs">
    <device>
      <name>{/device}</name>
      <config>
        <ip xmlns="urn:ios">
          <flow-export>
            <source>
              <GigabitEthernet>1/0</GigabitEthernet>
            </source>
            <?if-ned-id cisco-ios-cli-6.21:cisco-ios-cli-6.21?>
              <version>5</version>
              <destination>
                <ip>{/destination}</ip>
              </destination>
            <?elif-ned-id cisco-ios-cli-6.85:cisco-ios-cli-6.85?>
              <version>
                <version>5</version>
              </version>
              <destination>
                <ip>{/destination}</ip>
                <port>2055</port>
```

```
            </destination>
           <?end?>
         </flow-export>
       </ip>
       <interface xmlns="urn:ios">
         <GigabitEthernet>
           <name>1/0</name>
         </GigabitEthernet>
       </interface>
     </config>
   </device>
 </devices>
</config-template>
```

Step 6

Save the file.

Step 7

Enter NSO CLI and reload the packages.

No error should be present now for the netflow package.

```
student@student-vm:~/nso-run/packages/netflow/src$ ncs_cli -Cu admin

admin connected from 127.0.0.1 using console on student-vm
admin@ncs packages reload
reload-result {
    package cisco-ios-cli-6.21
    result true
}
reload-result {
    package cisco-ios-cli-6.85
    result true
}
reload-result {
    package netflow
    result true
}
admin@ncs
System message at 2022-09-08 16:34:23...
    Subsystem stopped: ncs-dp-17-cisco-ios-cli-6.21:IOSDp
admin@ncs
System message at 2022-09-08 16:34:23...
    Subsystem stopped: ncs-dp-18-cisco-ios-cli-6.85:IOSDp
admin@ncs
System message at 2022-09-08 16:34:23...
    Subsystem started: ncs-dp-20-cisco-ios-cli-6.21:IOSDp
admin@ncs
System message at 2022-09-08 16:34:23...
    Subsystem started: ncs-dp-21-cisco-ios-cli-6.85:IOSDp
```

Step 8

Synchronize the CDB configuration to the CE40 device and re-deploy the netflow service.

```
admin@ncs devices device CE40 sync-to
result true
admin@ncs services netflow CE40 re-deploy
admin@ncs
System message at 2022-09-08 16:36:46...
```

```
Commit performed by admin via ssh using cli.
admin@ncs
```

Re-deploy action will evaluate if any of the configuration elements of the service are missing on the CE40 device and add them to the device configuration again.

Step 9

Verify the configuration of the re-deployed netflow service.

```
admin@ncs show running-config devices device CE40 config ip flow-export | display xml
<config xmlns="http://tail-f.com/ns/config/1.0">
  <devices xmlns="http://tail-f.com/ns/ncs">
    <device>
      <name>CE40</name>
      <config>
        <ip xmlns="urn:ios">
          <flow-export>
            <source>
              <GigabitEthernet>1/0</GigabitEthernet>
            </source>
            <version>
              <version>5</version>
            </version>
            <destination>
              <ip>10.100.0.1</ip>
              <port>2055</port>
            </destination>
          </flow-export>
        </ip>
      </config>
    </device>
  </devices>
</config>
admin@ncs
```

Activity Verification

You have completed this task you attain the following result:

- The netflow service has been successfully redeployed using the new cisco-ios-cli-6.85 NED.