

## TUTORIAL 2: The Data Link Layer

1. *One of your classmates, Scrooge, has pointed out that it is wasteful to end each frame with a flag byte and then begin the next on with a second flag byte. One flag byte could do the job as well, and a byte saved is a byte earned. Do you agree?*
2. *Can you think of any circumstances under which an open-loop protocol (error-correction code, e.g., a Hamming code) might be preferable to the feedback type protocols discussed throughout this chapter?*
3. *A 3000-km-long T1 trunk (1.537 Mbps) is used to transmit 64-byte frames using sliding window protocol 5 (**using go-back-n**). If the propagation speed is 6  $\mu\text{sec/km}$ , how many bits should the sequence number be?*
4. *In protocol 6 (**using selective-repeat**), when a data frame arrives, a check is made to see if the sequence number differs from the one expected and NoNak is true. If both conditions hold, a NAK is sent. Otherwise, the auxiliary timer is started. Suppose that the else clause were omitted. Would this change affect the protocol's correctness?*
5. *Frames of 1000 bits are sent over a 1-Mbps satellite channel (with a propagation delay of 270 msec). Acknowledgements are always piggybacked onto data frames. The headers are very short. Three bit sequence numbers are used. What is the maximum achievable channel utilization for*
  - a. *Stop-and-wait.*
  - b. *Protocol 5.*
  - c. *Protocol 6.*