

13. M terminals are attached by a dedicated pair of lines to a hub in a star topology. The distance from each terminal to the hub is d meters, the speed of the transmission lines is R bits/second, all frames are of length 12500 bytes, and the signal propagates on the line at a speed of $2.5 (10^8)$ meters/second. For the four combinations of the following parameters $\{d = 25 \text{ meters or } d = 2500 \text{ meters}; R = 10 \text{ Mbps or } R = 10 \text{ Gbps}\}$, compare the maximum network throughput achievable when the hub is implementing: Slotted ALOHA; CSMA/CD.

Solution:

$$L = 12500 \times 8 \text{ bits}, t_{\text{prop}} = d / (2.5 \times 10^8 \text{ meters/sec}), a = t_{\text{prop}} R/L$$

Values for a :

R/d

	2x25	2x2500
1.00E+07	2E-05	2E-03
1.00E+10	2E-02	2E+00

Maximum Throughput for Slotted ALOHA:

R/d

	2x25	2x2500
1.00E+07	0.367879	0.367879
1.00E+10	0.367879	0.367879

Maximum throughput for CSMA-CD:

R/d

2x25

2x2500

1.00E+07

0.999872

0.98736

1.00E+10

0.886525

0.07246

37. Calculate the parameter a and the maximum throughput for a Gigabit Ethernet hub with stations at a 100-meter distance and average frame size of 512 bytes; 1500 bytes; and 64,000 bytes.

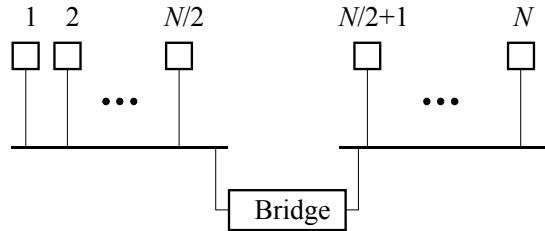
$$d = 100$$

$$T_{\text{prop}} = 0.0000005$$

$$R = 1.00\text{E}+09$$

	512	1500	64000
a	0.12207	0.041667	0.000977
Throughput	0.56	0.788525	0.993754

53. Suppose N stations are connected to an extended Ethernet LAN, as shown below, operating at the rate of 10 Mbps. Assume that the efficiency of each Ethernet is 80 percent. Also assume that each station transmits frames at the average rate of R bps, and each frame is equally likely to be destined to any station (including to itself). What is the maximum number of stations, N , that can be supported if R is equal to 100 kbps? If the bridge is replaced with a repeater, what is the maximum number of stations that can be supported? (Assume that the efficiency of the entire Ethernet is still 80 percent.)



Solution:

10 Mbps LAN
 $R = 100$ kbps
 efficiency = 0.80

Bridge:

Each station is equally likely to transmit to any other stations in the extended LAN. Then $R/2$ traffic is local.

$$\frac{100\text{kbps} \left(\frac{1}{2}\right) N}{10\text{Mbps}} \leq 0.8 \quad N \leq 160$$

Repeater:

$$\frac{100\text{kbps} N}{10\text{Mbps}} \leq 0.8 \quad N \leq 80$$