Experiment - 3: To design an external modulated Optical Transmitter and visualize the response in Optisystem 22

Date: -

1. **Aim:** To design an external modulated Optical Transmitter and visualize the response in Optisystem 22

2. **Requirements:** Optisystem 22

3. **Pre Experiment Exercise:**
   Brief Theory

An optical transmitter is a device that converts electrical signals into optical signals and transmits them through an optical transmission line such as fiber or waveguide. It consists of semiconductor optical sources, such as distributed feedback laser diodes (DFB-LD) and vertical-cavity surface-emitting lasers (VCSEL), as well as an LD driver that provides the necessary DC bias and modulation currents for optical transmission.

Understanding External Modulation

External modulation is used to modulate an optical signal without directly modulating the laser source. Instead, an external modulator (such as a Mach-Zehnder Modulator (MZM) or an Electro-Absorption Modulator (EAM)) is used. This approach avoids issues like chirp and frequency instability, leading to better signal quality in high-speed optical communication systems. The role of the communication channel is to transport the optical signal from transmitter to receiver without distorting it. Most lightwave communication systems use optical fibers as the communication channel because fibers can transmit light with a relatively small amount of power loss.

Fiber loss is an important design issue, as it dictates the repeater spacing of a long- haul light wave system. Another important design issue is fiber dispersion, which leads to broadening of individual pulses inside the fiber.

In order to observe the effects of loss and dispersion in the optical signal, you can change the values of fiber length and visualize the degradation of the signal at the receiver stage

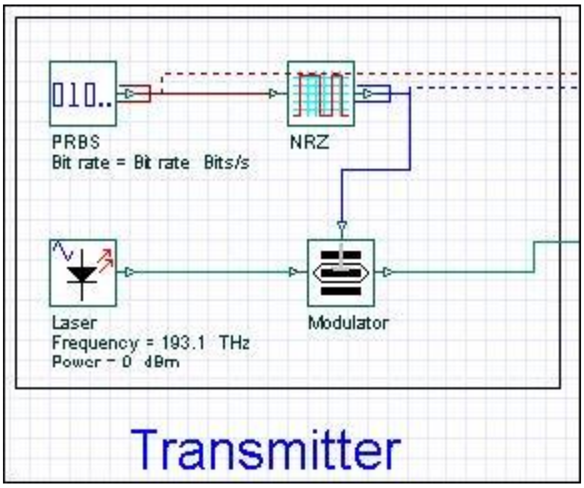

Fig. 1: Optical Transmitter Section

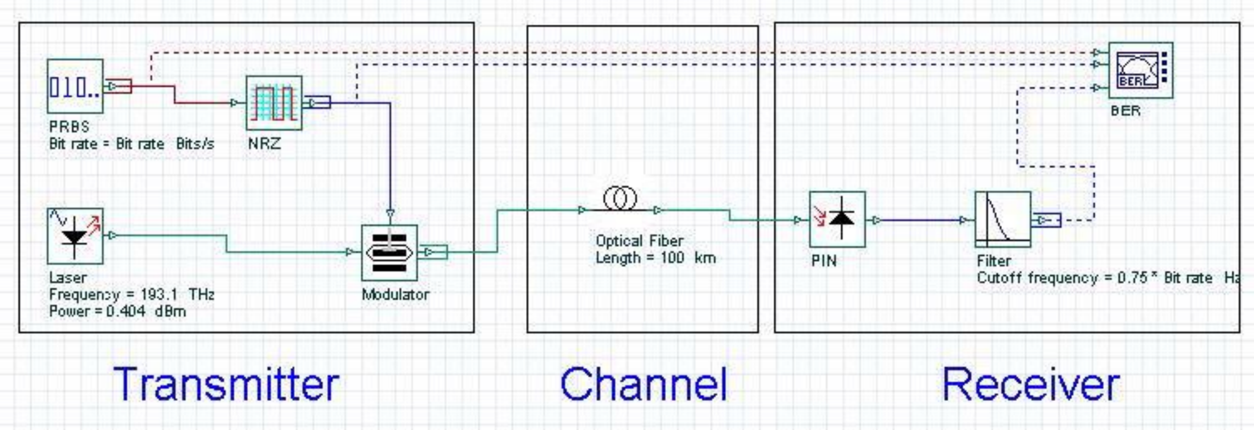

Fig. 2: Optical System

4. Procedure

Components Required in OptiSystem 22 and its function:

a. CW Laser Source: Generates a continuous optical signal.
b. Mach-Zehnder Modulator (MZM): Modulates the optical signal using an external electrical signal.
c. PRBS Generator: Generates a pseudo-random bit sequence for testing.
d. NRZ Pulse Generator: Converts the bit sequence into an electrical signal.
e. Bias Controller: Ensures proper MZM operation.
f. Optical Fiber (Optional): To transmit the modulated signal.
g. Optical Receiver: Converts the modulated signal back to an electrical signal.
h. Oscilloscope/BER Analyzer: For signal visualization and performance analysis.

5. Observations:

Attach the simulated block diagram and graphical observations

6. Conclusion/Comments:

Comment on your observations on the basis of following points:

a. Effect of varying length of fiber on the attenuation:
b. Effect of spectral width of source increases the effect on input and output power:
c. The effect of wavelength on scattering and hence attenuation:

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7. Questions

1. A continuous 12km long optical fiber link has loss of 1.5dB/km. What is the minimum optical power level that must be launched into the fiber to maintain an optical power level of 0.3uW at receiving end. What is the required input power if fiber has loss of 2.5dB/km.
2. Differentiate between linear and non linear scattering
3. Silica has an estimated fictive temperature of 1400K with an isothermal compressibility of $7x10^{-11}$ m^2N^{-1} The refractive index and photoelastic coefficient for silica are 1.46 and 0.286 respectively. Determine the theoretical attenuation in decibels per kilometer due to Rayleigh scattering in silica at optical wavelength of 850nm.