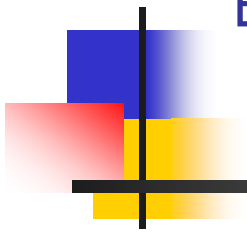

EMT2455 Data Communications

§ 4. Network Layer

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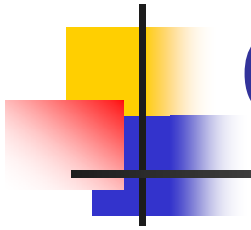
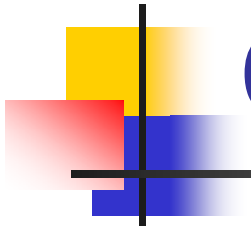


Contents

- **Ch4.1. ICMP, IGMP and ARP**
- **Ch4.2. IP Addressing**



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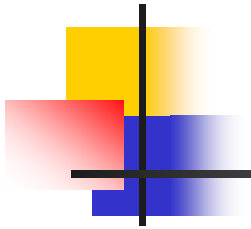
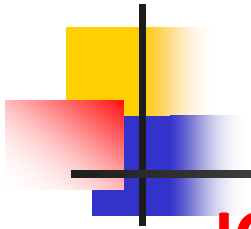
Protocols Defined on Network Layer

- ARP: Address Resolution Protocol
- NDP: Neighbor Discovery Protocol (similar to ARP, but used for IPv6)
- IP: Internet Protocol, including Internet Protocol version 4 (IPv4) and IPv6
- ICMP: Internet Control Message Protocol. Defines the "ping" command
- IGMP: Internet Group Message Protocol



TCP/IP Model

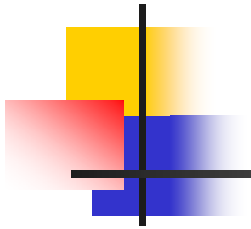
- Application Layer: HTTP, FTP, DHCP, DNS...
- Transport Layer: TCP, UDP
- Internet Layer: IP, ICMP, IGMP
- Link Layer: ARP, NDP, MAC, PPP



ICMP

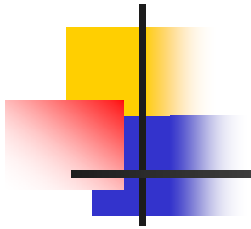
- **ICMP**: Internet Control Message Protocol
- **PING (Packet InterNet Groper)**: A very important network troubleshooting tool provided by ICMP.

- **How "ping" works?** By sending *ICMP echo request packet* to a target host, then waiting for ICMP response, and measuring the time duration.
- **What "ping" can do?** To verify connectivity with another host in the network. The destination host could be in a LAN, a WAN, or even the Internet.
- **Limits of PING:** If the destination host turns OFF, it cannot verify the connection.



IGMP

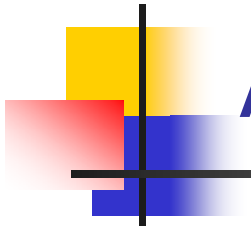
- **IGMP: Internet Group Message Protocol.**
- IGMP is used for **multicasting** (sending data to many destination hosts).
- The addresses used to send a multicast data packet are called **multicast addresses**.
- An example of an application that uses IGMP packets is when a router uses multicasting to share routing tables.



IGMP

- Another example of using IGMP: to stream video/audio to multiple hosts.

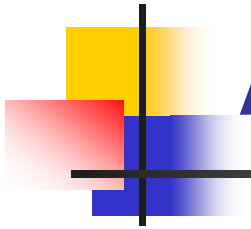
- Streaming means the data are sent without waiting for any acknowledgement that the data packets were delivered. In fact, in the IGMP protocol, the source doesn't care if the destination receives a packet.



ARP

- ARP (Address Resolution Protocol): to resolve an IP address to a hardware address for final delivery of data packets to the destination IP.

- Packets being used by ARP: ARP Request and ARP Response



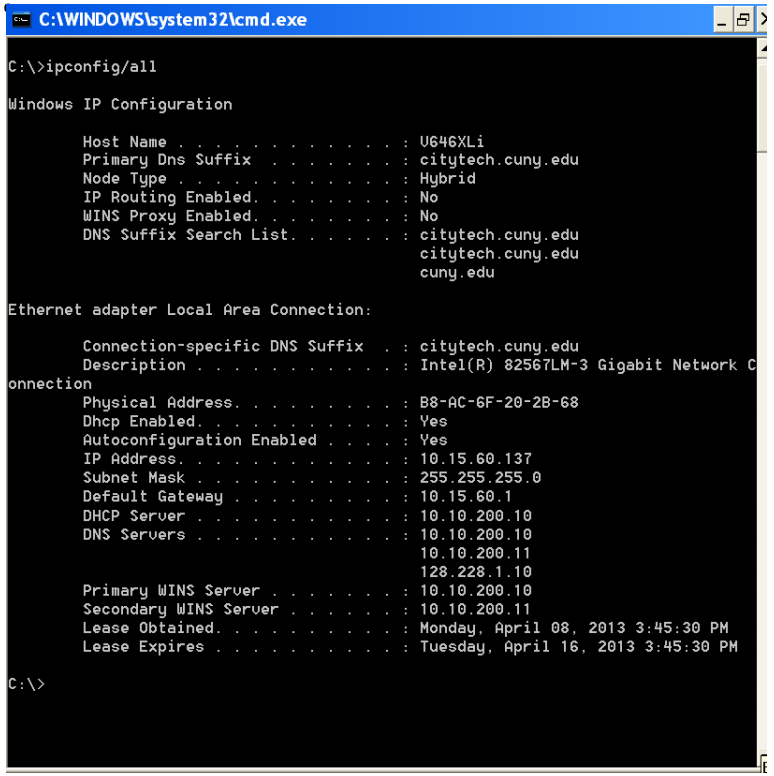
ARP Procedure

- Suppose computer *Alpha* wants to access a destination IP of 120.200.56.10
- **Step 1:** *Alpha* issues a query in the network by broadcasting a ARP Request packet, asking which NIC has this IP address (120.200.56.10).
- **Step 2:** the host with the IP address 120.200.56.10 replies with an ARP Response packet that contains the hardware address (MAC address) of the destination host.

ARP Revealed by Capsa

- **Capsa:** a popular packet/protocol analyzer. Easy to use. Supports Windows ONLY by now
- Find the MAC and IP Addresses of your computer first!
  - Windows command: ipconfig/all
  - Linux/Unix command: ifconfig

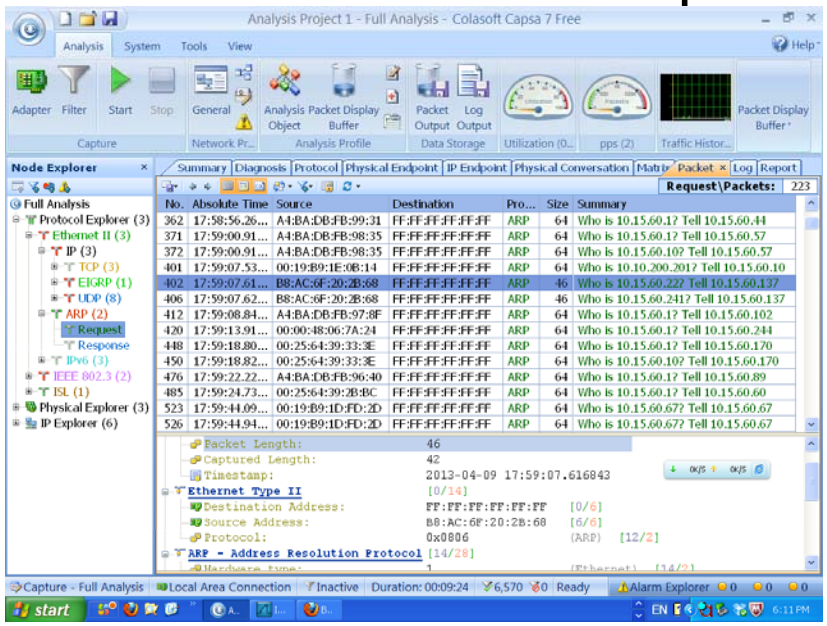
See instructor's demonstration



Address Resolving Procedure Revealed by Capsa

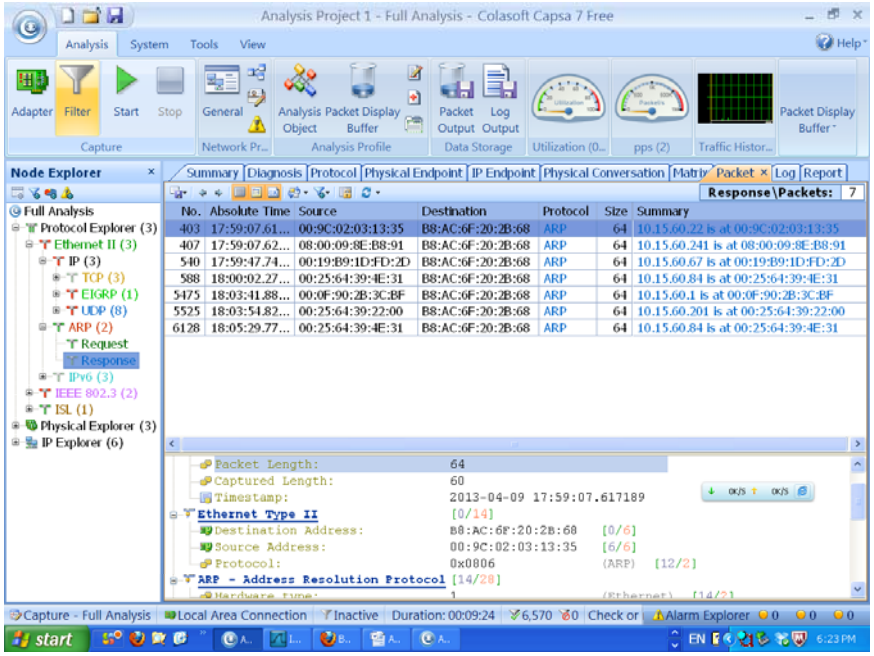
Step 1. An ***ARP Request*** packet is sent by source host B8:AC:6F:20:2B:68 (with IP: 10.15.60.137): *"Who is 10.15.60.22? Tell 10.15.60.137" (interpretion by Capsa).*

Note: Pay attention at the No. of the captured packet.



Address Resolving Procedure Revealed by Capsa

Step 2. An ***ARP Response*** packet is answered by 00:9C:02:03 :13:35 (with the asked IP: 10.15.60.22): *"10.15.60.22 is at 00:9C:02:03:13:35"(interpretion by Capsa).*

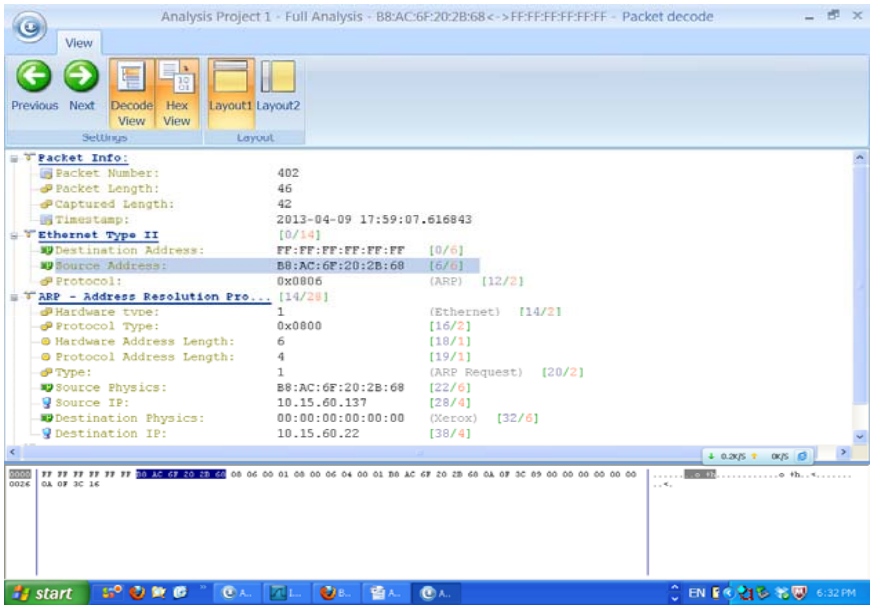


ARP Packets Revealed by Capsa

- ARP Request Packet:

Sender: B8:AC:6F:20:2B:68 (with IP: 10.15.60.137)

Destination: ???



- ARP Response Packet:

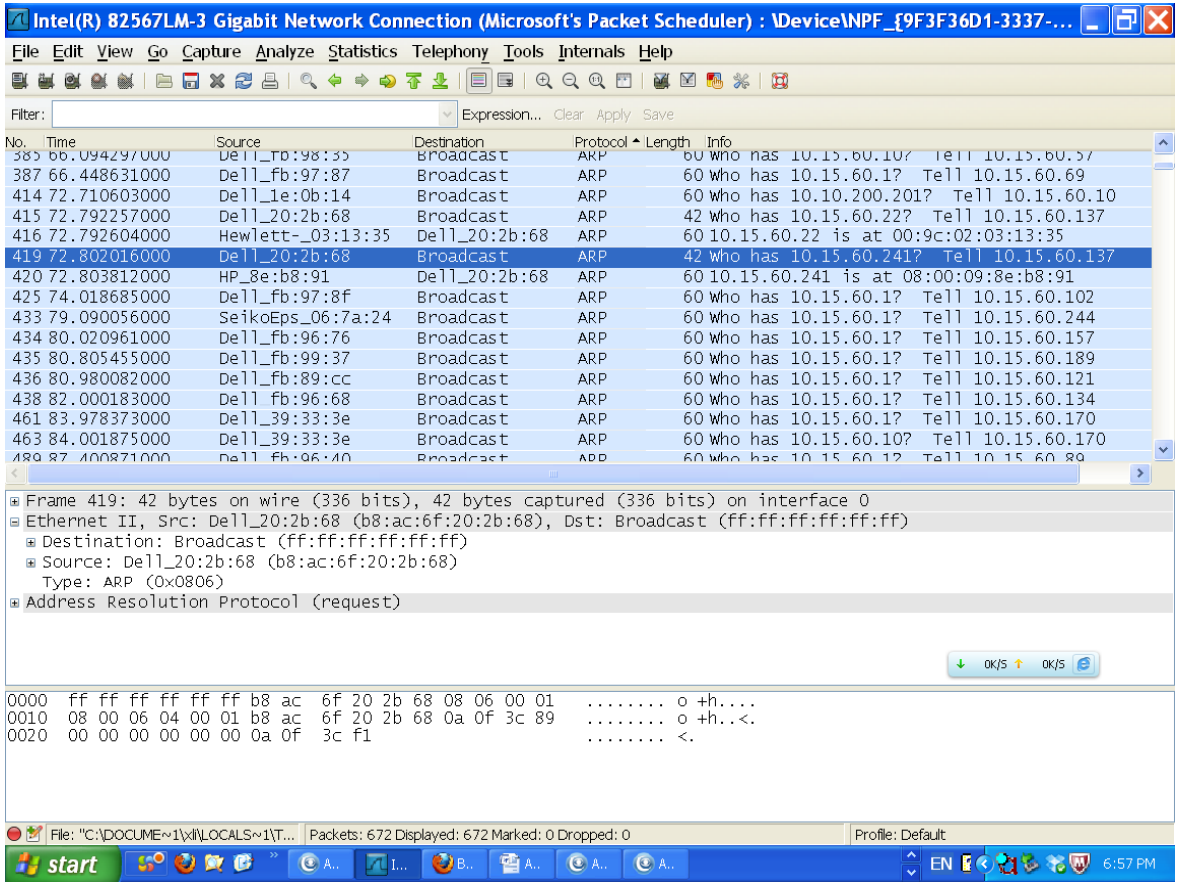
Sender: ???

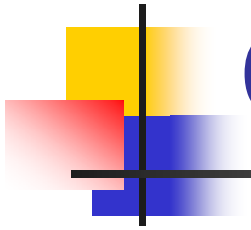
Destination: ???

❑ **Lab 3. ARP:** ***See lab handout for details***

ARP Revealed by WireShark

- **Similar to the above**





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  - *See lecture notes*