Northwest State
Community College

Networking in the PLC/Industrial Computing Lab

Upon completion of this lab procedure, the student should be able to:

1. Execute the Command Prompt for networking commands
2. Change the font within the Command Prompt application
3. Determine the IP, MAC and Subnet addresses on a network cark with Command Prompt.
4. Ping another computer to determine if there can be communications
5. Explain the purpose of the different networks in the Industrial Computing lab
6. Determine where the IP addresses are issued from for different network cards

*This lab should be performed in the PLC lab (E101), another computer lab, or on the student's virtual machine.

Part 1: Determining where the IP addresses are coming from for the network modules.

1. The computers in the Industrial Computing lab have two network cards. One is internal, which as the blue network cable connected to it, and the other is an extra network card that was inserted into the computer. This one has a black cable connected to it. The black cable network is internal to the room, and is not used for accessing the internet. The network with the blue cable does allow connectivity to the internet. It also has a network printer connected to it so students can print documents.
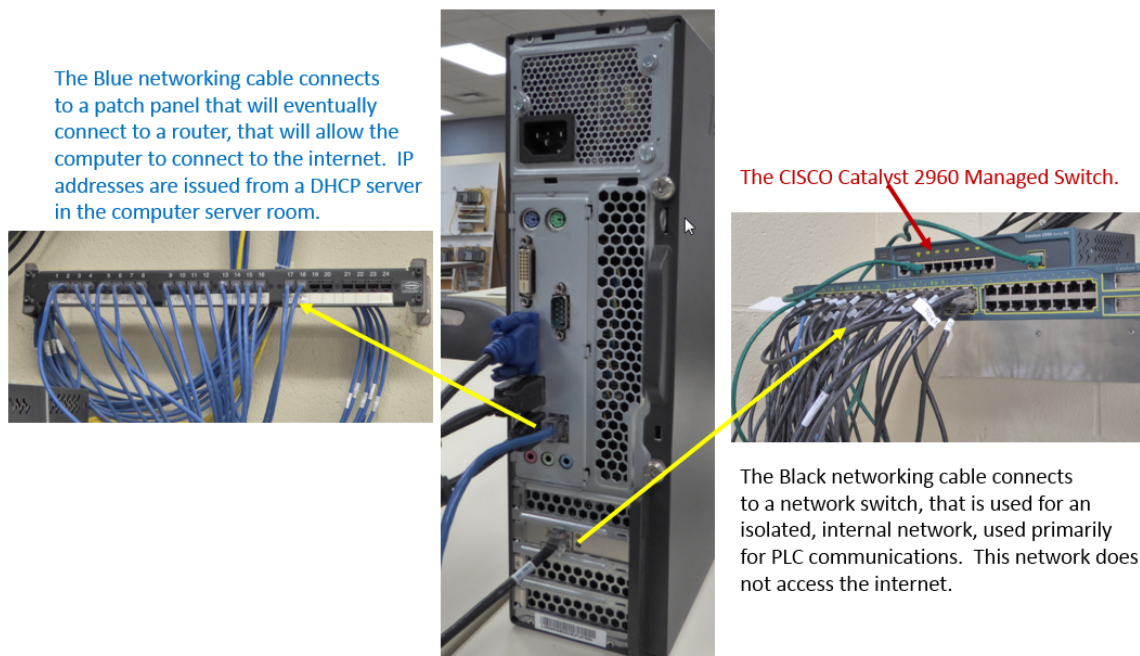

The Blue networking cable connects to a patch panel that will eventually connect to a router, that will allow the computer to connect to the internet. IP addresses are issued from a DHCP server in the computer server room.

The CISCO Catalyst 2960 Managed Switch.

The Black networking cable connects to a network switch, that is used for an isolated, internal network, used primarily for PLC communications. This network does not access the internet.

Figure 1. The two networks connected to each computer in the PLC lab.

2. The purpose of the dual network system is to allow the lab computers to get on the internet (blue network) for all of the courses, in order to find information required in the courses or for student learning. The "lab only" network (black wire network) allows the users to connect a PLC and VFDs to a network with the computers, similar to what they will find in an industrial environment. Since there are two network modules (network interface module, or NICs) in each computer, each module must have its own IP address, MAC address, and subnet address.

3. The Information Technology department at NSCC has locked down the computers in the labs, so the instructors and the students cannot change their network settings, since the wrong settings could blank out or stop the network from working. This is one of the reasons for going to virtual machines for the students. In the virtual machine, the settings of the network adapters (modules) can be changed. This was covered in another lab. The other way is to bring in laptop computer that is not locked down, and someone with Administrative rights on the computer can change the network module settings. It is important to understand that a student's laptop should never be connected to either network in the Industrial Computing lab. Only college computers should connect to a wired network.

4. To get to the network commands, the user must go to the Command Prompt. Start by clicking the Windows Start button (Step 1), and typing in CMD into the text field, and press Enter (Step 2). Change the font to a larger size by right clicking on the top portion of the Command Prompt window, and choosing properties (Step 3). Choose the font size that you feel comfortable with (Step 4). In the Command Prompt, type: ipconfig /all, and press Enter (Step 5).
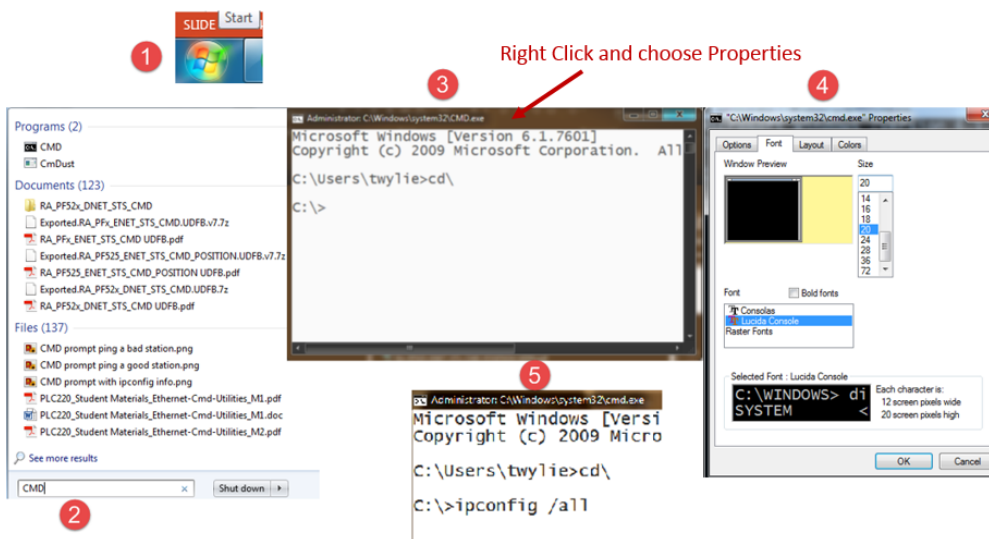

Figure 2. Changing the font in the Command Prompt window.

5. The images shown below is the results of an IPCONFIG on one of the student computers in the Industrial Computing lab. There are two Ethernet adapters. Ethernet adapter local area Connection 2 is for the blue wire network, and the Ethernet adapter Local Area Connection (bottom of screen) is for the black wire network.


```
C:\Windows\system32\cmd.exe

Ethernet adapter Local Area Connection 2:

   Connection-specific DNS Suffix  . : northweststate.edu
   Description . . . . . . . . . . . : Realtek PCIe GBE Family Controller #2
   Physical Address. . . . . . . . . : C8-9C-DC-D6-BB-73
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv4 Address. . . . . . . . . . . : 10.2.240.202(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Monday, October 02, 2017 12:03:32 PM
   Lease Expires . . . . . . . . . . : Tuesday, October 03, 2017 12:03:32 PM
   Default Gateway . . . . . . . . . : 10.2.240.1
   DHCP Server . . . . . . . . . . . : 10.1.1.49
   DNS Servers . . . . . . . . . . . : 10.1.1.188
                                       10.1.1.189
   Primary WINS Server . . . . . . . : 10.1.1.188
   NetBIOS over Tcpip. . . . . . . . : Enabled

Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Realtek PCIe GBE Family Controller
   Physical Address. . . . . . . . . : 00-13-3B-0E-E3-41
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv4 Address. . . . . . . . . . . : 192.168.101.103(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Monday, October 02, 2017 12:03:27 PM
   Lease Expires . . . . . . . . . . : Wednesday, January 10, 2018 12:03:27 PM
   Default Gateway . . . . . . . . . :
   DHCP Server . . . . . . . . . . . : 192.168.101.1
   NetBIOS over Tcpip. . . . . . . . : Enabled

C:\Users\student>
```

Figure 3. Results of doing an IPCONFIG/ All command.

Notice the following addresses for the black wire network is:
IP Address – 192.168.101.103
MAC Address – 00-13-3B-0E-E3-41
Subnet Mask – 255.255.255.0

6. After doing an IPCONFIG on the computer you are on, what is the following?

    IP Address –

MAC Address –

Subnet Mask -

7. Where do the IP Addresses come from?
The computers on the Blue Wire network gets their IP addresses from a DHCP server in the server room at NSCC. This IP address will allow the user to get on the internet and browse the world wide web.   The computer network modules on the Black Wire network will get their IP addresses from the Cisco Catalyst 2960 box that sits on the large Cisco switch where the black Ethernet cables are plugged into. The Catalyst 2960 is a managed switch that has an internal DHCP service built into it. The IT department has configured this to allocated IP addressees from 172.168.101.100 to 172.168.101.254. This will leave the range of addresses from 172.168.101.2 to 172.168.101.99 open for PLCs and other automation devices.

Part 2: Pinging another Computer Network Module:

1. The next important thing is to determine if your computer can communicate with another computer's network module. In this example, the user does a ping command to the IP address they wish to communicate with (192.168.101.103). Notice on the 2nd graphic, the computer sent out 4 requests to IP address 192.168.101.103, and got for replies in 2 milli-seconds or less. The TTL on the right is a parameter. TTL stands for Time To Live, which is how long the packet will exist on the network before it disappears. In this case, the TTL is 128 milli-seconds. This is the same thing a Technician does to an Ethernet PLC, before they try to setup a communication driver to it. They will do a ping, to see if they can communicate with it.

```
C:\>ping 192.168.101.103
```

Figure 4. How to Ping an IP address.

```
C:\>ping 192.168.101.103

Pinging 192.168.101.103 with 32 bytes of data:
Reply from 192.168.101.103: bytes=32 time=2ms TTL=128
Reply from 192.168.101.103: bytes=32 time<1ms TTL=128
Reply from 192.168.101.103: bytes=32 time<1ms TTL=128
Reply from 192.168.101.103: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.101.103:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Figure 5. Results of a successful PING.

2. Identify a user in the Industrial Computing lab and find out the IP address for the Black Wire network. Do a Ping command to that station. Does it look similar to the image shown above?

3. Now do a ping to a network device that you are sure is not on a network. In this example, address 192.168.101.20 is not on the network, so the ping command could not find it. Notice that all 4 requests for communications failed.

```
C:\>ping 192.168.101.20
```

```
C:\>ping 192.168.101.20

Pinging 192.168.101.20 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.101.20:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Figure 6. Results of an unsuccessful PING.

4. Try pinging the same address with your computer to see if you achieve the same results as shown above.

This concludes this lab procedure.

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