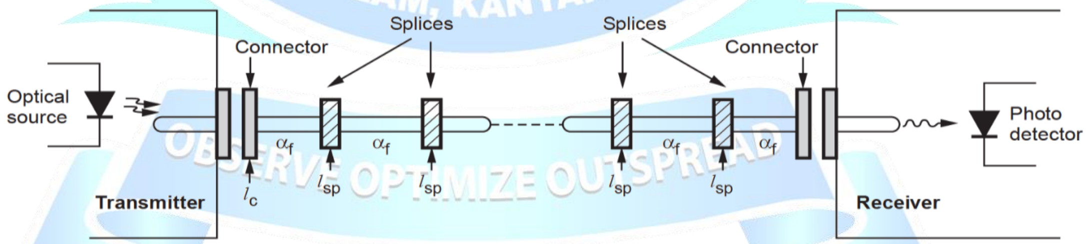
5.2 Link Power Budget

- For optimzing link power budget an optical power loss model is to be studied as shown in figure .
  Let l_c denotes the losses occur at connector.
  l_{sp} denotes the losses occur at splices.
  α_f denotes the losses occur in fiber.
- All the losses from source to detector comprises the total loss (P_T) in the system.
- **Link power margin** considers the losses due to component aging and temperature fluctuations. Usually a link margin of 6-8 dB is considered while estimating link power budget.
- Total optical loss = Connector loss + (Splicing loss + Fiber attenuation) + System margin (P_m)

$$P_T = 2l_c + \alpha_f L + \text{System margin } (P_m)$$



Rise Time Budget

- Rise time gives important information for initial system design. Rise-time budget analysis determines the dispersion limitation of an optical fiber link.
- Total rise time of a fiber link is the root-sum-square of rise time of each contributor to the pulse rise time degradation.

$$t_{sys} = \sqrt{t_{r1}^2 + t_{r2}^2 + t_{r3}^2 + \ldots}$$

$$t_{sys} = \left(\sum_{i=1}^{N} t_{ri}^2 \right)^{1/2}$$

- The link components 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.
- As the light sources and detectors has a finite response time to inputs. The device does not tum-on or turn-off instantaneously.
- Rise time and fall time determines the overall response time and hence the resulting bandwidth.
- Connectors, couplers and splices do not affect system speed, they need not be accounted in rise time budget but they appear in the link power budget.

Four basic elements that contributes to the rise-time are,

1. Transmitter rise-time (t_{tx})
2. Group Velocity Dispersion (GVD) rise time (t_{GVD})
3. Modal dispersion rise time of fiber (t_{mod})
4. Receiver rise time (t_{rx})

$$t_{sys} = \left[t_{tx}^2 + t_{mod}^2 + t_{GVD}^2 + t_{rx}^2 \right]^{1/2}$$

Rise time due to modal dispersion is given as

$$t_{mod} = \frac{440}{B_M} = \frac{440\ Lq}{B_0}$$