SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

OPTICAL AND MICROWAVE ENGINEERING

III YEAR/ VI SEMESTER

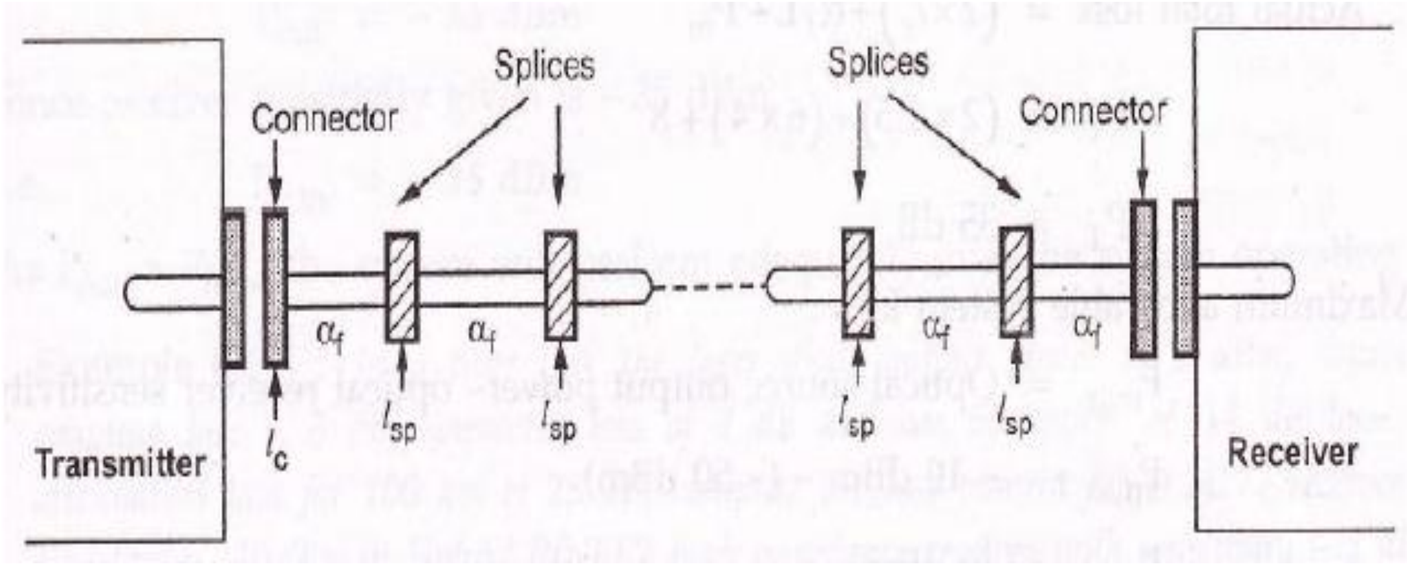
UNIT 5 – OPTICAL NETWORKS

TOPIC –LINK POWER BUDGET

LINK POWER BUDGET

For optimizing link power budget an optical power loss model is to be studied as shown in Fig.

- Lc denotes the losses occur at connector.
- Lsp denotes the losses occur at splices.
- αf denotes the losses occur in fiber.



POINT TO POINT LINK

All the losses from source to detector comprises the total loss (PT) 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 (Pm)

$PT = 2lc + \alpha fL + \text{System margin (Pm)}$

where, L is transmission distance.

Example 1 : Design as optical fiber link for transmitting 15 Mb/sec of data for a distance of 4 km with BER of 10-9.

Solution :

Bandwidth x Length = 15 Mb/sec x 4 km = (60 Mb/sec) km

Selecting optical source : LED at 820 nm is suitable for short distances.

The LED generates – 10 dBm optical power.

Selecting optical detector : PIN-FER optical detector is reliable and has – 50 dBm sensitivity.

Selection optical fiber : Step-index multimode fiber is selected. The fiber has bandwidth length product of 100 (Mb/s) km.

Links power budget :

Assuming :

Splicing loss ls = 0.5 dB/slice

Connector loss lc = 1.5 dB

System link powr margin Pm – 8 dB

Fiber attenuation αf = 6 dB/km

Actual total loss = (2 x lc) + αfL + Pm

PT = (2 x 1.5) + (6 x 4) + 8

PT = 35 dB

Maximum allowable system loss :

Pmax = Optical source output power- optical receiver sensitivity

Pmax = -10 dBm – (-50 dBm)

Pmax = 40 dBm

Since actual losses in the system are less than the allowable loss, hence the system is functional.

•Example 2 :

A transmitter has an output power of 0.1 mW. It is used with a fiber having NA = 0.25, attenuation of 6 dB/km and length 0.5 km.

The link contains two connectors of 2 dB average loss. The receiver has a minimum acceptable power (sensitivity) of – 35 dBm. The designer has allowed a 4 dB margin. Calculate the link power budget.

Solution :

Source power Ps = 0.1 mW

Ps = -10dBm

Since NA = 0.25

Coupling loss = -10log (NA2)

= -10log (0.252) = 12 dB

Fiber loss = αf x L

lf = (6dB/km) (0.5km)

lf = 3 dB

Connector loss = 2 (2 dB)

lc = 4 dB

Design margin Pm = 4 dB

Actual output power Pout = Source power – (Σ Losses)

Pout = 10dBm – [12 dB + 3 + 4 + 4] ,Pout = **-33 dBm**

Since receiver sensitivity given is – 35 dBm.

i.e. Pmin = **-35 dBm**

As Pout > Pmin, the system will perform adequately over the system operating life.

Example 3 : In a fiber link the laser diode output power is 5 dBm, source-fiber coupling loss = 3 dB, connector loss of 2 dB and has 50 splices of 0.1 dB loss. Fiber attenuation loss for 100 km is 25 dB, compute the loss margin for i) APD receiver with sensitivity – 40 dBm ii) Hybrid PINFET high impedance receiver with sensitivity -32 dBm.

Solution : Power budget calculations

Source output power 5 dBm

Source fiber coupling loss 3 dB

Connector loss 2 dB

Connector loss 5 dB

Fiber attenuation 25 Db

Total loss **35 dB**

Available power to receiver : (5 dBm – 35 dBm) – 30 dBm

i) APD receiver sensitivity – 40 dBm

ii) Loss margin [- 40 – (- 30)] 10dBm

ii) H-PIN FET high0impedance receiver -32 dBm

Loss margin [- 32 – (- 30)] 2 dBm

THANK YOU