Performance Analysis of IP over Optical CDMA system Based on RD code

Dr. Ammar D.Jasim

Lecturer, dep. Of ICE, College of IEC Alnahrain University

Abstract— this paper presents the architecture of the network of the NGT infrastructure (i.e, IP-OCDMA architecture), tested and presented the features and characteristic of the common models based on Spectral amplitude coding (SAC) optical CDMA system. Therefore; the suggested system present a powerful solution for achievement the placing of intelligent in optical and electrical layer which present a real big problem for many Operators. Moreover, in this suggested system the most advanced services can be used at the end user customers. The internet working models described in this paper is based on optical CDMA are powerful example that emerging optical layer intelligence brings to next-generation networks.

Keyword: OCDMA, RD, NGT, WDM, and SDH

1. Introduction

The fast progress in the telecommunication applications leds to looking for a technique that provides fast transmition capacity within sharing media, Optical CDMA considers one of the important technology for future demands [1]. .However, to make the management as simple as possible and minimize the cost, overhead of the signaling, and control, the present work focus on a solution that make a direct connection between the IP layer and the optical CDMA layer. The main idea for such integration is that the clients (like, routers of IP/MLPS) and optical core are connected directly over a well-known routing interface named (UNI). The optical fiber used to connect the OCXs included in the optical core network in a general mesh topology that can interact the well-defined signaling with routing interface named as the network-network interface (NNI). As discussed in other published papers [4] MPLS and G-MPLS are the drifts for the integration structure between IP and optical layers. However, these models are Overlay model, Peer Model and Augmented model which have been presented in [7]. Based on the previously published papers [5-8], the current implementations of optical technologies (WDM) are usually based on SONET/SDH and ATM, which plays as an interface to higher layers. The huge applications of Internet are based on Internet Protocol (IP) are making IP the dominant protocol, to which all communication network technology converges. The solution for communication networks will become IP over optical CDMA. The IP will become the convergence layer; Optical CDMA is and IP interface unit shall be the high-bandwidth carrier. A lot of researchers focuses on SAC codes on thier research [5,6] while in this paper we proposed RD code as prime code [9-10] to simulate the IP over optical CDMA with those codes. In section II, we present IP over optical CDMA system. The design steps and system scheme of the suggested system are present in section III and section IV shows the conclusion.

2. IP OVER OPTICAL CDMA

As seen in Figure 1, WDM adaptation layer was the first step introduced towards faster networks to the traditional SDH approach. This new layer would manage WDM channel and provide some level of protection recovery. This IP/ATM/SDH based solution configures an overlay model network (CLIP, MPOA), and carries a significant overhead due to the four framing layers and extra management burden. Using Packet over SONET (POS), based in IP /PPP /HDLC into SDH framing some overhead is eliminated [7]. The use of Generic Framing Procedure (GFP) reduces even more this overhead since GFP uses a more efficient framing technique than HDLC, and less error prone. In this solution IP runs over Ethernet or PPP. Traffic adaptation mechanisms such as ATM, HDLC or GFP shape the traffic to the SDH layer. GFP and Ethernet (i.e. Gigabit Ethernet) can also run over fiber directly. So it is possible to eliminate SDH framing, and reduce even more the overhead. This solution is not yet widely implemented in existing communications infrastructures based in Sonet/SDH, but with the standardization of the both protocols it has the potential to become dominant, for its simplicity and low cost. Once eliminating SDH framing it is possible to maintain GFP and Ethernet to assure the framing. Functions such as protection/recovery, if needed can be implemented at WDM optical layer. But, as Ethernet supports fiber directly it is possible to use direct GMPLS. This is the lighter and more flexible approach since a direct framing without monitoring is used, expensive synchronizations. Provisioning and survivability actions can be taken by GMPLS. For carrier class reliability an optional framing/monitoring sub-layer can be used.

The proof-of- principle setup shows in Figure 2 for the suggested scheme. The proposed system is based on the previously published paper at [5]. The work presented in [5] has been assumed coherent optical CDMA; whereas our

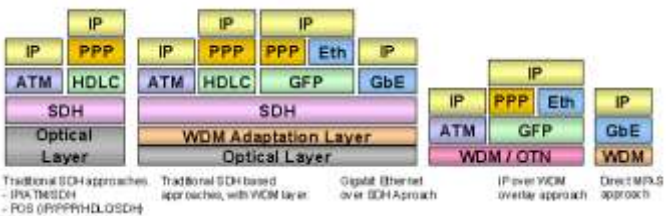


Figure1 IP over WDM system

proposed system is based on incoherent SAC technique utilizing the RD code presented in [7]. For the proposed system shown in Fig 2, the transmitter side recognized the upcoming IP based on the destination for packet. The buffer structure contains *K*- number for user could be accommodated by the system and allocated in the router. The buffer is used to ensure that all IP's have been transmitted at the same time and at a high speed. However, once the total packet reaches low threshold level (predefined time passes), then the SAC encoder adjusted for number of packets belonged to *k-th* user instead of tuned for every incoming IP packet individually, which means that the adjusting time is significantly reduced. We can define many parameters to calculate network performance, with many connection resolution schemes. This show the network utilization, reliability, latency, and physical impairments to the signal. The optical CDMA network throughput is defined as:

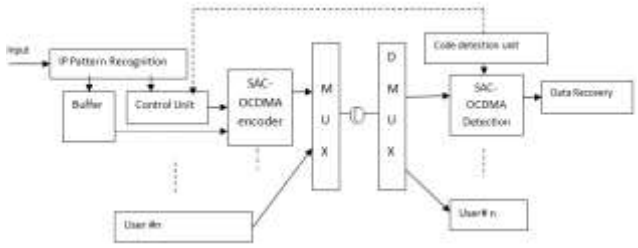
Optical CDMA network transmission capacity (k) = (total no. Link) × (no. of SAC channels) × (bit rate)

Also, we can define the average optical CDMA transmission capacity as:

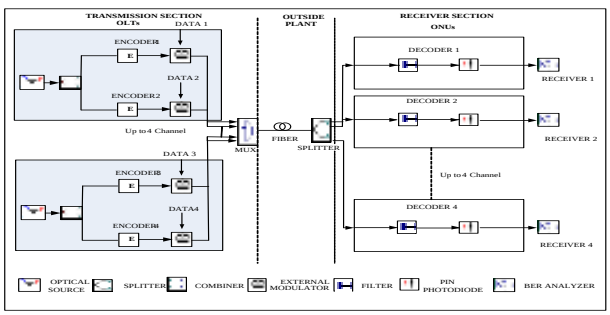
Optical CDMA Average capacity per distance (*S*) = (k × simulation time)/ ideal average hop distance

Then, the overall throughput capacity of optical CDMA network =

Total number of bits detected successfully/ *S*



(a)



(b)

Figure2 Proposed scheme (OCDMA: Optical CDMA); a) System Model; b) simulation setup.

The following equations for the RD code shows the BER and SNR [7]

$$SNR = \frac{\left(\frac{2\Re P_r W}{N}\right)^2}{\frac{2eBWP_r\Re}{N} + \frac{B\Re^2 P_r W}{2N^2\Delta V}\frac{K}{}(K-1+W) + \frac{4K_B T_n B}{R_L}} \quad (1)$$

$$BER = \frac{1}{2} erfc\sqrt{\frac{SNR}{8}} \quad (2)$$

OptiSystem Version 9.0 simulation software is used to find the performance of the suggested system. In this simulation 0.8 nm spectral width for each chip has been used. The simulation implemented for a distance of 20-km with rate of 622Mbps with standard ITU-T G.652 single mode optical fiber. To set the Simulation envuirement to be close to the real environment as possible all the parameters were operated and specified according to the typical industry values. By referring to the bit-error rate (BER) the performances of the system were characterized. The details design of SAC-optical CDMA utilizing RD code system is based on the previously published paper at [8]. Figure 3 shows the relationship between the numbers of simultaneous users (Homes) and different data rates values (622 Mbps, 2.5 Gbps, 5 Gbps, and 10Gbps). MAI is considered the dominate noise in an FTTH system as the number of active users increased. Also as the data rate increased (from 622 Mbps to 10 Gpbs) the received signal becomes more applied to the effect of dispersion on that low data rate. Avoiding crosstalk interference is possible by using an external switch [8]. The performance of the optical CDMA system using the RD code can become worse when the number of active users (homes) increases. the power ofv the received signal and the transmission distance for various values of input power relationship shows in Fig.4 . As shown in this figure the output power decreases with the increasing distance. For example, at 0 dBm the received power are -27dBm, -32.3 dBm for fiber lengths 10 km and 30 km individually. Note that changing data rates have no significant changing in the output

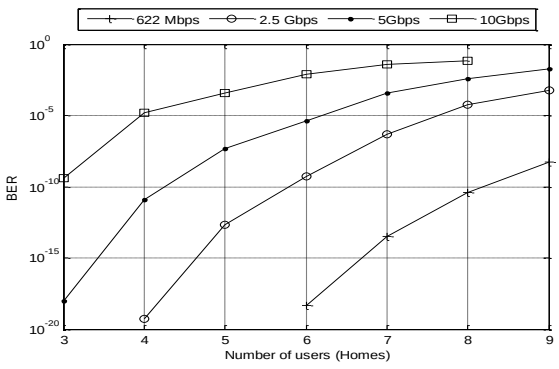


Figure3 BER vs number of users for the suggested scheme.

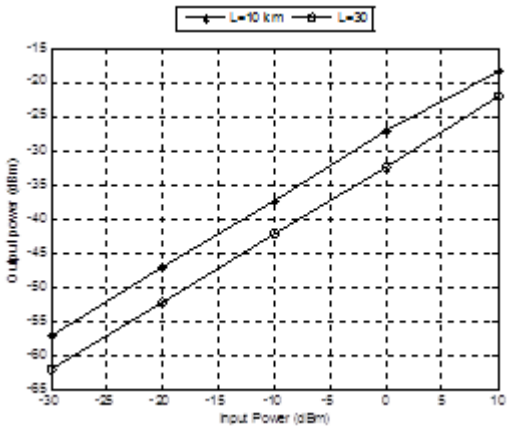


Figure4 Received power against transmit power for the proposed scheme.

III- CONCLUSION

The prevalence of optical CDMA spectral –amplitude – coding is distinct because its light source requirement is not firm and its simple to implement FBGs encoder/ decoder. The NGT infrastructure (i.e, IP- OCDMA network architecture) have been present in this paper,check out the features and characteristic of the general models based on SAC-OCDMA system. Nowady the network operators optimize the difficult customer services to the end users customers in order to optimize the network resources and overcome the problem of exploting the resident of intelligent in electrical or optical layers.

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