wdm-tdm ofdm hybrid pon incorporating wireless transmission and pulse width reduction 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 access solutions deployed today are the digital subscriber line (DSL) and community antenna television (CATV) (cable TV) based networks. However, both of these technologies have limitations because they are based on infrastructure that was originally 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 allocation and wire, wireless access synchronously. Based on the structure of networking, one OLT achieves and 240 Gbit⁄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.

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, enhanced security, and scalability to support several local subscribers [1]. On the contrary, wireless communication is becoming popular because it is more scalable and flexible [2]. To make proper use of the huge capability of optical fiber and the mobility natural in the wireless scheme, the addition of wireless and optical networks is shows further advance research path [3].

A real 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 millimetre-wave band, especially the unlicensed spectrum at the 60 GHz carrier frequency, is at the spectral frontier of high-bandwidth commercial wireless communication systems [5]. Next-generation wireless local area net-working (WLAN) will also exploit 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 benefits such as excellent immunity to interference, high security, and frequency reuse.

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

System description and results

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

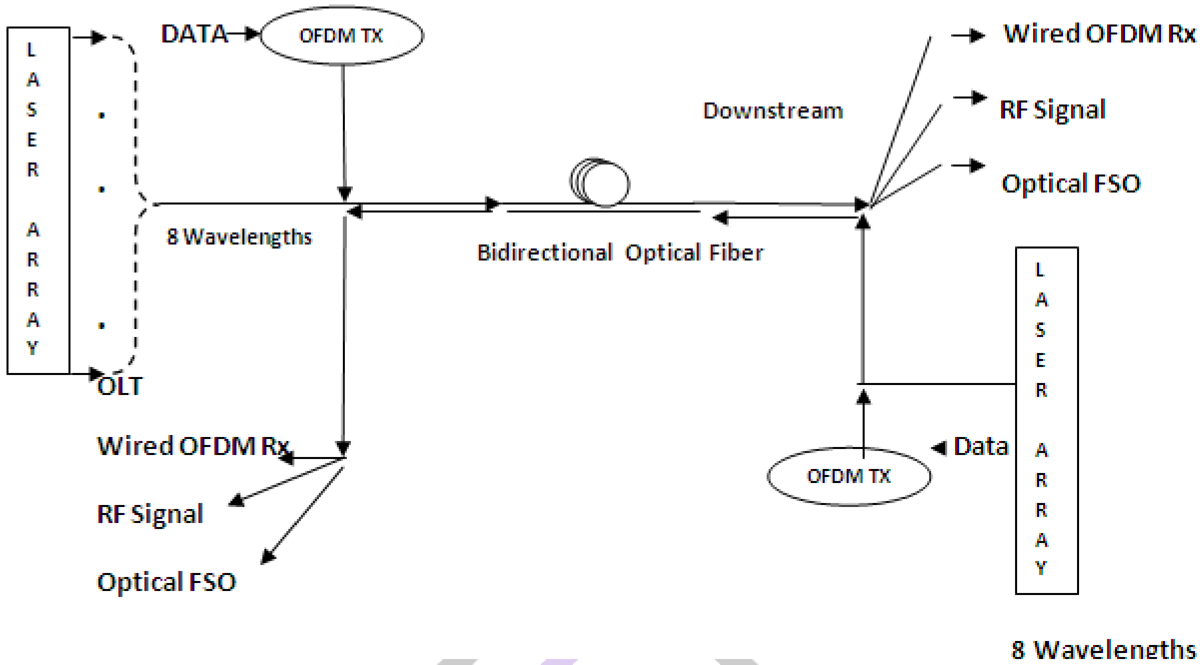
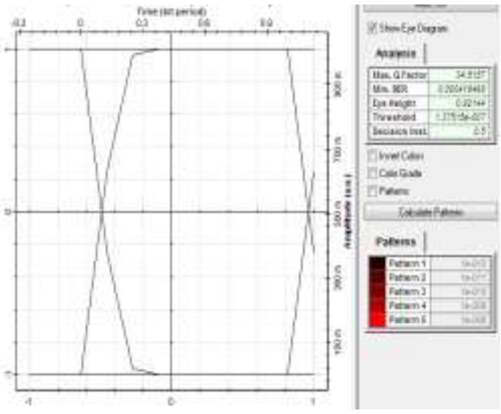


Figure 1.1 System setup of hybrid WDM-OFDM passive optical network

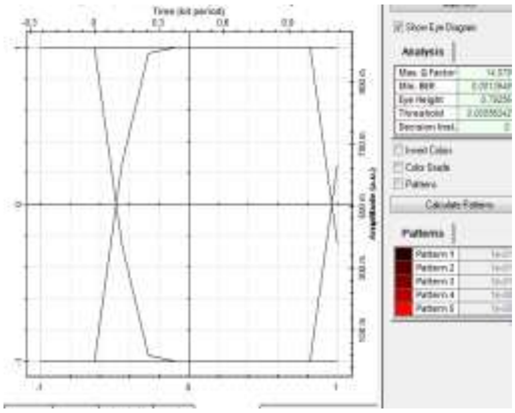
The bit sequence is designed to approximate the characteristics of random data. In this work, eight transmitters are specified for downstream communication at different laser frequencies and 8 transmitters at same wavelength as downstream for upstream signal. Frequency starts from 193.1 THz with 100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

An ideal multiplexer combines the 30Gbps signal from eight different wavelengths and transmit overall speed of 240Gbps followed by optical spectrum analyzer and signal time domain analyzer for inspection. In order to propagate signal, symmetrical 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 dispersion 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 dispersion compensation fiber and amplifiers are studied and implemented after calculation for optimal 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 realize passive optical network. WDM demultiplexer is first component and route specific 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 particular wavelength and splits into 256 wired and 80 fso users. This component made up of optical fiber and requires no power externally for operation, 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 within acceptable range of BER and Q-factor.

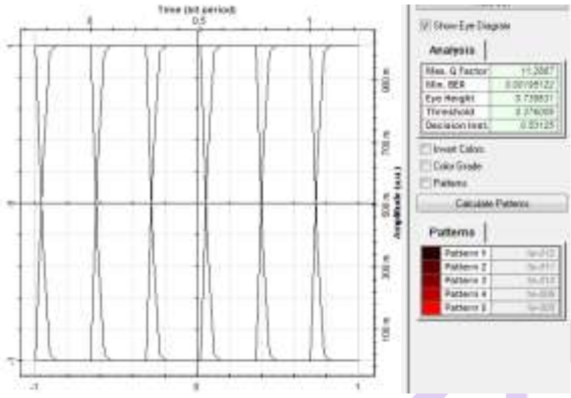
Free space optical link is having major advantage that it is easy to install and purely based on optical signals i.e. no conversion of optical signal to electrical domain is required. Free space optics also save the trenching cost as in case of optical fiber. In this system the flexibility to get signal 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 clear weather are studied with 0.1 dB/Km attenuation. Beam divergence is 0.1 mrad and distance support 1Km with transmitter antenna as short as 10cm and receiver 15 cm. As beam divergence more, than quality reduced and less bit error rate for short beam divergence.

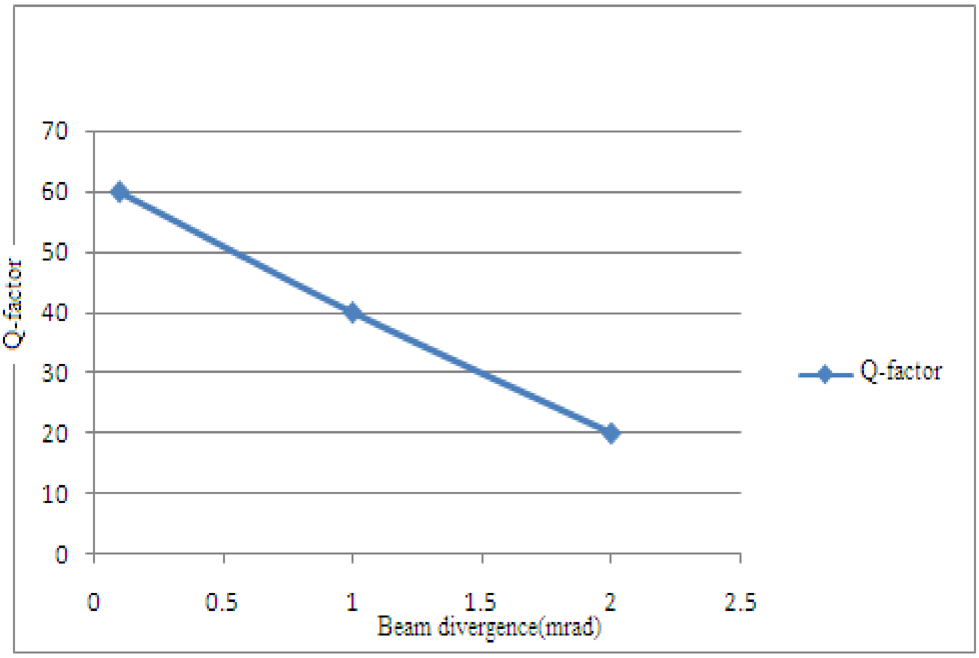


Figure 1.3 Effect of beam divergence of fso on Q-factor

Each wavelength after split ion is processed by OFDM receiver consisting of heterodyne receiver to receive the real and imaginary signal with help of local oscillator with same properties of laser of each wavelength. Four PIN photo detectors are for optical to electrical conversion of data and fed to OFDM demodulator.

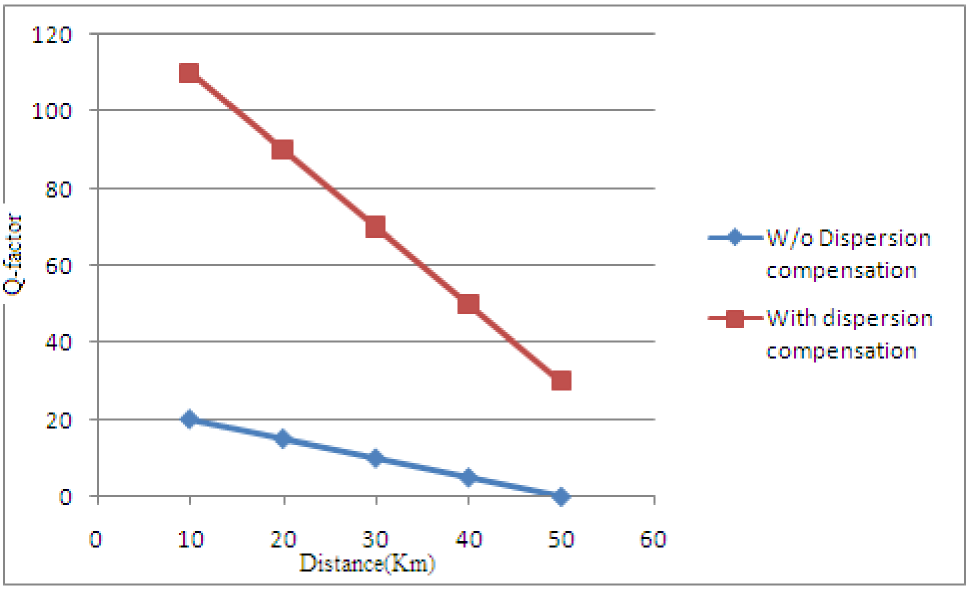


Figure 1.4 Graphical representation of system with and without dispersion compensation

This visualize allows the user to calculate and display the bit error rate (BER) of an electrical signal automatically. It can estimate the BER using different algorithms such as Gaussian and Chi-Squared and derive 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), plot BER patterns and estimate system penalties and margins. For decision, Quality factor should be more than 6 and BER 10^-3 according to international telecommunication union.

Conclusion

We proposed and analyzed a bidirectional hybrid orthogonal frequency multiplexed WDM passive optical network for 2688 users downstream which consists 256 for optical fiber and 80 users for free space along with the radio signal. Coherent detection OFDM is proposed as it is more efficient from direct OFDM system and former achieve high, elastic band-width allocation and wire, wireless access synchronously. Based on the structure of networking, one OLT achieves and 240 Gbit⁄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 transporting 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 technologies, the system achieves high band-width efficiency and excellent transporting property. At 60 km transmission span, the downstream have good receiving constellations, and low BER. Using optical heterodyne, the net-work implements the wireless access without adding a radio source.

REFERENCES

[1]W. Ji and J. Chang, "Design of WDM-RoF-PON for wireless and wire-line access with source-free ONUs," J. Opt. Com-mun. Netw., vol. 5, no. 2, pp. 127–133, 2013.

[2]W. Ji and Z. Kang, "The design of WDM-RoF-PON based on OFDM and optical heterodyne," J. Opt. Commun. Netw., vol. 5, no. 6, pp. 652–657, 2013.

[3]M. Döttling, W. Mohr, and A. Osseiran, Eds., Radio Technol-ogies and Concepts for IMT-Advanced. New York: Wiley, 2009.

[4]C. H. Park and T. S. Rappaport, "Short-range wireless commu-nications for next-generation networks: UWB, 60 GHz millimeter-wave WPAN, and ZigBee," IEEE Wirel. Commun., vol. 14, no. 4, pp. 70–78, Aug. 2007.

[5]Z. Guoying, M. D. Leenheer, A. Morea, and B. Mukherjee, "A survey on OFDM elastic core optical networking," IEEE Commun. Surv. Tutorials, vol. 15, no. 1, pp. 65–87,First Quarter2013.

[6]W. Shieh, "OFDM for flexible high-speed optical networks," J. LightwaveTech , vol. 29,no.10,pp.1560–1577,2011.