Openflow Enabled Firmware Update on CoreDirector CI Switch

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This deliverable documents the installation of Openflow enabled firmware on a Ciena CoreDirector CI Multi-service switch at University of Nebraska- Lincoln.

OVERVIEW

The CoreDirector CI Switch can deliver a wide range of optical capacities , along with Ethernet switching capabilities. The switch supports SONET as well as SDH interfaces, specifically, OC-3/12/STM-1/4, OC-48/STM-16, OC-192/STM-64 optical interfaces, STM-1e electrical interfaces and Gigabit Ethernet interfaces. They provide nonblocking, bidirectional switching capacity that can be configured to switch and groom traffic from any input port to any output port down to the STS-1/VC-3 level. The Openflow standard is designed to realize the concept of Software defined networks. Openflow is a specification that enables programmable networks at campus level.

Establishing Dynamic Circuit Network (DCN) is currently implemented in Internet2 by using the software components On-Demand Secure Service and Advance Reservation System (OSCARS)[8] and Dynamic Resource Allocation via GMPLS Optical Networks (DRAGON)[9] across various domains and technologies.

 OSCARS is a networking service deployed in the DoE ESnet to create dynamic, deterministic and secure circuits across the ESnet network. MPLS [7] and RSVP [6] are the key protocols used to create advance reservations of andwidth using the software components developed as part of OSCARS project. DRAGON was a NSF funded project to dynamically provision network resources across various domains and across heterogeneous networking technologies. GMPLS [10] is the key protocol used to create circuits spanning across both optical and Ethernet domain and hence DRAGON creates a Layer 1 virtual circuit. By making making the CoreDirector CI switch, which is capable of Optical Switching, Openflow enable d, a circuit switch can be controlled by Openflow.

BACKGROUND

As stated in [1], Openflow is an open interface that allows users such as researchers or network administrators to control a network remotely. By deploying Openflow interface implementation, users can control the forwarding of tables on network components such as switches, routers and network

access points. The ability to control the network comes through an external Openflow controller system being able to control the network switches through a secure channel connection to the network switches. The Openflow controller can be programmed according the requirement.[1]

With the deployment of Openflow on CoreDirector Switch, the switch can be controlled programmatically through a Openflow controller connected to the switch.

REQUIRED TOOLS

The Ciena Core Director at UNL is now being upgraded with Openflow enabled firmware.

The procedure includes: loading the software on the File Transfer Protocol (FTP) server, and upgrading the CoreDirector Network Element (NE) software.

- A Laptop Personal Computer (PC) running Windows 7 has been used. Laptop or Personal computer (PC) running Windows NT®, Windows 2000®, or Windows XP® can also be used. Following software should be available on the Laptop or Personal Computer (PC) being used:
  - Ciena CoreDirector Node Manager software that corresponds to the currently installed CoreDirector software release. The Core Director at UNL was running Version 5.2.6.
  - Ciena CoreDirector Node Manager software that corresponds to the CoreDirector software upgrade release. The Core Director at UNL is upgraded to Openflow capable Version 6.1.1.
  - HyperTerminal application or equivalent. Note: Windows 7 no more has HyperTerminal as an in built feature. It has to be downloaded in case the PC runs Windows 7.
  - FTP server application or equivalent (such as wftpd32.exe or equivalent). wftp FTP software has been used. The wftp FTP software is available at http://www.texis.com.

- Cables to physically connect from the Laptop or the PC to the Core Director node
  - 9-pin to 25-pin RS-232 serial cable (DB-9F to DB-25M straight cable) for connection to the Core Director node.

Note: Most of the newly manufactured computers do not have the 9-pin RS-232 port. So, we must use an USB to DB-9M adapter. Using this adapter we connected to the DB-9F to DB-25M straight cable. The DB-9F to DB-25M straight cable was in turn connected to the Core Director node.

USER PREREQUISITES

- The user must be able to log on to the CoreDirector Node Manager software.
- The user must have Administrator privileges account to access the CoreDirector Switch software.

- The user must be a registered system user with a valid user name and password to log in to the Command Line Interface (CLI).
- The entire upgrade is done by logging on to the telnet connection session.

OVERVIEW OF THE SOFTWARE UPDATE ON THE CORE DIRECTOR

1) Load Software on FTP Server

- Copy the CoreDirector software upgrade file to the Software Release directory of the FTP server on the laptop computer.
- Start the FTP server application.

2) Copy and Save Current Installation Settings

- Log on through hyper terminal, with the super user username and password:

  Username: superuser

  Password: ***********

- From the CoreDirector CM CLI Menu, type the option number to **Display the current install settings** and press **Enter**. This would save the current installation settings.
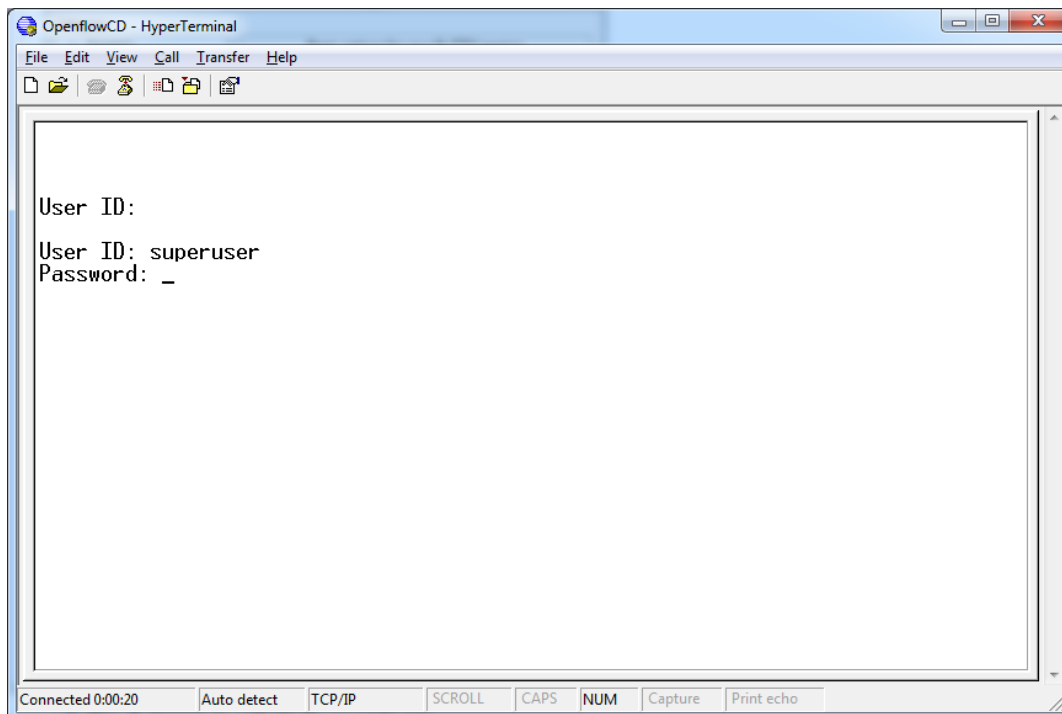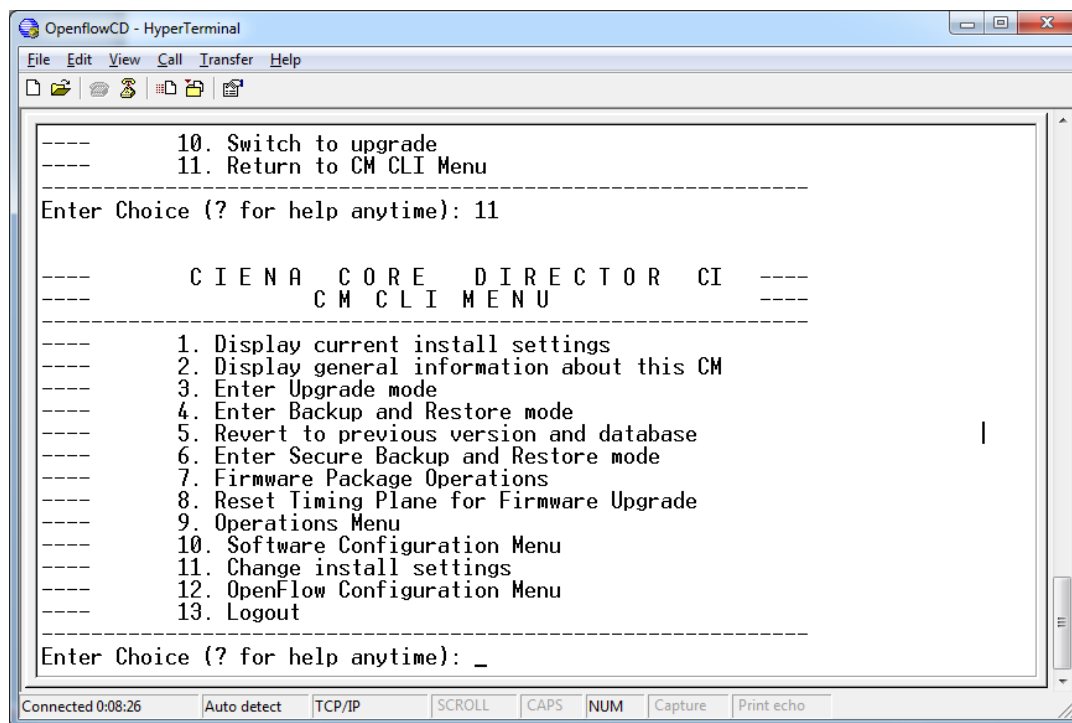
Figure 1

```
OpenflowCD - HyperTerminal
File  Edit  View  Call  Transfer  Help

----        10. Switch to upgrade
----        11. Return to CM CLI Menu
-------------------------------------------------------------
Enter Choice (? for help anytime): 11


----     C I E N A   C O R E    D I R E C T O R    C I   ----
----            C M  C L I  M E N U                      ----
-------------------------------------------------------------
----        1. Display current install settings
----        2. Display general information about this CM
----        3. Enter Upgrade mode
----        4. Enter Backup and Restore mode
----        5. Revert to previous version and database           |
----        6. Enter Secure Backup and Restore mode
----        7. Firmware Package Operations
----        8. Reset Timing Plane for Firmware Upgrade
----        9. Operations Menu
----        10. Software Configuration Menu
----        11. Change install settings
----        12. OpenFlow Configuration Menu
----        13. Logout
-------------------------------------------------------------
Enter Choice (? for help anytime): _

Connected 0:08:26    Auto detect    TCP/IP    SCROLL   CAPS   NUM   Capture   Print echo
```

Figure 2

3) Take backup of the CoreDirector Database

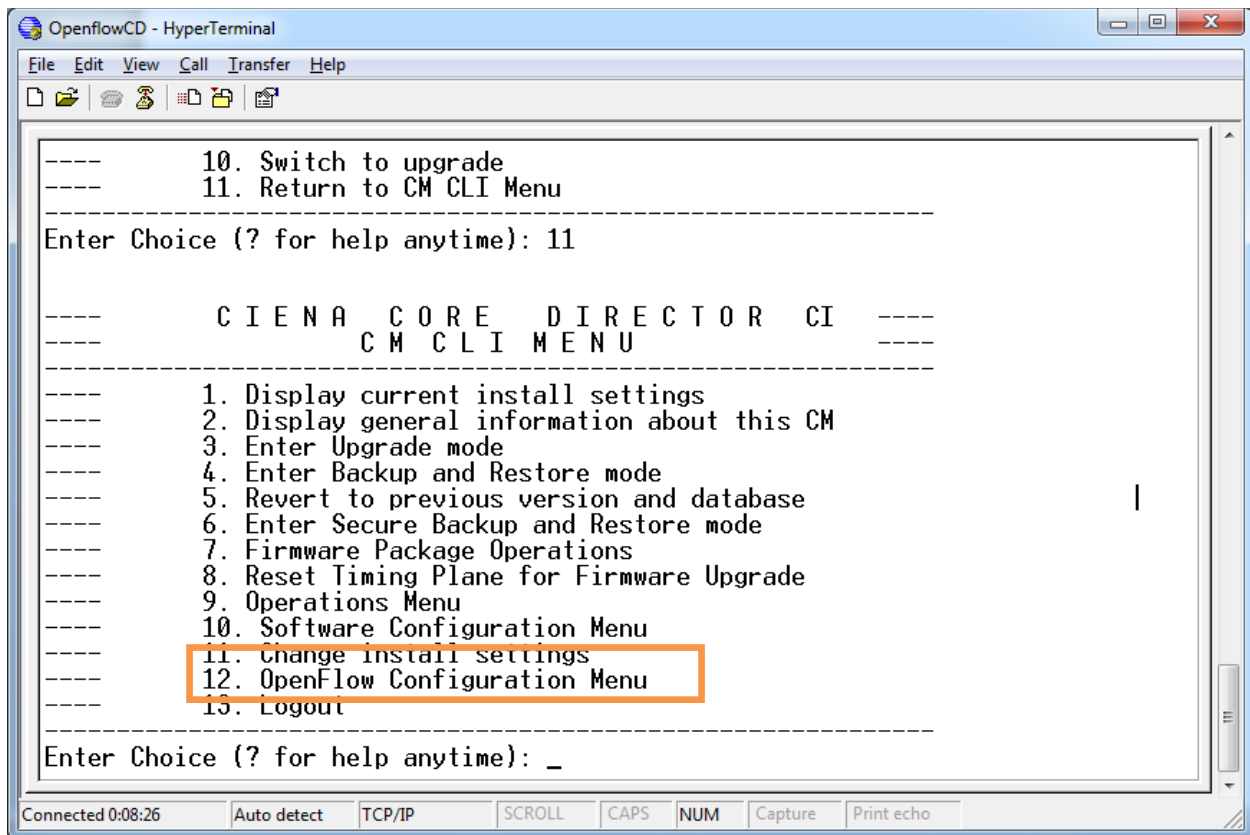## 4) Upgrade CoreDirector NE Software

- From the node's CLI(command line interface) Menu, type the option number to Enter Upgrade mode and press Enter. The Upgrade Menu is displayed.
- From the Upgrade Menu, type the option number to Download and process a new load and press Enter. The Transfer Software Load menu is displayed.
- From the Transfer Software Load Menu, type the option number to Specify the IP Address of the FTP site and press Enter. The FTP site may be a PC or laptop. The IP address of the laptop being used is specified as the IP address in our case.
- After giving the IP address of the FTP server, we load the file on to the switch, Unarchive the file and validate the load.
- Return to upgrade menu.
- From the Upgrade Menu, type the option number to List available software versions and press Enter.
- Type the option number to Select version to upgrade to and press Enter.
- Type the version for upgrade and press Enter.

- Type the option number to Start upgrade and press Enter. Once the upgrade is done, Type the option number to Switch to the upgrade and press Enter.

The upgrade is complete.

CONCLUSION

Now, the Ciena coredirector CI switch is Openflow enabled. The capability of the switch to switch and groom traffic down to a granularity of STS-1/VC-3 level can be controlled by an Openflow controller. After the firmware update, the Openflow Configuration option in the menu is present through command line interface (figure 3).

Figure 3

ACKNOWLEDGEMENTS

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References

[1] Openflow: Enabling Innovation in Campus Networks, Openflow white paper, March 14 2008.

[2] Coredirector CI Multiservice Switch Maintenance and Upgrade Guide (R5.2.6)

[3] CI Multiservice Switch Node Manager User Guide (R5.2.6)

[4] Openflow project page, http://www.openflow.org/wk/index.php/Main_Page

[5] Nox Controller project site, http://noxrepo.org/wp/

[6] RFC3477, http://www.ietf.org/rfc/rfc3477.txt

[7] RFC3031, http://www.ietf.org/rfc/rfc3031.txt

[8] ESnet OSCARS project website, http://www.es.net/oscars/

[9] DRAGON Project website, http://dragon.maxgigapop.net/twiki/bin/view/DRAGON/Network

[10] RFC3471, http://www.ietf.org/rfc/rfc3471.txt