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Simulation of a 3 Gb/s SAC-OCDMA Based on Multi-Diagonal Code

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Abstract : ***In this paper we've modelled and simulated a 3Gb/s (3×1Gb/s) optical system supported spectral amplitude coding writing for the optical code-division multiple-access (SAC-OCDMA) theme. So as to cut back the result of multiple-access interference, we've utilized a replacement family of SAC-OCDMA codes known as a multi-diagonal (MD) code. The new code family supported the MD code reveals properties of zero cross-correlation code, flexibility in choosing the code parameters and support of a large no of users, combined with high rate. each the numerical and simulation results have to make clear that our optical system supported the MD code will accommodate most numbers of co-occurring users with higher rate transmission and lower bit error rates, compared to the previous SAC-OCDMA codes.***

Keywords : *SAC-OCDM, OOC, spectrum, spread, multiple-access interference*

Introduction

The requirements of contemporary fiber–optic networks bring back the need Associate in Nursing elaboration of such multiple access algorithms that mix the probabilities of multi–bitrate transmission through a typical network, radical high capability and every one optical process options to avoid the speed bottleneck of electronic elements[1]. A fiber–OCDMA system represents one among the foremost promising multiple access techniques that respond absolutely to those desires. In Associate in Nursing OCDMA system, Associate in nursing optical orthogonal code (OOC) sequence is allotted to every user. A user sends information via the destination user's OOC sequence that is decoded at the receiving finish[5]. There are varied style techniques for OOCs that enable several users to access the optical channel at the same time, only if their destinations are completely different. as a result of the orthogonality of codes, users of Associate in Nursing OCDMA network are ready to transmit at overlapping times and wavelengths[3]. The main downside of Associate in Nursing OCDMA system is that the length of Associate in Nursing OOC that should be long to support an oversized range of users[2]. Associate in nursing implementation of those codes is completed victimization optical encoders/decoders using completely different arrangements of optical delay parts.The performance of the optical encoder and decoder affects the general system performance.

CDMA spread spectrum encodes / decode process

In order to visualise how the CDMA spread spectrum process operates, the easiest method is to show an example of how the system actually operates in terms of data bits, and how the data is recovered from the CDMA spread spectrum signal.The first part of the process is to generate the CDMA spread spectrum signal. Take as an example that the data to be transmitted is 1001, and the chip or spreading code is 0010. For each data bit, the complete spreading code is used to multiple the data, and in this way, for each data bits, the spread or expanded signal consists of four bits.

1 0 0 1 Data to be transmitted
0010001000100010Chip or spreading code
1101001000101101Resultant spread data output

With the signal obtained and transmitted, it needs to be decoded within the remote receiver:

1101 0010 0010 1101 Incoming CDMA signal
0010 0010 0010 0010 Chip or spreading code
1111 0000 0000 1111 Result of de-spreading
1 0 0 1 Integrated output

NB: 1 x 1 = 0 1 x 0 = 1

In this way it can be seen that the original data is recovered exactly by using the same spreading or chip code. Had another code been used to regenerate the CDMA spread spectrum signal, then it would have resulted in a random sequence after de-spreading. This would have appeared as noise in the system.The spreading code used in this example was only four bits long. This enabled the process to be visualised more easily. Commonly spreading codes may be 64 bits, or even 128 bits long to provide the required performance.

Set Up Model

Fig.1 shows the SAC–OCDMA configuration under investigation where number of users is set to three to demonstrate the main concepts behind this system.The optical output of a broadband optical source is digitally modulated by the user data signal (i.e., user information signal) using Mach–Zhender modulator. The frequency components of the modulated optical signal are encoded by selectively transmitting them in accordance with a signature code. Three uniform fiber Bragg gratings (FBGs), having the same bandwidth and different Bragg wavelengths, are used to obtain the three signature codes, one to each user.Two FBGs connected in series are used to obtain the signature code of each user as follows:

Signature Code of User1→ FBG1 + FBG3
Signature Code of User2→ FBG2 + FBG3

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Signature Code of User3→ FBG1 + FBG3

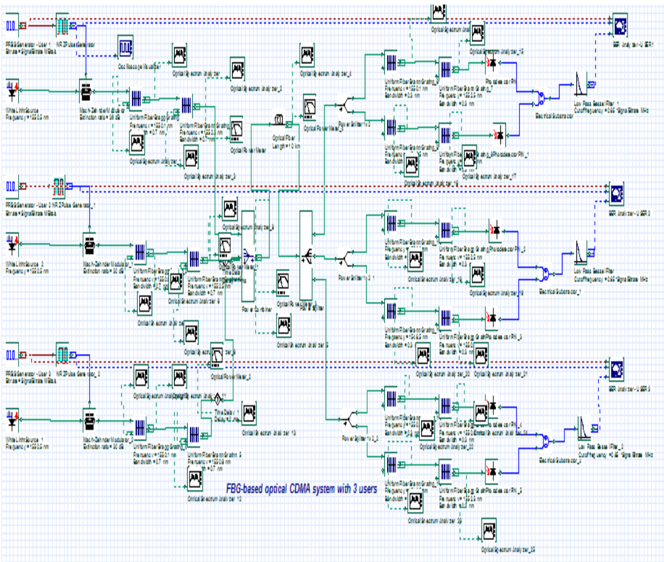

Fig. 1 complete Set-up model of SAC OCDMA

The modulated output signals from the optical modulators are combined using a 3:1 optical combiner whose output is lunched into the fiber. A conventional (standard) single mode fiber (SMF) is used at the transmission link between the transmitter and receiver.The optical power at the end of the transmission link is split into three parts using a 1:3 optical splitter, each corresponds to one user. The user optical signal is then split to two components using 1:2 optical splitter. The first component is filtered through a direct decoder H(f) which is the same encoder filter used at the transmitter. The second component , is filtered through its complementary decoder $\overline{H}$ (f). Table 1 shows how H (f) and $\overline{H}$(f) are implemented for each user. Three FBGs similar to those used in the transmitter are used here in addition to a fourth FBG, namely FBG0, which is common to all users. FBG0 has the same bandwidth as other FBGs but with different Brag wavelengthOutputs from each set of decoders, H(f) and $\overline{H}$(f), are detected using two PIN photo diodes connected in a balanced structure. The resultant signal from these two detectors is amplified, filtered by a fourth-order Bessel low pass filter, and then applied to the digital part of the receiver to extract the data.The low pass filter is used to reject noise and interference components that lie outside the information signal spectrum.

SIMULATION RESULTS:

Finally, Fig.2 shows variations of the *BER* as a function of varying bandwidth for the case of three opticalchannels and different input powers. One can see that the input power of the light source has asignificant impact on the system performance, especially when the data rate increases. Fig.indicatesthat, for a fibre length fixed at 30 km, the system performance deteriorates with decreasinginput light source power and increasing data rate. The system achieves low *BER* values when thelight source power decreases from 0 dBm to –10 dBm. At the same time, the system is characterisedby the parameter *BER* = 1.2×10–7 to 1.2×10–16 at10 Gb/s, for low input power (–10 dBm). As a consequence,in order to optimise the system and provide the parameters preferred by a designer, themaximum fibre length should be made as short as possible. The latter would ensure high data ratesand a desired system performance with resorting to no dispersion-compensating devices.

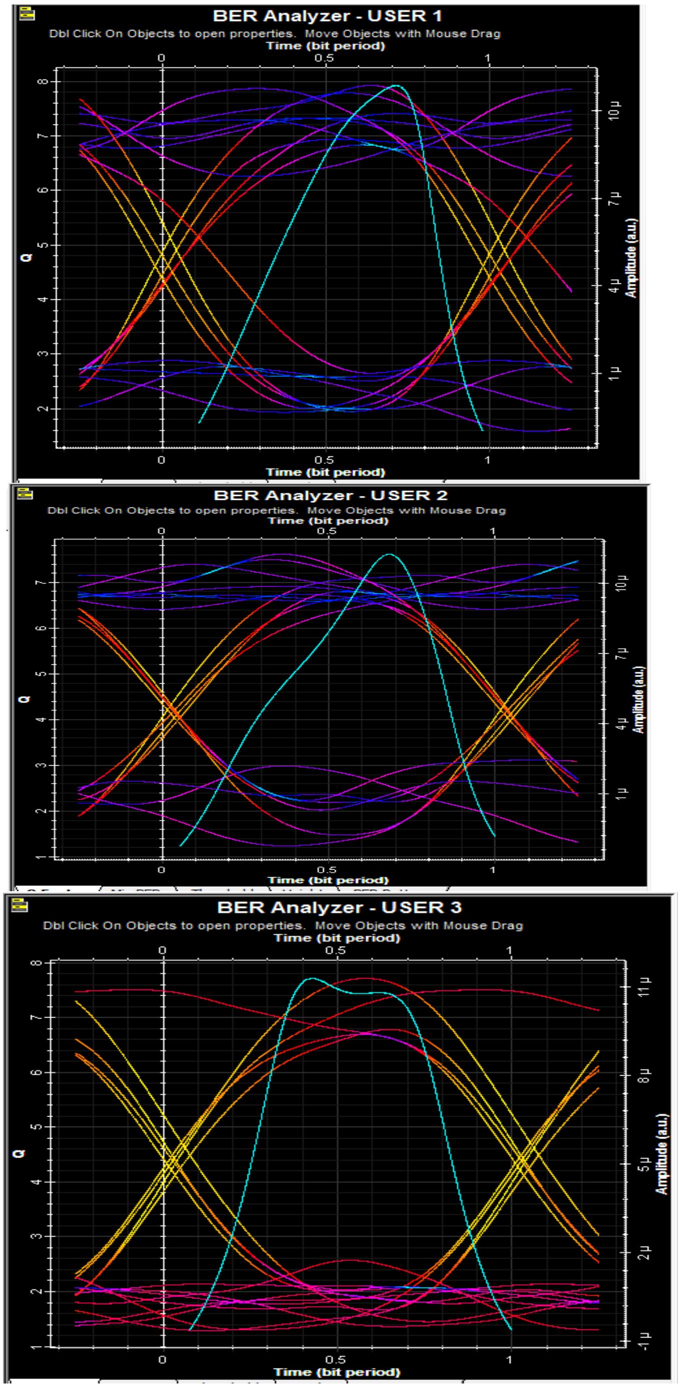

Fig.2Eye diagram of SAC OCDMA (All 3 channels)

Fig.3 Illustrates the received power as a function of bandwidth for 20 km fiber length. It can be seen thatthere is a small change in bandwidth value we get decreased received power, this is due to various non-linear effects.

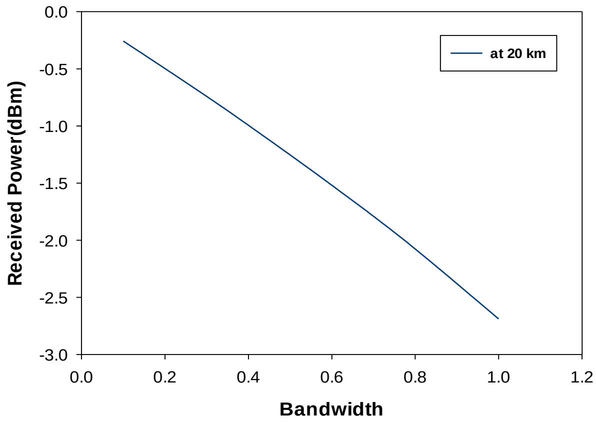

Fig.3 Plotting of Bandwidth v/s Received Power

Fig.4 illustrates the received power as a function of fiber lengths for two bandwidth (3nm,5nm). It can be seen thatthere is a small difference in received power value with --3dBm whichare for 3 nm bandwidth, and -4dBmfor 5 nm bandwidth.Considerably, the gap between the two bandwidth will increasewith the increase of fiber lengths, the received power get reduced.

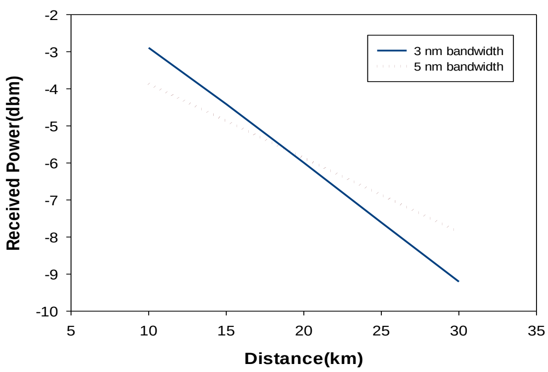

Fig.4 Plotting of Distance v/s Received power at different band width.

CONCLUSIONS:

The performance of SAC-OCDMA network operating with variable bandwidth and 10 Gchip/s chip rate has been investigated to address the effect of transmission through a single mode fiber. The results indicate that the performance of fiber optic-based SAC-OCDMA network is dispersion limited rather than loss limited. When the fiber dispersion is compensated, the length of the transmission link can be increased by considerable amounts.

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