ANALYSIS OF DIFFERENT TYPE OF MODULATION TECHNIQUES FOR 100km OPTICAL FIBER CATV TRANSMISSION SYSTEM

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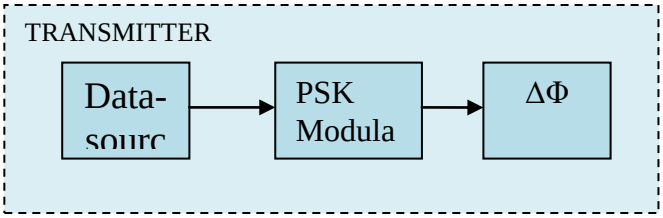
Abstract— In this paper we analyze the most preferred modulation techniques for 100km long single mode optical fiber CATV transmission system. PSK direct, PSK back to back, QPSK, 16QAM modulation techniques are compared so as to get result for CATV Transmission system with most suitable modulation technique in term of Jitter, Eye Diagram, Scattering Diagrams, Power requirements for 100km single mode optical cable set up.

Keywords— Phase Shift Keying (PSK), Quadrature Amplitude Modulation (QAM), Quadrature Phase Shift Keying (QPSK), Cable Antenna Television (CATV).

I. INTRODUCTION

THE advanced modulation formats for high speed internet services using potentially the bandwidth of single mode embedded fiber were analyzed, NRZ modulation format was compared with RZ modulation format onto the embedded fiber i.e. single mode fiber. In NRZ modulation format after 80 km losses were increased[1] .An externally modulated NTSC 77 channel erbium doped fiber amplifier (EDFA) repeated system using fabry-perot (FP) etalon at the receiving site to improve the system performance[2].Three different modulation formats return-to-zero (RZ), chirped RZ (CRZ) and vestigial sideband RZ (VSRZ) were systematically compared on the economically effective transmission link using standard single mode fiber (SSMF) and all erbium-doped fiber amplifiers (EDFAs). At 1600 km distance transmission without post dispersion compensation, CRZ signals gave better performance among the formats [3].The demonstration of a directly modulated amplitude modulation with vestigial sideband cable television (CATV) erbium-doped fiber amplifier repeated system that used an external light-injection technique to improve the system performance. The external light-injection technique greatly enhances the frequency response of the laser diode, and thus improves the overall performance of the fiber optical CATV system [4] .The noise floor of the analog TV and FM radio signals in the CATV networks in order to establish how the planning of the levels should be modified if QPSK, QAM and OFDM were used was analyzed [5]. Considered distortions such as composite second order, composite triple beat, and intermodulation distortion in fiber-based analog CATV transmission systems was analyzed, there was usually one wavelength used for the signal transmission with multiple analog RF channels modulated onto it [6] .The resonance frequency is increased by lower sideband injection locked frequency and system based on this lower sideband injection locked frequency was proposed and demonstrated[7].Chirped fiber grating (CFG) and large effective area fiber (LEAF) as dispersion compensation devices to reduce the dispersion and cross-phase modulation (XPM)-induced crosstalk was used in a bi-directional dense-wavelength-division-multiplexing (DWDM) CATV system[8] .For providing multiple services potential had been focused on optical sources and modulation techniques such as SSB and EAM for radio-on –wavelength division multiplexing was proposed[9].The optimum design of 1550-nm transmitter for long-distance AM- and QAM-CATV systems was implicated when the applied phase modulation index and modulating tone frequency to the integrated phase modulator are high[10].For the full frequency range of a coaxial cable CATV amplifier new method for calculating CSO/CTB for any input frequency plan[11] .Suppression of composite second-order and triple-beat signals to <-61 and <-63 dBc, respectively, had been achieved for a carrier-to-noise ratio (CNR) of 50 dB with a 77-channel loading of CATV carriers by tailoring devices and components performance was improved [12].Moreover directly modulated techniques are most simpler and cheaper as compare to externally modulated transmission system their they proposed directly modulated NTSC AM-VSB 80-channel fiber optical CATV long-distance (over 80 km) transmission systems by using 1550-nm digital distributed-

feedback laser diodes, half-split-band, wavelength division multiplexing and erbium-doped fiber amplifier-repeated techniques[13]. Moreover analysis of analog CATV Transmission system is successfully done by us [14-15] and including these good results in MIMO-OFDM system with OADM recently for OFDM system and Monitoring and compensation of optical Telecommunication Channels also have been achieved [16-21] ,the next motive will be doing work over CATV system using OFDM signals.



II. Simulation set up for Different Modulation Techniques for CATV Transmission System:

An 8-channel transmitter generates two PSK encoded sub-carrier signals at 50 Mb/s. The electrical signal is sent to an external dual arm modulator where at one arm a fixed voltage is applied. The signal is directly detected, in a back-to-back (no fiber) configuration. The PSK Direct system characteristics are the same of the CATV PSK subcarrier model. In this case the electrical signal directly modulates the laser, instead of using an external modulator. The QPSK encoded sub-carrier signals is generated by 4 channel transmitter at 30 Mb/s in the 1 GHz range. The electrical signal is sent to an external optical modulator and directly detected, in configuration which makes use of 100km optical fiber as shown in Fig.2. The non-linearity introduced by the external modulator gives rise to clipping effects that can be seen both on the received eye diagram and received spectra. The transmitter generates a 16QAM encoded sub-carrier signal at 0.8 Gb/s. The electrical signal is sent to an external optical modulator and is subsequently directly detected, in a configuration which makes use of 100km of optical fiber

The sub-carrier channel is filtered and demodulated. This project is a useful example of the use of a QAM demodulator as shown in Fig.3. Using the Logical Signal Displayer component it is possible to compare the transmitted and received information.

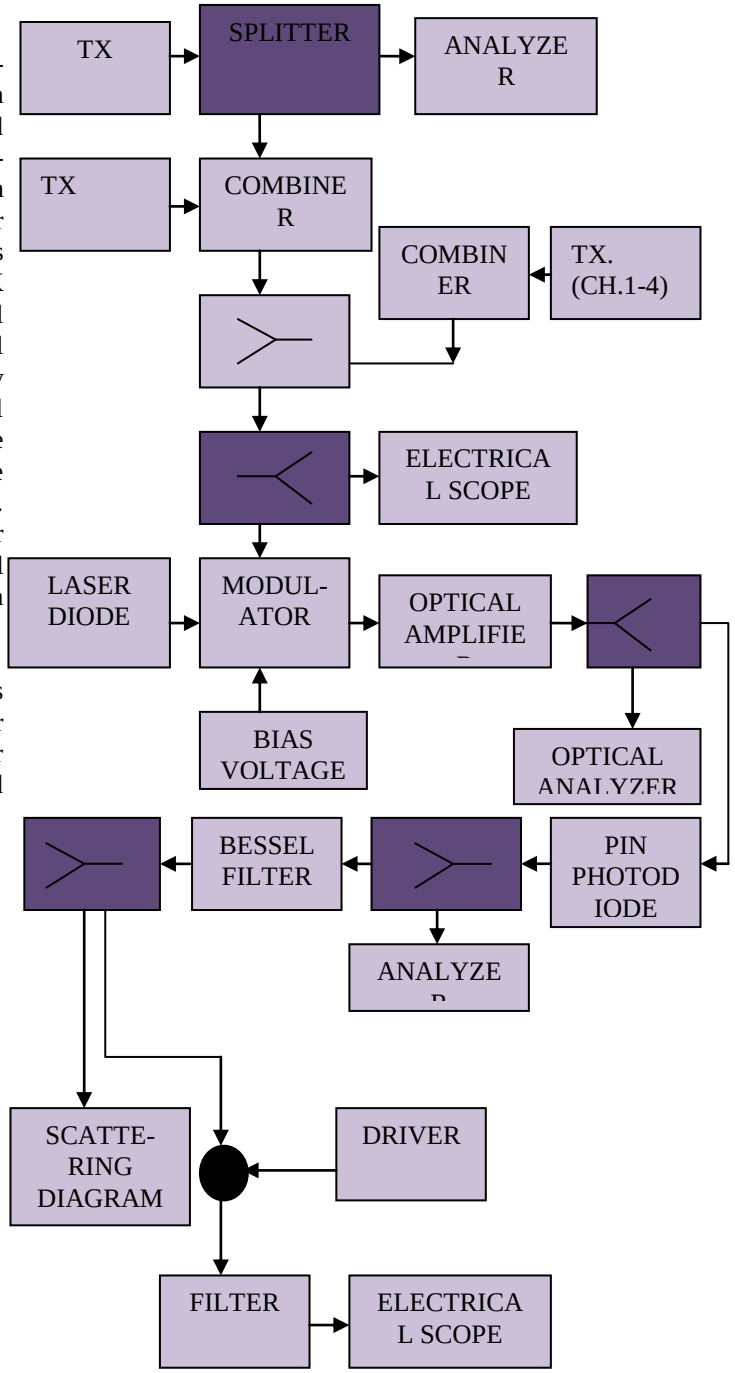


Fig.1. Block Diagram Representation for 100km SMF CATV using PSK Modulating Techniques.

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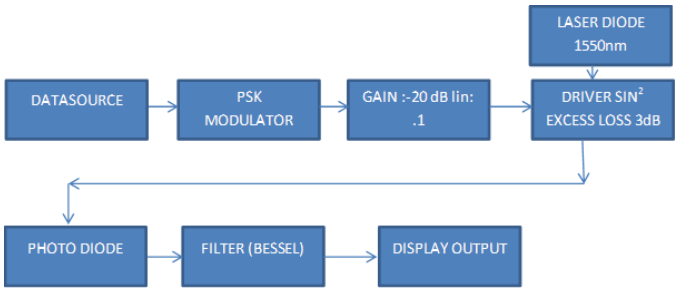

Fig.2. Block Diagram Representation for 100km SMF CATV using QPSK Modulating Techniques.

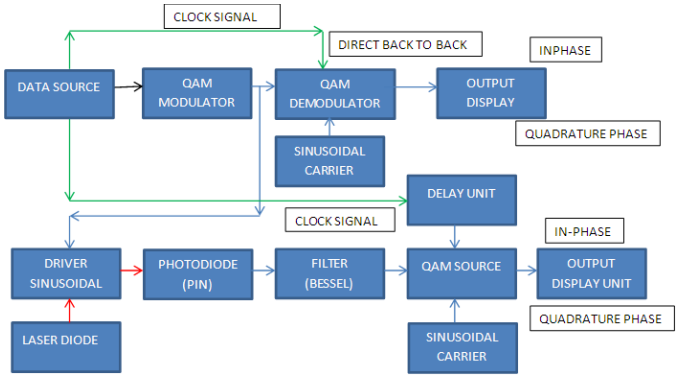

Fig. 3. Block Diagram Representation for 100km SMF CATV using QAM Modulating Techniques.

III. RESULTS AND DISCUSSION

Results are obtained for Q-value, BER, Eye Diagram, and Scattering Pattern. Scattering Patterns are shown for all the four different modulation techniques i.e. PSK, PSK direct, QPSK, 16QAM for CATV transmission system which make use of 100km long Optical Fiber. Q-value is the ratio of mean and standard deviation of received signals. To have good estimation of Q-value 100-200 bits are simulated so to have a good accuracy on the evaluation of the mean and standard deviation on the received signal. We can set the number of simulated bits at given bit rate. Q-value for different modulation format is shown in fig. 4.from the graph obtained we see that NRZ Rectangular has large Q-value which mean CSO/CTB distortion will be minimum when we preferred NRZ Rectangular modulation format as compare to other.

Error counting is usually impracticable, since the target BER is typically of the order of $10^{-9.}$ Therefore of this to measure a realistic BER it should be necessary to simulates 10^{-10} bits, a quantity that is not reasonable value in software simulation. The evaluation of the BER in optical system simulation is in general a nontrivial task as shown in fig.5.

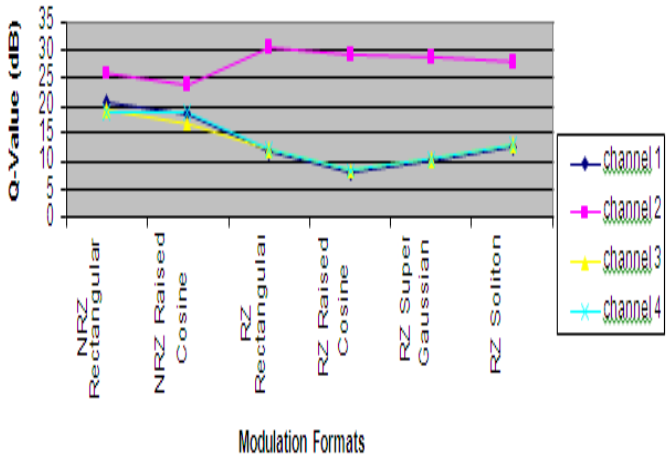

Fig.4. Q-Value at different modulation formats in 4-CATV transmission channels

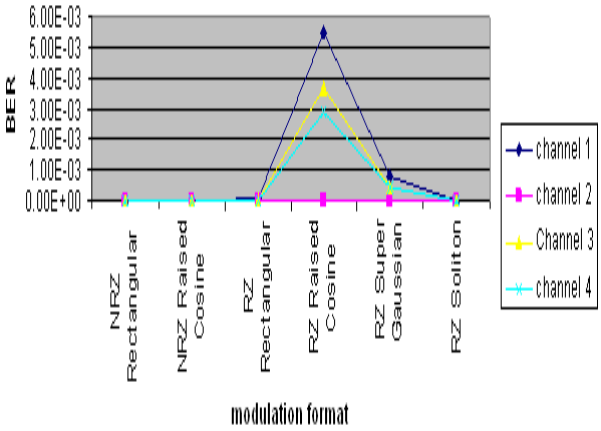

Fig.5. BER at different modulation formats in 4-CATV transmission channels

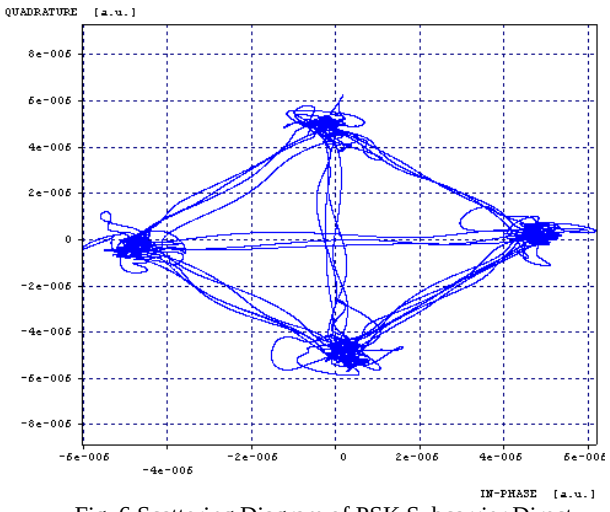

Fig. 6.Scattering Diagram of PSK Subcarrier Direct

The graphical representation by fig.6, fig.7, fig.8, fig.9 shows the scattering of two components of the signal.

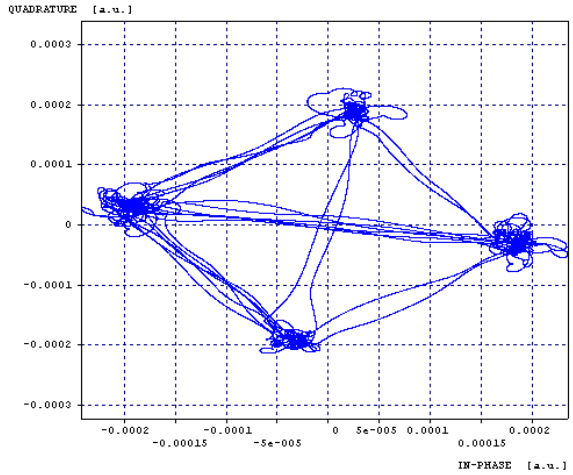

Fig. 7.Scattering Diagram of PSK

The units used in the diagram are arithmetic units for both axis i.e. In-Phase and Quadrature axis. The Measurements Tab contains no elements and there are no post-processing operations available for this diagram. The data is displayed as a collection of points, each having the value of one variable determining the position on the horizontal axis and the value of the other variable determining the position on the vertical axis. From the fig. 6,7,8,9 we analyze that 16 QAM has better Scatter Plot as compare to the other modulation techniques as more no.of dots are there and all are closely related to each other.

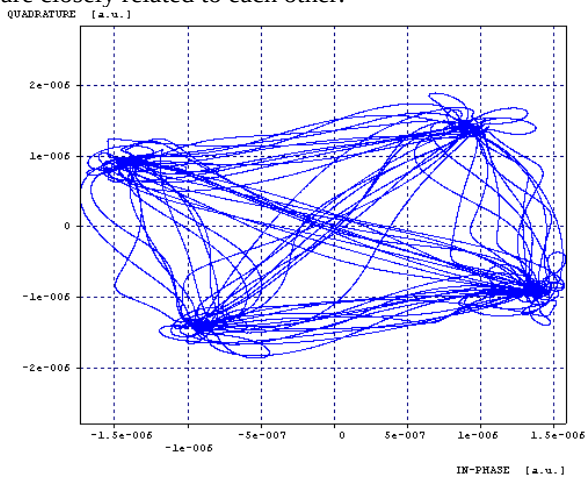

Fig. 8.Scattering Diagram of QPSK

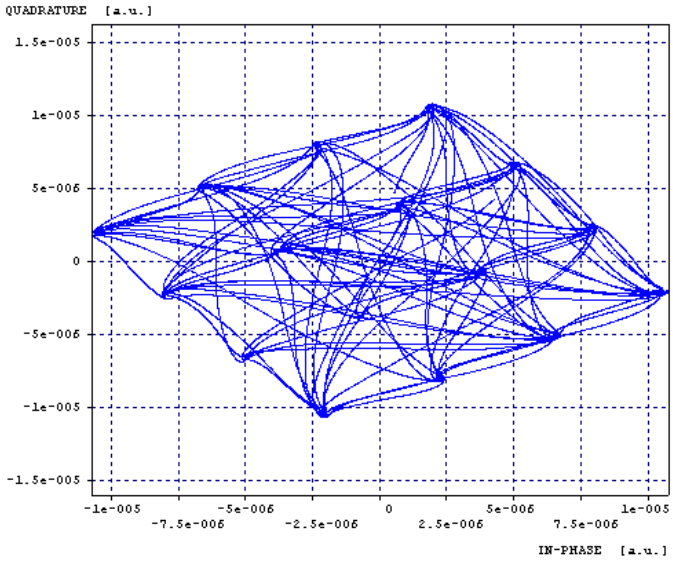

Fig. 9.Scattering diagram of 16-QAM

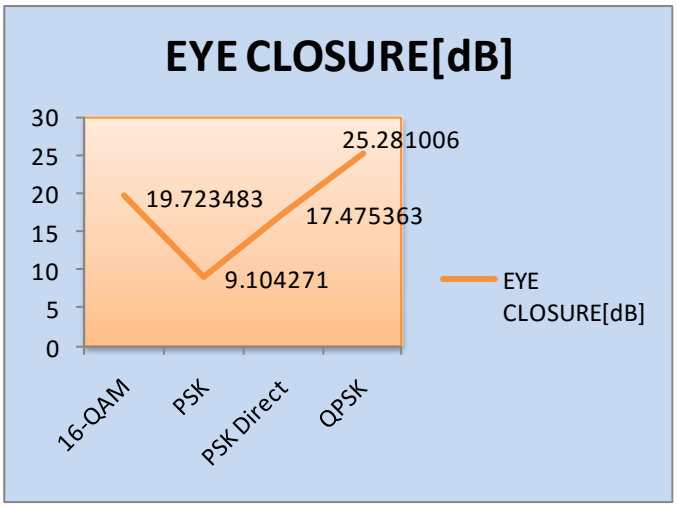

Fig.10.Representation of Eye Closure

Fig.10 graphically represents the one of the eye diagram feature comparison for different modulation techniques. Eye diagram indicate Quality of the signals in the particular transmission system moreover it provide various parametric information, From graphical comparison of various modulation schemes we can say that the value of Eye Closure for 16QAM is 19.723483 dB which is not very much less as compare to the simple PSK modulation scheme which is 9.104271 dB but value of eye closure of 16 QAM is less than PSK Direct and QPSK for 100km long optical fiber.

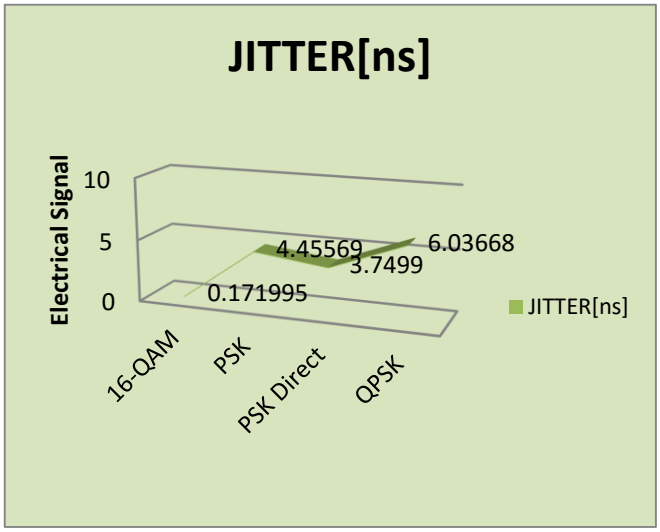

Fig.11.Representation of Jitter

Jitter is the absolute difference in the position of a clock's edge from where it would ideally be. Jitter is kind of noise, so we require its minimum value in our system and to design system with minimum value various above declared modulation scheme are analyzed. The value of Jitter is minimum for 16 QAM i.e. 0.171995 ns which is very much less than other modulation schemes consider. So if minimum value of jitter is require then 16 QAM modulation technique is prefer for CATV transmission system with 100km long optical fiber so as for the signal to be received accurately and of good quality, the comparison representation of jitter for various modulation scheme is shown in fig. 11.

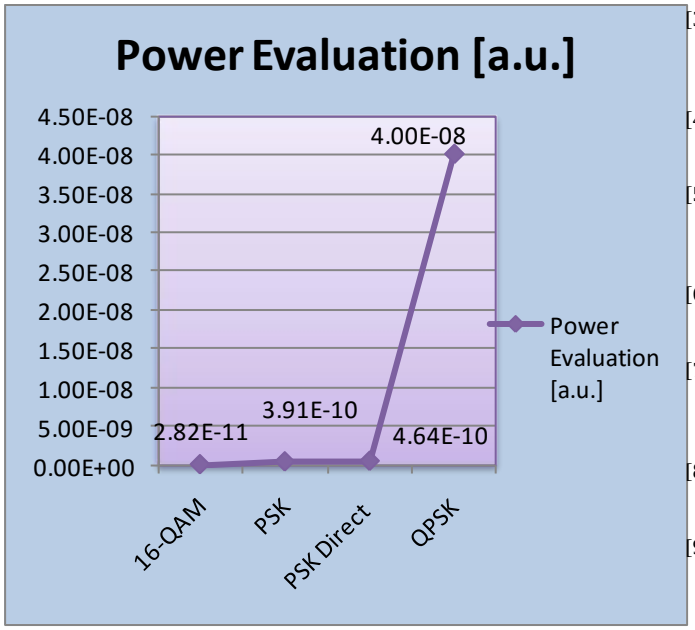

Fig.12.Representation of Electrical Power Evaluation

Fig.12 represents the Electrical Power Evaluation from the above line graph we can conclude that the electrical power requirement for 16 QAM is minimum i.e. 2.82e -11 as compare to the other modulation format.

CONCLUSION:

We conclude that different modulation techniques have different preferences for various values like for 16-QAM the value of Eye Closure is less than the PSK but more than the PSK Direct and QPSK that mean the signal received properly as compare to other techniques. The Jitter value is very much less for 16-QAM as compare to the other modulation schemes PSK, QPSK. The value of Power requirement is very much less for the 16 QAM modulation scheme than others. In all 16-QAM is most preferred one modulation technique for CATV transmission system for 100km long distance.

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