SY110
Networking – Data Link Layer

Major Brian Hawkins, USMC

U.S. Naval Academy

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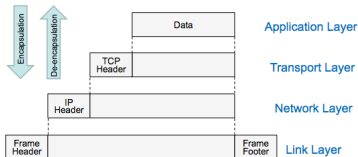
The TCP/IP Model is a layered model

- Encapsulation!
- Each layer provides a service to the layer above it.
- Application Layer - programs communicating with each other
  - Think web browser and web server or FaceTime between devices
- Transport Layer - responsible to get the data between the applications on the communicating hosts
- Network Layer - gets the data between communicating hosts

What do we know about the Data Link Layer so far?

- Between the Network Layer and the Physical Layer
- Responsible to get data from link to link / node to node (connect a host to a network)

So what? What does that imply?

- Rules (Protocols) for communicating between (interfacing with) Network Layer and Physical Layer
- Digital Data $\Rightarrow$ Digital Signal :: Data Link $\Rightarrow$ Physical
- Transition point for Logic and Circuit Aspects in the Cyber Domain
- All Data Link Layer protocols must have a physical **interface**.
  - Wire, RF transceiver, Fiber Optic Interface Modules (OIMs), etc.
  - May have multiple interfaces on one device
- Addresses: A way to identify communicating hosts
- We call data at this level a "frame"; has header and footer

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Ethernet Protocol (IEEE 802.3) - that network cable thing...

- Is a best effort protocol; is robust but does not guarantee delivery
- Uses a MAC (Media Access Control) Address to identify which interface that a frame is addressed to (destination address) and what interface the frame is from (sender/source address).

MAC addresses

- Other names include "physical address" or "hardware address"
- Associated with your Network Interface Card (NIC),
- Unique, permanently assigned addresses by manufacturer
- Six bytes (48 bits), displayed in hex format: `12:AB:34:CD:56:EF`
- Used to move from one device to another, or "one hop" across a link in a network
- Let's find the MAC addresses on your laptops.

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- Hub – Basically a (really) dumb repeater
  - ▶ Has no MAC address - really operates at just the Physical Layer;
  - ▶ Old-tech, rarely used any longer
- Switch – A smart repeater
  - ▶ Also has no MAC address - operates just at the Physical layer;
  - ▶ Connects to end devices, other switches, and a often a Router
- Router - a complex device
  - ▶ Has a MAC address, so it operates at the Link layer
  - ▶ Interfaces between the Network and Physical Layers
  - ▶ Also has it's own IP address and uses IP addresses to identify the path to send packets (data) towards the next network node using that node's MAC address
  - ▶ ...more on routers in the Network Layer lecture.

Since a switch/hub doesn't have a MAC address, the switch/hub itself cannot initiate (be a source) or be the target (destination) of communications.

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The whole purpose of ARP is to translate back and forth between Data Link Layer addresses and Network Layer addresses.

- Most network devices have an ARP table
- This ARP table contains a mapping of local IP addresses to MAC addresses
- Used to address and send frames to known hosts.
- If a host is not known, broadcast an ARP request to the entire local network asking for the MAC address of the destination host.
- If host is not local, the frame is sent to the gateway router who will send the frame outside the local network for it to find its destination .

Do this:

1. Connect your laptop to a local network
2. Open an Administrator Windows shell
3. Enter in the command: arp -a
4. How many hosts are listed in your ARP table?
5. Enter in the command: arp -d *
6. Enter in the command: arp -a
7. How many hosts are listed in your ARP table?

The -d option for arp stands for delete. Don't worry, as your computer receives more ARP announcements your local ARP table will be repopulated. And besides if you want to talk to someone before then, your computer will simply send out an ARP request, and wait for the ARP response to come back.

Questions?