WDM-TDM OFDM HYBRID PON TOGETHER WITH WIRELESS COMMUNICATION AND PULSE WIDTH DROPIN ACCESS NETWORK

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***Abstract*— With the advent rise in the demands of internet and high definition television (HDTV) from users led to the employment of OFDM passive optical networks. The main broadband accesses solutions deploy today are the digital subscriber line (DSL) and community antenna television (CATV) (cable TV) based networks. However, both of these technologies have restrictions because they are based on infrastructure that was initially built for carrying voice and analog TV signals ,we proposed the hybrid orthogonal frequency multiplexed WDM passive optical network for 2688 and former achieve high, elastic band-width allotment and wire, wireless access synchronously. Based on the structure of networking, one OLT achieves and 240Gbits ⁄s access bandwidth with 8 downstream wavelengths, and one OLT corresponds to 2688 ONUs. In case of upstream same number of user are supported. Using optical heterodyne, the network implements the wireless access without adding a radio source.**

***Index Terms*— WDM, TDM, O-OFDM**

I. INTRODUCTION

With increase of computers and internet demand, optical passive networks plays important role to meet the requirement of users. Wave-length division multiplexed passive optical network (WDM-PON) is analyzed for its large bandwidth, better security, and scalability to support several local subscribers [1]. On the divergent, wireless communication is becoming popular because it is more scalable and flexible [2]. To make suitable use of the enormous capability of optical fiber and the mobility usual in the wireless scheme, the addition of wireless and optical networks is shows further advance research path [3].

A actual revolution of optical and wireless access happens in radio-over-fiber (ROF) systems. A new scheme about PON/ROF convergence is to use the RF subcarriers on the fiber plant of a PON so that the baseband data stream and the data modulated RF signal can be directly delivered to wire-line and wireless users [4] .The millimeter-wave band, specially the unlicensed spectrum at the 60 GHz carrier frequency, is at the spectral limit of high-bandwidth commercial wireless communication systems [5]. Next-generation wireless local area net-working (WLAN) will also make use of 60 GHz spectrum through the development of the IEEE 802.11ad and WiGig standards. In addition to the high data rates that can be accomplished in this spectrum, 60 GHz band wireless communication has many other advantages such as excellent invulnerability to interference, high safety, and frequency reuse.

Optical orthogonal frequency division multiplexing (O-OFDM) brings the advantage of electronic equalization and sturdiness against multipath fading of wireless OFDM systems into the optical domain to achieve impairments-tolerant ultra-high-speed systems [6]. Most current research focus on non-return-to-zero (NRZ) coding scheme when adopting optical OFDM systems.

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II SYSTEM EXPLANATION AND OUTCOME

System consisting of dual direction communication from central office to user end and vice versa. A PRBS is operated at 30Gbps which generates a arbitrary sequence according to different operation modes. A simulator Opt system is taken into concern to realize the work of this segment. Wavelength division multiplexed orthogonal frequency divisional passive optical network is studied and enhanced from reported works. All components are taken as low-priced solution to high cost OFDM passive optical network underneath many users. Setup is shown in Fig.1.1.

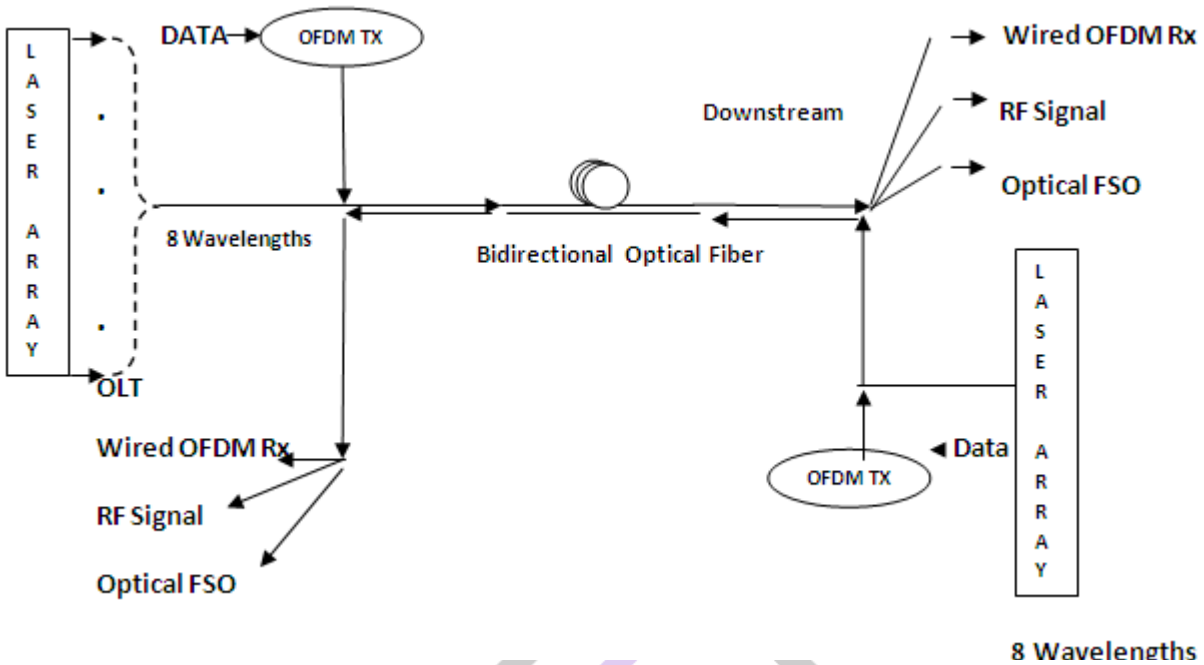
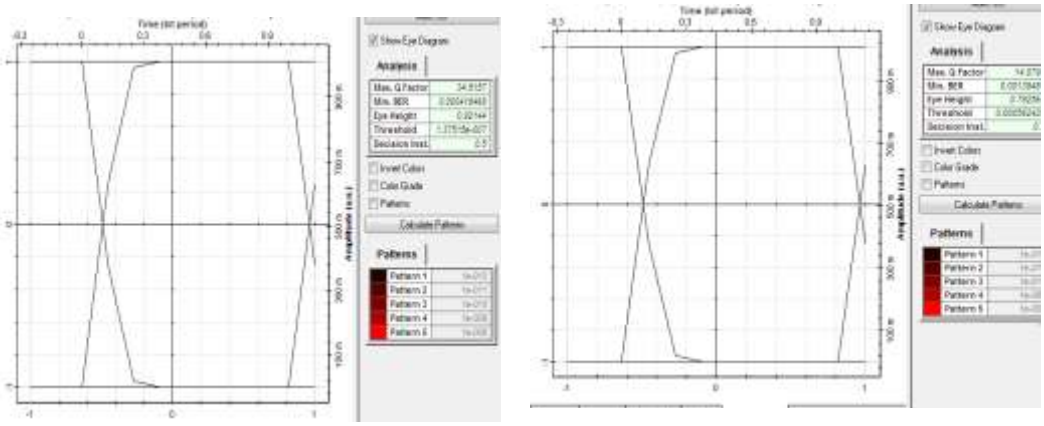


Figure 1.1 System setup of hybrid WDM-OFDM passive optical network

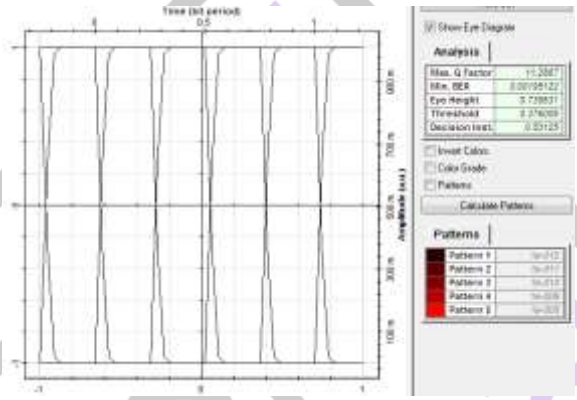
The bit sequence is designed to estimated the characteristics of arbitrary data. In this work, eight transmitters are specific for downstream communication at different laser frequencies and 8 transmitters at same wavelength as downstream for upstream signal. Frequency starts from 193.1 THz with 100 GHz channel spacing to alleviate effects of crosstalk in ultra-dense WDM OFDM systems. Continuous wave lasers to offer light frequency at 12 dBs launched power to MZM modulators for electrical to optical translation. Each transmitter consists of quadrature amplitude modulator and generates two parallel signals from serial data transmitter. After the operation of real and imaginary data, it feds to the produce subcarriers which are orthogonal. This modulator is called OFDM modulator and taken to this system due to its ample of benefits. OFDM is a MC (multicarrier communication method) used to separate the given band of frequency into sub carriers, every stream is carrying low data rate. Number of subcarrier are defined 512 in this work with 1024 FFT points. OFDM modulator followed by intensity modulator referred as machzehnder modulator with 60dB loss ratio.

An model multiplexer combines the 30Gbps signal from eight different wavelengths and transmit generally speed of 240Gbps followed by optical spectrum analyzer and signal time domain analyzer for scrutiny. In order to propagate signal, balanced dispersion compensation is considered because if better contraction of pulse after 25-25 Km. Single mode fiber of 25 Km is considered first having attenuation 0.2dB/Km at c band and 17ps/Km dispersal along with nonlinear effects. Optical fiber exhibits the loss of 5dB and compensated by introducing erbium doped fiber amplifier of same gain after 25 Km. All the scattering compensation fiber and amplifiers are studied and implemented after computation for best power and length. Whole loop is made up of 25Km SMF, 10Km DCF and 25Km SMF with three amplifiers of 5dB gain. Next stage is of reception after transmission of WDM OFDM signal to comprehend passive optical network. WDM demultiplexer is first module and route particular wavelength to certain port starting from 193.1 THz to 193.8 THz with spacing of 100 GHz. Optical network unit receives the signal of exact wavelength and divides into 256 wired and 80 fso users. This module made up of optical fiber and requires no power externally for function, thus called passive divider of signal. Splitting ratio of 256 users for each wavelength is taken and 80 users for free space optical link support 336 users inside acceptable range of BER and Q-factor.

Free space optical link is having main benefit that it is easy to mount and purely based on optical signals i.e. no translation of optical signal to electrical domain is necessary. Free space optics also save the trenching charge as in case of optical fiber. In this system the flexibility to get signal for transmitter is high as user can choose optical fibers, free space link and electrical radio waves.



(a) (b)



(c)

Figure 1.2 Eye diagram for 256 optical fiber users and 80 FSO users for (a) Optical fiber users (downstream) (b) FSO users (downstream) (c) optical fiber based users (upstream)

Parameters of FSO for plain weather are studied with 0.1 dB/Km attenuation. Beam deviation is 0.1 mrad and distance sustain 1Km with transmitter antenna as short as 10cm and receiver 15 cm. As beam deviation more, than quality reduced and less bit error rate for short beam deviation.

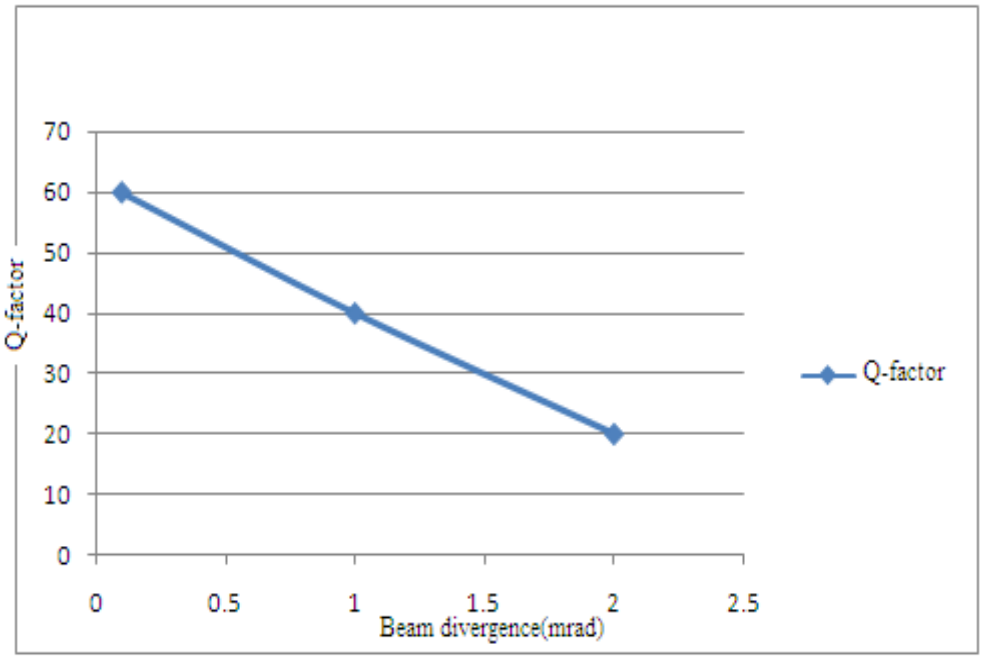


Figure 1.3 Effect of beam divergence of fso on Q-factor

Each wavelength following split ion is operated by OFDM receiver consists of heterodyne receiver to receive the real and imaginary signal with aid of local oscillator with same property of laser of each wavelength. Four PIN photo detectors are for optical to electrical translation of data and fed to OFDM demodulator

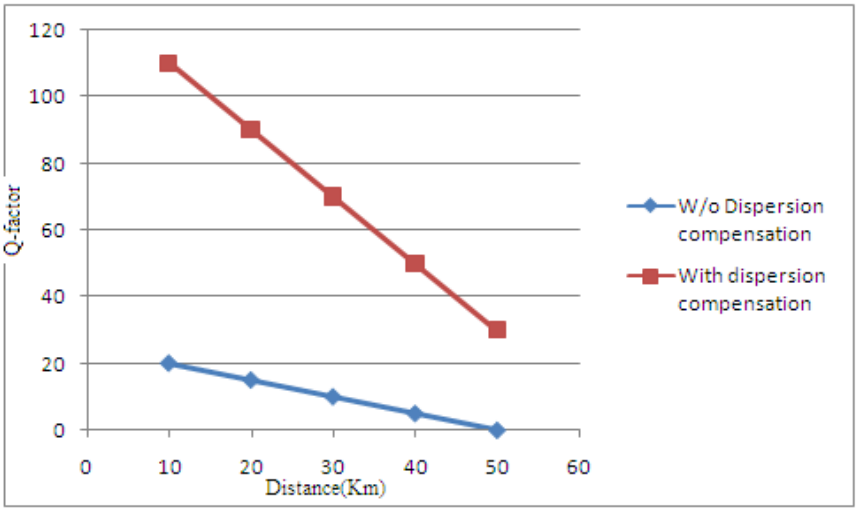


Figure 1.4 Graphical representation of system with and without dispersion compensation

This visualize allows the user to compute and show the bit error rate (BER) of an electrical signal automatically. It can approximate the BER using dissimilar algorithms such as Gaussian and Chi-Squared and obtain different metrics from the eye diagram, such as Q factor, eye opening, eye closure, extinction ratio, eye height, jitter, etc. It can also take in account Forward Error Correction (FEC), design BER patterns and approximate system penalty and limitations. For conclusion, Quality factor should be more than 6 and BER 10^-3 according to global telecommunication union.

Conclusion

We planned and analyzed a bidirectional hybrid orthogonal frequency multiplexed WDM passive optical network for 2688 users downstream which consist 256 for optical fiber and 80 users for free space all along with the radio signal. Coherent detection OFDM is planned as it is more efficient from direct OFDM system and previous achieves high, elastic band-width allotment and wire, wireless access synchronously. Based on the arrangement of network, one OLT achieves and 240 Gbits⁄s access bandwidth with 8 downstream wavelengths, and one OLT corresponds to 2688 ONUs. In case of upstream same number of user are supported. The NRZ-OFDM has the same transport property as the RZ-OFDM format and bandwidth efficient. NRZ has half the bandwidth of the RZ-OFDM signal. With NRZ-OFDM and coherent receiving technology, the system achieves high band-width competence and tremendous transporting property. At 60 km transmission length, the downstream have good receiving constellation, and low BER. Using optical heterodyne, the net-work equipment the wireless access with no adding a radio source.

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