Performance of Trench Assisted-uncoupled Multicore Fiber with universal Fiber for Passive Optical Network

Shakshi Goyal[1], Shivani Goyal[2], Simranjit Kaur[3], Baljeet Kaur[4]
[1, 3, 4]*Department of Electronics and Communication Engineering, Guru Nanak Dev Engineering College*
[2,] *Department of Electronics and Communication Engineering, Thapar University*

Abstract- We demonstrate trench assisted uncoupled multicore fiber (TA-UMCF) (before the splitter) with universal fiber (after the splitter) in passive optical network. Further, propose a novel network formation of hybrid combination of fibers for transmitting more number the data to more number of users. In the proposed system, BER for uplink and downlink have been observed after SDM transmission.

Keywords- Inline Amplifier,Line coding, TA-UMCF, TMC

I. INTRODUCTION

In order to endure up with the probable capacity crunch, the goal of coming unit optical communication system is to improve the transmission capacity [1-2]. In order to get this, the uncoupled multicore fiber has been described [3-4]. Further SDM based on homogeneous and heterogeneous multi-core multi-mode fiber (MC-MMF) has been reported withtransmission capacities 305Tb/s and 2.05Pb/s using hybrid modulation and multiplexing, respectively [5-6]. However, the transmission distances were limited to 10.1km with SDM MC-MMF. It is energetic to gain the transmission distance using various spans of MCF for long haul application while taking care of acceptable crosstalk between adjacent cores and span losses.Tapered uncoupled multi-core couplers (UTMCs) are used to perform several spans of MCF for long pull transmission with low span loss and low-crosstalk [7].

In earlier efforts, various hybrid modulation techniques for passive optical network has been reported such as NRZ rectangle [8], hybrid PON [9], Ethernet PON [10] and re-modulation scheme with different modulation formats [11] etc. But it is limited to short distances and limited number of users respectively.

In this work, we extended the previous work by TA-UMCF (before the splitter)with standard single mode fiber (after the splitter) using the core to core rotation scheme for a passive optical networkat different spans.

This paper is ordered as follows. Simulation Set up is described in Section 2. Results are presented in Section 3. Conclusions are given in Section 5.

II. SIMULATION SET UP

The system set up of TA-UMCF (before the splitter) with standard single mode fiber (after the splitter) for passive optical network is shown in Fig.1. It consists of an optical line terminal (OLT), optical network unit (ONU), TA-UMCF with TMC and 1:64 splitter-combiners. Seven OLTs are transferred and received over TA-UMCF with EDFA to increase the system performance and sent to 1:64 splitter combiner block then further transferred to ONU by SSMF at different delays. The uplink and downlink wavelengths are tuned at 1550nm for downstream and 1490nm for upstream with the data rate of 10Gbps and 2.5Gbps respectively. In OLT, pseudo random data sequence provides the data rate of 10Gbps and is converted into electrical pulses using NRZ and root-cosine filtering

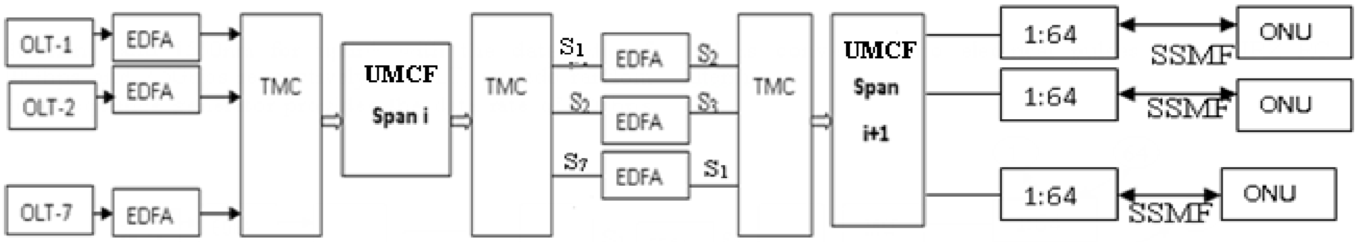


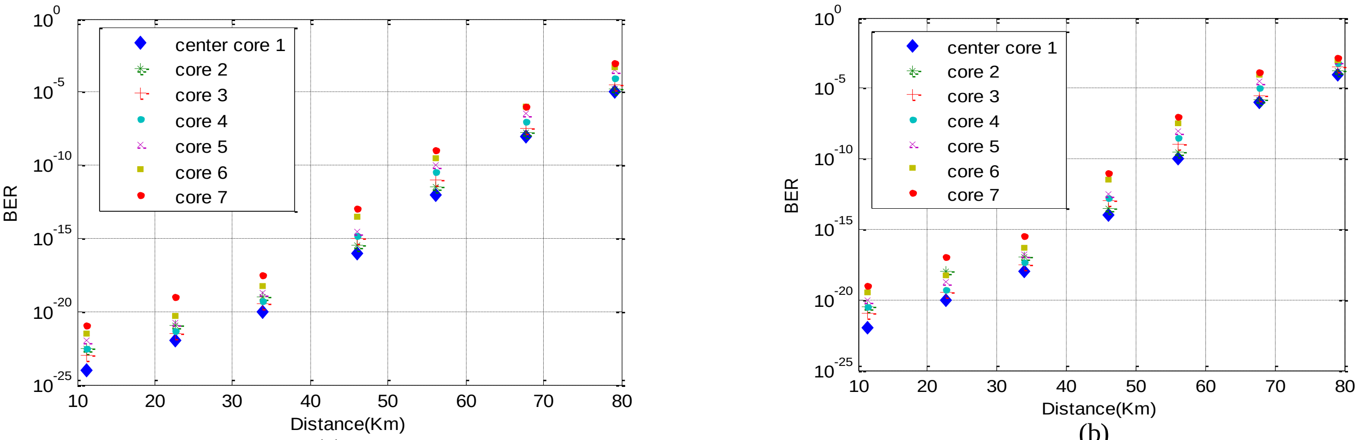
Fig.2: Block diagram of passive optical network system with hybrid fiber (TA-UMCF and SSMF)

The Mach-Zehnder modulator converts the electrical signal in to optical signal. The seven upstream and downstream signals from OLTs were travelled over UMCF which is coupled with Tapered multicore connector (TMC) at each end of UMCF using Inline amplifiers at seven recirculating span loops (i=7) for WDM/SDM transmission. The signal received at each of the seven loop inputs were first amplified by Inline amplifiers before being hurled into an 11.3-km seven-core-fiber through a UMCF. For efficient coupling, another TMC was used to acquire the signals at UMCF output. The upstream and downstream signals from 7- OLTs (S_1, S_2, ...S_7)initiated into seven cores of a TA-UMCF span which are further travel through spatially different cores in the next TAU-MCF span and core to core rotation scheme [12] persist along the TA-UMCF transmission fiber link. In-line amplifiers are used with TMC couples TA-UMCF. During the 1st span (i=1), the signals are transferred through cores (from 1st core to 7th core)and in 2nd span (i=2), they would be transferred through 2nd core to 1st core. This process is recurring seven times and signals will be transferred through different cores at each span. The signals are acknowledged by 448 users at ONU with the helpof SSMF and 1:64 splitters-combiners at a distance of 79.1km.

III. RESULTS AND DISCUSSION

Simulation results of BER performance of transmitted signals in 7 cores of TA-UMCF with respect to distance at 7 spans are shown in Fig. 2. The BER defines the probability of incorrect bits by decision circuit at the receiver.Fig. 2(a) shows the variation of BER as function of distance for downstream. The BER at center core of TA-UMCF ranges from 2.3×10^{-2} to 2×10^{-5} with respect to distance from 11.3km to 79.1km. The acceptable BER of 2×10^{-5} is achieved for downlink at the center core after covering 79.1Km of transmission distance. It is also observed that best BER is achieved at center core of TA-UMCF comparative to all other cores of TA-UMCF because there is minimum acceptable crosstalk -17dB at the center core for downlink transmission.Fig. 2(b) shows the variation of BER as function of distance for upstream. The BER at center core ranges from2.27×10^{-22} to 2×10^{-4} with respect to distance from 11.3km to 79.1km. The acceptable BER of 2×10^{-4} is achieved for downstream at the center core after covering 79.1Km of transmission distance.

It is also observed that best BER is achieved at center core comparative to all other cores because there is minimum acceptable crosstalk -25dB at the center core for downstream transmission. At the center core, there is minimum acceptable crosstalk as compared to other cores. The variations in the BER are low from all seven cores, demonstrating the advantage of core to core rotation at every loop to poise the performance of all seven cores.



(a) (b)

Fig.2: Simulation results of BER performance w.r.t distance of 11.3km using TA-UMCF at 7 spans (a) BER performance w.r.t distance for downstream (b) BER performance w.r.t distance for upstream

IV. CONCLUSION

In this paper, TA-MCF is used for bidirectional transmission in passive optical network (PON). The proposed PON can successfully transmit the data at the speed of 10Gbps and 2.5Gbps for 448 users up to 79.1km transmission distance. From the results, the acceptable BER is achieved from all cores with minimum crosstalk by 448 users.

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