Ethernet

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Ethernet

The most dominant scheme for wired LANs is based on the IEEE 802.3 standard, known as the Ethernet

- 802.3: is a working group and a collection of Institute of Electrical and Electronics Engineers (IEEE) standards produced by the working group
- Defines the physical layer and data link layer's media access control (MAC) of wired Ethernet
- Earlier systems - bus-based, operating at 10Mbps
- Now - switch-based operating up to 100 Gbps

Question

In the contention technique (also called random access),

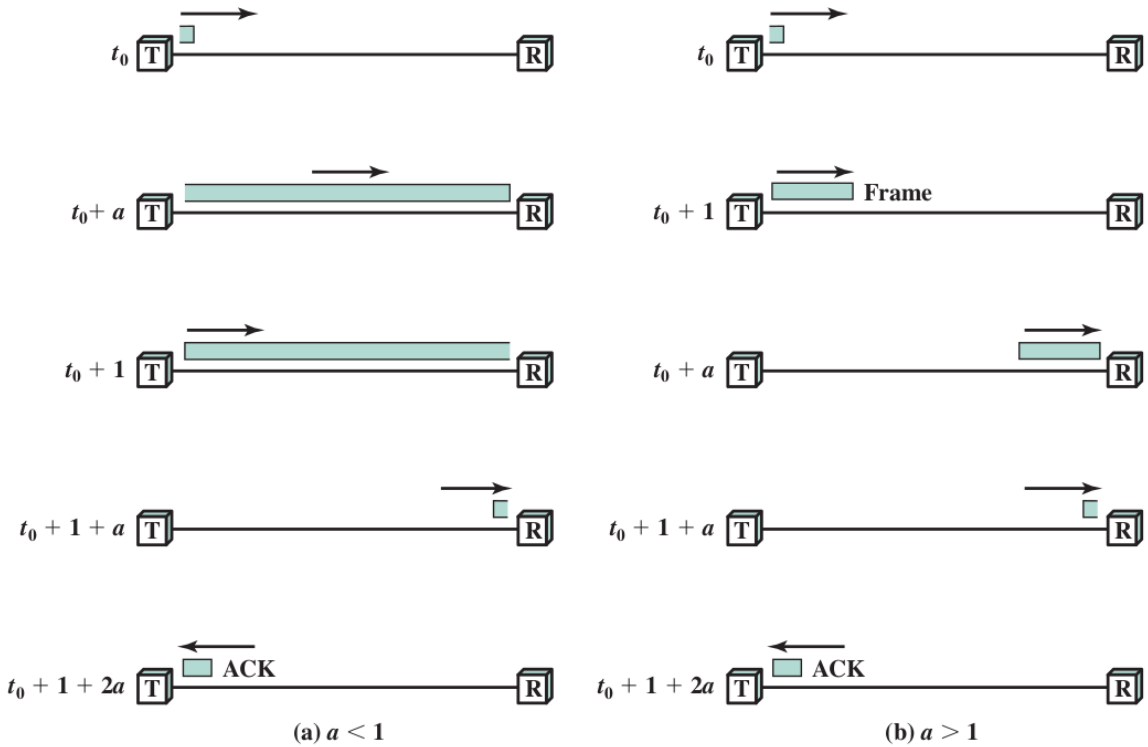
(A) stations transmit in a logical sequence

(B) stations reserve time slots ahead of transmission

(C) there is no predictable or scheduled time for any station to transmit

Propagation and transmission times

- Transmission time: the time it takes for a station to emit all of the bits of a frame onto the medium (proportional to the length of the frame)
- Propagation delay: The time it takes a bit to propagate from one node to the next.



Propagation and transmission times

- B = length of the link in bits; this is the number of bits present on the link at an instance in time when a stream of bits fully occupies the link
- L is the number of bits in the frame (length of the frame in bits)
- Then the propagation time (propagation delay)

$$a = B/L$$

Assume that transmission time = 1

- $a < 1$, the propagation time is less than the transmission time
- $a > 1$, the propagation time is more than the transmission time — larger values of a are consistent with higher data rates and/or longer distances between stations.

Traditional Ethernet : the MAC layer

Uses CSMA/CD. To understand CSMA/CD, let us understand the ALOHA technique

- Maximum round-trip propagation delay: twice the time it takes to send a frame between the two most widely separated stations
- A station may transmit a frame at any time
- The station then listens for an amount of time equal to the maximum possible round-trip propagation delay on the network
- If the station hears an acknowledgment during that time, fine; otherwise, it resends the frame
- If the station fails to receive an acknowledgment after repeated transmissions, it gives up

ALOHA technique contd.

- A receiving station determines the correctness of an incoming frame
- If the frame is valid and if the destination address in the frame header matches the receivers address, the station immediately sends an acknowledgment
- If the frame is invalid, a receiving station ignores the frame
- A frame may be invalid due to noise or due to collision

Question

In the ALOHA technique for medium access, when the load of the network increases, the maximum utilization of the channel

(A) increases

(B) remains the same

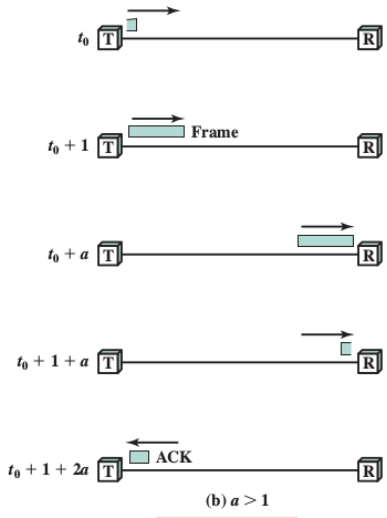
(C) decreases

Slotted ALOHA

- Time on the channel is organized into uniform slots whose size equals the frame transmission time
- All stations are synchronized with respect to a common clock
- Transmission is permitted to begin only at a slot boundary
- Frames that overlap will do so completely
- This increases the maximum utilization of the system

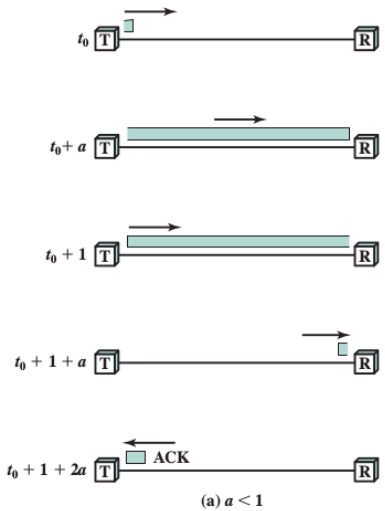
Observations

- A property of LANs: propagation delay between stations may be very small compared to frame transmission time
- If the station-to-station propagation time is large compared to the frame transmission time, then, after a station launches a frame, it will be a long time before other stations know about it
- During that time, one of the other stations may transmit a frame, causing a collision



Observations

- But if propagation time is small compared to transmission time when a station launches a frame, all the other stations know it almost immediately
- — then the other stations must not transmit
- a short propagation delay provides the stations with better feedback about the state of the network; this information can be used to improve efficiency

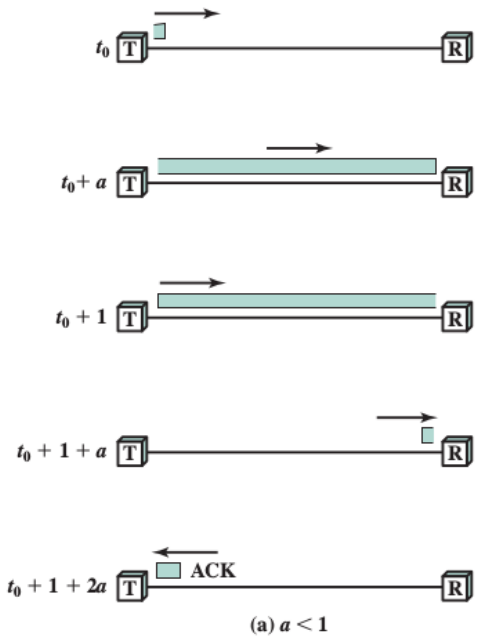


(a) $a < 1$

Carrier Sense Multiple Access

- A station wishing to transmit first listens to the medium to determine if another transmission is in progress
- Waits if the medium is in use
- Transmits if the medium is idle
- Waits a reasonable amount of time after transmitting for an acknowledgment, taking into account
- — the maximum round-trip propagation delay
- — the fact that the acknowledging station must also contend for the channel to respond
- Retransmits if there is no acknowledgement

Carrier Sense Multiple Access



(a) $a < 1$

- Effective for networks in which the average frame transmission time is much longer than the propagation time
- If there are no collisions during the time it takes for the leading edge of the packet to propagate to the farthest station there will be no collisions for this frame

Carrier Sense Multiple Access

- The maximum utilization of the medium achievable by CSMA $>$ slotted ALOHA $>$ ALOHA
- The maximum utilization depends on
- — the length of the frame
- — on the propagation time