Lab 5.2.3b Building a Basic Routed WAN

Objective

- Create a simple routed wide-area network (WAN) with two PCs, two switches or hubs, and two routers
- Identify the proper cables to connect a PC and router to each switch
- Identify the proper cables to connect the routers to form a WAN link
- Configure workstation IP address information
- Test connectivity using the **ping** command

Background / Preparation

This lab focuses on the ability to connect two simple LANs, each consisting of a workstation and a switch or hub, to form a basic router-to-router WAN. A router is a networking device that can be used to interconnect LANs which routes packets between different networks using Layer 3 IP addressing. Routers are typically used to connect the Internet.

In addition to the physical and data link connections, which are Layers 1 and 2, the computers and routers must also be configured with the correct IP network settings, which is Layer 3, so that they can communicate. Straight-through patch cables are used to connect each PC and router to its switch or hub. Two special V.35 cables are used to create the simulated WAN link between the routers.

Note: The two routers need to be preconfigured by the instructor or lab assistant to have the correct IP addresses on their LAN and WAN interfaces. Router A will provide the clocking signal as DCE.

Start this lab with the equipment turned off and with cabling disconnected. Work in teams of two with one person per LAN. The following resources will be required:

- Two workstations with an Ethernet 10/100 NIC installed

- Two Ethernet 10BaseT or Fast Ethernet switches or two hubs

- Two routers with an RJ-45 Ethernet or Fast Ethernet interface (or an AUI interface) and at least one serial interface.

- 10BASE-T AUI transceiver (DB-15 to RJ-45) for a router with an AUI Ethernet interface, which is a 2500 Series

- Four Ethernet straight-through cables for connecting the workstations and routers to the hub or switch

- One female (DCE) and one male (DTE) V.35 cable for interconnecting the routers

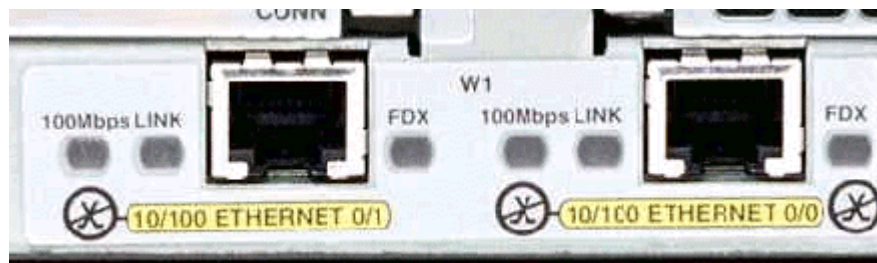## Step 1 Identify and connect the proper Ethernet cable from the PC to the switch

a. The connection between the PC and the switch will be accomplished using a Category 5 or 5e straight-through patch cable. Attach one end to the NIC and the other end to a port on the switch or hub. Be sure to examine the cable ends carefully and select only a straight-through cable.

b. Examine the switch or hub.

What is the model number of the switch or hub?

Answers will vary depending on switch model. Example: Cisco WS-C2924M-XL-EN

Step 2 Identify the Ethernet or Fast Ethernet interfaces on the routers

a. Examine the routers.

b. What is the model number of the Router A?

Answers will vary depending on router model. Example: Cisco 2501, Cisco 2621

c. What is the model number of the Router B?

Answers will vary depending on router model. Example: Cisco 2501, Cisco 2621

d. Locate one or more RJ-45 connectors on each router labeled "10/100 Ethernet" as shown below. The identifier may vary depending on the type of router used; a 2600 series router is shown. A 2500 series router will have an AUI DB-15 Ethernet port labeled "AUI 0". These will require a 10Base-T transceiver to connect to the RJ-45 cable.

e. Identify the Ethernet ports that could be used for connecting the routers. Record the information below. Record the AUI port numbers when working with a Cisco 2500 series router.

Answers will vary depending on model number of the Cisco 2500 series router.

Router	Port	Port
Router A	AUI 0	AUI 1
Router B	AUI 0	AUI 1

Step 3 Cable the router LAN links

a. Router configuration

The routers should be preconfigured by the instructor or lab assistant so that the Ethernet 0 interface on each router has the proper IP address and subnet mask as indicated in the table below. This will allow the routers to route packets between local-area networks 192.168.1.0 and 192.168.2.0.

Router	E0 Interface IP Address	Subnet mask
Router – A	192.168.1.1	255.255.255.0
Router – B	192.168.2.1	255.255.255.0

b. Connecting the cables

The connection between the router and the hub or switch will be accomplished using a Category 5 straight-through patch cable. Locate a patch cable that is long enough to reach from the router to the hub. Be sure to examine the cable ends carefully and select only straight-through cables. Connect the Ethernet interface that uses the 0 (zero) designation on the router to a port on the hub or switch. If connecting to 2500 series routers, use the 10BASE-T AUI transceiver.

Step 4 Verify the physical Ethernet connections

a. Plug in and turn on the computers, switches/hubs and routers. To verify the connections, insure that the link lights on the both PC NICs, both switch/hub interfaces and router Ethernet interfaces are lit. Are all link lights lit? Yes If not, check connections and cable types.

Step 5 Identify the serial interfaces on the router

a. Examine the routers.

b. Identify the serial ports on each router that could be used for connecting the routers to simulate a WAN link. Record the information below. If there is more than one serial interface, use Interface 0 on each router.

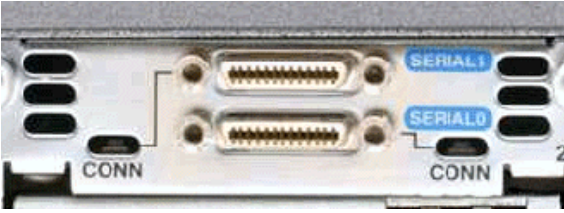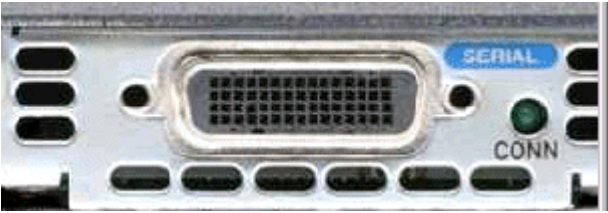Answers will vary depending on model number of the Cisco router.

Router Name	Router Serial Port	Router Serial Port
Router A	Serial 0 or Serial 0/0	Serial 1 or Serial 0/1
Router B	Serial 0 or Serial 0/0	Serial 1 or Serial 0/1

Step 6 Identify and locate the proper V.35 cables

    a.   Next, inspect the serial cables available in the lab. Depending on the type of router and/or serial card, the router may have different connectors.

    b.   Router serial port characteristics

The two most common types are the DB-60 connector and the smart serial. Using the table below indicate which type routers that are being used.

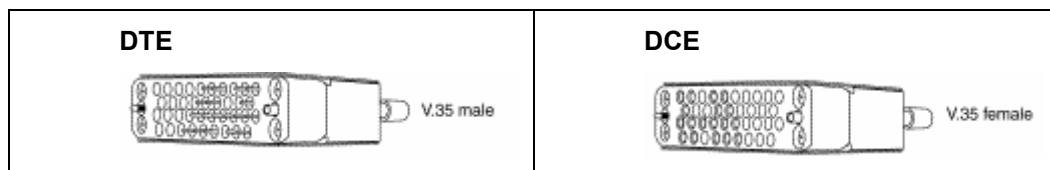Answers will vary depending on model number of the Cisco router.

Router	Smart Serial	DB60
RTR A	☐	☐
RTR B	☐	☐

    c.   Simulating the WAN link - DCE / DTE and Clocking

Since this will not be through a live lease line, one of the routers will need to provide the clocking for the circuit. This is normally provided to each of the routers by a DCE device such as a CSU/DSU. To provide this clocking signal, one of the routers will need a DCE cable instead of the normal DTE that is used on the other router. Therefore, the connection between routers needs to be done using one DCE cable and one DTE cable between routers. A V.35 DCE cable and a V.35 DTE cable will be used to simulate the WAN connection.

    d.   V. 35 cable characteristics

The V.35 DCE connector is a large female V.35 (34-pin) connector. The DTE cable has a large male V.35 connector. The cables are also labeled as DCE or DTE on the router end of the cable. Use the DCE cable on Router A since it will be providing the clock signal.

DTE	DCE
V.35 male	V.35 female

Step 7 Cable the router WAN link

a. Router configuration

Router A should be preconfigured by the instructor or lab assistant to provide the DCE clock signal on the Serial 0 interface. The Serial 0 interface on each router should have the proper IP address and subnet mast as indicated in the table below. The network interconnecting the router serial interfaces is 192.168.3.0.

Router	Clocking	S0 Interface IP Address	Subnet mask
Router – A	DCE	192.168.3.1	255.255.255.0
Router – B	DTE	192.168.3.2	255.255.255.0

b. Connecting the cables

The DCE cable will attach to the Serial 0 interface on Router A. The DTE cable should be attached to the Serial 0 interface on Router B. First make the connection between the two V.35 cables. There is only one proper way for the cables to fit together. Align the pins on the male cable with the sockets on the female cables and gently couple them. When they are joined, turn the thumbscrews clock-wise to secure the connectors.

Make the connection to each of the routers. Holding the connector in one hand, properly orient the cable connector and the router connecter so that the tapers match. Push the cable connector partially into the router connector and tighten the thumb screws to fully insert the cable into the connector.

Step 8 Configure Workstation IP settings

Note: Be sure to write down the existing IP settings so that they can be restored at the end of the lab. These include IP address, subnet mask, default gateway, and DNS servers. If the workstation is a DHCP client, it is not necessary to record this information.

Access the IP Settings window.

Windows 95 / 98 / ME/ users should do the following:

- Click on **Start** > **Settings** > **Control Panel** and then click the **Network** icon.

- Select the TCP/IP protocol icon that is associated with the NIC in this PC and click on **Properties**.

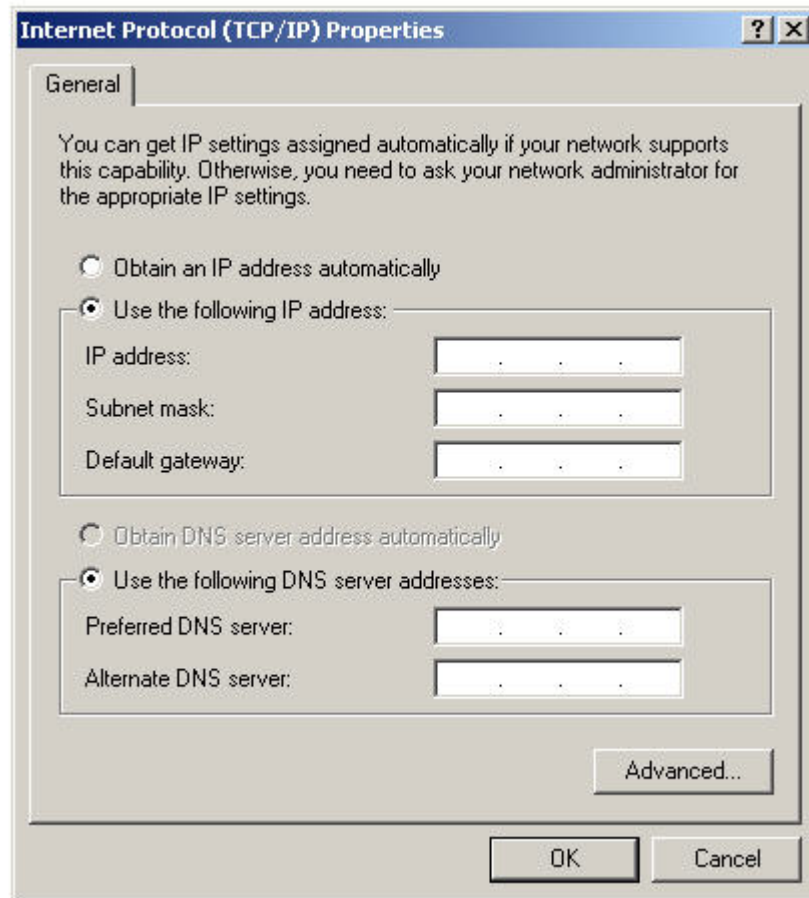- Click on the **IP Address** tab and the **Gateway** tab.

Windows NT / 2000 users should do the following:

- Click on **Start** > **Settings** > **Control Panel** and then open the **Network and Dial-up Connections** folder.

- Click and open the **Local Area Connection** icon.

- Select the **TCP/IP protocol** icon that is associated with the NIC in this PC.

- Click on **Properties** and click on **Use the following IP address**.

Windows XP users should do the following:

- Click on **Start** > **Settings** > **Control Panel** and then click the **Network Connection** icon.

- Select the **Local Area Network Connection** and click on **Change settings of this connection**.

- Select the TCP/IP protocol icon that is associated with the NIC in this PC.

- Click on **Properties** and click on **Use the following IP address**.

See the example below.

Set the IP address information for each PC according to the information in the table.

Note that the IP address of each PC is on the same network as the default gateway, which is the Ethernet interface of the connected router. The default gateway is required on local area networks that are connected to a router.

Computer	IP Address	Subnet mask	Default Gateway
PC – A	192.168.1.2	255.255.255.0	192.168.1.1
PC – B	192.168.2.2	255.255.255.0	192.168.2.1

Step 9 Verify that PCs can communicate across the WAN

a. Access the Command Prompt (MS-DOS-like):

Windows 95 / 98 / Me users should do the following:

Start > Programs > MS-DOS Prompt

Windows NT / 2000 users should do the following:

Start > Programs > Accessories > Command Prompt

Windows XP users should do the following:

Start > Programs > Accessories > Command Prompt

b. Test connectivity

Ping the IP address of the computer on the other LAN.

Enter the following command at the command prompt on PC-B.

`C:>ping 192.168.1.2`
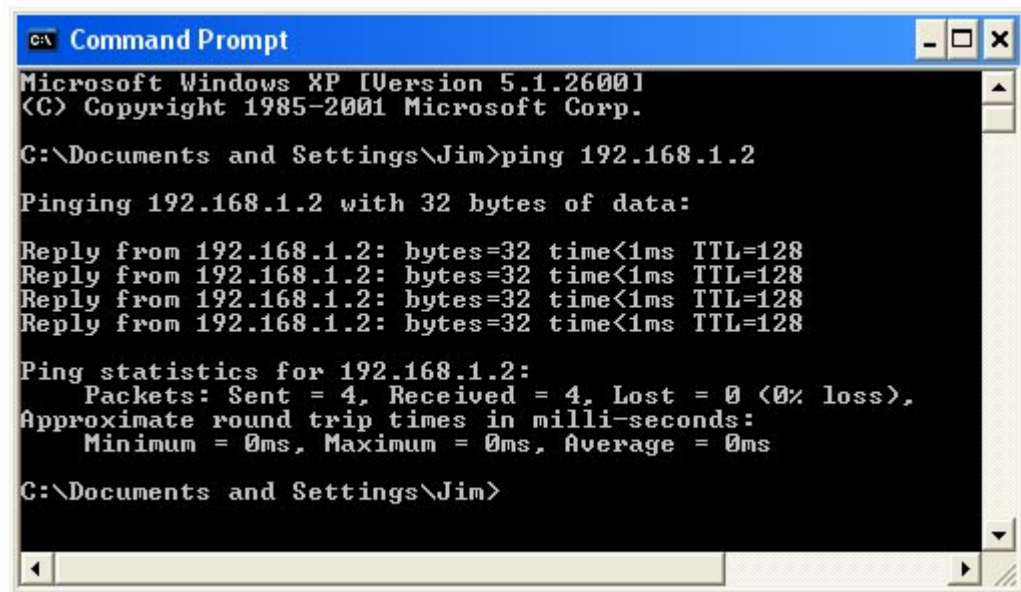
Enter the following command at the command prompt on PC-A.

`C:>ping 192.168.2.2`

This will test IP connectivity from one workstation through its switch and router across the WAN link and through the other router and switch to the other PC.

c. Look for results similar to those shown below. If not, check the PC connections and TCP/IP settings for both PCs. What was the ping result?

Results could possibly be: Sent=4 Received=3 Lost=1 (this is due to ARP)

Any other results probably indicate an error

```
C:\ Command Prompt                                          - □ ×

Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Jim>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Documents and Settings\Jim>
```

Step 10 Restore the PCs to their original IP settings, disconnect the equipment, and store the cables