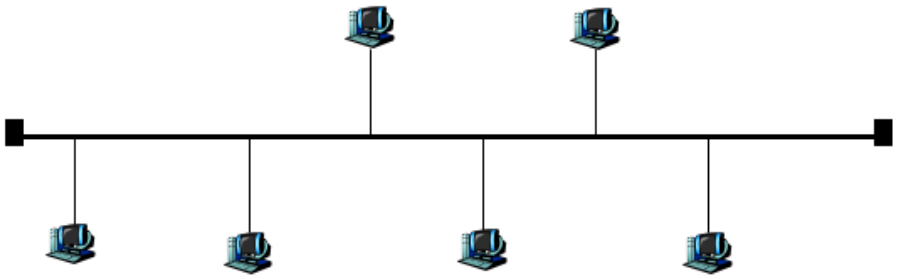
Exploration: LAN topologies and Ethernet

Introduction

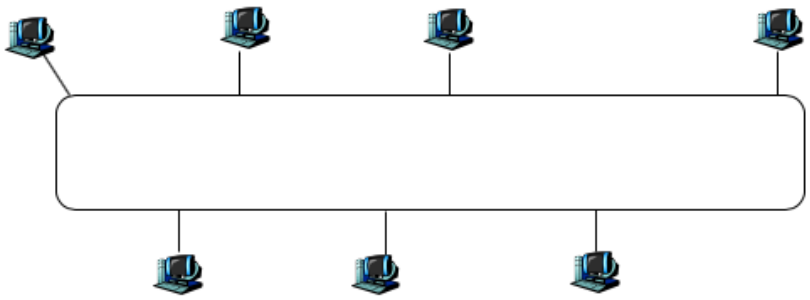
In this lecture we will discuss several LAN configurations and technologies. In particular, we will meet a very durable technology called Ethernet.

Up to this point we've classified networks by their shared medium. Networks can be classified in other ways. We can also classify networks by topology. Three of the most popular are Bus, Ring, and Star.

LAN Topologies

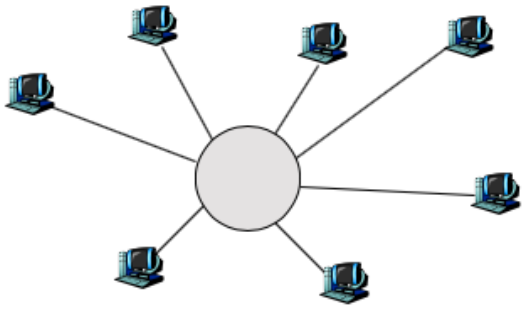


The bus topology has a single shared medium that all computers can connect to. The medium is normally twisted-pair. Both ends of the medium require a terminator so that signals don't reflect back and forth, but are absorbed. This is a legacy topology.



The second LAN topology is called a Ring. The shared medium is configured in a loop. This topology will normally use the token ring MAC protocol.

Note that the shape refers to logical connections, not the actual physical layout. The shared medium might follow a crooked path, but as long as it could be straightened out, and the result would be a ring, then it is a ring. Another way of looking at it, is if the token ring MAC protocol could be used, then it is a ring. This is also a legacy topology.



The topology that is used most frequently today is the star topology. With this configuration all computers are attached to a central hub, and connections are not shared. There is full-duplex communication between the computers and the central hub. This makes it possible for the central hub or computer to handle many simultaneous connections.

The central hub must be programmable, because it needs to be able to manage connections; To add and subtract them in a plug-and-play manner. If the central hub has this capability, we call it a switch (more details in the recorded lecture).

Ethernet

Each networking technology has its own standards. The original bus topology has the Ethernet standard. This topology and standard have been with us since the beginning of computer networking. Ethernet is still widely used. Its standards are managed by the IEEE, which defines physical metrics as well as the MAC protocol.

Ethernet uses Carrier Sense Multiple Access with Collision Detection (CSMA/CD). The bus topology typically uses a single coax cable or unshielded twisted-pair, sometimes known as the 'ether'. A coax cable running **10BASE5** **(https://en.wikipedia.org/wiki/10BASE5)** is limited to 500m, while the common unshielded twisted-pair running a number of common Ethernet technologies (such as **10BASE-T** **(https://en.wikipedia.org/wiki/Ethernet_over_twisted_pair)**, 100BASE-TX, 1000BASE-T, 10GBASE-T **(https://en.wikipedia.org/wiki/10_Gigabit_Ethernet#10GBASE-T)**) are generally limited to 100m because of signal degradation (though high quality cables can carry a signal a fair amount further). Min separation is 3 m because of the wavelength. This can be extended by using repeaters, but in general, the CSMA/CD will work better with a shorter network diameter (max node-to-node distance). The reason is that the signal and the carrier sensing capability degrade with distance because of propagation delay.

There are many different Ethernet standards that cover a variety of media and speeds:

Different speeds
10 Mbps, 100 Mbps, 1Gbps, 10G bps
Different physical layer media
Cable, fiber, and even wireless

Ethernet Standards - Commonalities

In spite of the differences, there are commonalities between all of the standards at the Link-layer. All of the Ethernet standards employ the MA protocol (CSMA/CD) and the common frame format shown here:

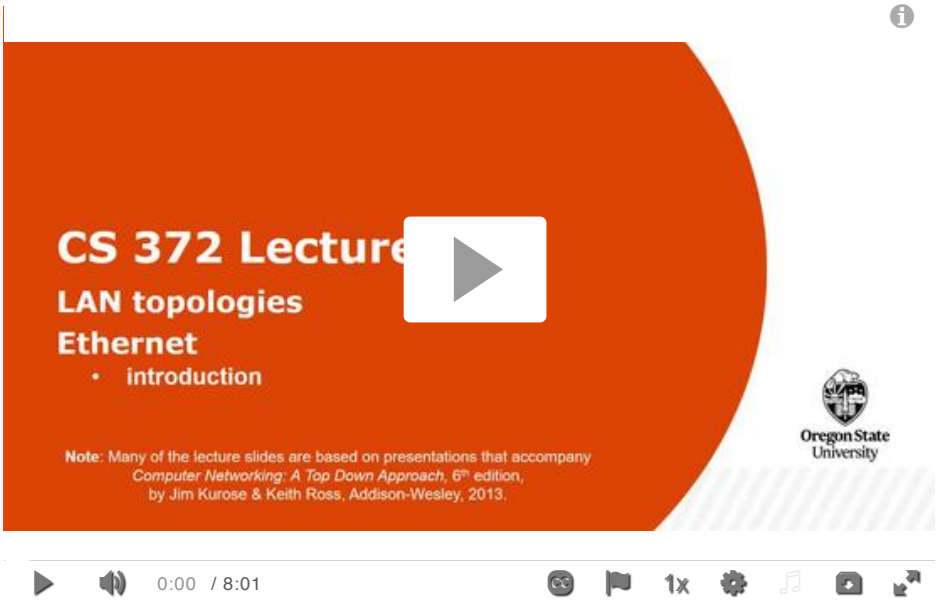
Other commonalities include:

1. Connectionless: no handshaking between sending and receiving NICs
2. Unreliable: receiving NIC does not send ACKs
3. Data in dropped frames is recovered only if the sender uses a higher layer reliable data transport (e.g., TCP)
    - otherwise dropped data is lost
4. The sending NIC encapsulates the IP datagram (or other network layer protocol packet) in the frame data

This concludes our discussion of LAN topologies and Ethernet. Be sure to watch the video lecture below for more in-depth details on Ethernet especially. Then head to the included Self-Check exercises to test your knowledge.

Video Lecture

LAN Topologies - Ethernet



(PDF (https://oregonstate.instructure.com/courses/1798856/files/83165272/download?wrap=1) (https://oregonstate.instructure.com/courses/1798856/files/83165272/download?wrap=1) |PPT (https://oregonstate.instructure.com/courses/1798856/files/83165082/download?wrap=1) (https://oregonstate.instructure.com/courses/1798856/files/83165082/download?wrap=1))

Self-Check Exercises

What is a bus topology? How is it different from a ring topology?

Turn

Card 1 of 2

The Ethernet “preamble” is used to synchronize clocks sender and receiver clocks. It is also used to signal the beginning of the rest of the Ethernet frame (since the clocks won’t always synchronize in the same amount of cycles).

- True
- False