S-72.3340 Optical Networks
Exercise 4

1) The optical cross-connect (OXC) node of Figure 1 is designed to cross-connect signals between two incoming and two outgoing fibers, whereby the maximum number of distinct wavelength channels carried per fiber is two (that is, λ_1; λ_2). Produce a sketch showing how the OXC could be scaled to handle three channels (λ_1 λ_2 λ_3) per fiber port.

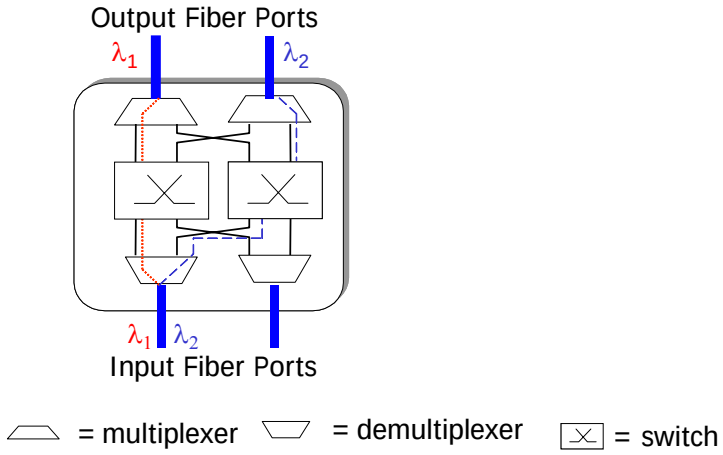
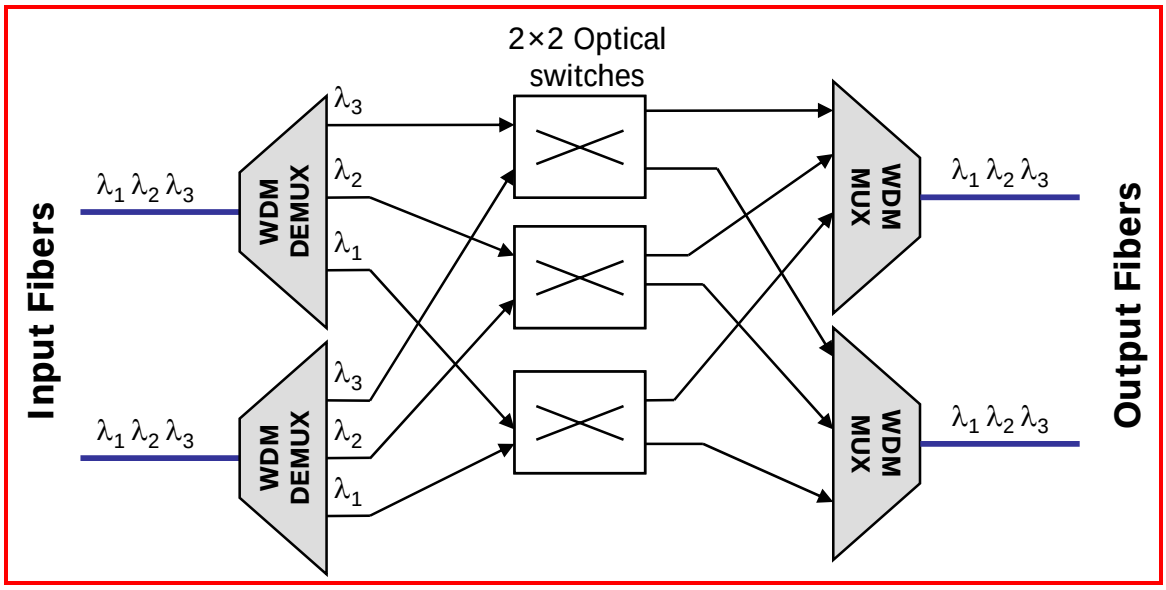


Figure 1 Example OXC with 2 input and 2 output fibers implemented using two 2x2 switches



2) A single-fiber unidirectional DWDM optical ring is constructed using reconfigurable OADMs (ROADMs) located at three different sites A, B and C as shown in Figure 2. The traffic between any two sites is carried on single wavelength channels. Currently, traffic between sites A→C, B→C and C→A is carried on channels λ_1, λ_2 and λ_3, respectively. However, with all the connections still up, a new request for a connection is made to provide capacity (equivalent to capacity of a single wavelength channel) for data traffic between sites B→A.

a) Assuming that there are no wavelength conversion capabilities within the network, show how you can configure the network to handle the extra capacity demand without disrupting any of the existing connections. Same wavelength should be used end-to-end and no two streams can use same wavelength on common fiber. B→A link made of spans B→C (channels λ_1, λ_2 in use) and C→A (channel λ_3 in use). Therefore, a new wavelength channel λ_4 required to enable B→A connection.

b) Repeat the above configuration, this time assuming that full wavelength conversion capabilities are available in all ROADMs. Wavelength converters eliminate the wavelength continuity constraint and enable reuse of wavelength channels. Therefore, now connection could use channel λ_3 in span B→C, and after wavelength conversion use either channel λ_1 or λ_2 on span C→A.