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Design and Investigation of Time Wavelength Division Multiplexing Passive Optical Network

A Thesis

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by

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ABSTRACT

Today's access networks are in high demand to fulfill the high bandwidth requirement because of extensive improvement in high transmission rate applications for big data rate such as fiber to the premises/home (FTTP/FTTH), online-games and other next-generation 5G smart applications. The main access network design for the next-generation is called a time and wavelength division multiplexing passive optical network (TWDM-PON). The TWDM-PON has a number of special features, including the cost-effective capacity acquisition, high bandwidth, long-distance data transfer, and multi-user connection capability. Regardless of the mentioned advantages of the TWDM NG-PON2, the current low data rate of a symmetric 40 Gbps and asymmetric 40/10 Gbps no longer satisfies the desire of users in the future, so it is considered one of the main problems the next-generation PON. Therefore, this work proposed a simple and cost effective designs to solve these issues for both of symmetric and asymmetric configuration. Regarding to the asymmetric configuration, the proposed E2-class TWDM-NG-PON2 system offer the ITU-T G.989.1 target capacity of 160 Gbps downstream and 80 Gbps upstream, due to employed both of Er-doped fiber amplifier (EDFA) and fiber Bragg grating (FBG). According to the results, the optimum possible distance under communication conditions (6 for the Q-factor and 1E-9 for the bit error rate (BER)) is around 40 km and 65 km for the system without and with FBG, respectively, which represents an enhancement of about 62.5%. In addition, the directly-modulated laser (DML) proposed to enhance the splitting ratio from 256 –to– 512. Furthermore, the proposed symmetric with 160 Gbps E2-class TWDM-NG-PON2 is demonstrated and the link distance is enhanced by 75 % by using both of EDFA and FBG as well as produced a splitting ratio of 256. Finally, in order to evaluate the efficiency of the proposed designs the capacity, network distance, Q-factor, BER, and receiver sensitivity were compared with the previous works and ITU-T recommendations.