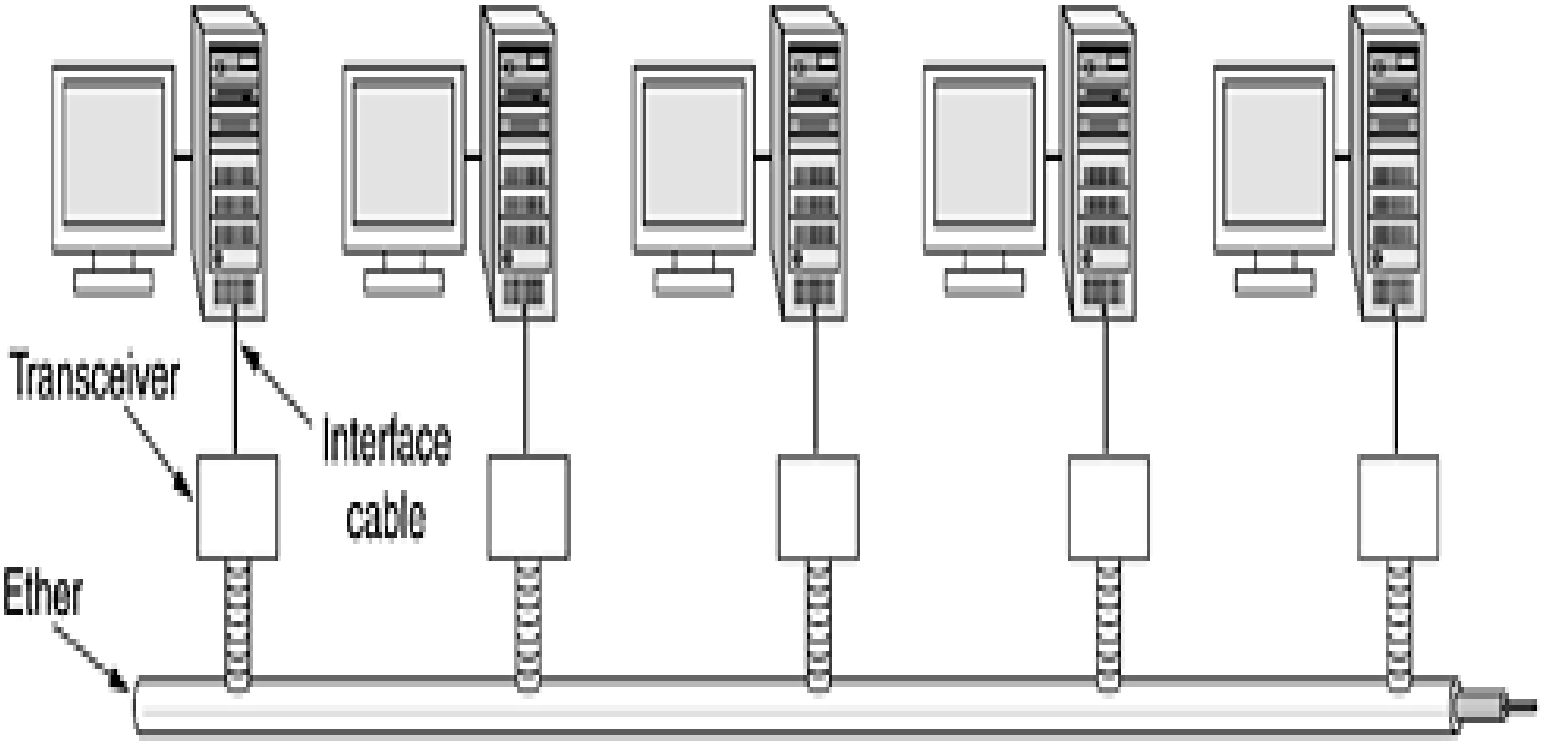
Ethernet

- Ethernet: In Ethernet the transmission medium is a thick coaxial cable (the ether).
- **Ethernet LAN standard: IEEE 802.3**. The committee also standardized a token bus (**802.4**) and a token ring (**802.5**).



Ethernet performance

- The performance of Ethernet under conditions of heavy and constant load, that is, *k stations always ready to transmit.*
- If each station transmits during a contention slot with probability *p, the probability A that some station acquires the* channel in that slot is:

$$A = kp(1-p)^{k-1}$$

Ethernet performance

- If the mean frame takes *P sec to transmit, when many stations have frames to send,*
- The longer the cable, the longer the contention interval, efficiency is less, So the Ethernet standard specifies a maximum cable length.
- Each slot has a duration 2τ,

$$\text{Channel efficiency} = \frac{P}{P + 2\tau/A}$$

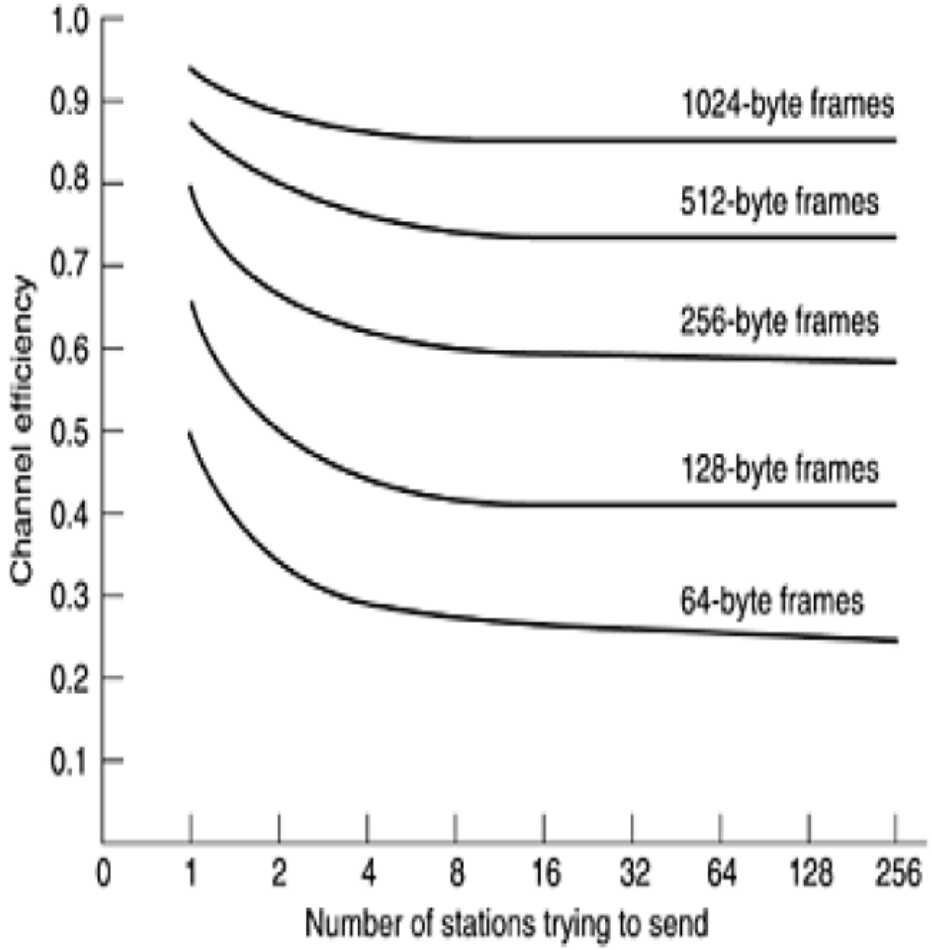
Ethernet performance

- In terms of the frame length, *F, the network bandwidth,B, the cable length, L, and the speed of signal propagation, c, for the optimal case of e* contention slots per frame. With *P = F/B:*

$$\text{Channel efficiency} = \frac{1}{1 + 2BLe/cF}$$

- When the second term in the denominator is large, network efficiency will be low.
- More specifically, increasing network bandwidth or distance (the *BL product) reduces efficiency for a* given frame size.
- If high bandwidth over long distances (fiber optic MANs, for example) is required, Ethernet implemented in this manner may not be the best system for these applications.

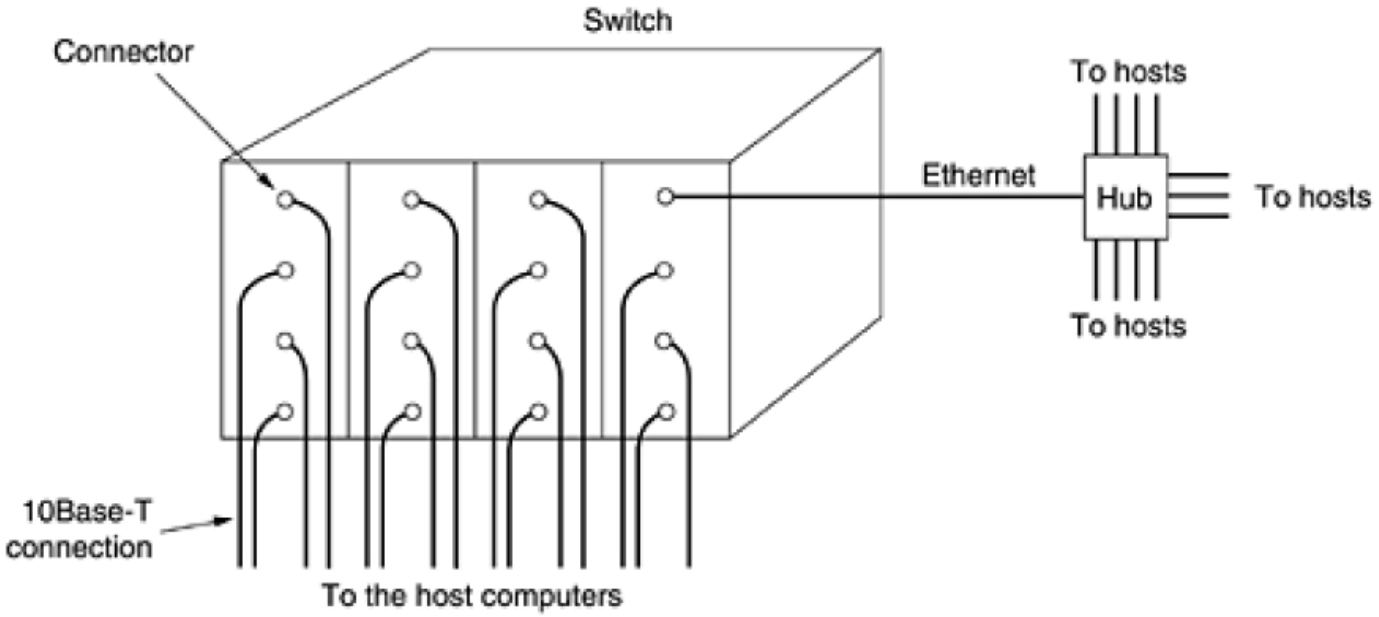
Figure 4-19. Efficiency of Ethernet at 10 Mbps with 512-bit slot times.



Switched Ethernet

- As more and more stations are added to an Ethernet, the traffic will go up.
- But with the growth of multimedia, even a 100-Mbps or 1-Gbps Ethernet can become saturated.
- An additional way to deal with increased load: **switched Ethernet**

Figure 4-20. A simple example of switched Ethernet.



- The heart of this system is a **switch** containing a high-speed backplane and room for typically 4 to 32 plug-in line cards, each containing one to eight connectors.
- A backplane is an electrical connector that joins several electrical circuits together. The backplane connectors are parallel to each other in order to link each pin to its relative pin on each connector, forming a complete computer bus.
- Most often, each connector has a 10Base-T twisted pair connection to a single host computer.
- When a station wants to transmit an Ethernet frame, it outputs a standard frame to the switch.

- The plug-in card getting the frame may check to see if it is destined for one of the other stations connected to the same card. If so, the frame is copied there.
- If not, the frame is sent over the high-speed backplane to the destination station's card.
- The backplane typically runs at many Gbps, using a proprietary protocol.

- What happens if two machines attached to the same plug-in card transmit frames at the same time?
- All the ports on the card to be wired together to form a local on-card LAN.
- Collisions on this on-card LAN will be detected and handled the same as any other collisions on a CSMA/CD

Fast Ethernet

- Fast Ethernet is one of the versions of the Ethernet standard.
- It support and provide 100 Mbps data transmission speeds on local area networks (LAN).
- It was launched in 1995 and was the fastest network connection of its time.
- Fast Ethernet is also known as 100 Base X or 100 Mbps Ethernet, and is defined by the IEEE 802.3u protocol.

- The basic idea behind fast Ethernet was simple: keep all the old frame formats, interfaces, and procedural rules, but just reduce the bit time from 100 nsec to 10 nsec.
- It was initially designed for copper-based twisted pair cable networks and included the 100 Base-TX, 100 Base-T4 and 100 Base-T2 standards.
- The length of the cable in copper-based fast Ethernet was restricted to 100 meters and supported different cable categories.

- The fiber-based fast Ethernet standards 100 Base-FX, 100 Base SX, 100 Base BX and 100 Base LX10 use one or more strands and modes of fiber optics to transmit data.
- The range of fast Ethernet for fiber mode is around 2000m.

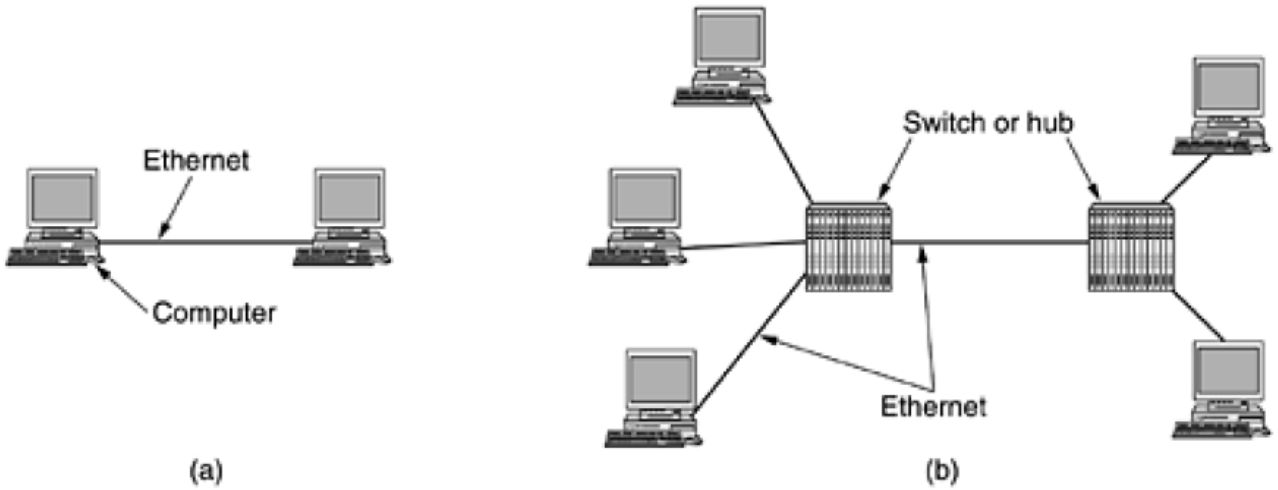
Figure 4-21. The original fast Ethernet cabling.

Name	Cable	Max. segment	Advantages
100Base-T4	Twisted pair	100 m	Uses category 3 UTP
100Base-TX	Twisted pair	100 m	Full duplex at 100 Mbps (Cat 5 UTP)
100Base-FX	Fiber optics	2000 m	Full duplex at 100 Mbps; long runs

Gigabit Ethernet

- Gigabit Ethernet (GbE), a transmission technology based on the Ethernet frame format and protocol used in local area networks (LANs).
- It support and provide 1 gigabit per second (1 Gbps) data transmission speeds.
- It was introduced in 1999 and Defined by IEEE 802.3z standard.
- It is currently being used as the backbone in many networks.
- Newer standards, such as 10 GbE, a networking standard that is 10 times faster than Gigabit Ethernet, are also emerging.

Figure 4-22. (a) A two-station Ethernet. (b) A multistation Ethernet.



- In the simplest gigabit Ethernet configuration, two computers are directly connected to each other.
- The more common case, however, is having a switch or a hub connected to multiple computers and possibly additional switches or hubs.
- In both configurations each individual Ethernet cable has exactly two devices on it, no more and no fewer.
- Gigabit Ethernet supports two different modes of operation: full-duplex mode and half-duplex mode.

- Gigabit Ethernet uses the same 802.3 framing structure as standard Ethernet.
- It supports 1 Gb per second (Gbps) speeds using Carrier Sense Multiple Access/Collision Detect (CSMA/CD).

Figure 4-23. Gigabit Ethernet cabling.

Name	Cable	Max. segment	Advantages
1000Base-SX	Fiber optics	550 m	Multimode fiber (50, 62.5 microns)
1000Base-LX	Fiber optics	5000 m	Single (10 μ) or multimode (50, 62.5 μ)
1000Base-CX	2 Pairs of STP	25 m	Shielded twisted pair
1000Base-T	4 Pairs of UTP	100 m	Standard category 5 UTP