

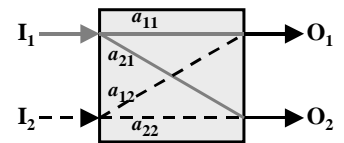
Course S-38.165 (Switching Technology), Exam questions, September 2, 2004

1. Describe characteristics of a switch fabric, which is
 - a.) a self-routing one
 - b.) a rearrangeably non-blocking one
 - c.) a fault tolerant one.

2. A crossbar switch fabric is constructed of 2×2 cross-point components. The maximum driving current of an output is 120 mA and the maximum drain current of an input is 8 mA.
 - a.) Show by a drawing how the switch fabric is constructed of the cross-point components.
 - b.) How large ($N \times N$) crossbar switch can be build by using these components, i.e., what is the maximum value of N ?
 - b.) If fan-out of the above given cross-point component were 20 and the maximum driving current of an output were 150 mA, what should the maximum drain current of an input be and how large crossbar fabrics could be build by using these components?

3. What are the major functional blocks of a router. Explain performance of each block.

4. An optical directional coupler component includes two inputs and two outputs (as shown in the figure beside). Both inputs are coupled to both outputs and parameter a_{ji} indicates the amount of input power that is transferred from input i to output j .



- a.) Design a static optical 4×4 broadcast star using the given directional coupler. Draw a diagram showing required components and connections between them. Show also how wavelengths ($\lambda_1, \lambda_2, \lambda_3, \dots$) should be assigned.
 - b.) Suppose that the signal powers at the different inputs (of the broadcast star) are equal and the coupler components are lossless. What should the values of the different power transfer parameters (a_{ji}) be to guarantee that the signal powers of the different wavelengths (λ_k) at the different outputs are equal ?
 - c.) Suppose that the parameters of the optical coupler component are fixed to be $a_{11} = a_{22} = \alpha$ and $a_{21} = a_{12} = 1 - \alpha$. Derive expressions for the power levels at the different outputs of the broadcast star when the power level of each wavelength at the inputs is P .
5. The switch fabric of an ATM switch is dimensioned to support exactly 20 STM-1 interfaces. The switch logic is designed so that separate STM-1 interfaces can be upgraded to STM-4 interfaces. Provided that no data is lost in the switch fabric and the fabric switches native ATM cells, then
 - a.) What is the total throughput of the switch fabric (given in bits/s) ?
 - b.) If the ATM switch is equipped only with STM-4 interfaces, how many such interfaces can be active at a time ?
 - c.) If routing decisions of ATM cells are performed locally at each interface, i.e., each interface implements a RIT (Routing Information Table), what should the routing speed (given in cells/s) of an STM-1 and STM-4 interface be to avoid buffer overflows at the interfaces ?