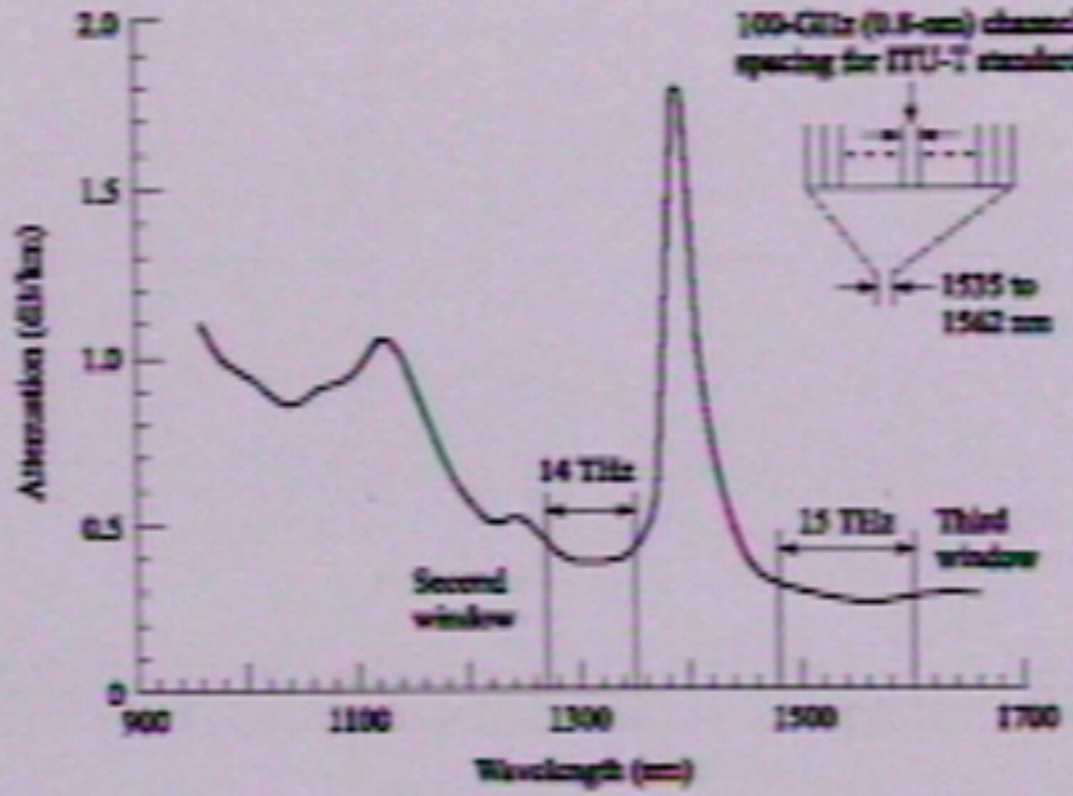
Wavelength Division Multiplexed (WDM) Systems

Transmission windows



Optical Window 1270-1350 nm

1480-1600 nm

☹ WDM SYSTEMS

- Low Loss BW of Fiber 1.2 to 1.6 μm
  ⇒ 30 THz
- Capable of Carrying
  300,000 ch of 10 Mb/s
- Pulse width Required ~ few tens of fs
  (System employment is not practical)

☹ Easy to access the BW in
WAVELENGTH DOMAIN
than in Time domain

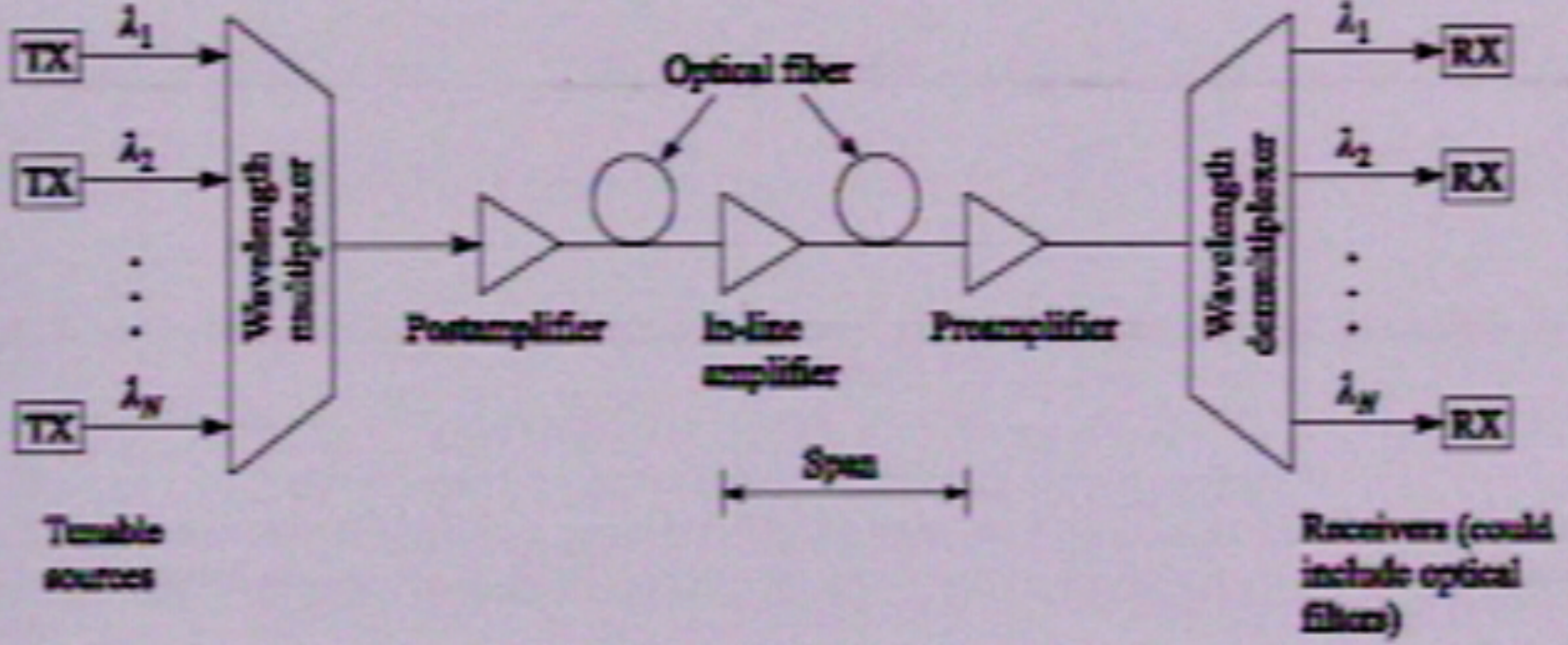
ITU G.692

Reference : 193.100 THz
→ 1552.524 nm

spacing : 100 GHz (≈ 0.8 nm
at 1552 nm)

DWDM

Typical WDM Network



DWDM Systems

- Capacity Upgrade
- Transparency
- Wavelength Routing
- Wavelength Switching

WDM Requirement

- Dispersion Shifted/Flattened Fiber
- Tunable / Multi-wavelength Lasers
- Broadband Optical Amplifiers
- Wavelength Dependent Optical Devices

☹BACKGROUND TECHNOLOGIES

- SOA or FIBER AMPLIFIER (EDFA)
- INTEGRATED OPTICAL SWITCHES / COUPLERS
- FIBER BRAGG GRATINGS (FBG)
- ARRAYED WAVEGUIDE GRATINGS (AWG)

Need for Optical Amplifier

- **Power Budget**

  Data rate 10Gbps

  BER 10^{-9}

  Tx Power 10dBm

  Min Rx power –45 dBm

  Fiber Loss 0.3 dB/Km

  Repeater spacing ~ 200 Km

- **Rise Time Budget**

  Date rate 10Gbps

  DSF 1ps/Km/nm

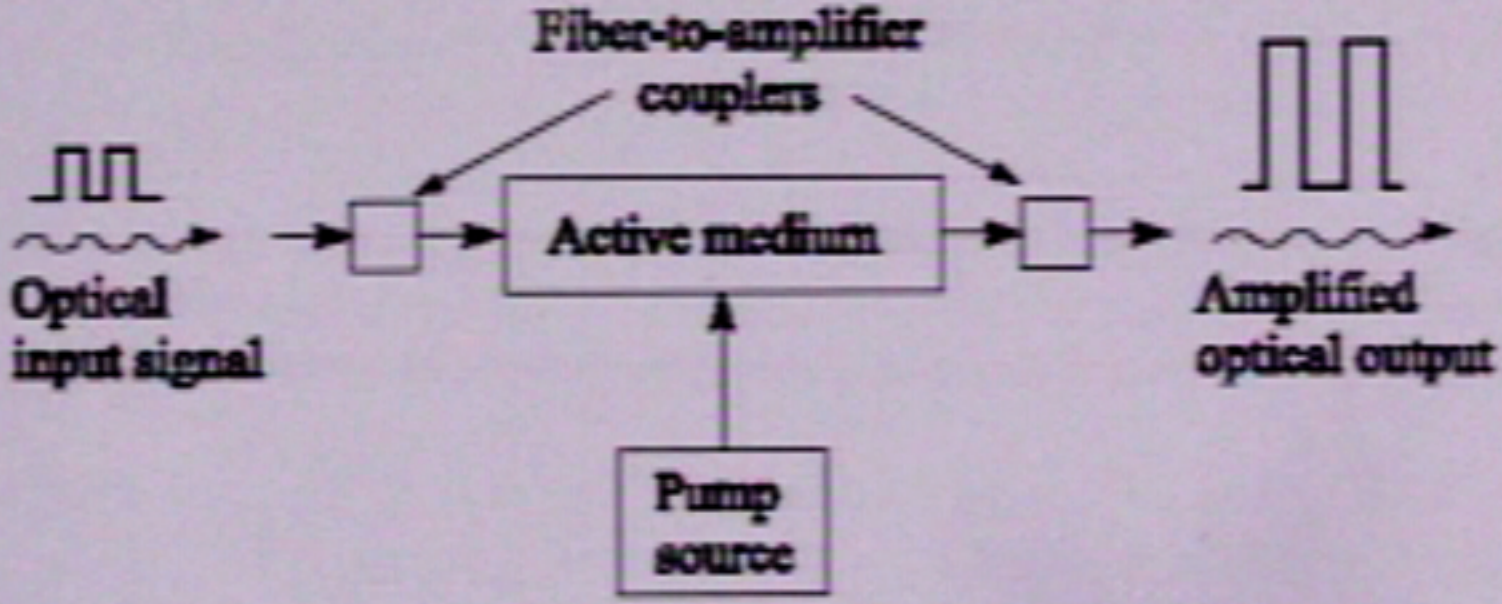
  DFB laser 0.01nm

  Repeater Spacing 3000Km

Optical Amplifier Technology

- **Semiconductor Amplifier**
  - 1300 or 1550 nm band
  - High power output
  - Higher coupling loss
  - Integrable
  - Non-linearities
- **EDFA**
  - 1550nm ONLY
  - Low cross talk
  - High gain (25dB)
  - High power
  - Low coupling loss
  - Low noise
  - Polarization insensitive

Generic optical amplifier



Erbium energy-level diagram

Er^{3+}