SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

OPTICAL AND MICROWAVE ENGINEERING

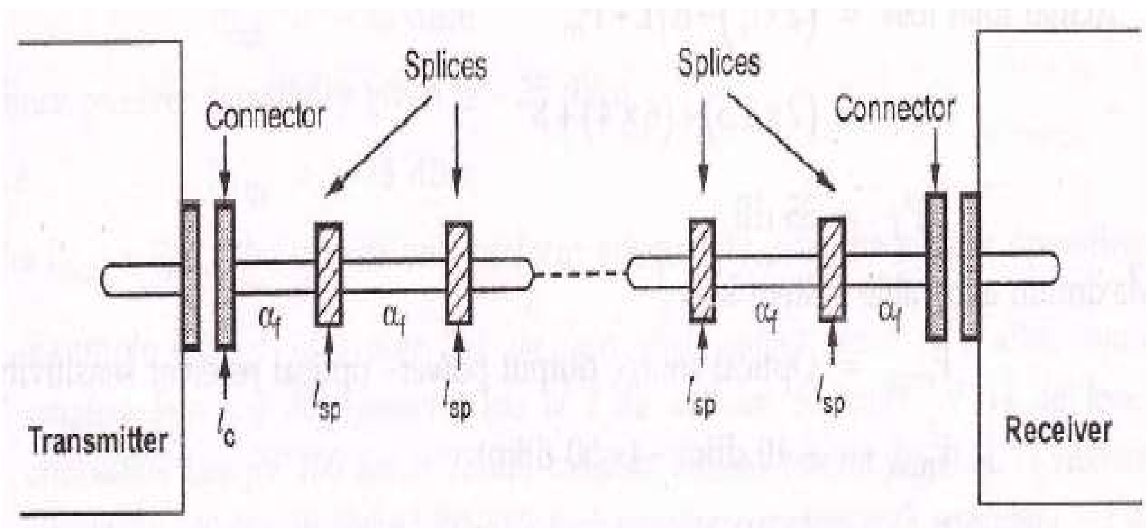
III YEAR/ VI SEMESTER

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. 6.2.3. Let lc denotes the losses occur at connector.
L_{sp} denotes the losses occur at splices.
α_f 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 + αfL + 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

ASSESSMENT TIME

Think, Pair, Share

What's the issue / question / topic?	What do I think about it?	What does my partner think?	What will we share?

THANK YOU