



# Lecture 5: WDM Network Design

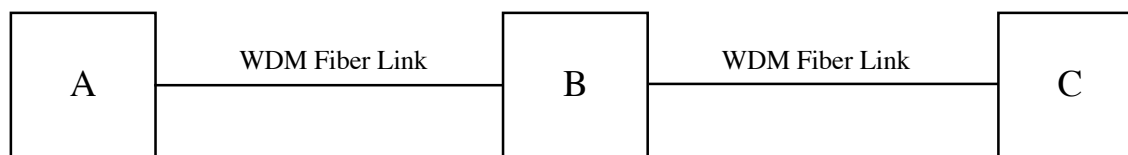
# Lightpath Topology



- ⇒ The topology seen by layers that sit on top of the optical lightpath layer is called the ***Lightpath Topology*** (Sometimes referred to as the ***Logical*** or ***Virtual*** Topology)
- ⇒ Examples of layers that sit on top include IP Routing and SONET/SDH.
- ⇒ The Lightpath Topology Design (LTD) problem is as follows:
  - ⇒ The fiber topology is specified
  - ⇒ The traffic requirements (traffic matrix) are specified
- ⇒ The Routing Wavelength Assignment (RWA) problem is as follows:
  - ⇒ Given an LTD, a ***lightpath*** topology is designed to realize the ***Logical*** topology within the optical layer.

# LTD and RWA Example

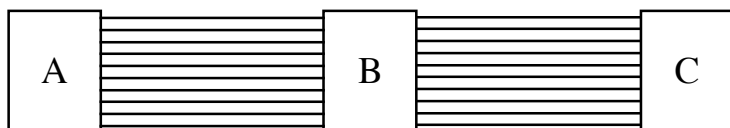
3-Node Network



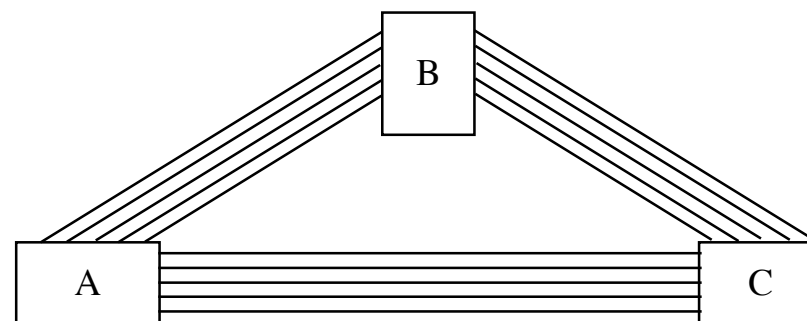
Traffic Requirements

	A	B	C
A		50Gbps	50Gbps
B	50Gbps		50Gbps
C	50Gbps	50Gbps	

Lightpath Topology A

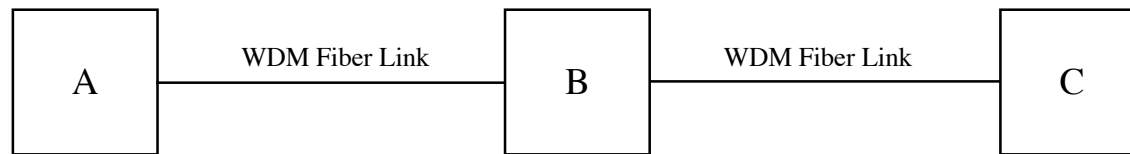


Lightpath Topology B

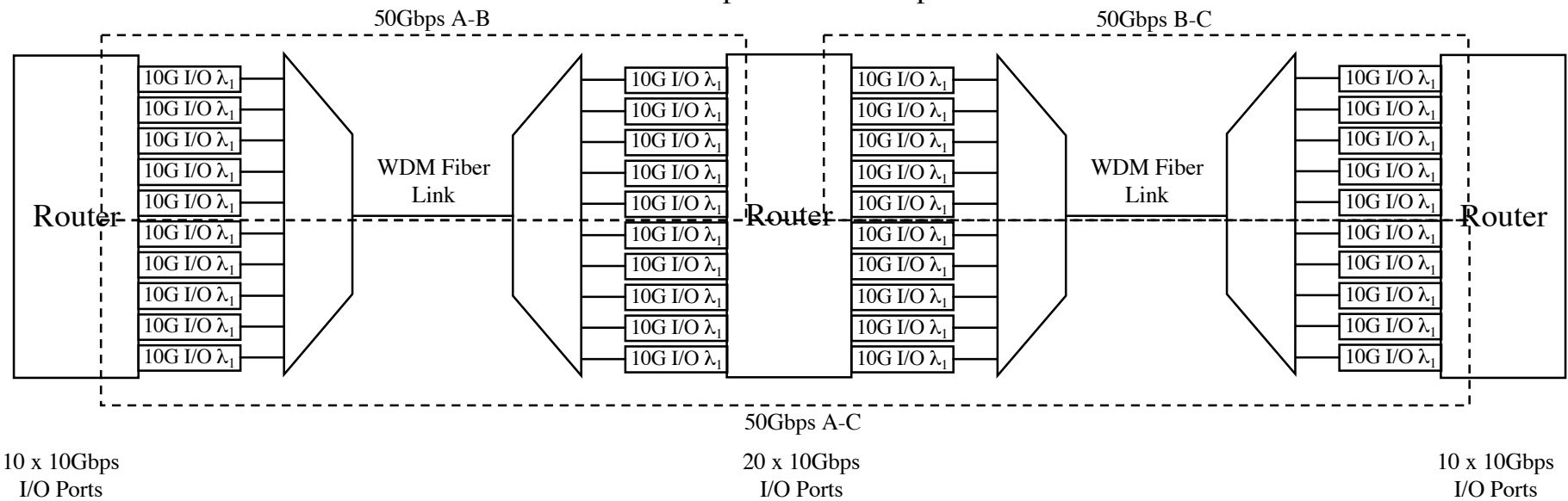


# Design 1

3-Node Network

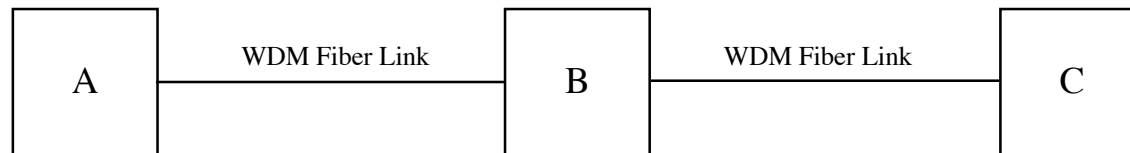


No Optical Add/Drop

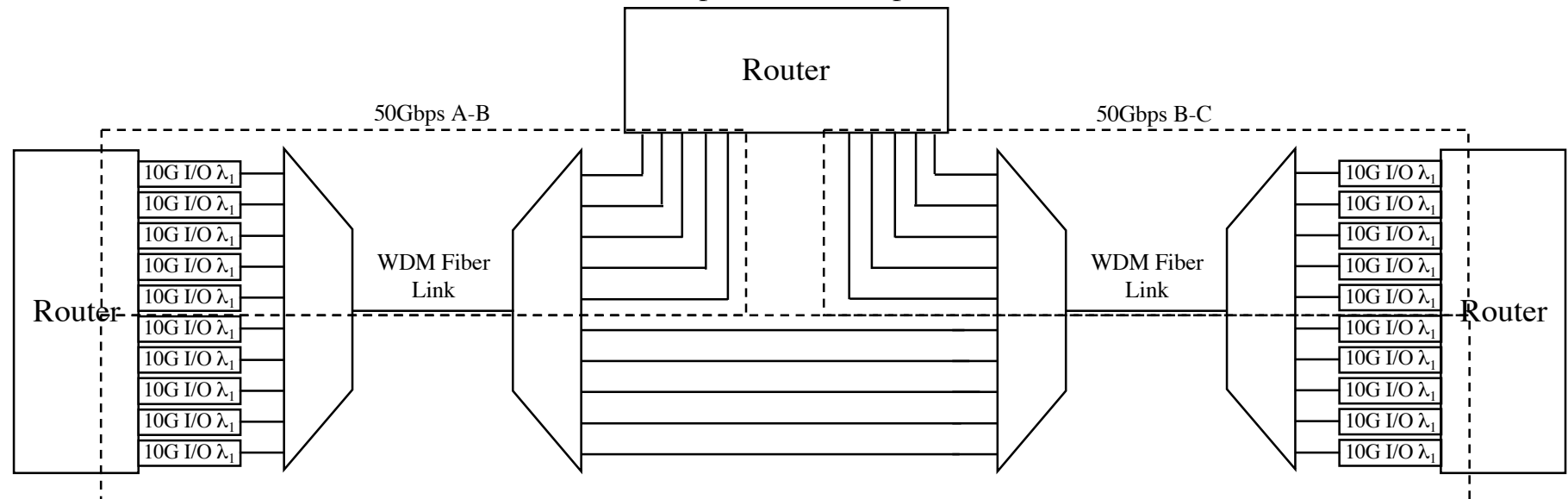


# Design 2

## 3-Node Network



## Optical Add/Drop



10 x 10Gbps  
I/O Ports

ECE162C, Spring 2008, Prof. Blumenthal

50Gbps A-C

10 x 10Gbps  
I/O Ports +  
OADM

10 x 10Gbps  
I/O Ports

Lecture 5.5

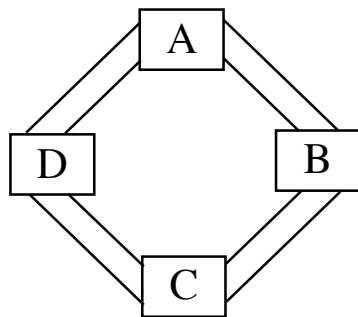
# Cost Tradeoffs



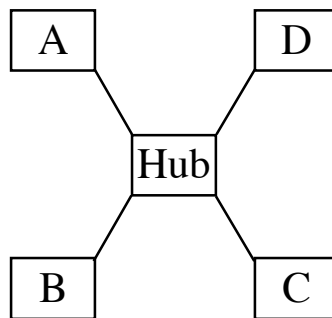
- ⇒ What are the cost tradeoffs, for networks that handle the same traffic demand, between cost of the higher-layer equipment and the optical layer equipment.
- ⇒ Cost metrics need to be assigned to fairly compare. For example use the number of router I/O ports. But there are many many more examples and metrics.
- ⇒ Number of transponders in the OLTs and OADM is an important metric. Transponders typically represent a large fraction of the equipment cost (up to 90%!).
- ⇒ The remainder of the physical layer costs can be divided up into transport (number of wavelengths on link, bit rate per wavelength and distance between links, and number of optical amplifiers).

# Cost Trade-Offs

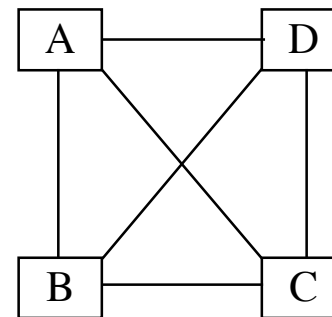
- ⇒ Consider a 2-connected network topology.
  - ⇒ Two node-wise disjoint routes between every pair of nodes in the network.
  - ⇒ Examples can include ring and mesh 2-connected.
  - ⇒ Rings are widely deployed today, but networks are moving to mesh connected. Lower fiber deployment cost -  $N$  nodes requires only  $N$  links for a 2-connected network.
- ⇒ Consider 3 example topologies



P-t-P WDM ring



Hub



Full Mesh