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PERFORMANCE ANALYSIS AND COMPARISON OF ONE – DIMENSIONAL CODE FOR OCDMA SYSTEM WITH MODIFIED PRIME SEQUE NCE CODES (MPC)

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Abstract: CDMA is a "spread spectrum" technology, allowing many users to occupy the same time and frequency allocations in a given band/space. Basic concept of the cdma, allowing several users to transmit message/date simultaneously over the optical fiber communication (OFC) channel by allocating the available bandwidth to each user simultaneously. There are many techniques to provide multiple access but optical code division multiple access (OCDMA) is the best suited for optical communication. CDMA is a multiuser communication scheme through which many users simultaneously share a common channel. The objective of the paper is to analyse the performance of one dimensional code for an optical code division multiple access (OCDMA) with modified prime sequence codes. The designe of the system, implementation and performance analysis of one dimensional code in an optical CDMA.

Index Terms— code division multiple access (OCDMA); modified prime sequence codes; optisystem simulation tools..

1 Introduction

Code-division multiple-access (CDMA) communication system allows multiple users to access the network simultaneously using unique codes. Optical CDMA has the advantage of using optical processing to perform certain network applications, like addressing and routing without resorting to complicated multiplexers or demultiplexers. The asynchronous data transmission can simplify network management [1] and control. Therefore, OCDMA is an attractive candidate for LAN application. Particularly, OCDMA can provide a secure network connection providing dynamic encoding. One of the basic concepts in data communication is the idea of allowing several transmitters to send information simultaneously over a single communication channel. This allows several users to share a bandwidth of frequencies. This concept is called multiplexing [2]. CDMA employs Spread-spectrum technology and a special coding scheme (where each Transmitter is assigned a code) to allow multiple users to be multiplexed over the same physical channel. In CDMA, every user will be allocated the entire spectrum all of the time. CDMA uses unique spreading codes to spread the baseband data before transmission. The signal is transmitted in a channel, which is below noise level. The receiver then uses a correlator to dispread the wanted signal, which is passed through a narrow band pass filter. Unwanted signals will not be dispread and will not pass through the filter. Codes take the form of a carefully designed one/zero sequence produced at a much higher rate than that of the baseband data [2]. The rate of a spreading code is referred to as chip rate rather than bit rate.

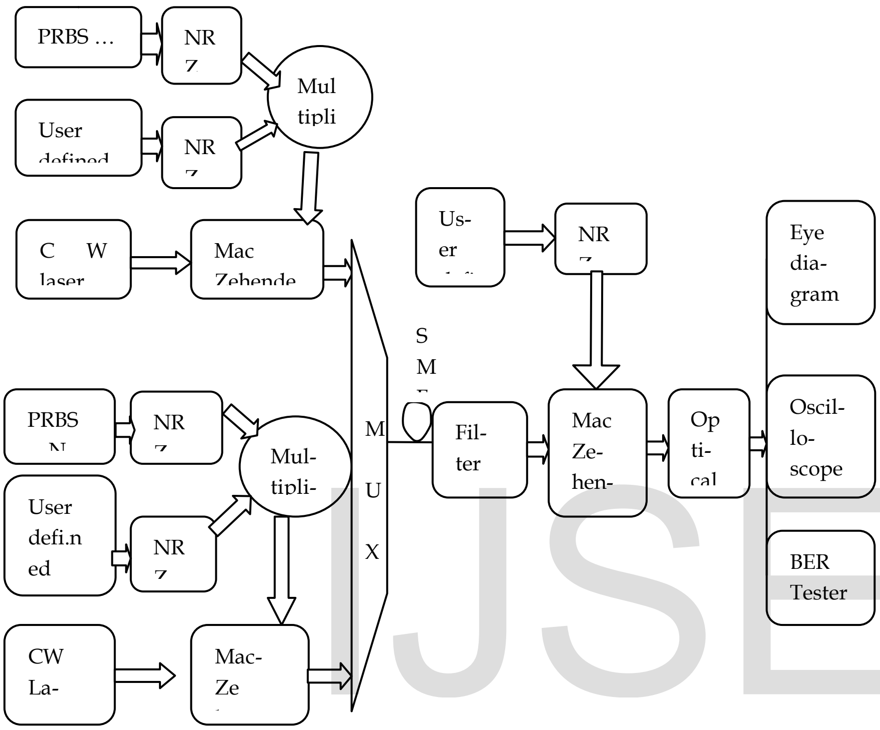
Advantages of optical CDMA: fully asynchronous access, dynamic allocation of bandwidth and soft capacity on demand, decentralized architecture, self routing and robust information security.

2. Block Diagram of OCDMA

An OCDMA system share a common strategy of distinguishing data channels not by the wavelength or the time slot, but by distinctive spectral or temporal code (or signature) impressed onto the bits of each channel.

The figure 1.1 shows an OCDMA network with N pairs of transmitters and single receiver [3] connected with the multiplexor. Carrier signal is send through the optical fiber cable to the receiver end. At the receiver end the signal is filter with the help of Mac-Zehnder Modulator and send to the decoder. Again carrier signal decode with the help of Mac-Zehnder decoder and then signal send to the optical receiver. Here we can analyze the received signal through the Eye diagram, Oscilloscope visualizer, Q factor, BER and Power received at the receiver end.

Pseudorandom bit sequence (PRBS) is used for carrier signal generation. PRBS Generator generates data bits at 1.0 Gbps data rate. A pseudorandom number generator (PRNG), also known as a deterministic random bit generator (DRBG).



PRBS	Bit rate	Order	No of leading zeros	No of trailing zeros	Iteration	Sequence
	1Gbps	4	3	3	1	25

NRZ	Amplitude	Rise time	Fall time	Sample rate	Rectangle shape
	1 a.u	0.05 bit	0.05 bit	6.4e+010	Exponential

User defined bit sequence generator	Bit rate	Bit sequence	No of leadings zeros	No of trailing zeros	Iteration
	25 Gbps	25	3	3	1

CW laser	Power	Linewidth	Sample rate	Noise threshold	Noise dynamic	frequency
	20 dBm	10 MHz	6.4e+010	-100 dB	3dB	1550nm

filter	Sample rate	Noise threshold	Noise dynamic	Order	Depth	BW	frequency
	500 GHz	-100 dB	3 dB		100 dB	20G Hz	1550 nm

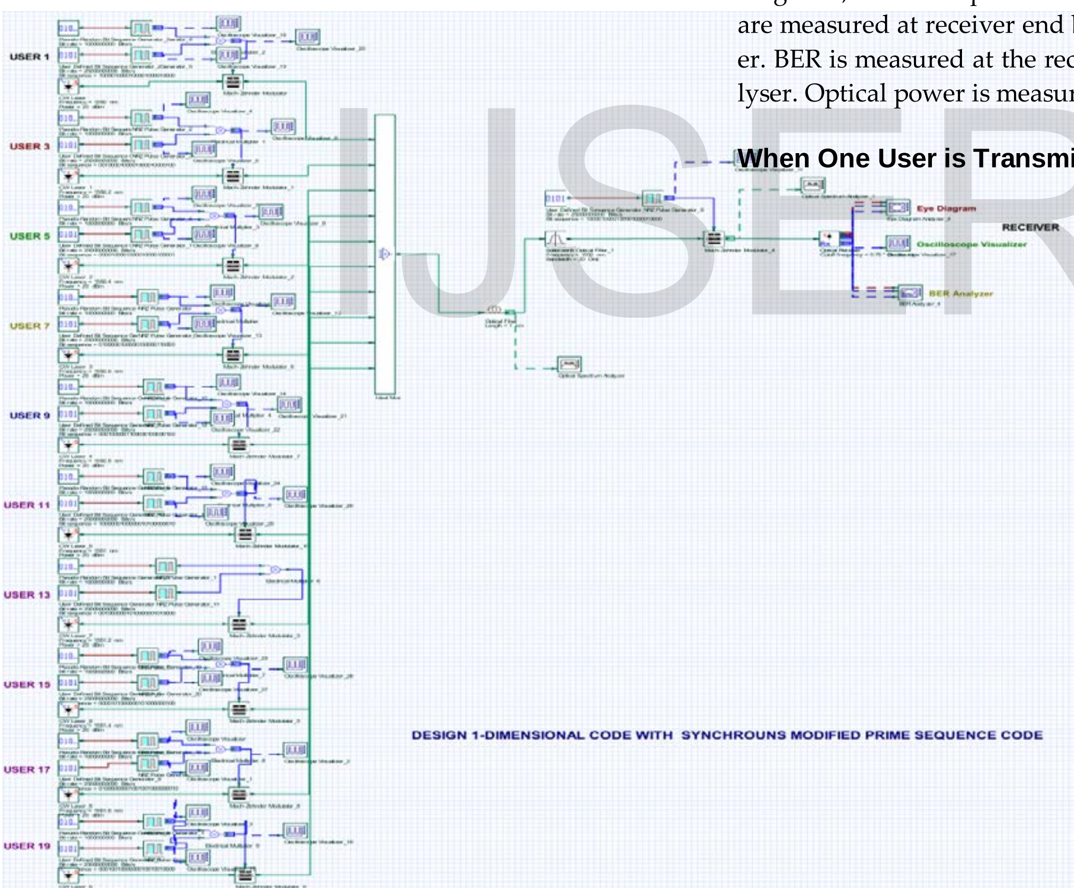
SM	wavel	att	dispersion	dispersion slop	le
	1550 nm	0.2db/km	16.75 ps/nm/km	0.075ps/nm^2/k	1km

Opti Rx	Photo detector	Cutoff frequency	Sample rate	Centre freq.	Thermal noise	Sensitivity	Ref. Q factor
	PIN	7.5e+008	3.2e+011	193.1 Thz	1e-022 w/Hz	-18 dB	6.463

Here we have taken number of trailing zeros '3' and number of leading zeros '3'. We have calculate trailing and leading zeros from equation number 1 and 2.

No. of trailing zeros= (time window * 3)/100... (1)
No. of leading zero= (time window*3)/10.........(2)
No. of order= log (sequence length)/log (2)…..(3)

Mach-Zehnder (DPMZ) modulator is ideally suited for use in metro, long-haul (LH) and ultra long-haul (ULH) optical transport applications. Here we select extinction ratio 30db and symmetry factor '-1'. UDSG generates data bits at 25Gbps and send to NRZ pulse generator. Again multiplier multiplies the both carrier signal. Here we have taken bit sequence length "10000 10000 10000 10000 10000" and we can calculate no. of trailing zeros and no. of leading zeros from equation no. (1) and (2).



Fiber optic code division multiple access is one of the technique to allow several users to transmit simultaneously over the same optical fiber. An OCDMA can, for each user, be described by a data source, containing the data that will be sent, followed by an encoder and then a laser that maps the signal from electrical form to an optical pulse sequence by using a modulator. At the receiver end an optical decoder is used to extract the original data with the help of oscilloscope Visualiser, BER and eye diagram. Here used multiplexor, combiner the all signal and transmit on a single fiber link.

3. Simulation Setup

Here we have simulated 1-D code using Modified Prime Sequence code. we taken PRBS Generator, [4] [5] generates the signal .NRZ signal convert logical signal to electrical signal and multiplied with the electrical multiplier with users defined sequence bits . Here we have simulated up 25 users. Mac-Zehnder modulator operates with the 1550nm Laser source. After that those signal transmit to single mode fiber. in the receiver side we have received the same carrier signal . We have seen by the help of Oscilloscope visualizer

4. Result and Discussion

Using simulation setup the value of bit error rate (BER), Eye diagrams, Oscilloscope visualizer are measured. Eye diagrams are measured at receiver end by using an eye diagram analyzer. BER is measured at the receiver end by using the BER analyser. Optical power is measured at receiver end.

When One User is Transmitting.

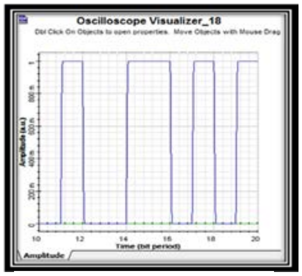


Fig 1.3(a): PRBS code

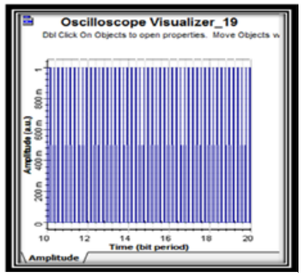


Fig 1.3(b): Users defined Codes

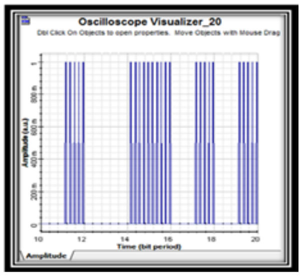


Fig 1.3(c): after Multiplication

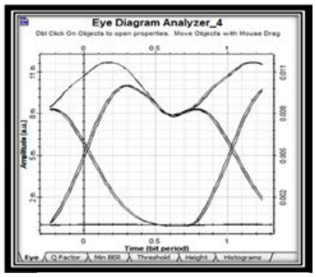


Fig 1.3(d): Eye diagram

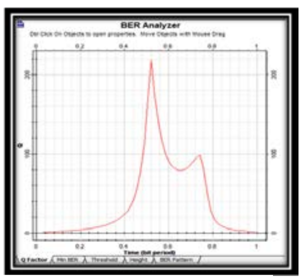


Fig 1.3 (e) Q factors

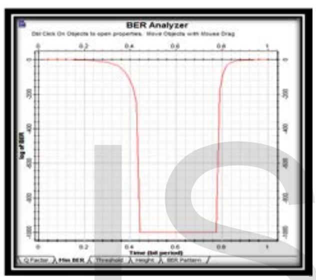
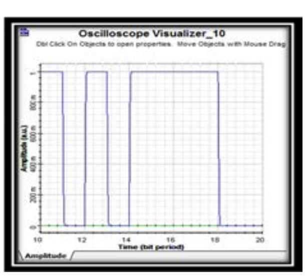


Fig 1.3 (f) BER diagrams

Figure 1.3(a) and 1.3(b) shows PRBS Generator generates data bits at 1Gbps data rate and User Defined Sequence Generator generates bits at 25Gbps. These codes send to the NRZ and NRZ convert logical signals to electrical signals after that both signal multiply with the electrical multiplier shows figure 1.3(c) and send to Mac-Zehnder modulator. CW optical laser operate at 1550 nm with 20dBm power. After that those signal modulate with the help of modulator and send to the single mode optical fiber. In the receiver side those signal filter and decode with the help of decoder and then transmits to the optical receiver. We can calculate BER, Power, Q factor and analyze with the help of Eye diagram. Here we have received BER '0', Q factor 218.837 and power -13.380dBm / 45.920E^{-6} W at 1 km fiber distance. Eye diagram shows figure 1.3 (d), Q factor shows figure 1.3 (e), BER diagram shows figure 1.3 (f) and received signal shows figure 1.3 (g). Carrier signal has received at 1Gbps data rate.

When Seven Users are Transmitting.



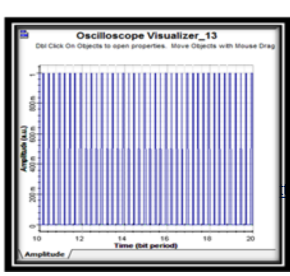


Fig. 1.4 (a): PRBS codes

Fig. 1.4 (b): Users defined codes

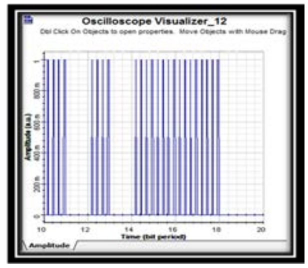


Fig. 1.4 (c): After multiplication

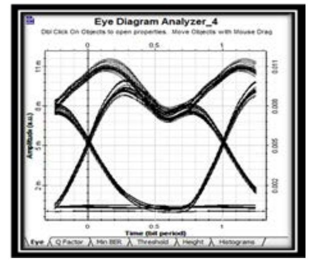


Fig.1.4 (d): Eye diagram

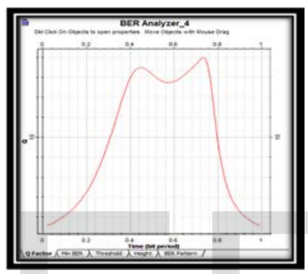


Fig. 1.4 (e): Q factor

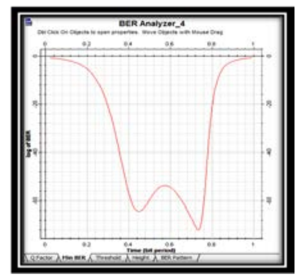


Fig. 1.4 (f): BER diagram

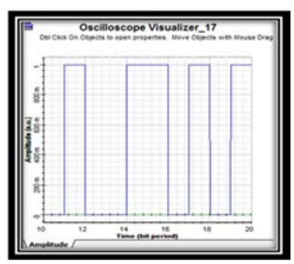
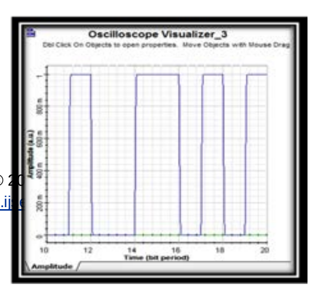


Fig. 1.4 (g): Received signal

We have received eye height 0.00684073 from diagram 1.4 (d) and threshold value 0.00284464. We have calculate BER, Power, Q factor and analyze with the help of Eye diagram. Here we have received BER 8.46203e^{-073} Q factor 18.0056 and power -14.171dBm / 38.276E^{-6} W at 1 km fiber distance. Eye diagram shows figure 1.4 (d), Q factor shows figure 1.4 (e), BER diagram shows figure 1.4 (f) and received signal shows figure 1.4 (g). Carrier signal has received bits 0100110101 at 1Gbps data rate.

When Nineteen Users are Transmitting



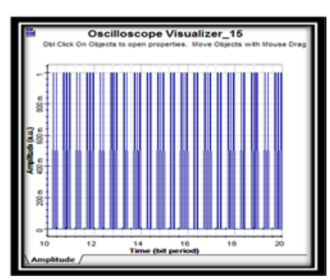
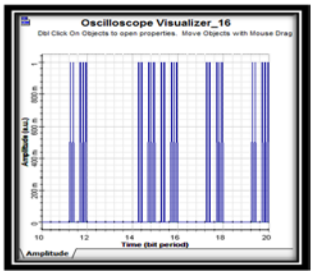


Fig 1.5(a): PRBS code

Fig 1.5(b): Users defined code



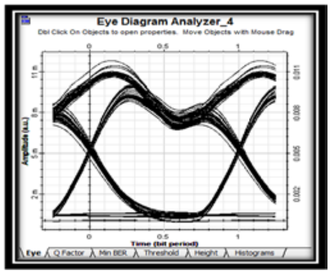
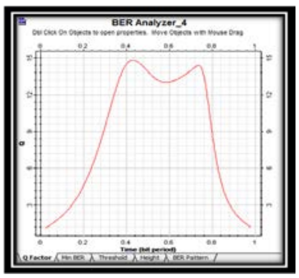


Fig 1.5 (c): after multiplication

Fig 1.5(d): Eye diagram



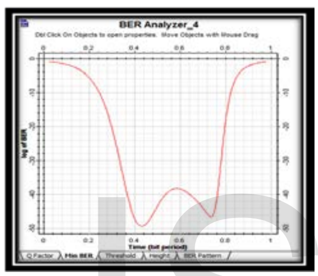


Fig. 1.5 (e): Q factor

Fig. 1.5 (f): BER diagram

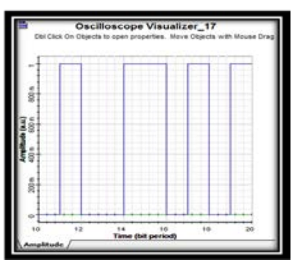


Fig. 1.5 (g): Received signal

We have received eye height value from eye diagram analyzer 0.00669747 and threshold value 0.00321114. We have calculate BER, Power, Q factor and analyze with the help of Eye diagram. We have received BER 5.18728e-050, Q factor 14.8205 and power -14.161dBm / 38.363E-6 W at 1 km fiber distance. Eye diagram shows figure 1.5 (d), Q factor shows figure 1.5 (e), BER diagram shows figure 1.5 (f) and received signal shows figure 1.5 (g). Carrier signal received at 1Gbps data rate.

Table 1.2

Users	BER	Q FACTOR
Users 1	0	218.546
Users 3	2.93729e-115	22.787
Users 5	1.41587e-088	19.916
Users 7	8.46203e-073	18.005
Users 9	5.41876e-067	17.249
Users 11	6.95085e-060	16.276
Users 13	6.28254e-053	15.265
Users 15	8.07049e-053	15.248
Users 17	7.11505e-052	15.109
Users 19	5.18728e-050	14.820

We can be analyze from table 1.2, when we increase the more number of active users in the transmitter side then bit error rate increases gradually and quality factor decreases. Here we have used Synchronous Modified Prime Codes. We calculate user, 3 users, 5 users, 7 users, 9 users, 11 users, 13 users, 15 users, 17 users and 19 users at 1Gbps data rate and we can compare with the help of BER and Q factor at 1Gbps data rate. We can be seen table 1.2, bit error rate and quality factor taken for different numbers of transmitting users with standard single mode optical fiber length of 1.0 Km distance. It can be seen many diagram after that we found, if number of transmitting users are increasing then eye opening is considerably decreasing. When we increase the number of users in transmitter side then the bit error rate increases in the receiver side.

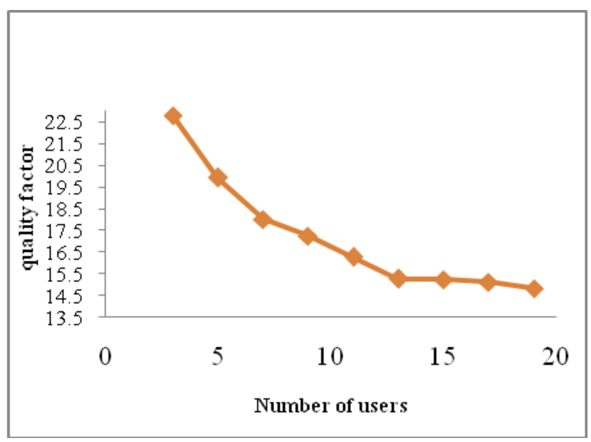


Fig 1.6(a): Q factor

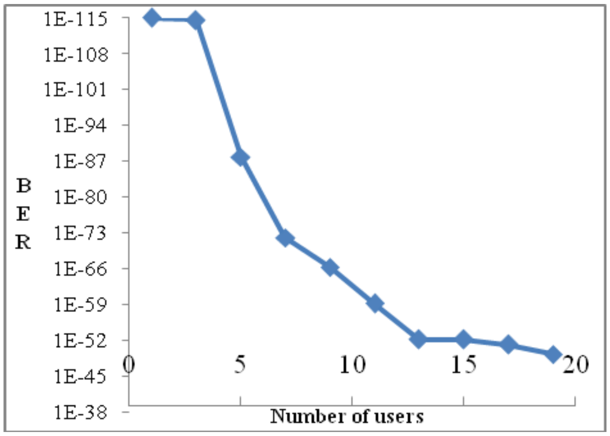


Fig 1.6(b): BER

It can be seen figure 1.6 (b), if we are transmitting more number of active users at the transmitter side then we can analyze BER increasing gradually. Here we simulate one user, two users up to 25 users. It can be seen figure 1.6 (a), number of users increases then the Quality factor decreases respectively. Multiple access interference is the co-channel interference from other transmitting users and it is the dominant source of bit error rate in an OCDMA system. Hence the performance of the OCDMA system degrades with increase in number of active users.

5. Conclusions

In this paper design, implementation and performance evaluation of one dimensional code presented here. The quality factor degrades and the BER increases as the number of active users increases. The BER further increases with the increase in number of transmitting users.

6. Future Scope

Simulation can be performed for more no. of active Users and effect of interference could be studied. It can be done to reduce MAI and can also Analysis of Optical CDMA using Fuzzy Logic

7. References

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