Study and Analysis of Downstream ROF PON using TWDM concept

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ABSTRACT-Radio over fiber technology is increasing increasingly now days for wireless communication area in order to support the growing need of data traffic volume. In such systems fiber is used as an ideal medium to transmit modulated optical signals by microwave signals to the remote sites of network. Due to offered distinguished low loss and high wide bandwidth characteristics, fibers are used with PONs where they serve as high capacity wireless distribution nodes. With possible deployment of the FTTH project, a PON overcome the challenges of fixed users. Suggested combined TWDM technology also offers increased capacity with reduced cost. In this paper we have shown simulation of basic RoF link with QAM modulation technique using Optisystem 13 software, which can be is proven the best technology to be used with OFDM PON networks in future.

IndexTerms—Orthogonal frequency division multiplexing(OFDM); Passive optical network(PON) ; Gigabit passive optical network(GPON); Radio Access point (RAP) ; Fiber to the home (FTTH); Wavelength division multiplexing(WDM);Time wavelength division multiplexing(TWDM)

Introduction

A) ROF

Radio over Fibre (RoF) provides better reliability, coverage network, and more secure for users. RoF is one of demanding technology in terms of wired and wireless networks. RoF can be used to enhance the capacity and bandwidth for wireless signals over long distance. RoF system consists of a Central Site (CS) and a Remote Site (RS) which is connected by an optical fiber network shown by Figure1. RoF technology provides simplified RAP, which includes optoelectronic conversion devices, an amplifier and the antenna. Radio signal perform functions like carrier modulation multiplexing, frequency up-conversion are carried out at the Central Base Station [6].

The RF signals processing functions at the Central Base Station allow equipment sharing system operation and maintenance, dynamic allocation of resources. CS will work as Mobile Switching Centre and the RS as the base station when RoF is used in GSM network.

B) PON

PON is a combination of multiple optical network unit, Optical Distribution Network, optical line termination

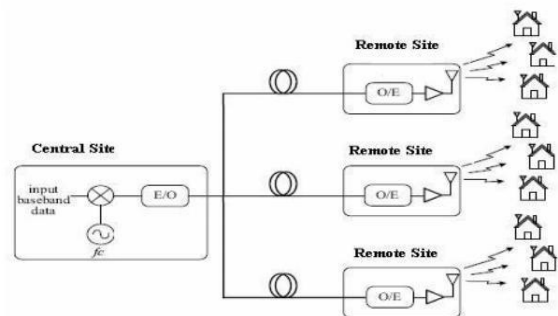.PON is generally suits to managing protocols, transmission of convergence layer and physical layer.

Fig 1: Radio over fiber system Architecture

PON uses point-to-multipoint i.e. tree topology which carries frames of data between multiple optical network units (ONU) and optical line termination (OLT) via a passive optical splitter. Figure 2represent PON architecture.
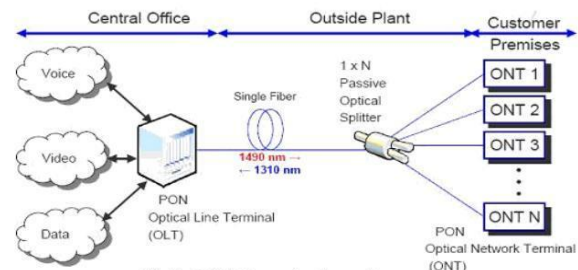

Fig.2: PON General schematic

II. Access technologies

A) TDM PON

For next-generation optical access, current NG-PON1 with TDM-PONs standards do not satisfy the current demand for a new revolution of technology. 40 Gb/s TDM-PON standards is a starting point towards higher capacity. The problem with 40 G TDM-PON for NG-PON2 is to involving more users in the feeder fiber due to limited power , the maturity and availability of the components require is and the cost issue being more impactful for high-speed transmitter and reeiver.

Also chromatic dispersion limits the transmission distance.

B) WDM PON

Parameters	WDM-PON	TDM-PON
Splitting loss [dB]	3 to 5 dB (filter loss)	16 to 17 dB (32 user splitter loss)
SNR penalty	No	N4 ~ N5
Bit rate transparency	Unlimited	~ 10 Gb/s
Open architecture and unbundling Support	Simple	Hard
Fault finding (OTDR)	Simple	Hard

WDM PON provide separate wavelength channel in the operation of transmission. However, this require a point-to-point link from source to destination ,thus the WDM-PON is affected by high cost and poor resource utilization. To remove the static wavelength and to to avoid the high cost of WDM-PON several XG-PONs are combined and separated by multiplexer and de-multiplexer.

C) OFDM PON

OFDM require a large number of carriers which are closely-spaced with each other orthogonally to carry data traffic. Since the data rate carried by each subcarrier is low, the period of each symbol is relatively large. Thus, the inter-symbol interference can be efficiently reduced in a wireless multipath channel. Cheaper electronic devices are used instead of costly optical devices in OFDM PON and ASIC-based AD/DA and DSP also reduce equipment costs [7]. OFDM-PON can be used with WDM to increase the bandwidth requirement, and become a competitive technology for NG-PON2.
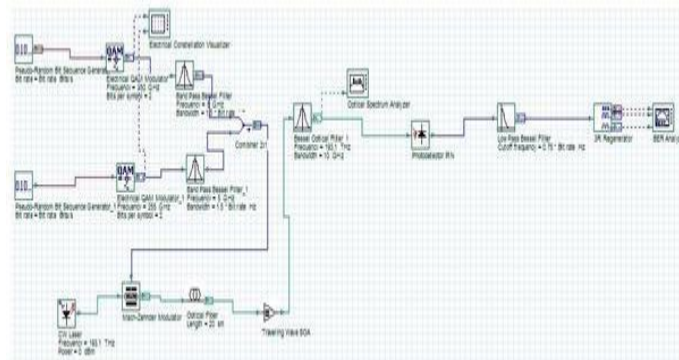

Fig 3:Link setup for OFDM PON

OFDM PON exhibits the advantages like enhanced spectral efficiency, it avoids use of costly optical devices. it allows use of cheaper electronic devices and converged wire line and wireless access Long distance optical access suffers from the problem of chromatic dispersion. The OFDM modulation is used to address the polarization-mode and chromatic dispersion in optical fiber.

Fig-3 shows RoF with QAM modulation. The Q-factor about 20.962 and low BER of 6.8e^-98 is obtained for QAM which is better than all other modulation techniques used .The resultant eye opening is also better. OFDM system gives better result with QAM modulation technique.

D) TWDM PON

TWDM is the combination of WDM and TDM technologies. Having advantage of higher capacity it is used in PON. Key features of such technology are[1] It support capacity from 128 Gbit/s up to 500 Gbit/s per feeder fibre, It support ONU i.e. (customer) from 256 up to 1024 per feeder fibre and the working range can be extended up to 20 to 40 km.

III .Performance of PON ROF link with TWDM

As shown in figure-4, 32 users were provided service using PON ROF with TWDM concept .Here signals from various transmitters were multiplexed using WDM multiplexer. we have used 2.5Gbps transmission data rate which is the latest one used in GPON. Then we shifted PON signals in to optical domain. Later on they were transmitted over fiber maximum up to having length of 25 Km. We have passed them through EDFA with 5m length. Then at receiver side we have splitted it through power splitter of 1:4 and at ONU side, then we have detected optical signal with PIN photo detector and passed through filter then results observed through BER analyser. In this design, sequence length is 256 and samples per bit are 64[2]. We have observed that PSK modulation technique is best for 2.5GPONArchitecture[5].
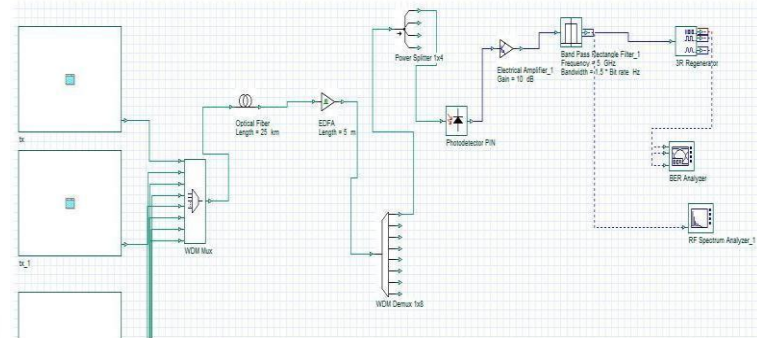

Fig 4: Simple PON ROF link with TWDM
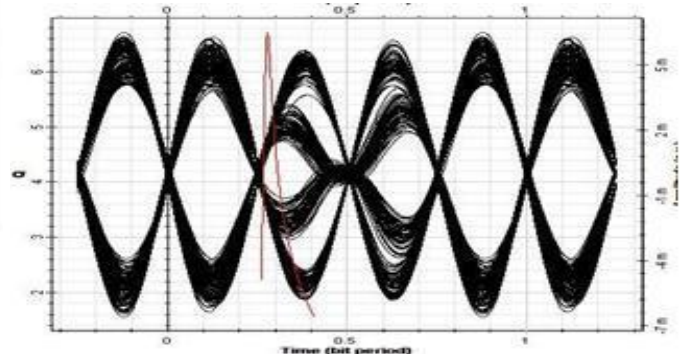
IV. Simulation Results and discussion
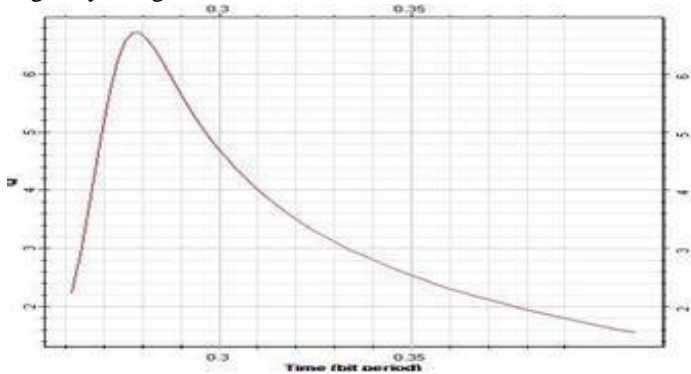
Fig.5 Eye diagram of ROF PON basic downlink

Fig.6 Q factor output

From fig.5 we can analyze the output of basic PON ROF downlink. Then we can show that we are getting Q factor is about 6.71 and BER is about 10^-13 order which is low comparable to standard BER value. We observe the Q factor out put in the fig 6. We can see the Q factor out put in the above diagram. Maximum Q factor is about 6.74

Eye opening is very good so we can say that we can get the high quality of signal at the output.

IV.CONCLUSION

Using Optisystem13 software our simulation results shown that output of the system provides better quality of signals. Use of TWDM technology with ROF PON has shown enhanced capacity of such network in term of received signal quality with reduced of overall cost of implementation of actual system. Transmission of OFDM signals through such ROF PON with TWDM technology can give better possible results.

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