Access Methods

- Understand what channel access methods are
- Understand different media access methods

Reference:

•http://www.delmar.edu/Courses/ITNW2313/access.htm

Channel Access Methods

- It is also called Media Access Control (MAC)
- When several entities share the same communications medium (channel), some mechanism must be in place to control access fairly
- Three most common channel access methods:
  - Polling
  - Contention
  - Token Passing

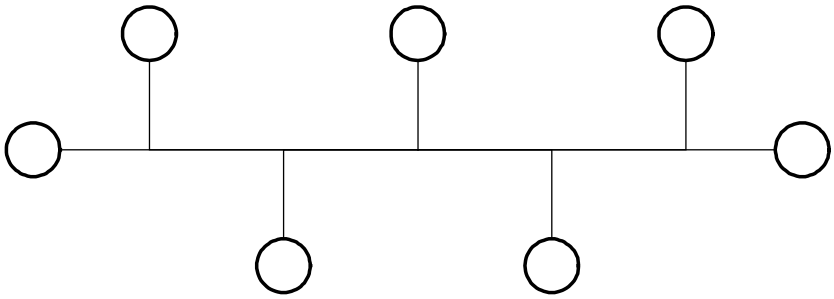
•It is unproductive to have everyone in a meeting speak at once, so rules of order were defined long ago for managing meetings. Similar rules, or *access methods*, are applied to networks.

•Theoretically independent of the topologies.

•In reality, however, only a few combinations of physical and logical topologies work well together.

•Access methods use a certain amount of the channel's bandwidth for access control. The usable portion of the channel's bandwidth is limited by the access method being used. Each method has a different effect on network traffic.

Polling



•Polling resembles a well-ordered meeting in which the chairman must recognize an attendee before that person is allowed to speak. The chairman's responsibility is to maintain order in the meeting and ensure that each person who wants to speak has an opportunity to do so.

•It’s also called master-slave method

•The master device calls out the slave device’s address, the slave responds

Polling

- Advantages:
  - Easy to control (e.g., polling order and priorities)
  - Channel access is predictable
  - Channels will not be over saturated
- Disadvantages:
  - Time delays
  - Bandwidth wasted in polling idle devices
  - Bandwidth wasted in half-duplex communications
  - Sophisticated and reliable central control mechanism

Advantages of Polling:

•Many characteristics of polling can be determined centrally, including the polling order and node priorities.

•Polling ensures that channel access is *predictable* and fixed. Because the time delays between the primary and secondary devices can be calculated, this access method is called deterministic. Deterministic access methods are suitable for controlling some automated equipment because each piece of equipment is guaranteed access to the network at predetermined intervals.

•Polled channels cannot be *over saturated* with traffic. As demand increases, traffic increases up to a maximum level. The polling mechanism ensures that maximum traffic level cannot be exceeded. Nor can excess traffic reduce the performance of the network.

Disadvantages of Polling :

•Some applications cannot function with the time delays required for polling other devices.

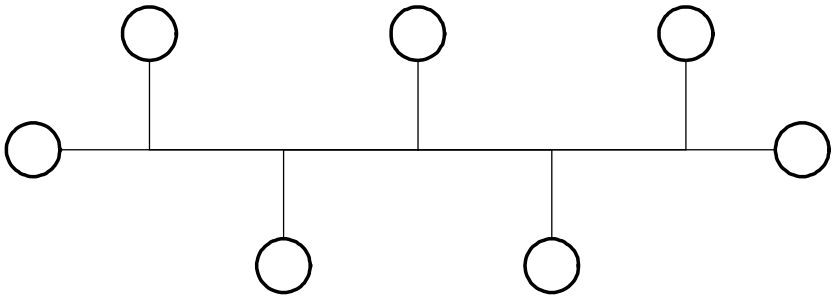
•The process of polling involves large numbers of messages that take up available band width. Traffic is required to poll each node, even nodes that are idle.

•Some polled networks use half-duplex transmission lines. This means that the primary and secondary devices must "turn around" the line, requiring some band width.

•Polling requires a sophisticated central control mechanism that requires extensive configuration.

Contention

- random access
  - unlike polling and token passing, there is no fixed order in which the nodes can transmit



CSMA/CD

- Carrier Sense Multiple Access with Collision Detection
- The CSMA/CD protocol is designed to provide fair access to the shared channel so that all stations get a chance to use the network. After every packet transmission all stations use the CSMA/CD protocol to determine which station gets to use the Ethernet channel next

•CSMA/CD likes a dinner party in a dark room:

  •Everyone around the table must listen for a period of quiet before speaking (Carrier Sense). Once a space occurs everyone has an equal chance to say something (Multiple Access). If two people start talking at the same instant they detect that fact, and quit speaking (Collision Detection).

•CSMA/CD is covered by IEEE 802.3 standard

Carrier Sense

- each interface must wait until there is no signal on the channel, then it can begin transmitting
- If some other interface is transmitting there will be a signal on the channel, which is called carrier
- All other interfaces must wait until carrier ceases before trying to transmit

Multiple Access

- All interfaces are equal in their ability to send data onto the network
- No one gets a higher priority than anyone else, and democracy reigns

Collision Detect

- Signals take a finite time to travel from one end to the other, the first bits of a transmitted frame do not reach all parts of the network simultaneously
- It's possible for two interfaces to sense that the network is idle and to start transmitting their frames simultaneously
- When this happens, the system has a way to sense the "collision" of signals and to stop the transmission and resend the frames

Since signals take a finite time to travel from one end of an Ethernet system to the other, the first bits of a transmitted frame do not reach all parts of the network simultaneously. Therefore, it's possible for two interfaces to sense that the network is idle and to start transmitting their frames simultaneously. When this happens, the Ethernet system has a way to sense the "collision" of signals and to stop the transmission and resend the frames.

Contention

- Advantages:
  - Simple method
  - Low overhead
- Disadvantages:
  - Data collisions increase dramatically when the network size increases
  - Probabilistic rather than deterministic

Advantages of Contention :

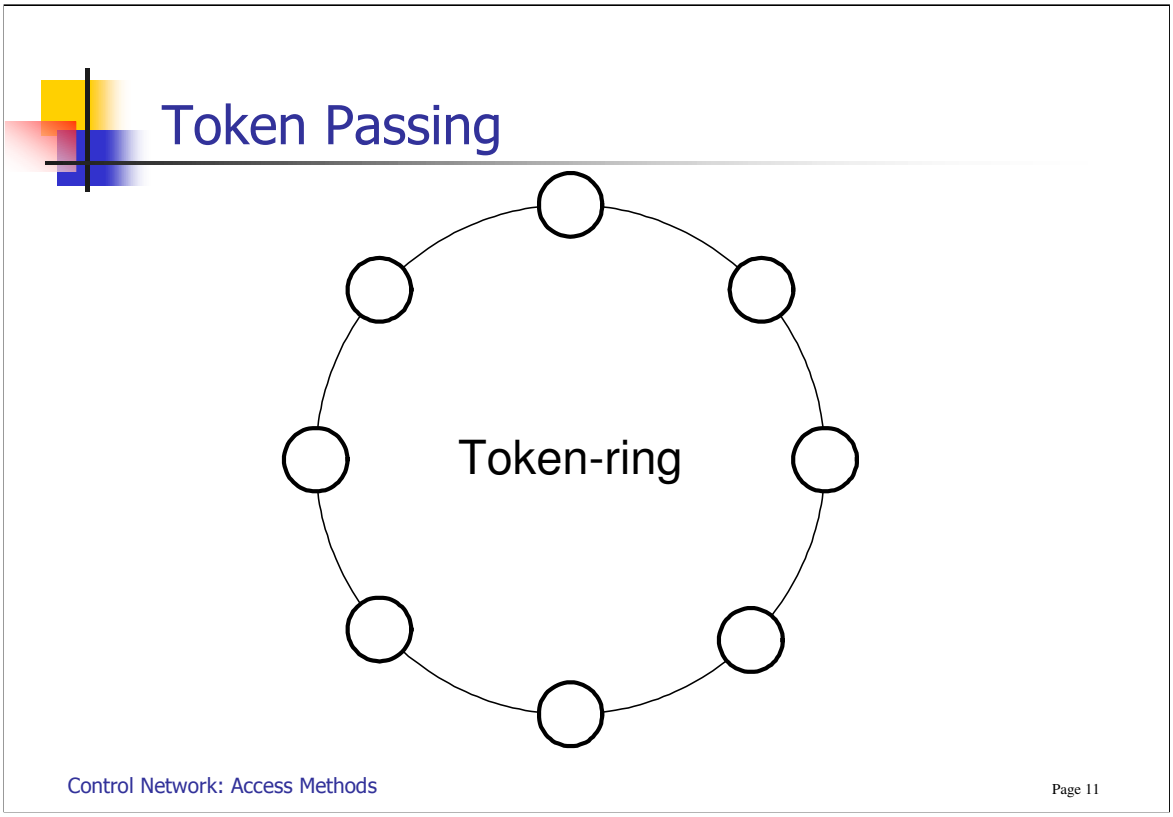
•Contention is a very simple access method that has low administrative overhead requirements. No network traffic is necessary to manage the access scheme.

•Actual user data throughput is rather high at low traffic levels in comparison to the total amount of utilized network band width.

Disadvantages of Contention:

•At high traffic levels, data collisions and the resulting retransmission diminish performance dramatically. It is theoretically possible that collisions can be so frequent at higher traffic levels that no station has a clear chance to transmit.

•Channel access is *probabilistic* rather than *deterministic*. Because of retransmissions and the time it takes to sense collisions, automated equipment that cannot tolerate delays cannot use this type of access. Contention offers no means of establishing the frequency of a station's opportunities to transmit.



•Token passing on different topology: token bus (IEEE802.3) and token ring (IEEE802.4)

•Only one device can talk at a time

•The device wait for a free token in order to use the communication channel to talk

•The token circulates among the devices until one of them wants to use the channel

•The device then grabs the token and uses the channel

- •The sending device sets the token busy bit, adds an information field, adds the message it would like to send, and adds a trailer packet
- •The header packet contains the address of the device for which the message was intended
- •The entire message is then sent out on the communication channel
- •Every device examines the header and checks the address to see if it is being talked to. If not, it ignores the message
- •The intended device copies the message and sets bits in the trailer field to indicate that the message was received, then sends the message back out on the communication channel
- •The original device receives the message back and checks that the message was received. It then frees the token and sends it out for other device to use

Token Passing

- Advantages:
  - High data throughput
  - Deterministic
  - Priorities setting
- Disadvantages:
  - Complicated protocols and software
  - Higher bandwidth overhead
  - Expensive cabling and hardware
  - Additional central controller may require in some systems

Advantages of Token Passing:

•Token passing offers the highest data throughput possible under high traffic conditions. Only one transmission can occur at a time, and collisions *cannot* occur (non-contention). Therefore, token passing experiences less performance degradation at higher traffic levels than contention.

•Token passing is *deterministic*. Each station is guaranteed an opportunity to transmit each time the token travels around the ring.

•Some token passing systems enable you to set priorities for devices that need controlled access to the token.

•As the traffic increases, data throughput also increases to a certain level, and then stabilizes.

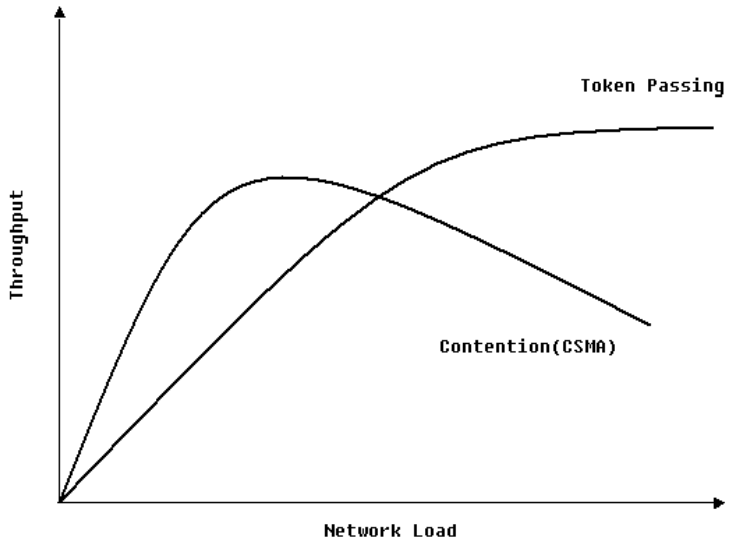
Disadvantages of Token Passing:

•Token passing involves complicated protocols for managing the network and recovering from errors. The traffic associated with these protocols has higher band width overhead then is required for CSMA.

•All devices require complicated software that needs to be modified whenever a station is added or removed.

•Some systems require an additional central controller that adds to the overhead and reduces throughput. Cabling and network hardware can be more expensive for token passing networks than for CSMA networks.

Performance Comparison



Control Network: Access Methods

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•Token passing and CSMA, the most common access methods used in networks, have different *performance characteristics* (see the graphs above). The *Load* x-axis represents the demand being placed on the network. The *Throughput* y-axis represents the data actually being transmitted.

•Notice that the throughput of a *CSMA* network rises smoothly with increased traffic levels up to a point. At that point, collisions begin to occur with greater frequency, resulting in a gradual reduction in network throughput. At some point, network throughput reaches unacceptably low levels.

•*Token passing* exhibits reduced performance at lower traffic levels than CSMA. This is a result of the many administrative mechanisms required for token access. Throughput rises smoothly until the network is fully utilized. At that point, throughput stabilizes. Throughput does not degrade because no collisions can occur. However, beyond the plateau, all workstations are sharing a strictly limited band width. Although total throughput remains stable, the bandwidth available to a given station diminishes as demand increases.