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Analysis of different OCDMA techniques: A Review

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***Abstract*—**The use of optical fiber which offers large bandwidth in the telecommunication sector has shown a lot of developments in the last decade mainly in television cables and cell phone cables. But these are not fully efficient and to do this, the fiber should allow multiple access which means allowing various users to send and receive data in the fiber at the same time. There are three main schemes of multiple access namely, Time Division Multiple Access (TDMA), Wavelength-Division Multiplexing (WDM) and Code Division Multiple Access (CDMA). In this paper, different types of optical networks using CDMA has been reviewed. CDMA is one of best multiple access scheme that allows a great flexibility in multiple accesses. It provides secure and asynchronous transmission.

Keywords- *CDMA, optical fiber, multiple access.*

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I. INTRODUCTION

There is a large gap between the wavelength required by user and the capacity. Because of this we need wavelength sharing mechanisms that would allow more than one user that can share the wavelength channel capacity. In Fig. 1, basic technique of multiple accesses is shown in which users A, B and C send a message at the same time in a communication device and the multiple access technique helps to properly deliver every message [1][2].

Fig. 1: Multiple access technique principle

One such technique to do this is optical code division multiple access. OCDMA is a spread spectrum technique. This technique allows a large no. of users to share the same transmission bandwidth. Each individual user is allocated a specific address that can be used to label bits that are either to be transmitted to the user, or to be transmitted by the user. In the basic technique of CDMA, the bits '1' or '0' of a binary message, sent by the user are replaced at the level of the transmitter by codes attributed to the user [3][4].

II. REVIEW ON OCDMA BASED TECHNIQUES

A. Bi-Directional Optical CDMA-Based Fiber-Radio Ring Networks:

In this technique, the author has proposed a fiber radio network based on OCDMA. This scheme uses a ring topology and has self-healing ability and it also allows bi-directional communication between the control base station (CBS) and the remote base stations (RBSs) [5]. The author has proposed two code families for this scheme and the corresponding correlation properties are used for interference elimination. As compared to the conventional codes that are used these not only have better carrier-to-noise ratio (CNR), but also increase the influence of splitting loss for the broadcasting of RBSs' signal. Also the encoding and decoding devices in the RBSs have smaller sizes as compared to that of conventional codes. Thus the complexity and cost of RBSs are reduced and a large number of RBSs can be allowed to deploy in future for low power radio mobile communications [6].

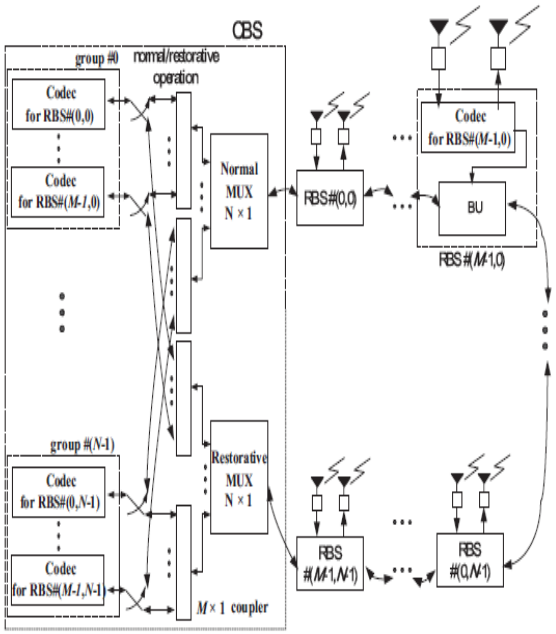

Figure2. Fibre radio ring network

The author has used Balanced Incomplete Block Design (BIBD) codes and Hadamard codes in previous SAC schemes with wavelength division duplexing technique, the BIBD code

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and the Hadamard code are constructed and also the structure of the associated coding devices has been designed in such a way so as to reduce cost in RBSs [7]. Also, one bi-directional unit (BU) has been proposed for the connection between the RBSs and the core network. With the help of this BU and the codes that have been proposed, the influence of splitting loss during the signal transmission can be mitigated. Thus under a given carrier-to-noise ratio (CNR) larger number of RBSs are allowed to access the network simultaneously. As, it has been assumed that mobile terminals use modulation with constant envelope, more complex signals such as orthogonal frequency division multiplexing(OFDM) signals can also be transmitted through the fiber channels in this technique [5].

B. Design of Code Division Multiple Access Filters Using Global Optimization Techniques:

The author has given a semi-deterministic global optimization method which is based on the search of a suitable initial condition for a given optimization algorithm. The author has focussed on the design of an optical filter that is based on the CDMA technique. At present, there is a huge demand of optimization methods for the design of these types of filters [8]. Also, these methods should perform global optimization as the functional that are involved in the designs have multiple minima.

The author has proposed to design a part of a transmitter based on the CDMA codification. In other words, they have considered the code separator of a particular user 'A' shown in Figure 3. The purpose of this code separator is to separate the spectra. Basically, it is formed of three components:

1. An optical isolator which forwards signals that are directed to a CDMA filter and backwards to an optical fiber.
2. A CDMA filter compound by a Sampled Fiber Bragg Gratings (SFBG) which reflects the spectrum.
3. An optical fiber that lets a signal to pass [1]

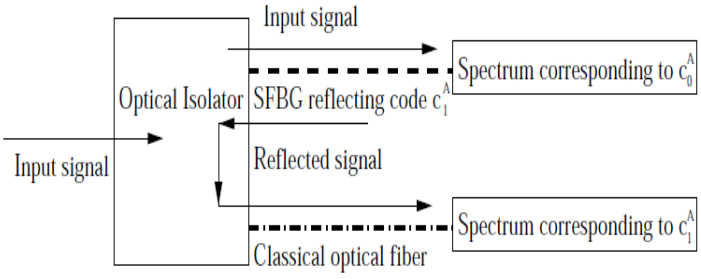

Fig. 3. Code separator

C. Enhancing Carrier-To-Noise Ratio In Optical CDMA-Based Fiber Radio Networks:

In this technique, the authors have proposed a Bi-Directional fiber4re5df radio network which is based on Spectral Amplitude Coding (SAC) with Optical Code Division Multiple Access (OCDMA) and also having interference elimination. In this technique, hybrid ring/star topology is used having self-healing ability and it also eliminates addition of direct current signal before the process of optical encoding. This technique improves both the power efficiency and Carrier-to–noise ratio at the decoder end. Also, it has simple encoding/decoding structures with small sizes in the control base station so that to reduce the cost of large number of remote base stations [9][10].

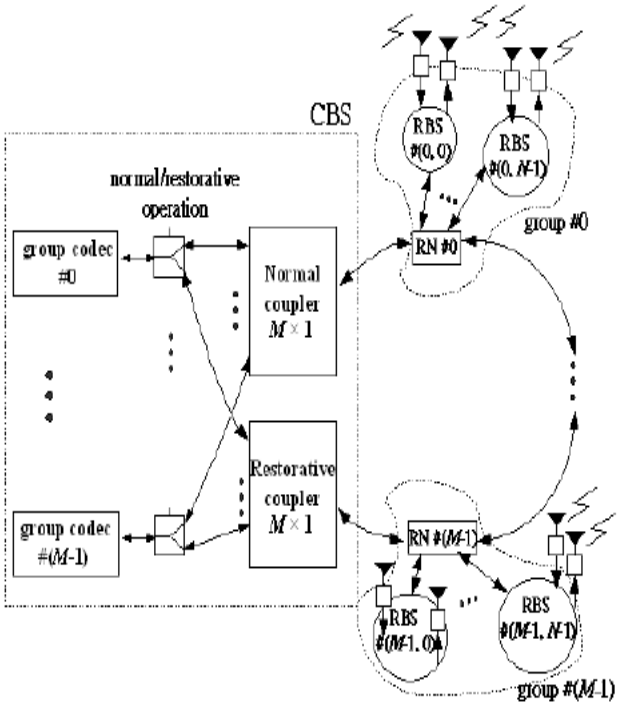

Fig. 4. The proposed fiber-radio network

The fiber-radio network based on OCDMA is shown in Fig. 4. In this Fig., there is one CBS and there are M groups of RBSs in the ring network, where M is a positive integer. Each RBS consists transmitting and receiving antennas for the communication with the mobile terminals that are roaming nearby and also these RBSsare indexed as RBS #(m, n) (m = 0, 1, . . . , M-1, n = 0, 1, . . . , N-1). Also, all of the remote nodes (RN) and CBS are connected by the use of ring topology for the self-healing function. In the CBS, there are M group codecswhich are responsible for the transmission and reception of the signals. These group codecs use the corresponding optical switches to determine the transmission and reception behaviour for the normal operation [11]. There are two operations for the bi-directional transmission between one specific RN and the corresponding group codec in the

CBS namely, normal and restorative. In normal operation, the CBS transmits encoded signals clockwise to RNs while for restorative operation, the CBS transmits anticlockwise to RNs in the ring network.The RNs in the core network pass a part of these signals to the next RN, and the signal that remains is distributed to the RBSs in the corresponding group. After the decoding process, the resulting signal is transmitted to the mobile terminals by the transmitting antennas present in the RBSs [13].

D. Modified Power Control for Downlink CDMA-Based LMDS Networks:

Local Multipoint Distribution Service (LMDS) is the most obtrusive technique among other wave propagation techniques because it can provide wideband integrated services. The signals in this frequency range limit the potential coverage area of a single cell site up to 5 miles. Also the signals are transmitted from a point to multipoint *i.e.* broadcast method. The author has proposed a CDMA based LMDS network whose simplified transmitter and receiver structures of data channel are shown in Fig. 5 [12].

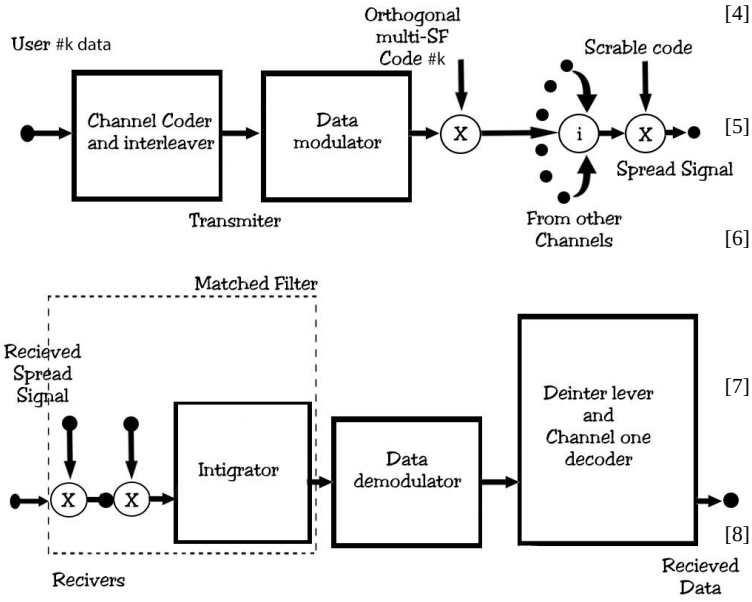

Figure5. Orthogonal Forward Link Transmitter and Receiver Structure

It is a two-layer CDMA concept in which transmitted signals are first spread with a multiplication sequence and then remultiplied with a long pseudo-noise sequence. The pseudo-noise multiplication is a pure scrambling operation, which makes the adjacent cell signals look like noise. Since the first spreading sequence forms a set of orthogonal sequences, thus there is no downstream interference between different users present in the same cell. Also, as each user is distinguished from other user with the help of a set of orthogonal sequences thus all the available bandwidth is used in each sector [14].

III. CONCLUSION

The investigations have shown that by using different proposed techniques and algorithms, we can bring a lot of improvement in CDMA based systems. Different techniques showed improvement in different parameters. Thus, by selecting appropriate techniques for different purposes we can really improve the quality of CDMA based systems.

REFERENCES

[1] B. Ivorra, B. Mohammadi, and A. M. Ramos,"Design of Code Division Multiple Access Filters Using Global Optimization Techniques," Proc. EngOpt – International Conference on Engineering Optimization, June 2008, pp. 1-10.

[2] R., Surya, and K. Thilaka, "Enhancing Carrier-To-Noise Ratio in Optical Cdma-Based Fiber Radio Networks," International Journal of Engineering Science and Technology, Vol. 5, June 2013, pp. 57-60.

[3] A. Viterbi, "CDMA: Principles of spread spectrum communication" Indianapolis: Addison-Wesley, 1995.

[4] D. Opati, "Radio over Fiber Technology for Wireless Access," International Journal of Computer Applications, Vol. 58, Nov. 2012.

[5] C. Yang, "Bi-Directional Optical CDMA-Based Fiber-Radio Ring Networks," IEEE Transactions on Communications, Vol. 60, March 2012, pp. 810-816.

[6] C. Y. Chu, and K. S. Chen, "Effects of Rain Fading on the Efficiency of the Ka-band LMDS System in the Taiwan Area," IEEE Transactionson Vehicular Technology, Vol. 54, Jan. 2005, pp. 9-19.

[7] H. Sari, "Some Design Issues in Local Multipoint Distribution System," Proc. URSI International Symposium on Signals, Systems, and Electronics, Oct. 1998, pp.13-19.

[8] V. I. Roman, "Frequency Reuse and System Deployment in Local Multipoint Distribution Service," IEEE Personal Communications, Dec. 1999, pp. 20-27.

[9] M. K. Tsay, and F. T. Wang, "A Twisted Sector Cellular Pattern in Local Multipoint Distribution System," Journal of the Chinese Institute of Electrical Engineering , Vol.10, 2003.

[10] C. H. Lee, B. Y. Chung, and S. H. Lee, "Dynamic Modulation Scheme in Consideration of Cell Interference for LMDS," Proc. International Conference on Communication Technology, Oct.1998.

[11] L. C. Wang, K. Chawla, and L. J. Greenstein, "Performance Studies of Narrow-Beam Trisector Cellular

ISSN: 2321-8169
1726 – 1729

Systems," International Journal of Wireless Information Networks, Vol.5, 1998, pp. 89-101.

[12] B. J. Choi, and L. Hanzo, "RAKE receiver detection of adaptive modulation aided CDMA over frequency selective channels," Proc. Vehicular Technology Conference, 2001.

[13] R. E. Ziemer, and W. H. Tranter, "Principles of communications: Systems, Modulation, and Noise," Boston: Houghton Mifflin Company, 1976.

[14] S. Bernard, "Digital communications fundamentals and applications," New Jersey: Prentice Hall PTR, 1988.

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