CNL
Communications & Networking
Laboratory

ECE 462 – Data and Computer Communications

Lecture 19A: Ethernet Animation

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Outline

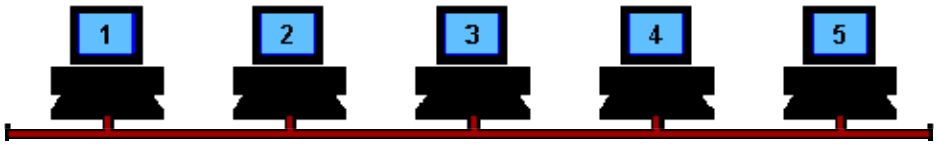
- Animation of IEEE 802.3
- Basic case
- Collision
- Hub
- Switch

Ethernet Operation

- Carrier sense Bus (CSMA), CD, etc.
- **Carrier Sense Multiple Access -** When a device connected to an Ethernet wants to send data it first checks to make sure it has a carrier on which to send its data
  - This means that all Terminals on the network are free to use the network whenever they wish so long as no one else is transmitting
- **Collision Detection -** A means of ensuring that when two stations start to transmit data simultaneously, that the resultant corrupted data is discarded, and re-transmissions are generated at differing time intervals

The Basic Ethernet Bus

- Station 2 wants to send a message to station 4, but first it 'listens' to make sure no one else is using the network
- If all clear it starts to transmit its data on to the network (yellow flashing screens)
  - Each packet of data contains the destination address, the senders address, and the data to be transmitted
  - The signal moves down the bus and is received by every station on the network but because it is only addressed to number 4, the other stations ignore it
- Station 4 then sends an ack to station 2 for the receipt of the data (purple flashing screens)

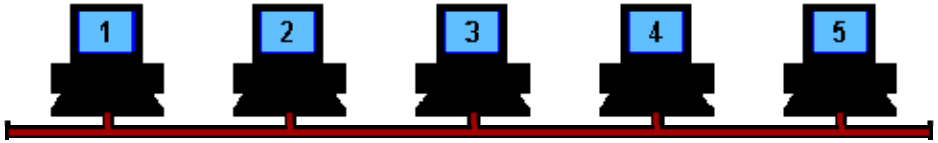


- But what happens when two terminals try to transmit at the same time?

  ... a collision occurs, and each station has to “back off” for a random period of time before re-trying

Collision

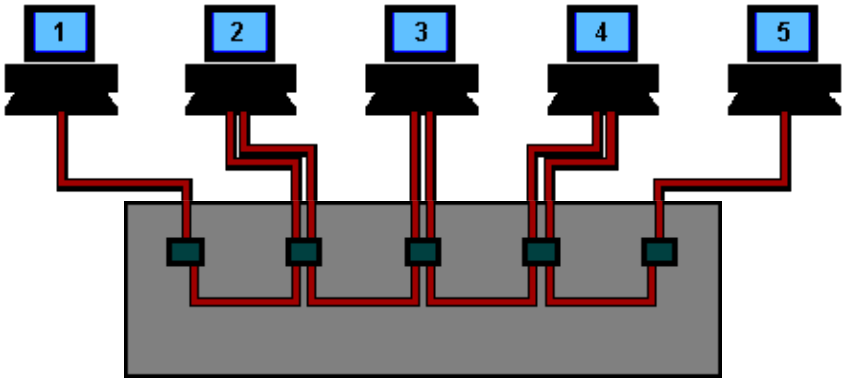
- Stations 2 and 5 both trying to transmit simultaneously
  - The resulting collision destroys both signals and each station knows this has happened because they do not 'hear' their own transmission within a given period of time (this time period is the propagation delay and is equivalent to the time it takes for a signal to travel to the furthest part of the network and back again).
- Both stations then wait for a random period of time before re-trying
- OK on small networks but the number of collisions rises dramatically as more nodes are added



Note: For simplicity we omit the ack transmissions from the animation

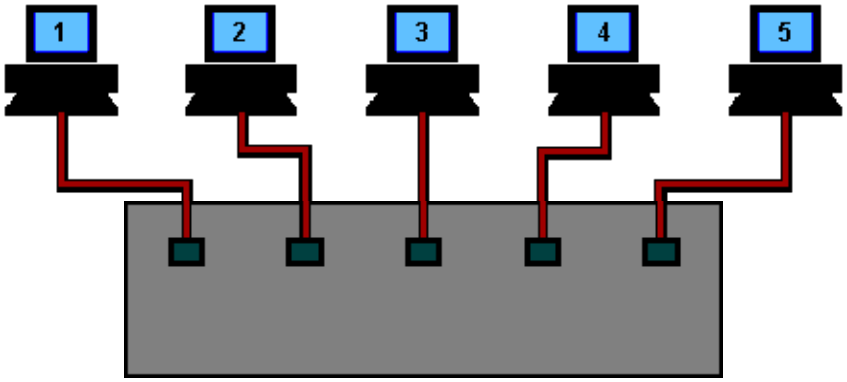
Using a Hub

- An Ethernet hub changes the topology from a “bus” to a “star wired bus”
- Again, station 1 is transmitting data to station 4, but this time the signal travels in and out of the hub to each of the other stations
- It is still possible for collisions to occur but hubs have the advantage of centralized wiring, and they can automatically bypass any ports that are disconnected or have a cabling fault

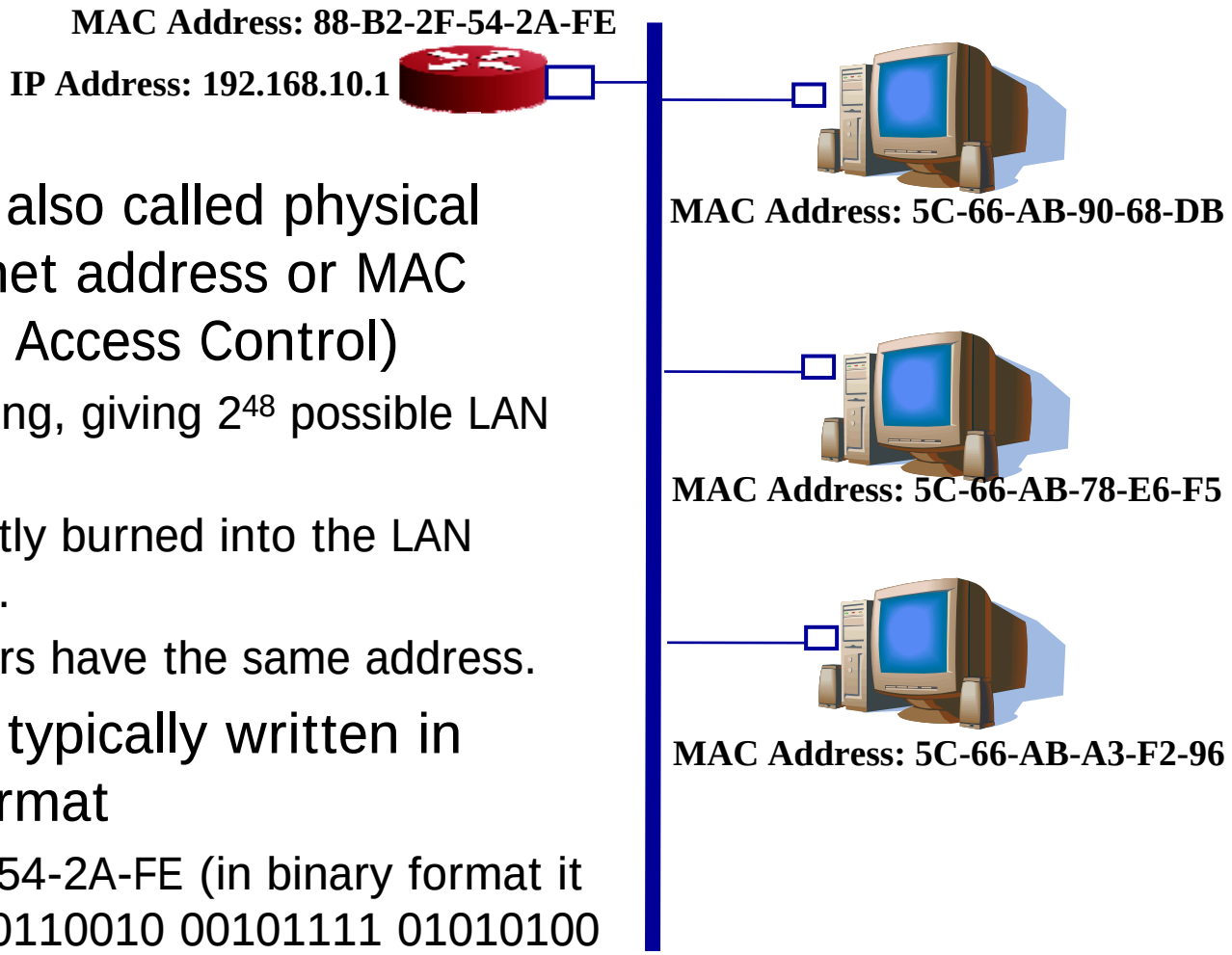


Using A Switch

- To overcome the problem of collisions and other effects on network speed, a switch is used
  - With a switch, stations can transmit simultaneously
- Stations 1 & 5 first, and then 2 & 4
- The switch reads the destination addresses and 'switches' the signals directly to the recipients without broadcasting to all of the stations on the network
  - This 'point to point' switching alleviates the problems associated with collisions and considerably improves network speed
- In the real world however, one or more of these stations will be servers, and as most network traffic is between the clients and a server a serious bottleneck can occur



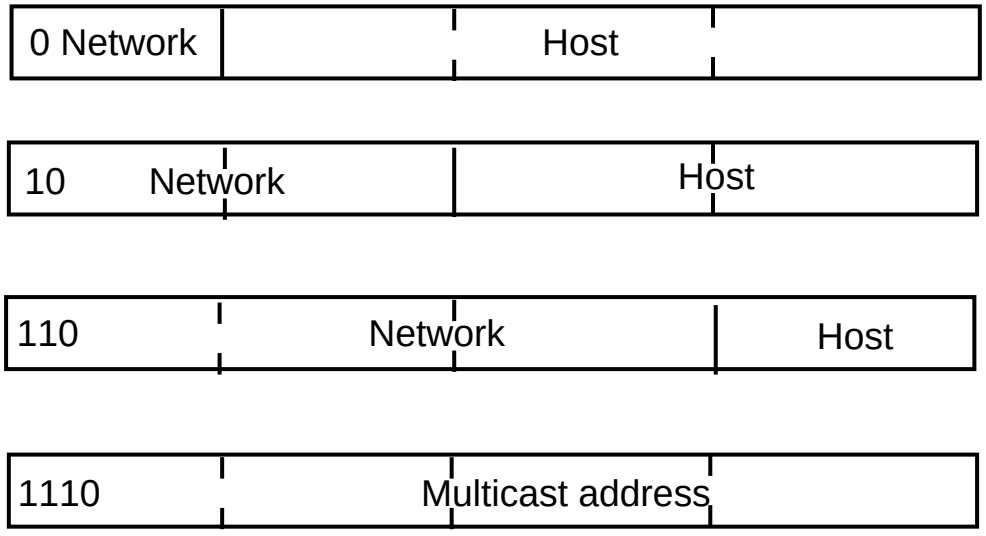
LAN Addresses



- LAN Address is also called physical address, Ethernet address or MAC address (Media Access Control)
  - It is six-byte long, giving 2^{48} possible LAN addresses.
  - It is permanently burned into the LAN adapter's ROM.
  - No two adapters have the same address.
- LAN Address is typically written in hexadecimal format
  - E.g. 88-B2-2F-54-2A-FE (in binary format it is 10001000 10110010 00101111 01010100 00101010 11111110)

IP Addresses

- Each IPv4 Address is 32 bits long, written in dotted decimal notation, e.g. 223.1.1.10
- Original IP Addresses architecture defined four classes of address.
  - **Class A, 2^7 networks and 2^{24} interfaces**
  - **Class B, 2^{14} networks and 2^{16} interfaces**
  - **Class C, 2^{21} networks and 2^8 interfaces**
  - **Class D, multicast addresses**



Class A:
1.0.0.0 to 127.255.255.255

Class B:
128.0.0.0 to 191.255.255.255

Class C:
192.0.0.0 to 223.255.255.255

Class D:
224.0.0.0 to 239.255.255.255

Classless Interdomain Routing (CIDR) Addresses

- CIDR network addresses release the constraint that the network part of the address has to be 8, 16 or 24 bits. It has dotted-decimal form a.b.c.d/x, where x indicates the number of the leading bits that constitutes the network part of the address
  - **e.g. 192.168.240.10/20 means the first 20 bits are network address and the rest 12 bits are interface addresses.**
- In practice, an organization can further divide the interface addresses to create its own internal network. This procedure is known as subnetting

Classless Interdomain Routing (CIDR) Addresses