

Polarization-Based Modulation Techniques in Fiber Communication: A Review of PDM-QPSK Formats

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ABSTRACT

The on-going growing demand for bigger capability in optical communication systems, whereas maintaining signal quality. during this report, increasing the fiber spectral potency and enhancing bit rate of trans-receiver by mistreatment circular polarization at the side of linear polarization and DQPSK modulation techniques has been planned. planned formula is employed during this system for multiplexing linearly polarized and circularly polarized signals. additionally to polarization DQPSK for enhancing bit rate while not moving the spectral dimension of trans-receiver. at the start linear polarization is employed for enhancing the bit rate. currently at the side of circular polarization the bit rate and potency becomes double.

I. INTRODUCTION

Circular polarization isn't as fascinating as linear polarization. The explanations for this read don't seem to be clear one main reason is because of the client not being absolutely educated to the advantages or the worth sensitivity towards arrangement Some customers may additionally feel that since Intelsat is that the solely satellite supplier giving C-Band, the availability of antenna should become a difficult. However, it's vital to comprehend that the inflated dependability in signal strength, resistance to weather, and simple installation outweigh the expense of the feed horn. Technically speaking, circular polarization involves the plane of polarization rotating in an exceedingly corkscrew pattern, creating one complete revolution throughout in every wavelength. The radiated energy of circularly polarized wave can be part with in horizontal and vertical plane, and maximum time in middle of each plane. In circular polarization only two types of polarization exist which are: Right-Hand-Circular (RHC) that follows a dextrorotatory pattern, and Left-pattern. The carrying capacity over fiber can be double for the satellites by using constant frequency at same time in each direction which helps to improve in higher revenue generation through linear polarization. The characteristics of ku-band and c-band both are suitable for circular polarization. However one interesting factor should be note that Intelsat does not give any Ku-Band Fleet with circular polarization [1].

II. CIRCULAR POLARIZATION IN FIBER COMMUNICATION

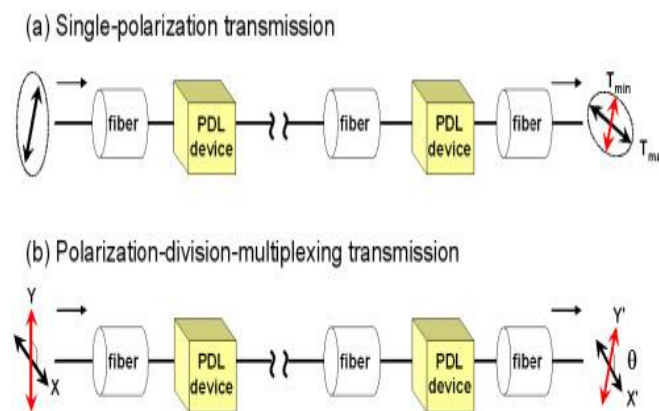
Optical fiber communication is entrenched a part of the globally info infrastructure, that's high performance optical networks square measure essential to economic condition and well-being of communities [2]. The attraction of transmission high associate fiber are principally in its highly capability compared to copper counterparts and immunity to magnetic force interference and alternative external influence. Now a day's glass fiber transmission is seen as a dominant technology for each long-haul and short-haul broadband transmission [3-4]. The on-going growing demand a rise in transmission speed from 10 Gbps to 40 Gbps and on the large side, whereas maintaining signal quality. Optical communication systems have wide used some sort of on/off keying (OOK) as a modulation format. As knowledge rates increase, the unskillfulness of those modulation formats from a information measure purpose of read is changing into a large of apparent. With knowledge rates moving to forty Gbps and on the far side, dispersion within the fiber limits the space over that the info will be transmitted. alternative impairments like polarization mode dispersion or PMD become vital at forty Gbps. mistreatment binary modulations, notwithstanding detection technique, spectral potency cannot exceed one b/s/Hz per polarization [6, 7]. Thus, in long distance transmission such as inter-city transmission, which needs transmission of over many hundred km, has not been potential to it. the modulated signals coming from the transmitter will be recovered at the receiver end through differential detection (in the case DPSK or DQPSK) or a lot of sensitive technique, coherent detection (in BPSK, QPSK). Moreover, the entire info of the electrical fields at each the transmitter and receiver parades the likelihood of electronic Digital Signal process (DSP) for pre-compensation and post-compensation [3,4].

Spectral efficiency of optical fiber system can be enhanced with help of polarization division multiplexing (PDM) and it also helps to double the information carrying capacity of the fiber glass cable and optical communication. Some phase modulation techniques like BPSK, DPSK, QDPSK, are in demand with differential as well as coherent detection and PDM technique used in routinely high speed systems without affecting their spectral widths outside the 50GHz standard ITU-T grid.

III. POLARIZATION-DIVISION MULTIPLEXING (PDM)

PDM should be a physical layer technique for multiplexing signals carried by magnetism waves, permitting 2 channels of data to be transfer on constant carrier frequency by victimization waves of 2 orthogonal polarization states. it's utilized in microwave links like television system downlinks to increase the information carry by victimization 2 orthogonally polarized feed antennas in satellite dishes. it's conjointly utilized in fiber optic communication by transmittal separate left and right circularly polarized light-weight beams through constant glass fiber. Polarization techniques has been long been utilized in radio transmission by scale back interference between channels, significantly at VHF frequencies and beyond [2].

Under some circumstances, the info-rate of a link is enhanced by transmittal 2 separate mediums of radio waves on particular frequency, victimization orthogonal polarization. As an example, in purpose to purpose microwave links, the transmittal antenna will has 2 feed antennas; a vertical feed antenna that used to transmits microwaves with their field of force vertical (vertical polarization), and a horizontal feed antenna that used to transmits microwaves on constant frequency with their field to force horizontally (horizontal polarization). These separate vertical and horizontal feed antennas at the receiver end. For space and satellite communication, orthogonal circular polarization is preferred touse instead, (i.e. right- and left-handed), reason is the sense of circular polarization isn't enhanced by the relative orientation of the antenna in area.



Fig(1) PDM in optical Fiber.

IV. OLD RESULT AND LITERATURE SURVEY

Mariamorant, joaquin Pérez, and roberto llorente: This paper helps to understand the state-of-the-art of polarization multiplexing for optical networks transmission and satellite communication. In optical fiber communication polarization division multiplexing helps to improve the capacity of users and helps to improve the spectral efficiency of glass fiber. We can get the maximum fiber transmission capacity over the optical cable through mixing both polarization division multiplexing and OFDM. The experimental reports to send OFDM signals follows ECMA-368 ultra-wide-band (UWB) status in radio-over-fiber using PDM in passive fiber networks is herein reported. The experimental result of cross channel polarization and co-channel crosstalk is produced experimentally in a three-user OFDM-UWB sub-carrier multiplexing (SCM) configuration for each polarization.

Siva kumar raju nadimpalli Due to exponential growth in fiber communications, wavelength division multiplexing (WDM) phenomenon is popular because these systems help us to expand the capacity of the networks without adding more optical fiber cables. In this paper, we are formed the coupled nonlinear Schrodinger (CNLS) equations, consisting a periodic definition of the complex form, Fourier transform, state of polarization, and Derivation into the engineering notation. After understanding the coarse step based second order summarized split-step-Fourier (SSSF) simulation methods, which are useful to find out the numerical solution of the CNLS equations, analytical step-size selection based local error methods are useful to the WDM optical glass communication systems.

Nidhi, mukesh sone: The exponentially growing demand for higher capacity in optical communication systems, push up for an increase in communication speeds from 10 Gbps to 40 Gbps and so on, while the quality and strength of signal remains unchanged and undamaged. In this paper, the spectral efficiency of fiber is going to modified and improving the bit rate of trans-receiver by using circular polarization technique along with linear polarization and DQPSK modulation techniques has been estimated to propose. Linearly polarized and circularly polarized signals [2] are multiplexed with help of PDM.

Andrés macho ortiz r.horche:In process to design 100Gb/s and 200-Gb/s traffic wavelength-division-multiplexed (DWDM) network, we need to advanced optical modulation format PDM- quadrature-phase-shift keying (PDM-QPSK) which is a milestone phenomenon. The performance of this modulated depends on the curve of the waves work for the optical carriers: non-return-zero (NRZ), return-to-zero (RZ). Return to zero formats with a low duty cycle value reduces pulse-to-pulse interaction produce a higher tolerance to CD, PMD and intra channel nonlinearities [2]. This paper described the difficulties of linearly and nonlinearly optical impairments in PDM-QPSK: fiber Kerr nonlinearities, amplified-spontaneous-emission (ASE) noise by optical filtering, chromatic wave dispersion (CD), and polarization-mode based dispersion (PMD).

V. THE PROBLEM STATEMENT

To satisfy the demands for higher bandwidth of optical communication systems advanced optical modulation formats need to be investigated. The long haul transmission format is one of them in which we can use the larger order modulation techniques which have minimum shift keying (MSK) with differential quadrature phase shift (DQPSK) keying is ideal to replace the older techniques of modulation formats like differential binary phase shift keying (DBPSK) technique. They provide two times more spectral efficiency rate in compare to conventional method at moderate additional complexity [3-4-5]. Generally a high-frequency based sinusoidal waveform is used as carrier signal with message signal [6].

- **Cross-Polarization Interference:** The residual polarization crosstalk has been measured for both polarization paths. The cross-polarization crosstalk is obtained measuring the received electrical spectrum when the UWB modulated signal is only travelling over one of the polarizations.
- **SCM Multichannel Crosstalk:** Taking into account the cross-polarization over the received signal, the effect of channel aggregation and inter channel distortion is evaluated when multiple OFDM channels are transmitted simultaneously 6 in a PDM system. The EVM of the received PDM-UWB signal for each multiuser SCM configuration at different fiber lengths L .
- **Maximum Reach in PON:** Once the effect of multiuser transmission is evaluated, the SCM-UWB performance after L km repeater-less optical transmission in PDM networks is studied using different launch power levels.
- **Larger BW then higher ISI:**
- **Lower S/N Value and higher path loss factor:**

VI. OPTICAL COMMUNICATION MODELLING

➤ PDM co-ofdm transmitter:

Independent OFDM signals are generated by multiplexing data symbols on subcarriers through the iFFT block. The data symbols can be represented as a $2 \times N_{sc}$ matrix $S = [s_1 \dots s_{N_{sc}}]$ where $s_k = [s(X)_k, s(Y)_k]^T$ are the two data symbols transmitted on two polarizations by the k th subcarrier. Then, at the output of the iFFT block, a cyclic prefix is inserted and the sampled digital signals are converted to analog signals by DACs, and then filtered by low-pass filters to eliminate the aliasing replicas of the baseband OFDM spectrum. After, they are up-converted to the optical domain using an MZM I/Q modulator as the one. For PDM-QPSK with the binary signals replaced by the OFDM signals. Given their sinusoidal transfer. The MZMs are biased at their null points (trough) to achieve a linear conversion between the baseband electrical OFDM signal and the optical field.

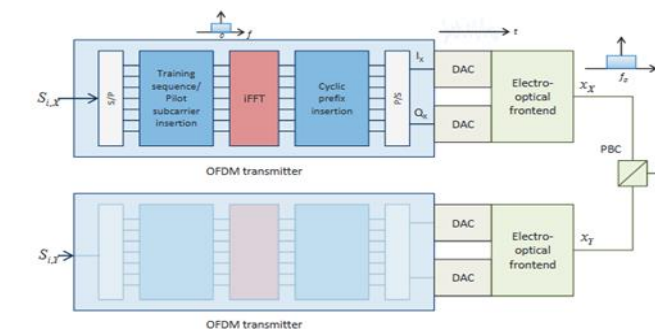


Fig (2) PDM CO-OFDM transmitter

➤ PDM co-ofdm receiver:

At the receiver, a polarization beam splitter separates the incoming signal by projecting it on two Orthogonal polarization states. The signals are then down-converted to the optical domain through a dual-polarization coherent receiver as the one.

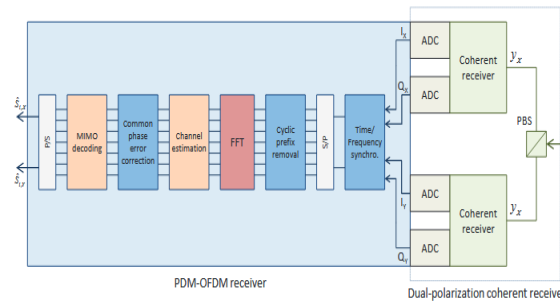


Fig (3) PDMCO-OFDM receiver

Polarization:

As bit rates increase to meet expanding demands, system sensitive increases towards the polarization related impairments. In all other kinds of electromagnetic waves as well as in light waves, the oscillating electro-magnetic fields are directed at 90 degree angles to each other and propagate into the direction of the wave. We can say the fields are transverse, and light can be described as a **transverse wave**. Since in a light wave both the directions and the magnitudes of the electro- magnetic fields are related in a particular fixed manner, which is sufficient to describe only one of them, mostly electric field use to describe [8].

Time and frequency synchronization:

Accurate temporal location of the beginning of an OFDM frame as well as accurate location of the OFDM sub-carriers are crucial as otherwise the orthogonality of OFDM subcarriers can be broken leading to both ISI and inter-carrier interference (ICI). Several algorithms were suggested and used to perform these synchronizations. They all rely on special OFDM training symbols such as an OFDM symbol with identical halves in the time domain or by X-fold repetition of a pattern with a possible alternation of signs. These symbols are then detected through an auto-correlation operation over a sliding window followed by a search for the highest value of the auto-correlation metric to determine the beginning of an OFDM frame.

VII. EXPECTED RESULTS AND SIMULATION

In the past two decades the traffic carried in optical backbone networks has been leading exponentially and going so on. Nowadays, the required capacity on each DWDM channel ranges between 100 and 200-Gb/s. In 2012, the ITU-T recommended the use of “Flexible-Grids” networks enabling the possibility to continue working with the PDM-(D)QPSK format beyond 100-G, due to the current technological difficulties to achieve long-haul data communications with the multilevel PDM-16-QAM format, mainly focused on short-reach transmissions. An intensive analysis has been made of polarization-division multiplexed quadrature phase shift keying modulation formats in 100 and 200-Gb/s DWDM systems. There are many variations in performance offered by PDM-(D)QPSK with the line code that is serve to carve the pulses of the optical carrier: NRZ, 33% RZ, 50% RZ, 67% RZ or CSRZ. Each option gives different tolerances to linear and nonlinear impairments of a light path. There are some features of PDM-(D)QPSK have been characterized to measuring the robustness to ASE noise, chromatic dispersion, polarization mode dispersion, optical filtering, crosstalk and intra-channel nonlinearities. PDM-33%RZ-(D)QPSK reveals an enormous resistance against the ghost pulses generated by IFWM and the phase fluctuations of IXPM, but the handicap of this signal is its low SE in DWDM systems, 1 b/s/Hz. Thanks to its great tolerance to filtering distortion, the SE may be increased from 1 to 2 b/s/Hz in DWDM systems pre filtering this format in the TX and allowing its integration in the grids of 50 and 100 GHz for 100 and 200 Gb/s transmissions, respectively. In this way, it is possible to exploit the great advantage of RZ pulses with low duty cycle: the reduction of pulse-to-pulse interaction. This feature offers to increasing the tolerance to PMD, CD and intra- channel nonlinearities. In contrast, the PDM-NRZ-(D) QPSK format has a slightly higher SE than the other options. It shows better tolerance to filtering distortion and chromatic dispersion in filterless networks [7].

VIII. FUTURE SCOPE:

The combination of PDM STBC OFDM had been proposed for PDM coherent optical communication. The OSNR sensitivity had been lots of improvement. QPSK are often achieved which that's 6 bits info in constellation mapping. This is often very high spectrum efficiency. For QPSK, The system performance includes a significant improvement once QPSK is applied. We are going to prove that FFT spread reduces PAPR as well as it helps to increase the computational speed and reduces the multiplication and Addition compared to DFT spread

IX. REFERENCES

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