1. With pure ALOHA the usable bandwidth is 0.184 × 56 kbps = 10.3 kbps. Each station requires 10 bps, so $N = 10300/10 = 1030$ stations.

3. Each terminal makes one request every 200 sec, for a total load of 50 requests/sec. Hence $G = 50/8000 = 1/160$.

4. (a) With $G = 2$ the Poisson law gives a probability of e^{-2}.
(b) $(1 - e^{-G})^k e^{-G} = 0.135 \times 0.865^k$.
(c) The expected number of transmissions is $e^G = 7.4$.

14. By definition

$$\mathbf{S} \bullet \mathbf{T} \equiv \frac{1}{m} \sum_{i=1}^{m} S_i T_i$$

If T sends a 0 bit instead of 1 bit, its chip sequence is negated, with the i-th element becoming $-T_i$. Thus

$$\mathbf{S} \bullet \mathbf{T} \equiv \frac{1}{m} \sum_{i=1}^{m} S_i(-T_i) = -\frac{1}{m} \sum_{i=1}^{m} S_i T_i = 0$$

17. (a) Number the floors 1-7. In the star configuration, the router is in the middle of floor 4. Cables are needed to each of the $7 \times 15 - 1 = 104$ sites. The total length of these cables is

$$4 \sum_{i=1}^{7} \sum_{j=1}^{15} \sqrt{(i-4)^2 + (j-8)^2}$$

The total length is about 1832 meters.
(b) For 802.3, 7 horizontal cables 56 m long are needed, plus one vertical cable 24 m long, for a total of 416 m.
(c) The ring is a little trickier. One solution is a spiral passing through the points (1,1), (15,1), (15,7), (1,7), (1,2), (14,2), etc. The end of the spiral is connected back to (1,1). The total length here is about 462 m.

20. Number the acquisition attempts starting at 1. Attempt i is distributed among 2^{i-1} slots. Thus the probability of a collision on attempt i is $2^{-(i-1)}$. The probability that the first $k-1$ attempts fail, followed by a success on round k is

$$P_k = (1 - 2^{-(k-1)}) \prod_{i=1}^{k-1} 2^{-(i-1)}$$

which can be simplified to

$$P_k = (1 - 2^{-(k-1)})\, 2^{-(k-1)(k-2)/2}$$

The expected number of rounds is then just $\sum k P_k$.

21. For a 1 km cable, the one-way propagation time is 5 μsec, so $2\tau = 10$μsec. To make CSMA/CD work, it must be impossible to transmit entire frame in this interval. At 1 Gbps, all frames shorter than 10,000 bits can be completely transmitted in under 10 μsec, so the minimum frame is 10,000 bits or 1250 bytes.

26. At 5 Mbps, a bit time is 200 ns. In 200 ns, the signal travels 40 meters. Insertion of one new station adds as much delay as insertion of 40 meters of cable.