

EE 420 Design Project  
First Semester 2008/2009

A single mode optical fiber link is required to link two major cities that are 1200 km apart. The link must be capable of transmitting (RZ) data rate of at least 10 Gbps. The properties of the optical fiber to be used in the link are summarized in Table 1.

Table 1

|   |                          |
|---|--------------------------|
| Core diameter   | 5.0 $\mu m$              |
| Core / Cladding refractive indices                    | 1.470 / 1.460            |
| Operating Wavelength                                  | 1.3 $\mu m$              |
| Fiber attenuation                                     | 0.6 dB/km                |
| Splice Loss   | 0.05 dB per splice       |
| Longest continuous cable length available             | 0.50 km                  |
| Type of fiber   | Single mode / Step Index |
| Combined Material and Waveguide Dispersion Parameter. | 1.2 ps/(nm.km)           |

Repeaters are required in the construction the link. Assume that all repeaters are identical and that each repeater is cable of *perfectly* regenerating the digital bit stream (provided the incident optical power is not less than the threshold power of the repeater's photodetector and that pulse spread does not exceed a preset value). Table 2 summaries the properties of each repeater.

Table 2

|                          |                                      |
|--------------------------|--------------------------------------|
| Detector Threshold Power | 0.7 $\mu W$ at $\lambda = 1.3 \mu m$ |
| Source Output Power      | 5.0 mW                               |
| Source Wavelength        | 1.3 $\mu m$                          |
| Source Spectral Width    | 0.4 nm                               |
| Source Type              | High Quality Laser Diode             |

Assume that the optical source used at the input end of the link has the same characteristics as the source used in the repeater and that the detector at the output end of the link has the same characteristics as the detector used in each repeater. Assume also that there is no optical power loss at the input or the output sides of the repeater.

The design has to satisfy the following conditions:

- 1- The total number of repeaters used in the link must be as low as possible.
- 2-The design has to allow for 3dB power loss between repeaters due to unforeseen causes of loss and also for the possibility of future splices.

Design the above link by calculating:

- 1- The distance that separates the individual repeaters.
- 2- The total number of required repeaters.
- 3- The total number of splices needed to construct the link.

Summarize your results in table 3 below:

Table 3

|                            |    |
|----------------------------|----|
| Distance Between Repeaters | km |
| Number of Repeaters        |    |
| Total Number of Splices    |    |

*Show your work as clearly as possible and work on an individual basis.*

Deadline for submitting the design is on Monday January, 26, 2009.