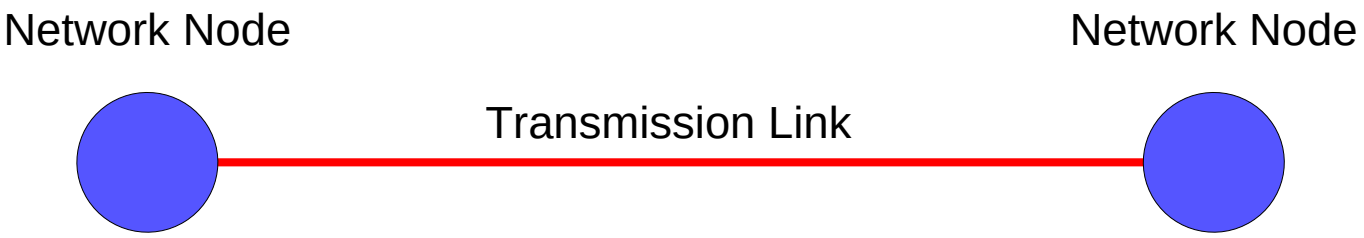
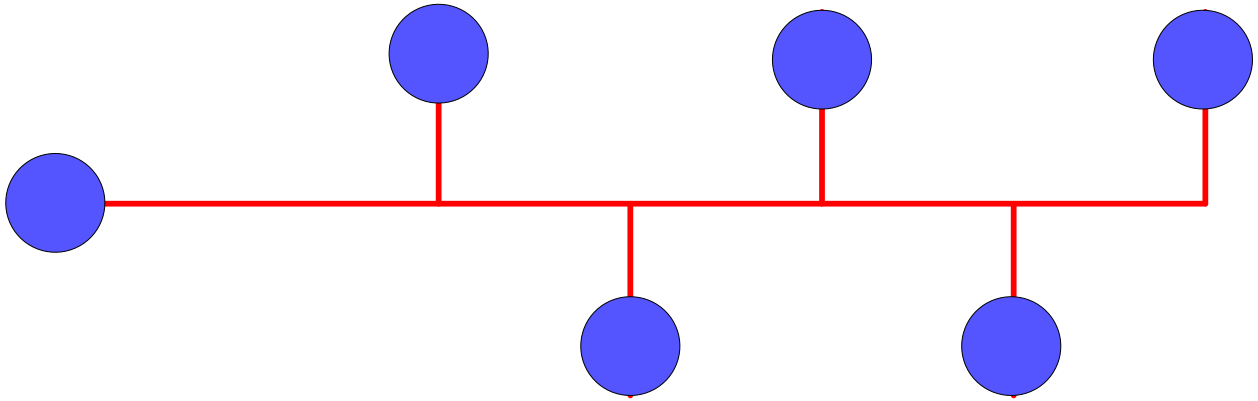
Introduction to Networks

- Network Topology – How we interconnect network users
- Network Hierarchy – The connection between network topology and geographical size
- Telecommunication (Phone Networks)
  - Circuit Switching
  - Multiplexing
  - SONET

The Simplest Network Topology

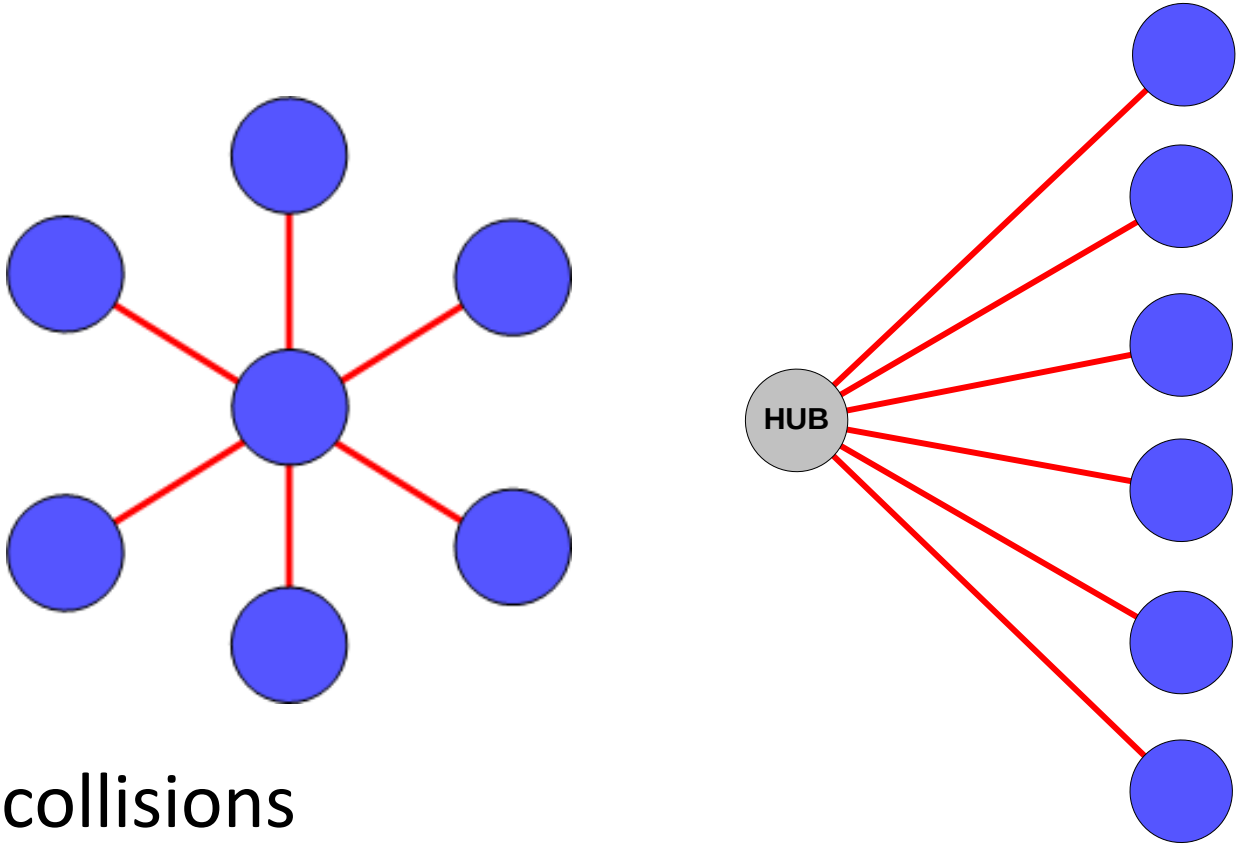


Bus Topology



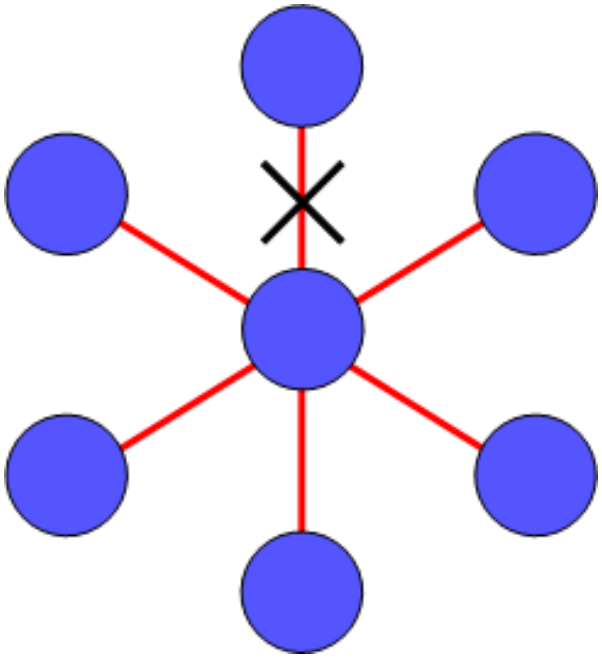
- Very easy to add a device to the bus
- Common topology for connecting devices by Ethernet
- The network must handle “Collisions”

Star and Hub Topology



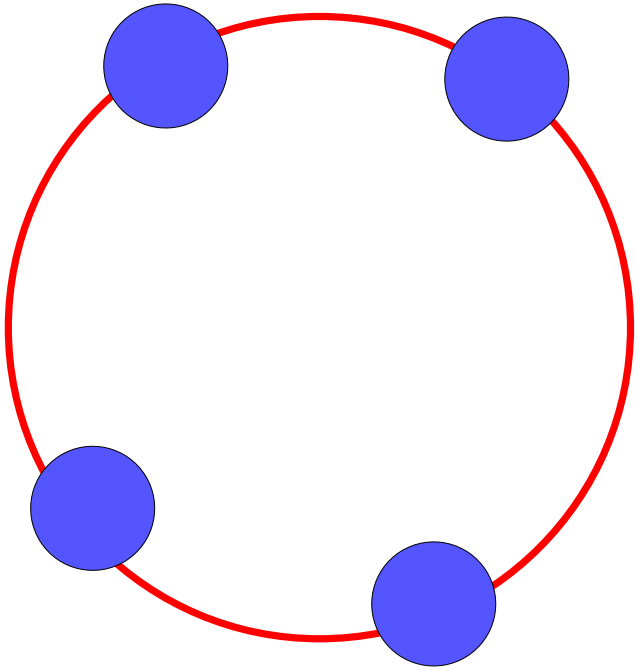
- No collisions
- Devices easily added by connecting them to the hub, but may require more wiring than a bus

Recovery from Link Failure



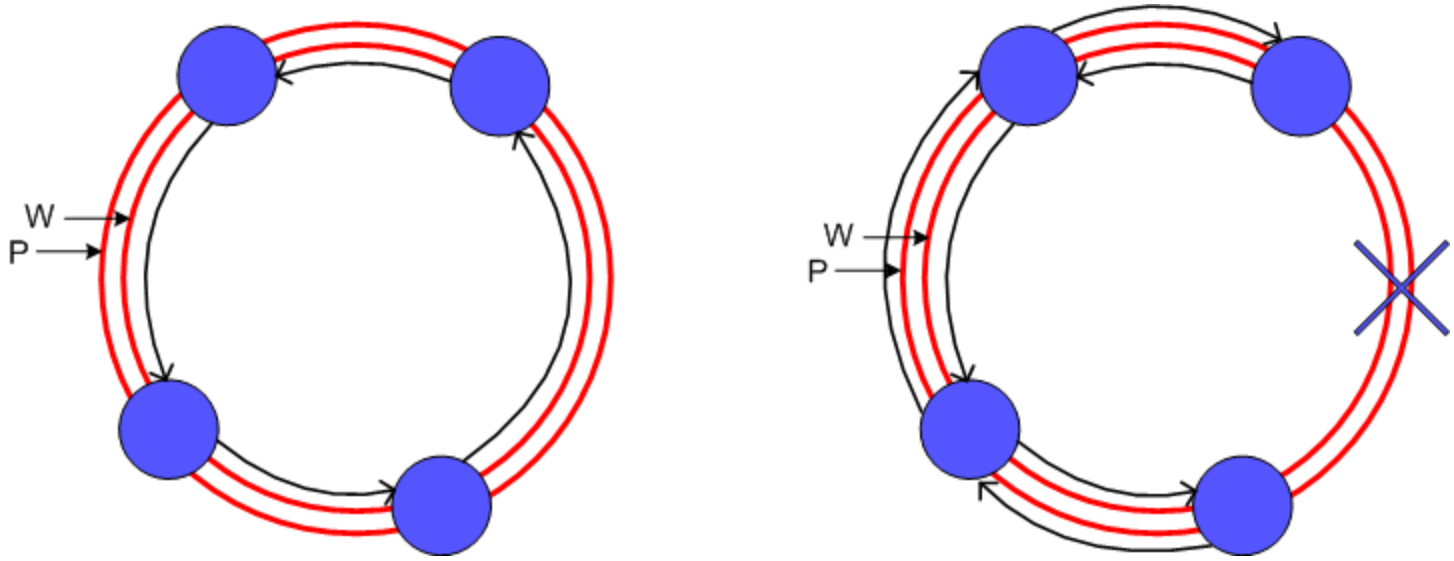
- A link failure isolates a node in a network with star topology until the link can be repaired.

Ring Topology



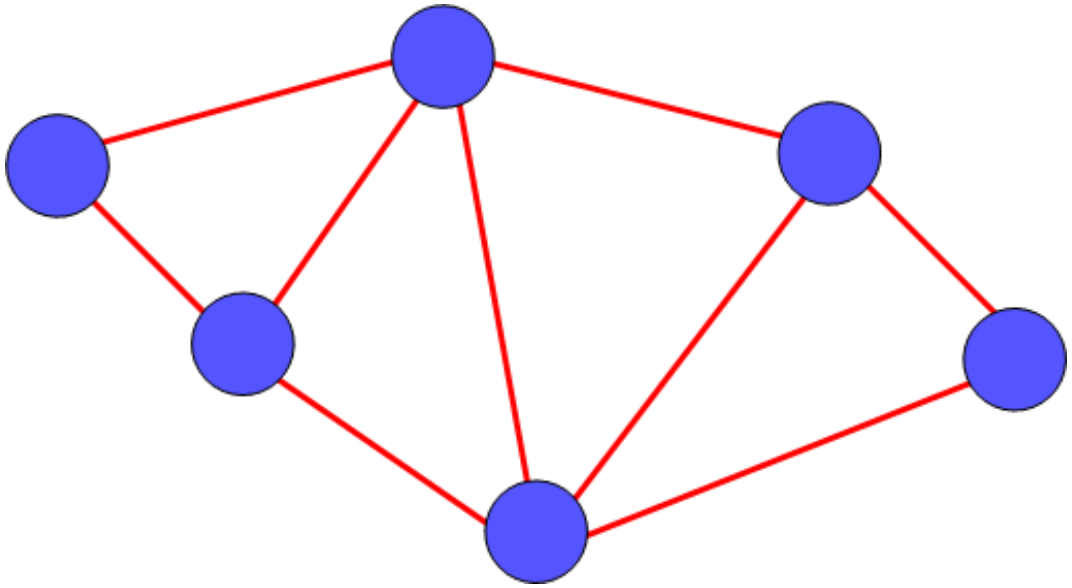
- A ring is the simplest topology for which all nodes remain connected after a link failure.

Dual Rings



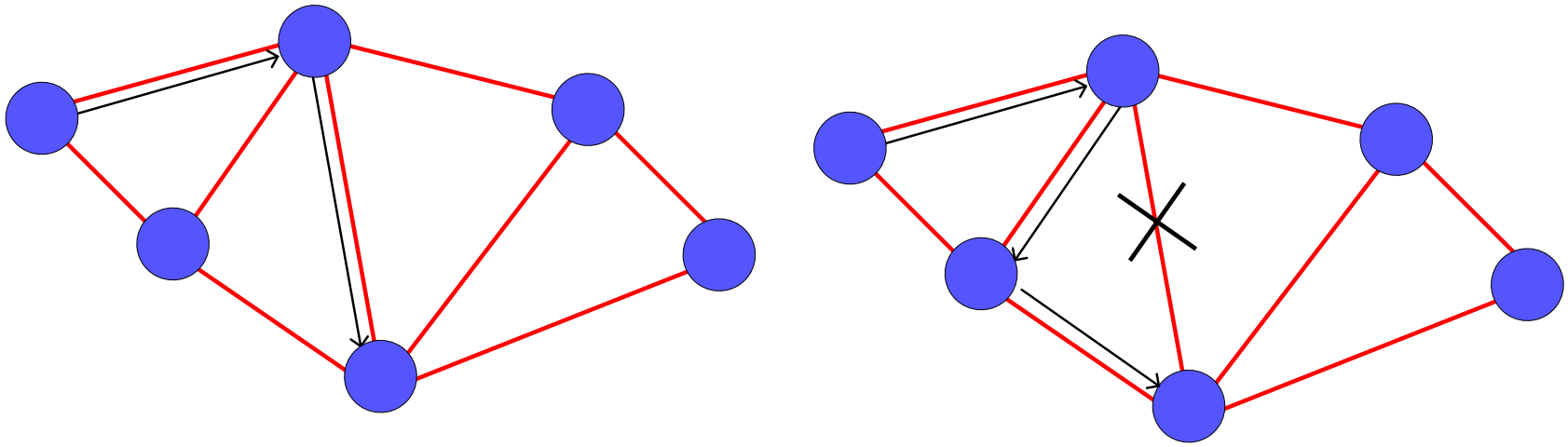
- Dual uni-directional rings, with working (W) and protection (P) rings are are part of the popular SONET networking protocol

Mesh Topology



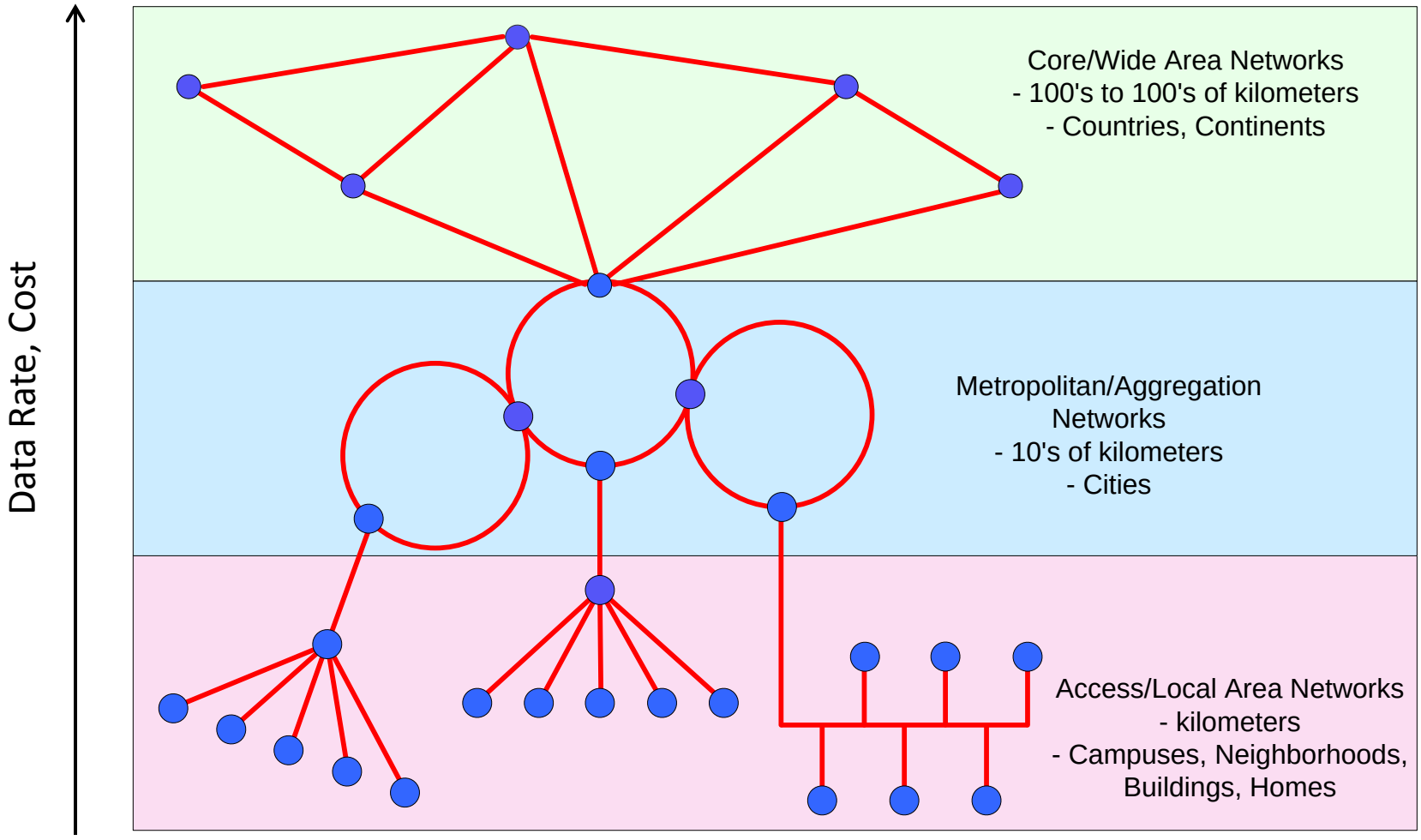
- Mesh networks are used to connect nodes that are distributed over large geographical areas.

Recovery from Link Failure

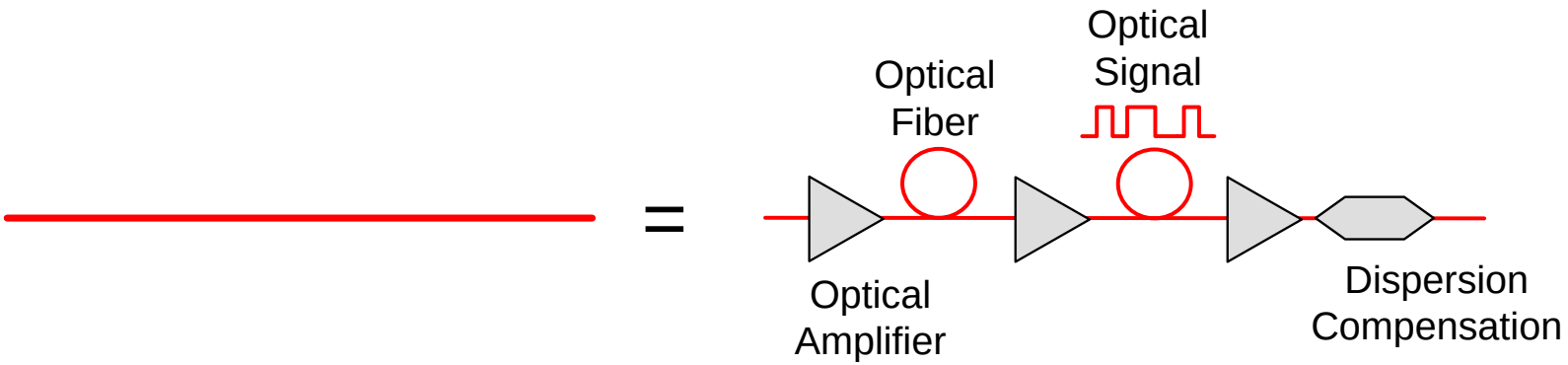


- Networks with mesh topology are robust

Network Hierarchy

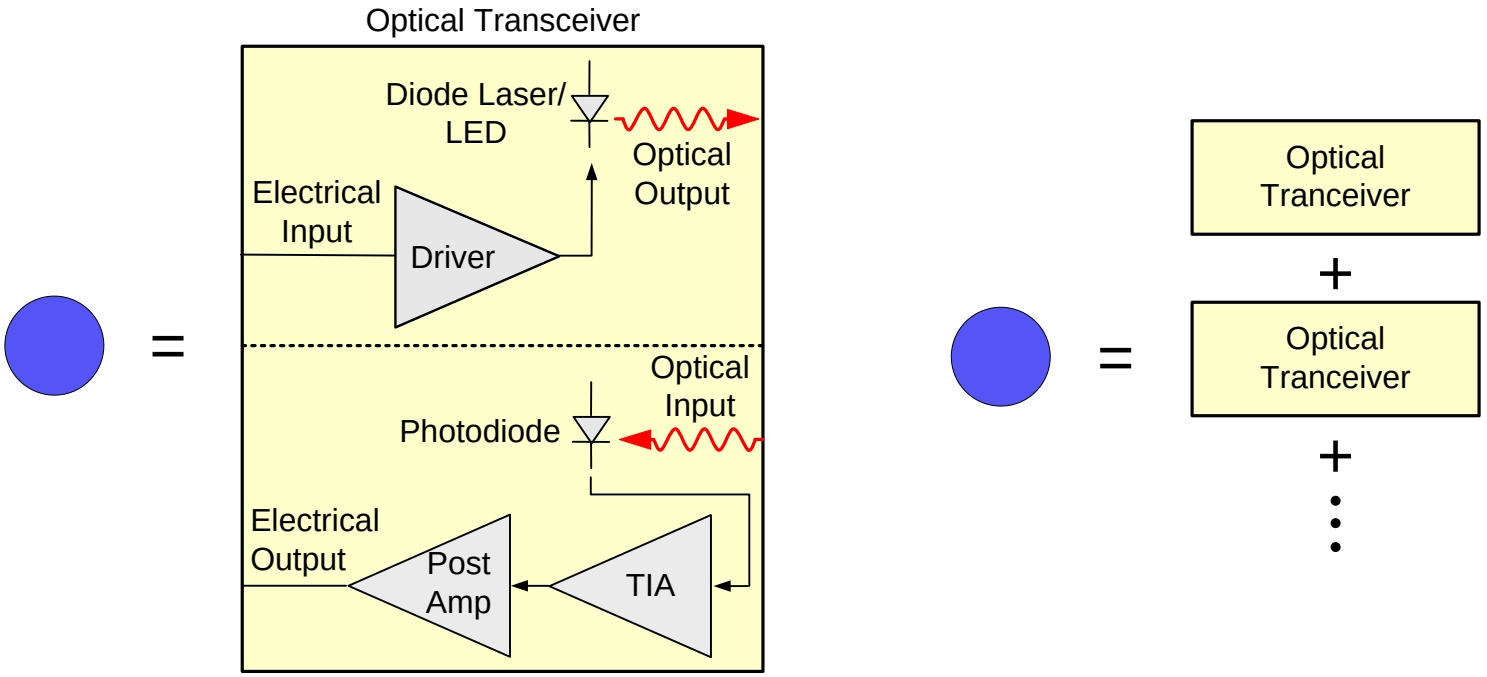


Optical Networks



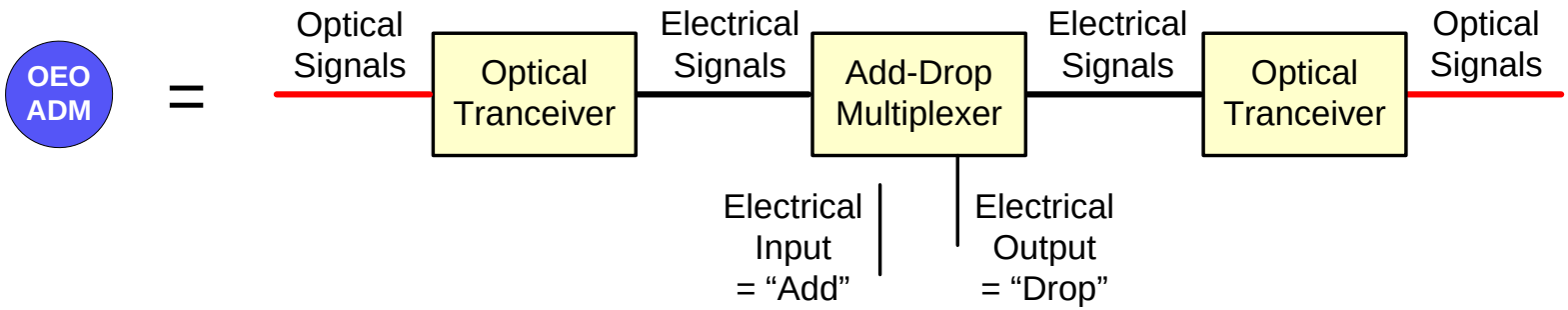
- Transmission links are lengths of optical fiber (or free-space beam paths) that may have components inserted that condition the optical signal

Optical Network Nodes



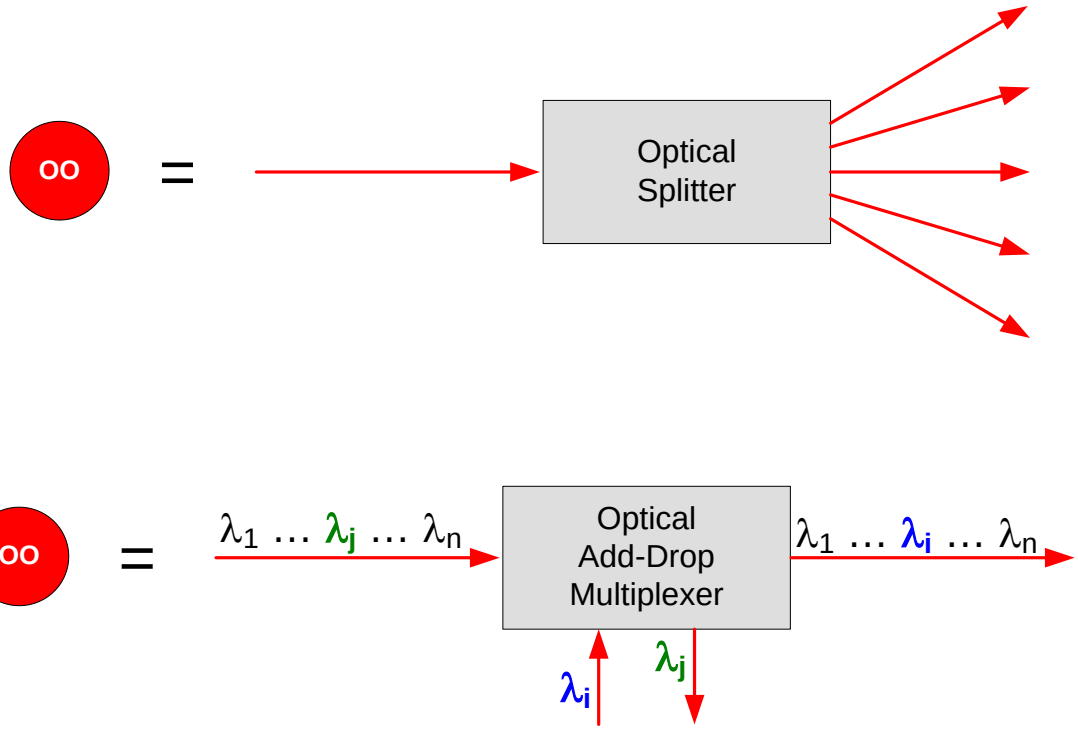
- Most nodes contain one or more optical transceivers

Optical Network Nodes



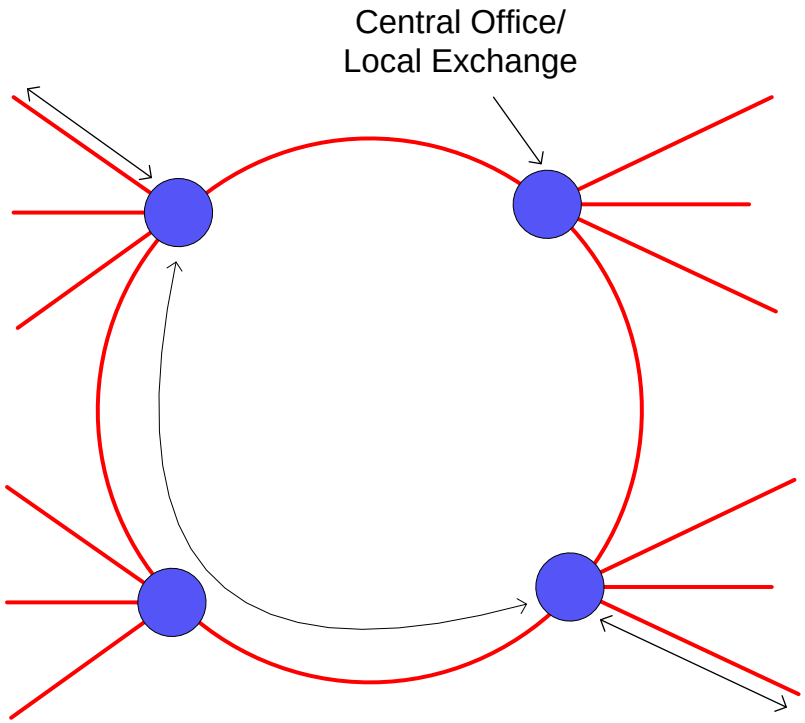
- Nodes such as an add-drop multiplexer, process data in the electrical domain

“O-O” Optical Network Nodes



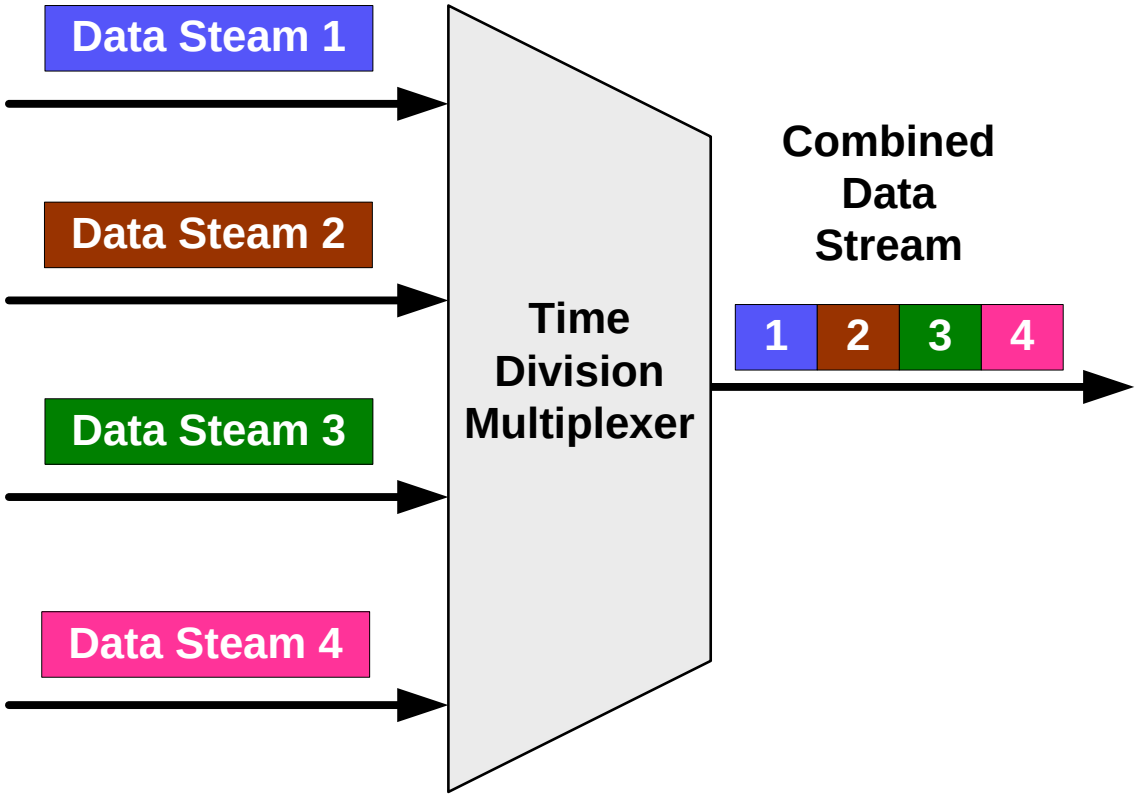
- “Transparent” optical-to-optical nodes are becoming more common.

Telecommunication (Phone) Networks



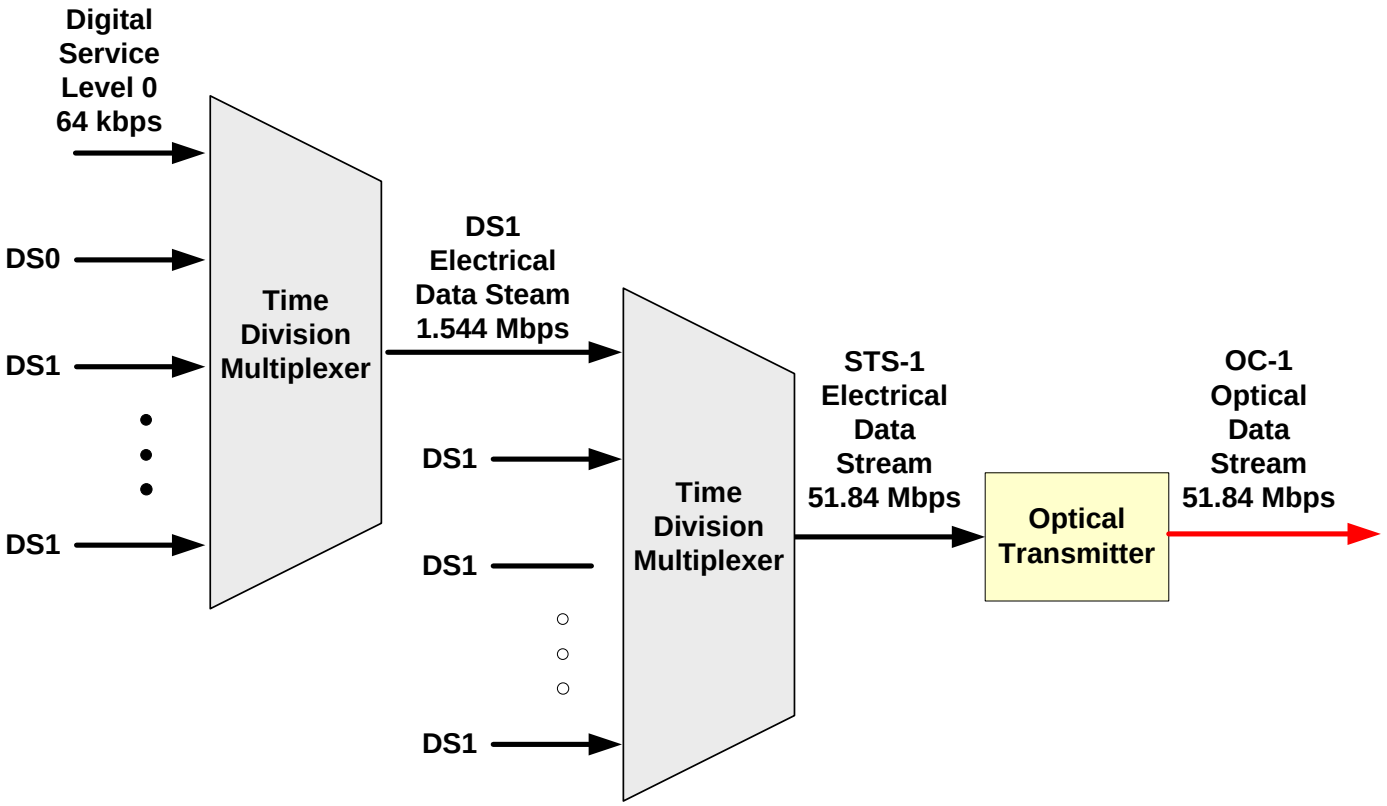
- Phone networks are “Circuit Switched” meaning that links are allocated to phone call for the entire duration of the call.

Time Division Multiplexing



- Time Division Multiplexing (TDM) combines lower data rate signals into higher data rate signals

Time Division Multiplexing

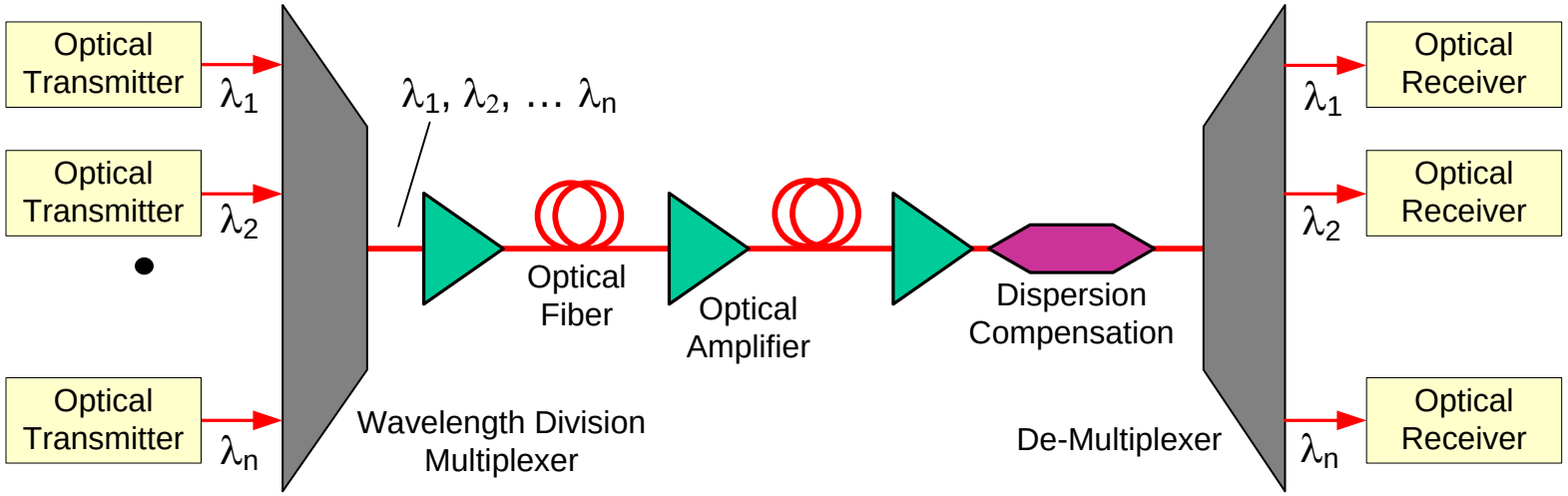


- Many individual phone calls carried by Digital Service Level 0 (DS0) links can be multiplexed for transmission over long distances.
- An OC-1 (Optical Carrier 1) carries 672 phone calls.

The Synchronous Optical Network (SONET) Hierarchy

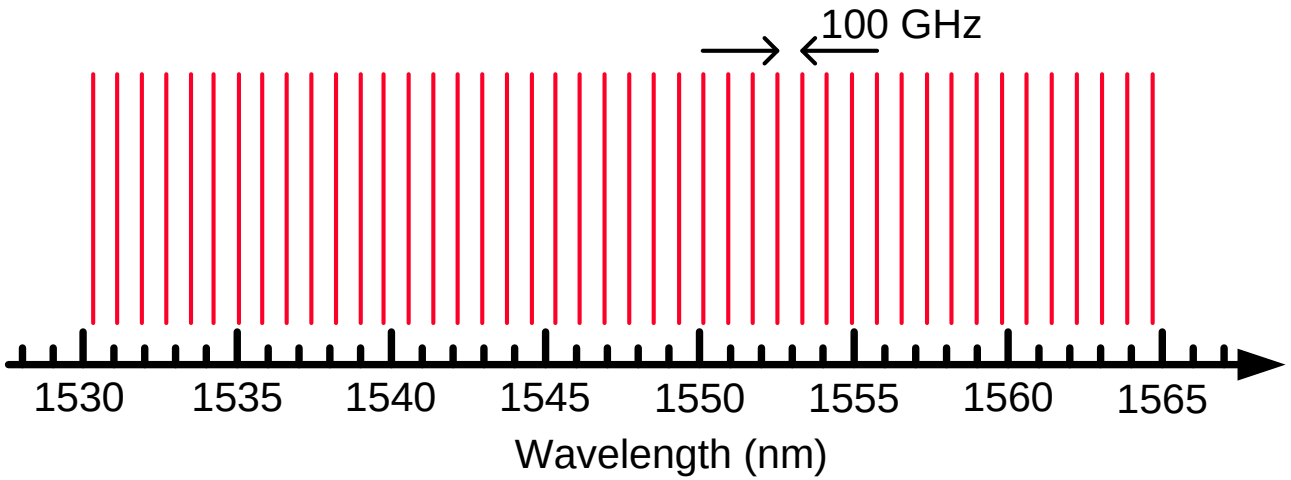
Signal Designation	Data Rate (Mbps)	Phone Call Capacity
OC-1	51.84	672
OC-3	155.82	2016
OC-12	622.08	8064
OC-48	2488.32	32256
OC-192	9953.28	129024
OC-768	39,813.12	516096

Wavelength Division Multiplexing



- A wavelength division multiplexed (WDM) link with 80 OC-192 wavelength channels operates at close to 1 Terabit per second and carries just over 10,000,000 simultaneous phone calls

The International Telecommunication Union (ITU) Grid



- The ITU specifies wavelengths centered at 193.1 THz spaced by 50 GHz GHz to be used for WDM.