

OPTI 500 A, Fall 2011
Take Home Exam
Solutions

1. a) How many links are in a network with ring topology and N nodes? N
b) How many links are in a network with star topology and N nodes? $N-1$
c) How many possible links can we make in a mesh network with N nodes? $N(N-1)/2$
2. The bandwidth of the electronics required to generate an optical pulse is roughly the frequency content of the pulse. The frequency content of a square pulse of temporal length τ_p is approximately $1/\tau_p$.
 - a. Find the bandwidth required to generate the bits for an OC-192 signal.
 $\sim 1/100ps = 10 \text{ GHz}$
 - b. Find the bandwidth that would be required if a SONET OC-192 signal were to use return-to-zero coding where the amplitude goes high for one quarter of the bit period. $\sim 1/25ps = 40 \text{ GHz}$
3. A network link carries an OC-48 SONET signal. We wish to increase the capacity of the link by a factor of four. Two options are proposed:
 - i) add three fibers carrying OC-48 signals, and ii) use wavelength division multiplexing to add three wavelengths to the existing fiber, each carrying an OC-48 signal. Suppose the cost of installing additional fiber is \$10 per meter and the cost of a WDM multiplexer/demultiplexer is \$10,000.
 - a) Considering the cost of the link, determine the maximum length for which we would want to use the multi-fiber solution. $\$30/meter \times L = 2 \times \$10,000$, so $L = 667 \text{ m}$
 - b) Suggest a third option for expanding the link capacity. *Convert the link to OC-192*
4. Very briefly describe how virtual circuit switching is similar to old-fashion telephone switching. *In both cases data follow a single path set up for the communication session.*
5. List the four items that can be switched in networks using GMPLS (generalized multiprotocol label switching) control functions. *Fibers, wavelengths, TDM slots, and packets*