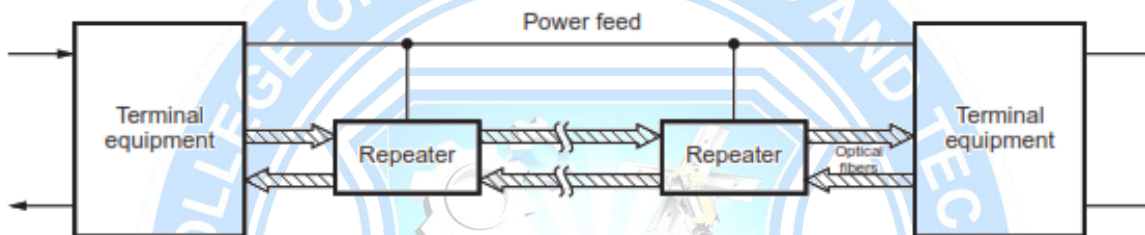


5.1 System Design Consideration, Point-to-point link design

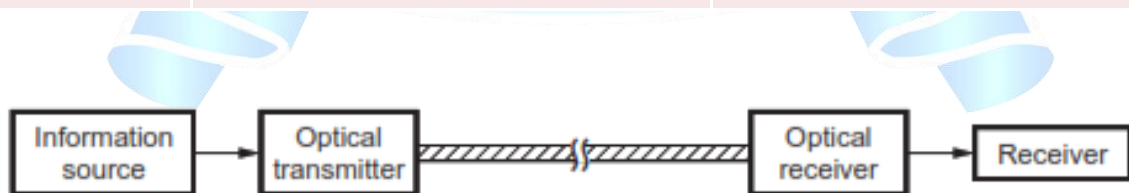
- In optical system design major consideration involves
 1. Transmission characteristics of fiber (attenuation and dispersion).
 2. Information transfer capability of fiber.
 3. Terminal equipment and technology.
 4. Distance of transmission.
- In long-haul communication applications repeaters are inserted at regular intervals as shown in Figure



- Repeater regenerates the original data before it is retransmitted as a digital optical signal. The cost of system and complexity increases because of installation of repeaters.
- An optical communication system should have following basic required specifications
 -
 - 1. Transmission type (Analog/digital)
 - 2. System fidelity (SNR/BER)
 - 3. Required transmission bandwidth
 - 4. Acceptable repeater spacing
 - 5. Cost of system
 - 6. Reliability
 - 7. Cost of maintenance
- A point-to-point link comprises of one transmitter and a receiver system. This is the simplest form of optical communication link and it sets the basis for examining complex optical communication links.
- For analyzing the performance of any link following important aspects are to be considered.
 - a) Distance of transmission
 - b) Channel data rate
 - c) Bit-error rate

- All above parameters of transmission link are associated with the characteristics of various devices employed in the link. Important components and their characteristics are listed in following the table.

Sr. No.	Components	Characteristics
1)	Optical fiber (multimode/single mode)	<ul style="list-style-type: none"> i) Core size (2a) ii) Core refractive index (n_c) iii) Bandwidth (B) iv) Attenuation v) Numerical aperture (NA) vi) Dispersion
2)	Optical source (LED/Laser)	<ul style="list-style-type: none"> i) Emission wavelength (X) ii) Output power (P) iii) Emission pattern iv) Number of modes (M) v) Effective radiating area
3)	Optical detector (PIN/APD)	<ul style="list-style-type: none"> i) Responsivity (R_o) ii) Operating wavelength (X) iii) Speed iv) Sensitivity v) Efficiency



- When the link length extends between 20 to 100 km, losses associated with fiber cable increases. In order to compensate the losses optical amplifier and regenerators are used over the span of fiber cable.

- A regenerator is a receiver and transmitter pair which detects incoming optical signal, recovers the bit stream electrically and again convert back into optical form by modulating an optical source. An **optical amplifier** amplify the optical bit stream without converting it into electrical form.
- The spacing between two repeater or optical amplifier is called as **repeater spacing (L)**. The repeater spacing L depends on bit rate B. The bit rate-distance product (BL) is a measure of system performance for point-to-point links.
- Two important analysis for deciding performance of any fiber link are -
 - Link power budget / Power budget
 - Rise time budget / Bandwidth budget
- The Link power budget analysis is used to determine whether the receiver has sufficient power to achieve the desired signal quality. The power at receiver is the transmitted power minus link losses.
- The components in the link must be switched fast enough and the fiber dispersion must be low enough to meet the bandwidth requirements of the application. Adequate bandwidth for a system can be assured by developing a rise time budget.

