1   LAN Topologies

LANs can be organized into various different structures. The key thing is that there are physical and logical topologies. The physical topology is how wires are organized. The logical topology is how the network behaves logically.

1.1   Addressing

To support several transfer modes, there are several different addressing schemes.

- Unicast: Addressing is one-to-one, where one computer sends a frame to another computer. Even though many stations *can* receive the same data, they *should* ignore it since it is not addressed to them.

- Multicast: Addressing is one-to-many, where one computer is sending a frame to many other computers. This can be done via a list of addresses, or some masking scheme that selects a subset of addresses.

- Broadcasting: Addressing is one-to-all, where one computer sends data to all computers connected to the LAN.

1.2   Broadband vs. Baseband

Transmission on LANs can use either the whole bandwidth capacity of the medium, or split it into channels. Baseband is when the whole capacity of the medium is used, while Broadband is when the medium capacity is split into channels.

Baseband is generally used for digital transmissions, while Broadband is generally used for analog transmissions.

1.3   Physical Topologies

There are three primary physical topologies: Bus, Ring, and Star.

1.4   Bus

The *bus* topology is basically a wire that all devices connect to using a passive interface (they listen, but don't amplify/repeat). There are terminators on both ends of the wire to remove the frame.

Since all computers are connected to the medium, they all get all the frames sent. The terminators are responsible for the removal of the frame.

In baseband setup, each computer sends frames in all (both, as there are 2) directions. In broadband setup, the transmission is unidirectional (but then it can use a separate channel for transmissions in the opposite direction).

The bus topology generally uses coaxial cable.

Characteristics of Bus topology:

- Failure of the medium disrupts communication.

- Failure of devices doesn't effect the communication (passive interface).

- There is a limit on the length of the network (devices don't amplify/repeat the signal).

- The propagation delay isn't effected by the number of devices.

1.5   Ring

Ring topology is somewhat different from the bus topology. The major differences are:

- There is no need for terminators (the receiving or sending stations remove the frame).

- Devices are active: they receive a message and then they retransmit it.

- All transmissions are baseband, and go in a single direction.

The connected devices can be in several modes, the bypass mode, and operational mode.

In bypass mode, the device is not connected to the medium. In operational mode, the device can be either listening or transmitting.

1.5.1   Removing Frames

The major issue in ring topology is who gets to remove the frame. If the frame is removed by the destination, then we can only have unicast transmissions (one-to-one). If the source removes the frame (after the frame has gone around the ring), then we can have unicast, multicast, and broadcasting capability.

Characteristics of Ring topology:

- Failure of the medium seriously disrupts communication.

- Malfunctioning of the interface can seriously effect communication (devices are active).

- There is no limitation on the length of the network (devices repeat/retransmit the frame).

- Propagation speed is effected by the number of stations (because each station reads and retransmits the frame).

- The network can use any medium, like twisted pair, coax, or fiber.

1.6   Star

In a stat topology, each station is connected to a central node, or hub (or switch). Each station only talks to the central node.

Each station generally has two connections to the hub; one to send data to the hub, and another to get data from the hub. Thus, each connection is unidirectional.

The Star topology can use either broadband or baseband transmissions. Baseband is used for guided media (like wire), while broadband is used for unguided (wireless).

The central hub can be either active or passive. A passive hub just links all workstations together (without retransmitting). An active hub reads and then retransmits the frame to all workstations.

Normally, the hub retransmits data to all the connected stations. If a switch is used, it can learn to only send data to the destination station. It does that by first operating like a regular hub, and then observing and recording which addresses appear on which interfaces.

If the star uses a hub, then addressing works just like in the bus network. If the star uses a switch, then the destination is determined by the switch (as in, unicast works just as expected, while broadcasting and multicasting has to be supported by the switch).

Characteristics of Ring topology:

- Failure of the medium does *not* seriously disrupt communication.

- Malfunctioning of the station doesn't seriously effect the communication.

- The network can use guided or unguided media.

- Failure of the hub disrupts the communication.