# Address Summaries and ARP

## Objectives:

This lab will address the following:

- The functions of Router's serial port
- The difference between DCE cable and DTE cable
- Configuration of HDLC
- Use of subnet masks with address summarizing
- The Address Resolution Protocol (ARP)
- Use of the SNOOP utility on SUN workstations.

## Background:

This lab will help you become familiar with the configuration of a CISCO 2600 Router and 5500 Switch, and with the CISCO IOS commands to modify the configurations. Furthermore the lab illustrates a multi-router hierarchical architecture that includes remote routers connected with serial connections to enterprise routers (as might be the case in a simple business design). Typically the enterprise routers (at headquarters) might then be connected through a switch to routers, servers, printers and other nodes of the business IT infrastructure. Lab steps include the configuration of the devices that are part of this new architecture plus the manual configuration of the static routing tables. (The next two labs will introduce dynamic routing). When the network is fully configured, it is then used in investigating the ARP protocol using SNOOP.

## Equipment:

- Workstations with monitor, keyboard, mouse, and power cords, and configured IP.
- Windows or SUN Solaris operating system installed on workstations
- NIC card and console cable with connection to the console port and Cat5 patch cable to LAN with DCE and DTE cables for connections among the routers.
- HyperTerminal or VI/PICO/NEDIT for initial router configuration through the console port.
- SNOOP software available on at least one SUN SOLARIS workstation
- Lab instructions for student direction

## Preparation:

Before you begin, the teacher or lab assistant will assign a Pentium-based (or comparable) PC for your use. The operating system of that PC will be either Windows or SUN Solaris, which include HyperTerminal and VI/PICO respectively. Furthermore, each PC has a console cable in order to connect to a console port. You may work individually or in terms and chose a type of operating system or try both of them, but before that you should have basic idea about that OS and familiar to the interface and basic idea about routers at least. Additionally, you should read CISCO Internetwork Operating System commands, a reference book will be helpful, and you also should review last two lab's direction.

- For the first time configure of the router, exactly procedure will be available on CISCO *Software Configuration Guide for Cisco 3600 Series and Cisco 2600 Series Routers,* from page 1-10 to 1-49.
- Also more information can be available from website: http://www.cisco.com/pcgi-bin/Support/PSP/psp_view.pl?Product_Name=2600
- For the troubleshooting also available on website: http://www.cisco.com/pcgi-bin/Support/PSP/psp_view.pl?p=Hardware:2600&s=Troubleshooting
- For the IOS command information visit: http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/index.htm

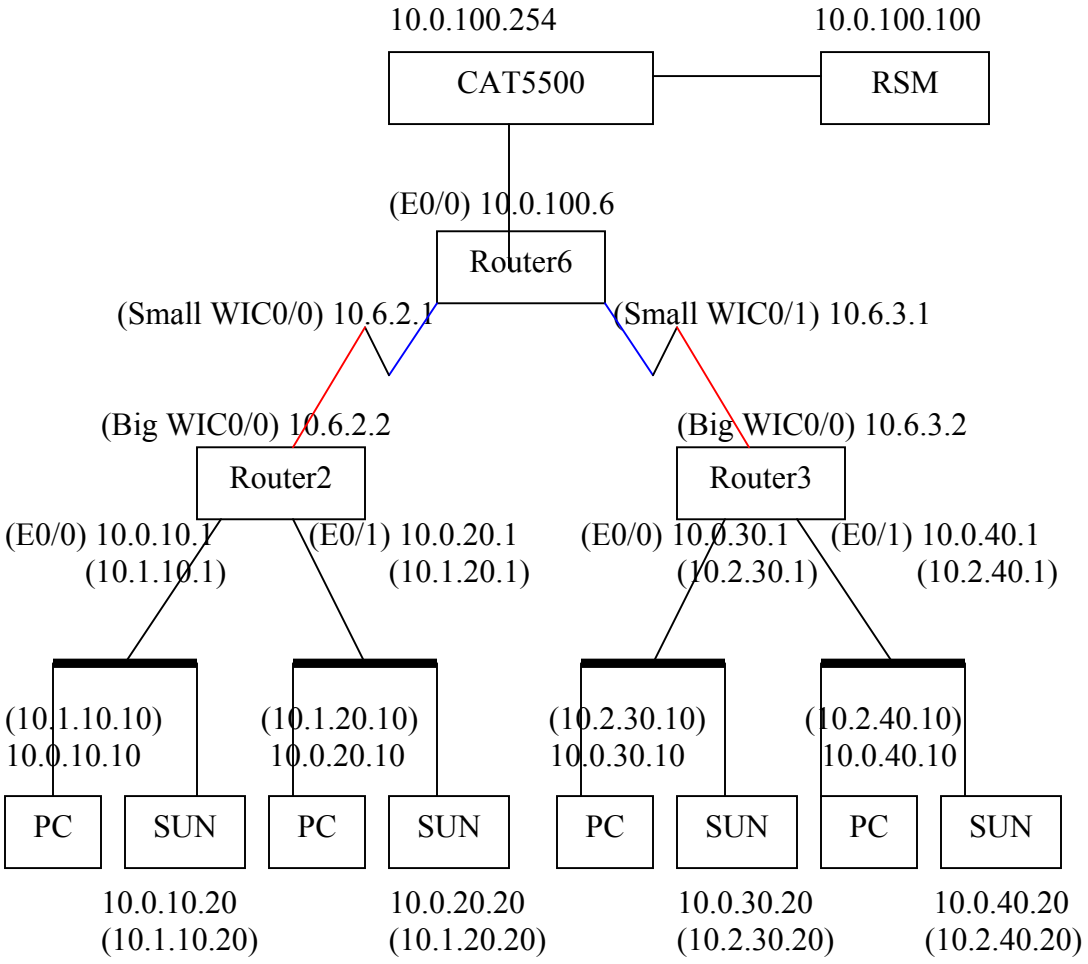
- Summary of useful commands:

1. General Commands
   $ telnet <host ip address>
   $ tip hardwire
   $ arp <args>
   $ ifconfig

2. IOS Commands
   $ enable
   $ show config
   $ config t
   $ interface Fastethernet<port number>
   $ interface Serial<port number>
   $ clock rate <number>
   $ encapsulation hdlc
   $ ip route
   $ ip address
   $ write
   $ exit

3. arp
   $ arp –a / -d / -s
   $ snoop -c –V

## Lab 6 Configuration




Straight line: cat5 cable.
Segmented line: DCE and DTE connected cable, while blue is DCE and red is DTE.

- **Bring up all physical connections in the Lab 6 configuration shown above.**

  **Direction:** in order to build up new architecture, connect the routers and the switches as follows:

  1. Router—Router connections:

     Connect via WIC port with DCE/ DTE cable, where the DCE end is associated with the small WIC port and the DTE end is associated with the big WIC port. We have arbitrarily assigned core (enterprise) routers to use big WIC ports, and the other (remote) routers to use small WIC ports.

  2. Router—Switch connections:

     LAN switches connect to Router Ethernet Ports with CAT5 straight-through cable.

  3. connect wire according to the figure:

     Router6 (Ethernet0/0) --- CAT5500
     Router2 (Ethernet0/0) --- Switch1
     Router2 (Ethernet0/1) --- Switch2
     Router3 (Ethernet0/0) --- Switch3
     Router3 (Ethernet0/1) --- Switch4
     Router6 (WIC0/0) --- Router2(WIC0/0)
     Router6 (WIC0/1) --- Router3(WIC0/0)

- **Learn to bring up HDLC over WIC connections**

  **Direction:** after building up the new multi-router layer architecture, we configure the WIC ports for each Router to run HDLC. The following instructions are given assuming the use of Router 6 in the core and Routers 2 and 3 remotely. You may be assigned to different routers. Check with the instructors if you have questions.

  Assume: Router 6 is a core Router (big WIC port and DCE connection)
  Router2 and Router3 are sub-Routers (small WIC port and DTE connection)

***Only configure <u>your</u> router below.***

*<u>Configure Sub-Router2:</u>*

1. Connect to sub-Router2 via console
   **Router2> enable**
   **$password: ******

2. Enter serial0/0 ports configuration environment and configure it
   **Router2#config t**
   **Router2<config># interface serial0/0**
   **Router2<config-if>#ip address 10.6.2.2 255.255.255.0**
   **Router2<config-if>#exit**

3. Enter ethernet0/0 ports configuration environment and configure it
   **Router2<config># interface FastEthernet0/0**
   **Router2<config-if># ip address 10.0.10.1 255.255.255.0**
   **Router2<config-if>#exit**

4. Enter ethernet0/1 ports configuration environment and configure it
   **Router2<config># interface FastEthernet0/1**
   **Router2<config-if># ip address 10.0.20.1 255.255.255.0**
   **Router2<config-if>#exit**
   **Router2<config>#exit**

2. Save the configuration
   **Router2# write**

*<u>Configure Sub-Router3:</u>*

1. Connect to sub-Router3 via console
   **Router3> enable**
   **$password: ******

2. Enter serial0/0 ports configuration environment and configure it
   **Router3#config t**
   **Router3<config># interface serial0/0**
   **Router3<config-if>#ip address 10.6.3.2 255.255.255.0**
   **Router3<config-if>#exit**

3. Enter ethernet0/0 ports configuration environment and configure it
   **Router3<config># interface FastEthernet0/0**
   **Router3<config-if># ip address 10.0.30.1 255.255.255.0**
   **Router3<config-if>#exit**

4. Enter ethernet0/1 ports configuration environment and configure it
   **Router3<config># interface FastEthernet0/1**
   **Router3<config-if># ip address 10.0.40.1 255.255.255.0**
   **Router3<config-if>#exit**
   **Router3<config>#exit**

5. Save the configuration
   **Router3# write**

*Configure Core Router 6:*

3. Connect to core Router6 via console
   **Router6> enable**
   **$password: ******

4. Enter serial0/0 ports configuration environment
   **Router6# config t**
   **Router6<config># interface serial0/0**
   **Router6<config-if># ip address 10.6.2.1 255.255.255.0**
   **Router6<config-if># clock rate 1300000**
   **Router6<config-if># encapsulation hdlc**
   **Router6<config-if>#exit**

5. Enter serial0/1 ports configuration environment
   **Router6<config># interface serial0/1**
   **Router6<config-if># ip address 10.6.3.1 255.255.255.0**
   **Router6<config-if># clock rate 1300000**
   **Router6<config-if># encapsulation hdlc**
   **Router6<config-if>#exit**

6. Enter ethernet0/0 ports configuration environment and configure it
   **Router6<config># interface FastEthernet0/0**
   **Router6<config-if># ip address 10.0.100.6 255.255.255.0**
   **Router6<config-if>#exit**
   **Router6<config>#exit**

7. Save the configuration
   **Router6# write**

- **Build up route table in Lab 6 configuration**

  **Direction:** Having configured the interfaces we next build the routing tables in each router.

  *Build route table on Core Router6:*

  1. Connect to Router 6 via console
     **Router6> enable**
     **$password: ******

  2. Enter configuration environment
     **Router6# config t**

  3. Build routing table
     **Router6<config># ip route 10.0.10.0 255.255.255.0 10.6.2.2**
     **Router6<config># ip route 10.0.20.0 255.255.255.0 10.6.2.2**
     **Router6<config># ip route 10.0.30.0 255.255.255.0 10.6.3.2**
     **Router6<config># ip route 10.0.40.0 255.255.255.0 10.6.3.2**
     **Router6<config># ip route 0.0.0.0 0.0.0.0 10.0.100.100**
     **Router6<config>#exit**

  4. Save the configuration
     **Router6# write**

  *Build route table on Sub-Router2:*

  1. Connect to Router 2 via console
     **Router2> enable**
     **$password: ******

  2. Enter configuration environment
     **Router2# config t**

  3. Build route table:
     **Router2<config># ip route 10.0.10.0 255.255.255.0 Fastethernat0/0**
     **Router2<config># ip route 10.0.20.0 255.255.255.0 Fastethernet0/1**
     **Router2<config># ip route 0.0.0.0 0.0.0.0 10.6.2.1**
     **Router2<config>#exit**

  4. Save the configuration
     **Router2# write**

*Build route table on Sub-Router3:*

1. Connect to Router 3 via console
   **Router3> enable**
   **$password: ******

2. Enter configuration environment
   **Router3# config t**

3. Build route table
   **Router3<config># ip route 10.0.30.0 255.255.255.0 Fastethernet0/0**
   **Router3<config># ip route 10.0.40.0 255.255.255.0 Fastethernet0/1**
   **Router3<config># ip route 0.0.0.0 0.0.0.0 10.6.3.1**
   **Router3<config>#exit**

4. Save the configuration
   **Router3# write**

- **Change address and subnet masks to result in removing half of the routes in the core route**

  **Direction:** Because the core router sends to either of two remote LANs through the same remote router, it is possible to reduce the number of entries the core router's route table so that one entry serves for two remote LANs. This is done by appropriate choice of subnet address and mask.

  *Build route table on Core Router6:*

  1. Connect to Router 6 via console
     **Router6> enable**
     **$password: ******

  2. Enter configuration environment
     **Router6# config t**

  3. Build route table
     **Router6<config># ip route 10.1. 0.0 255.255.0.0 10.6.2.2**
     **Router6<config># ip route 10.2. 0.0 255.255.0.0 10.6.3.2**
     **Router6<config># ip route 0.0.0.0 0.0.0.0 10.0.100.100**
     **Router6<config>#exit**

  4. Save the configuration
     **Router6# write**

*Build route table on Sub-Router2:*

1. Connect to Router 2 via console
   **Router2> enable**
   **$password: ******

2. Enter configuration environment
   **Router2# config t**

3. Change the ip address of interfaces
   **Router2<config>#interface fastethernet0/0**
   **Router2<config-if>#ip address 10.1.10.1 255.255.255.0**
   **Router2<config-if>#exit**
   **Router2<config>#interface fastethernet0/1**
   **Router2<config-if>#ip address 10.1.20.1 255.255.255.0**
   **Router2<config-if>#exit**

4. Build up route table
   **Router2<config># ip route 10.1.10.0 255.255.255.0 Fastethernet0/0**
   **Router2<config># ip route 10.1.20.0 255.255.255.0 Fastethernet0/1**
   **Router2<config># ip route 0.0.0.0 0.0.0.0 10.6.2.1**
   **Router2<config>#exit**

5. Save the configuration
   **Router2# write**

*Build route table on Sub-Router3:*

1. Connect to Router 3 via console
   **Router3> enable**
   **$password: ******

2. Enter configuration environment
   **Router3# config t**

3. Change the IP address of interfaces
   **Router2<config>#interface fastethernet0/0**
   **Router2<config-if>#ip address 10.2.30.1 255.255.255.0**
   **Router2<config-if>#exit**
   **Router2<config>#interface fastethernet0/1**
   **Router2<config-if>#ip address 10.2.40.1 255.255.255.0**
   **Router2<config-if>#exit**

4. Build route table
   **Router3<config># ip route 10.2.30.0 255.255.255.0 Fastethernet0/0**
   **Router3<config># ip route 10.2.40.0 255.255.255.0 Fastethernet0/1**
   **Router3<config># ip route 0.0.0.0 0.0.0.0 10.6.3.1**
   **Router3<config>#exit**

5. Save the configuration
   **Router3# write**

*Change terminal computer's IP address:*

Using the Lab Configuration on page 3, change the workstation IP addresses to enable the route summaries For example: 10.0.10.10 is changed to 10.1.10.10. You learned how to do this is Lab 2.

- ## Illustrate how ARP works

ARP, Address Resolution Protocol, is implemented as part of the IP layer in the network model. It resolves IP addresses to physical network addresses. For instance, if machine "A" knows that machine "B" has an IP address of 10.0.10.50, and A wants to speak with B, the ARP mechanism is used to determine the physical address of B. The process works as follows.

Machine A casts a broadcast packet out onto the net as an ARP, with a question enclosed:

For IP address 10.0.10.50, what is the physical address?

Because an ARP is a broadcast, all machines on the net that are running IP receive this question. If the sought IP address is their own, they reply directly to the machine that posed the question:

My IP address is 10.0.10.50, and my physical address is 08:DD:01:OF:7A:B5.

Machine A, hoping to save time and effort in the future, adds machine B to its ARP cache, which is a memory resident list of known mappings. This structure is also often referred to as an ARP table. By storing these values in the ARP cache, the actual ARP broadcast may be avoided the next time. Machine B adds machine A to its cache as well.

*Note: ARP is only used between machines on the same Ethernet segment.

For further information on ARP review RFC 826.

The following exercise is designed to illustrate how ARP works.

**Directions:**

**1.** Seat one group member at the UNIX station on your group's subnet. Seat the other at the Windows machine.

**2.** UNIX user
At the terminal prompt type "arp" and review the arp command.

Windows user
At the command prompt type "ipconfig /?" and review the ipconfig command.

**3.** Use the arp/ipconfig command to answer the following questions.

**What is the physical address for your machine's Ethernet interface?**

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**When available, record the physical address of the Ethernet interface on your lab partner's machine.**

**4.** Unix user
Type “man arp” and review the ARP command.

Windows user
Type “arp /?” and review the arp command.

**5.** Review the commands “arp –a”, “arp –d”, and “arp –s”.

**What does each command do?**

**arp –a**

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**arp –d**

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**arp –s**

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**6.** Use the arp command to view the contents of the ARP table on your machine.

**Are there any entries in the ARP table?**

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**7.** Now use the arp command to clear the ARP table.

8. On the UNIX machine open a new terminal window and type “man snoop”. Review the purpose of the snoop application.

**What does snoop do?**

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**9. NOTE: In this step ask instructor to change the user to root.**

From the second terminal window on the UNIX machine begin running snoop in verbose summary mode by typing “snoop -c –V”.

**10.** UNIX user
Return to the first terminal window.

**11.** Attempt to generate ARP traffic by using the “ping” command to contact your lab partner’s machine.

**12.** In the second terminal window on identify an ARP request frame.

**Record its contents.**

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Identify a corresponding ARP reply frame.

**Record its contents.**

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**13.** View the contents of the ARP table for your machine.

**How has it changed?**

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