**Assignments -- Chapter 4**

1. A group of *N* stations share a 56-kbps pure ALOHA channel. Each station outputs a 1000-bit frame on an average of once every 100 sec, even if the previous one has not yet been sent (e.g., the stations can buffer outgoing frames). What is the maximum value of *N* ?

参考答案

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.

2. Consider building a CSMA/CD network running at 1 Gbps over a 1-km cable with no repeaters. The signal speed in the cable is 200,000 km/sec. What is the minimum frame size?

参考答案

For a 1-km cable, the one-way propagation time is 5 μsec, so 2τ = 10 μsec. To make CSMA/CD work, it must be impossible to transmit an 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.

3. An IP packet to be transmitted by Ethernet is 60 bytes long, including all its headers. If LLC is not in use, is padding needed in the Ethernet frame, and if so, how many bytes?

参考答案

The minimum Ethernet frame is 64 bytes, including both addresses in the Ethernet frame header, the type/length field, and the checksum. Since the header fields occupy 18 bytes and the packet is 60 bytes, the total frame size is 78 bytes, which exceeds the 64-byte minimum. Therefore, no padding is used.

4. Ethernet frames must be at least 64 bytes long to ensure that the transmitter is still going in the event of a collision at the far end of the cable. Fast Ethernet has the same 64-byte minimum frame size but can get the bits out ten times faster. How is it possible to maintain the same minimum frame size?

参考答案

The maximum wire length in fast Ethernet is 1/10 as long as in Ethernet.

5. Give two reasons why networks might use an error-correcting code instead of error detection and retransmission.

参考答案

One reason is the need for real-time quality of service. If an error is discovered, there is no time to get a retransmission. The show must go on. Forward error correction can be used here. Another reason is that on very low quality lines (e.g., wireless channels), the error rate can be so high that practically all frames would have to be retransmitted, and the retransmission would probably damaged as well. To avoid this, forward error correction is used to increase the fraction of frames that arrive correctly.

6. A LAN uses CSMA/CD protocol to achieve media access control, the data transmission rate is 10Mbps, the distance between host *A* and host *B* is 2000 m, and the signal propagation speed is 2x108 m/s. If there is no conflict and error in the network, host *A* always sends data to host *B* in the standard longest Ethernet data frame (1518 bytes). Host *B* immediately sends a 64-byte acknowledgement frame to host *A* after receiving a data frame successfully, and host *A* can send the next data frame after receiving the acknowledgement frame. What is the effective data transmission rate of host *A* in this case? (regardless of the preamble of the Ethernet frame). Please explain the reasons or write down the calculation process.

参考答案

The transmission delay for a data frame with 1518 bytes:

=1518\*8bit/10Mbps=1214.4μs

and

the transmission delay for an acknowledgement frame with 64 bytes:

=64\*8bit/10Mbps=51.2μs

the signal propagation delay from *A* to *B*:

= 2000 / 2\*108=10μs

The total time of host *A* from sending data frame to receiving acknowledgement frame: T=1214.4+51.2+2\*10=1285.6μs

During this time period, the actual amount of data sent by host *A* is

(1518-18)\*8 = 12000 bit；

So, the effective data transmission rate of host *A* is

=12000bit/1285.6μs≈9.33Mbps