Don’t Count Magnetic Media Out Yet  An LTO-7 tape cartridge has a native capacity of 6.0 TB (that’s $6 \cdot 10^{12}$ bytes). It has a size of $102 \times 105.0 \times 21.0$ mm, and weighs 200 g. That’s $4.0 \times 4.1 \times 0.8$ inches and 0.441 pounds. How many of them could you get in the back of a station wagon with a weight limit for the cargo of 882 lb, and a cargo space of 20 cubic feet? Imagine that you need to transmit that much data to a location 1000 km distant, and that the station wagon can travel 100 km/h. How fast would a network link have to be to get all of the data there faster than the station wagon? You may ignore the time it takes for a single bit to traverse the length of the link, only consider the data rate of the link.

Layers and Interfaces  Suppose there is a change in the interface between layers $k$ and $k+1$. What impact does this have on any other interfaces?

Data Rate of Noiseless and Noisy Channels  Given a communications channel with a signal-to-noise ration of 33 dB and a bandwidth of 100 kHz, what is the maximum data rate?

If the channel had no noise (which never actually happens, but for the sake of this problem say that it does) what would the maximum data rate be? (Careful, this is a bit of a trick question.)

Data Rate of a Television Channel  Television channels are 6 MHz wide. How many b/s can be sent if eight-level digital signals are used? Assume that the signal-to-noise ratio of the channel will support eight levels.

Nyquist Theorem  Is the Nyquist theorem true for wireless communication or only for guided media?

Wavelengths and Frequencies  Radio antennas often work well when the diameter of the antenna is equal to half the wavelength of the radio wave. Reasonable antennas range from 1 cm to 5 m in diameter. What frequency range does this cover?

Laser Beams in Air  A laser beam 1 mm wide is aimed at a detector 15 mm wide 75 m away on the roof of a building. How much of an angular diversion (in degrees) does the laser have to have before it completely misses the detector?

Clock Recovery and Signal Transitions  Prove that in 4B/5B encoding, a signal transition will occur at least every four bit times.

Simplex, Half-Duplex, and Full-Duplex  Is a gas pipeline a simplex system, a half-duplex system, or a full-duplex system? How about broadcast radio?
CD Sampling Rate  Why has the sampling rate for Compact Discs been set at 44.1 kHz?

$n$-node packet-switching networks  Three packet-switching networks each contain $n$ nodes. The first network has a star topology with a central switch, the second is a (bidirectional) ring, and the third is fully interconnected, with a wire from every node to every other node. What are the best-, average-, and worst-case transmission paths in hops?