At the central station, a WDM demultiplexer separates the signal and fed to corresponding detectors. The resulting electrical signals are then passed through low pass filters and given to BER analyzer through which the Q factor and BER of the signal is analyzed. The entire simulation is shown in Figure 2.

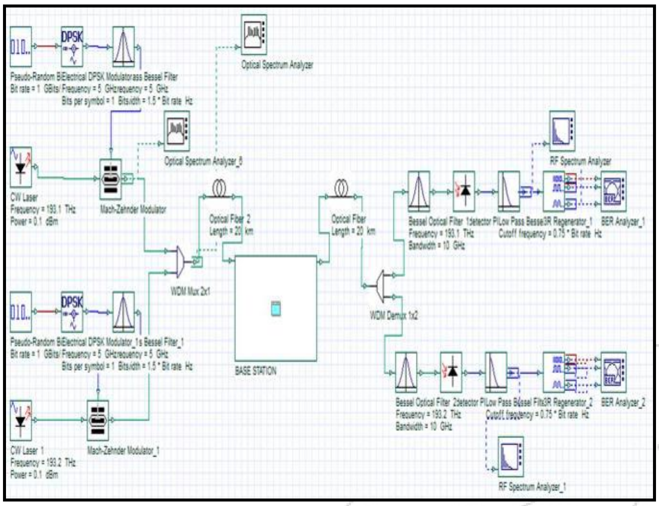

Figure 3: Full duplex RoF system with DPSK modulation.

Figure 3 shows RoF employing DPSK modulation. The optical carriers of frequencies 193.1 THz and 193.2 THz are emitted by two CW lasers. The digital data of bit rate 1Gb/s from PRBS generator is given to a DPSK modulator, which has an inbuilt carrier of frequency 5 GHz. The modulated optical carriers from two channels are multiplexed by WDM multiplexer and given to SMF through which it reaches the BS, addressed to a frequency of 193.1 THz.

At the BS, signal with frequency 193.1 THz is simultaneously added and dropped as uplink and downlink data respectively. The dropped signal is first passed through an optical Bessel filter of frequency 193.1 THz and bandwidth 10 GHz. Then the signal is detected using a PIN detector, filtered using a low pass Bessel filter and fed to a BER analyzer for the analysis of Q factor and BER of downlink. The multiplexed signal having frequency 193.2 THz along with uplink data of 193.1 THz, added from BS, is transmitted to CS via SMF of attenuation 0.2 dB/Km. At CS, the signal is demultiplexed, optically filtered using an optical Bessel filter and detected using a PIN detector of responsivity 1 A/W and dark current of 10 nA. The recovered electrical signal is filtered using a low pass Bessel filter and given to a BER analyzer for the analysis of uplink data. To analyze the performance of RoF system with other three digital modulations (OQPSK, MSK and CPFSK), DPSK modulator is replaced by corresponding digital modulators.

4. Results and Discussions

4.1 Relationship of Q factor and BER with Fiber Length

The Q factor and BER observed by varying the fiber length is plotted in Figure 4. The fiber length was varied from 10 km to 100 km at a transmitter power of 0.1 dBm and input bit rate of 5 Gbps. From the graph, it is observed that with increase in fiber length, Q factor decreases and BER increases.

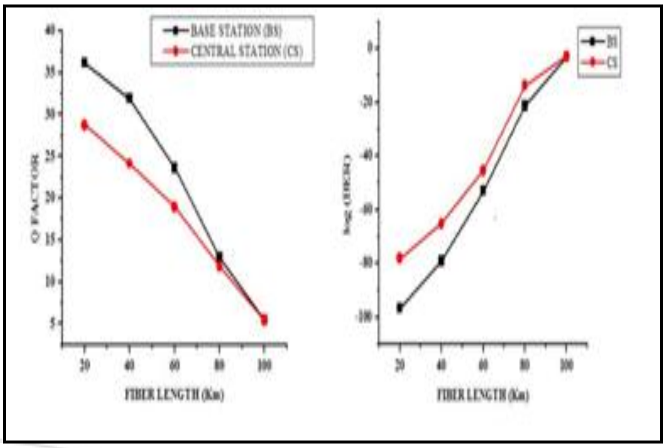

Figure 4: Variation of (a) Q factor Vs fiber length (b) log(BER) Vs fiber length.

4.2 Relationship of Q factor and BER with bit rate

The variation of Q factor and BER with bit rate is shown in Figure 5. Both Q factor and BER are analyzed for bit rates 5 Gbps and 10 Gbps. Here input power and fiber length are kept constant at 0.1 dBm and 20 Km respectively. From the analysis, it is clear that as bit rate increases, Q factor decreases and BER increases.

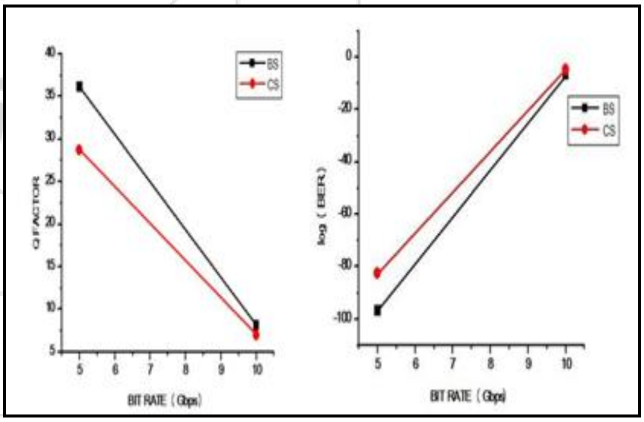

Figure 5: Variation of (a) Q factor Vs bit rate (b) log(BER) Vs bit rate.

4.3 Comparison of various digital modulation formats

Table 1: Q factor and BER values for various digital modulations

Modulation	*Max. Q* Factor		*Min.BER*	
	BS	*CS*	*BS*	*CS*
DPSK	20.57	15.06	2.17e-^{94}	1.117e-^{51}
OQPSK	5.65	5.39	1.24e^{-8}	2.91e^{-8}
MSK	15.28	12.54	2.32e^{-53}	1.57e^{-36}
CPFSK	10.9	8.86	2.19e^{-17}	3.19e^{-28}

The performance of digital modulation formats are analyzed strictly on the basis of Q factor and BER. The CW laser power, bit rate and fiber length are kept constant at 0.1 dBm, 1 Gbps and 20 Km respectively. Table 1 shows Q factor and BER values obtained from BS and CS respectively, for various digital modulations. From the analysis, it is observed that DPSK modulation provides better Q factor and low BER.

5. Conclusion

A full duplex radio over fiber system employing WDM and OADM techniques is simulated using optisystem 12.0. WDM enables transmission of multiple signals through a single fiber over large distance whereas OADM permits simultaneous transmission of downlink and uplink data via same single mode fiber. The performance of RoF system with various digital modulation formats is analysed. Better Q factor and low BER is achieved for all the simulations, which implies better performance of the system. RoF system with DPSK modulation not only results in high performance but also brings reduction in electronic components and elimination of electrical demodulation.

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