SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

OPTICAL AND MICROWAVE ENGINEERING

III YEAR/ VI SEMESTER

UNIT 5 – OPTICAL NETWORKS

TOPIC –POWER BUDGET ANALYSIS

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.

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

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

RISE TIME BUDGET

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 turn-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,

- Transmitter rise-time (ttx)
- Group Velocity Dispersion (GVD) rise time (tGVD)
- Modal dispersion rise time of fiber (tmod)
- Receiver rise time (trx)

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

Rise time due to modal dispersion is given as

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

where,
BM is bandwidth (MHz)
L is length of fiber (km)
q is a parameter ranging between 0.5 and 1.
B0 is bandwidth of 1 km length fiber,

•Rise time due to group velocity dispersion is

$$t_{GVD} = D^2 \sigma_\lambda^2 L^2$$

where,

D is dispersion [ns/(nm.km)]

Σλ is half-power spectral width of source

L is length of fiber

□ Receiver front end rise-time in nanoseconds is

$$t_{rx} = \frac{350}{B_{rx}}$$

where,

Brx is 3 dB – bW of receiver (MHz).

□ Equation can be written as

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

$$t_{sys} = \left[t_{tx}^2 + \left(\frac{440\ Lq}{B_0}\right)^2 + D^2 \sigma_\lambda^2 L^2 + \left(\frac{350}{B_{rx}}\right) \right]^{1/2}$$

The system bandwidth is given by

$$BW = \frac{0.35}{t_{sys}}$$

Example1 . For a multimode fiber following parameters are recorded.
i) LED with drive circuit has rise time of 15 ns.
ii) LED spectral width = 40 nm
iii) Material dispersion related rise time degradation = 21 ns over 6 km link.
iv) Receiver bandwidth = 235 MHz
v) Modal dispersion rise time = 3.9 nsec

Calculate system rise time.

Solution : $t_{tx} = 15$ nsec

$tT_{mat} = 21$ nsec

$t_{mod} = 3.9$ nsec

Now

$$t_{rx} = \frac{350}{B_{rx}}$$

$\therefore$ $t_{rx} = \frac{350}{25}$

$\therefore$ $t_{rx} = 14$ nsec

Since

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

$$t_{sys} = [15^2 + 21^2 + 3.9^2 + 14^2]^{1/2}$$

=29.61nsec

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