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Performance check/measurement /Enhancement of Optical Link with & without EDFA

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Abstract—** **Radio over fiber technology is becoming increasingly important for wireless market in order to support the ever growing data traffic volumes. By implementing RoF technology, the unique properties of optical fibre known for its low loss and high wide bandwidth make it an ideal medium to transmit microwave signals to the Remote Site. It combines with PON and serves as high capacity wireless distribution nodes. Meanwhile with the FTTH project deployment, the PON is counted as the good method to meet the challenge of the fixed users. So the integration configuration of RoF with PON gets more researched, which is considered as a promising solution to offer end users greater choice, convenience and high bandwidth services. Hybrid GPON is a hybrid passive optical network, where WDM GPON and TDM-GPON are integrated into a single passive optical network, reducing cost and increasing the data rate. TWDM is the recent technology for increasing capacity and to reduce the cost. In this paper we have explained this technology and simulated basic link for 25km.

***Index Terms*—Radio over fiber (RoF); Passive optical network(PON) ; Orthogonal frequency division multiplexing (OFDM);Time division multiplexing (TDM);Wavelength division multiplexing (WDM);Fiber to the home (FTTH);Gigabit passive optical network (GPON).**

I. INTRODUCTION

A) ROF

Radio over Fibre (RoF) is emerging technology in terms of reliability, coverage, and more secure. RoF is one of highly in demand technology when industry fell for the convergence of wired and wireless networks. RoF is one very promising technique to enhance the capacity and bandwidth for wireless radio signals over long distance. Some of well known applications in this era are cellular networks, satellite communications, video distribution systems, mobile broadband services, vehicular communications, airports, shopping malls and etc.

A RoF system consists of a Central Site (CS) and a Remote Site (RS) connected by an optical fibre network as shown in Figure 1 RoF technology allows the RAPs to be simplified significantly since they only consist of optoelectronic conversion devices, an amplifier and the antenna. RF signal processing functions such as frequency up-conversion, carrier modulation and multiplexing are performed at the Central Base Station.

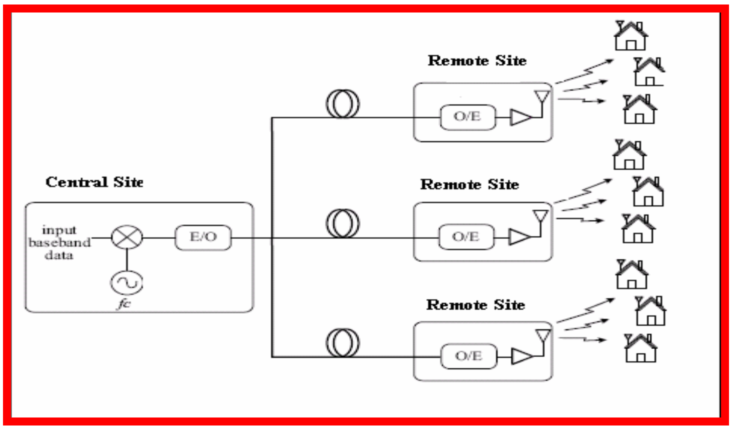


Fig 1: Radio over fiber system Architecture

The centralization of RF signal processing functions at the Central Base Station enables equipment sharing, dynamic allocation of resources and simplifies system operation and maintenance. If the application area is in a GSM network, then the CS could be the Mobile Switching Centre (MSC) and the RS could be the base station (BS).

B) PON

PON is a combination of network elements in an ODN (Optical Distribution Network) based optical access network that includes an optical line termination (OLT) and multiple optical network units (ONU) and implements a particular coordinated suite of physical medium dependent layer, transmission convergence layer, and management protocols.

PON has a point-to-multipoint tree topology that carries data frames between an optical line termination (OLT) and multiple optical network units (ONU) via a passive optical splitter. To share the upstream bandwidth among ONUs without collisions, robust and efficient medium access control is required. The various elements of PON architecture are shown in figure 2.

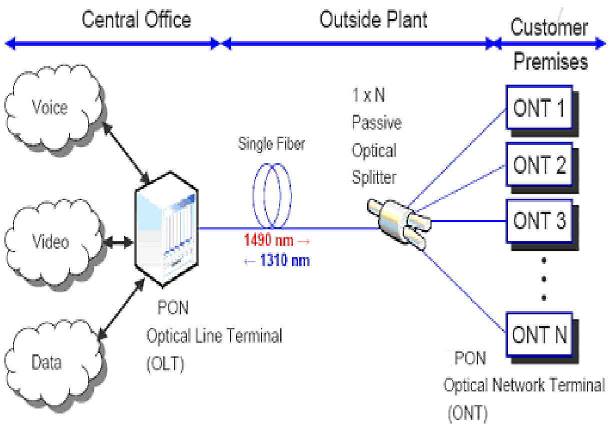


Fig.2: PON General schematic

Optical-access networks have been developed to remove the access-network bandwidth bottleneck. However, the current solutions do not adequately address the network economics to provide a truly cost-effective solution. Long-reach optical-access networks introduce a cost-effective solution by connecting the customer directly to the core network, bypassing the metro network, and hence, removing significant cost.

Need of PON

A passive optical network does not include electrically powered switching equipment and instead uses optical splitters to separate and collect optical signals as they move through the network. A passive optical network shares fiber optic strands for portions of the network. Powered equipment is required only at the source and receiving ends of the signal.Thus cost will be reduced and capacity will enhance.

II. Access technologies

A) TDM PON

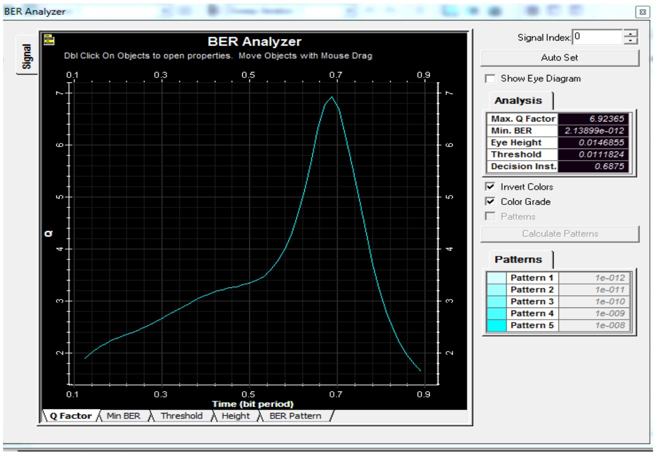
With future requirements for next-generation optical access, current NG-PON1 based on previous TDM-PONs standards are not enough to satisfy the current demand for a new revolution of technology. 40 Gb/s TDM-PON standard is a starting point towards higher capacity. The main issue with 40 G TDM-PON for NG-PON2 is difficulty in involving more users in the feeder fiber due to limited power budget, the availability and maturity of the compo- nents needed being low and finally the cost issue being more impactful for high-speed transmitter and receiver. Moreover, the limited reach is due to chromatic dispersion, which limits the transmission distance.

B) OCDMA PON

Optical code-division multiple access (OCDMA) is another approach of NG-PON2 technologies that utilizes a tree topology with a power splitter at the remote node . OCDMA has advantages such as point-to-point virtual links over one physical point to multipoint architecture, and supports high data and data transparency security. Hence, OCDMA is a promising approach towards optical access network. Unlike the TDM-PON and WDM-PON, in OCDMA, each ONU involved must have unique encoder and decoder fixed optical codes, while the OLT may have all encoder decoder pair required for communication with each ONU. The unique code contains all data about the user, such as the address and sign of each transmitted data bit. The issue of OCDMA PON configuration is the noise of source and the interference of multiple accesses. OCDMA PON is not capable of supporting the requirements of NG-PON2 due to immaturity of its components such as photonic encoder and decoder technology.

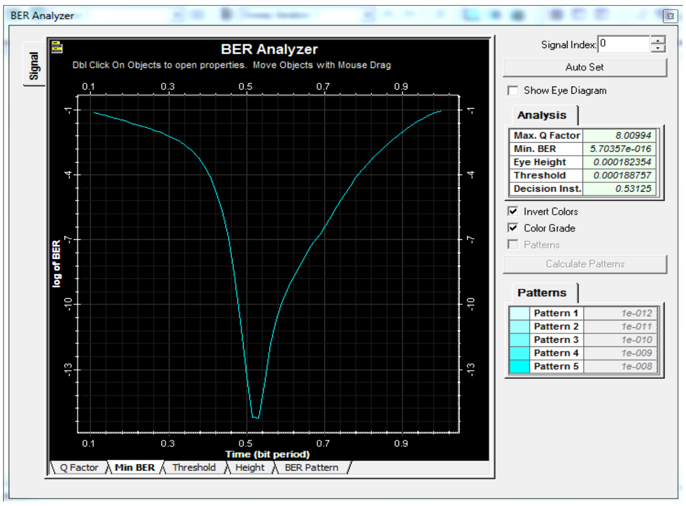
A. QUALITY FACTOR

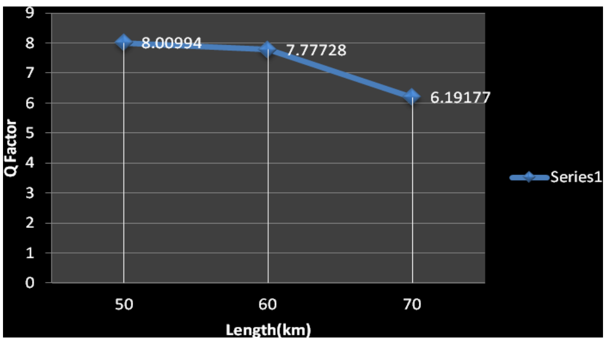
Quality Factor is a dimensionless parameter that describes quality of received signal



B .BIT ERROR RATE

BER is ratio of number of error bits to the total number of transmitted bits during a finite time interval. Lower the value of BER means more reliable recovery of received signal .The following figure shows BER value 5.70357e-016 for 50 Km optical link.





IV. Performance of Link with EDFA

EDFA can be inserted in link at various locations throughout length of link as Pre amplifier, Post amplifier or Hybrid amplifier structure. In this paper we have used post amplifier configuration because we got higher values of Q as compare to other amplifier configurations. Same configuration link is shown in following figure( ).

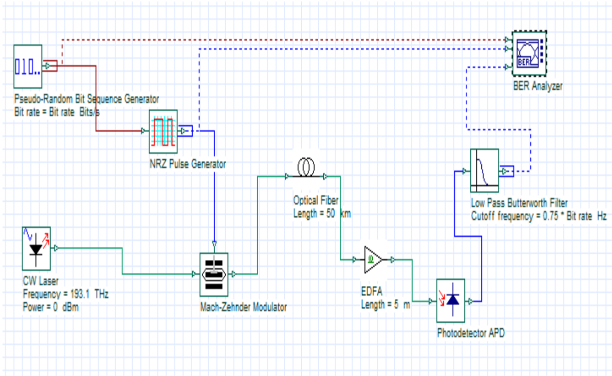


Fig 6: Simple ROF link with Post Amplification

As discussed earlier same way the signal is processed at various stages in link only with one change is that EDFA had been inserted in post amplifier configuration in the link and again such received signal analyzed in terms of Q factor, Min BER, Eye height, threshold and decision instant using BER analyzer. Obtained results were tabulated shown in table

Table (3)

Fiber Length	50km	60km	70km
Max.Q Factor	8.2826	7.73684	6.22363
Min. BER	5.92148e-017	4.99995e-015	2.42668e-010
Eye Height	0.158935	0.124903	0.0830492
Threshold	0.171785	0.143891	0.0966901
Decision Inst.	0.515625	0.5625	0.578125

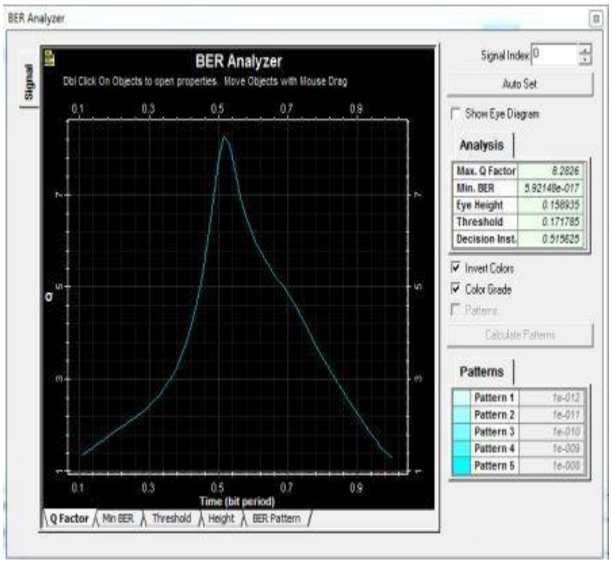
Table(4)

Pulse Generator	NRZ	RZ	Gaussian
Max.Q Factor	8.2826	2.14442	13.704
Min.BER	5.92148e-017	0.0151604	4.80688e-043
Eye Height	0.158935	-0.0211356	0.000166633
Threshold	0.171785	0.0598929	0.000117546
Decision Inst.	0.515625	0	0.546875

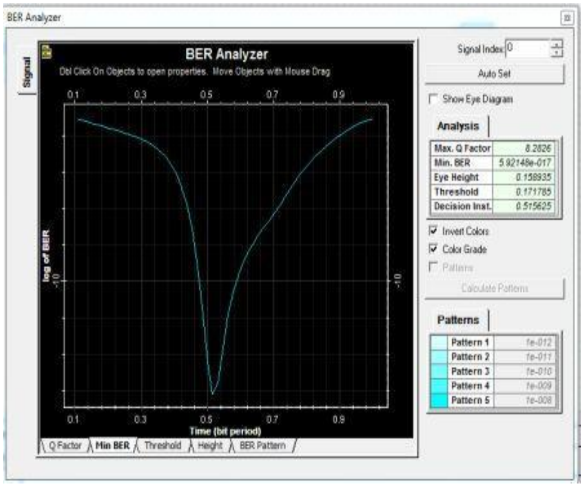
Simulation Result of Link With EDFA

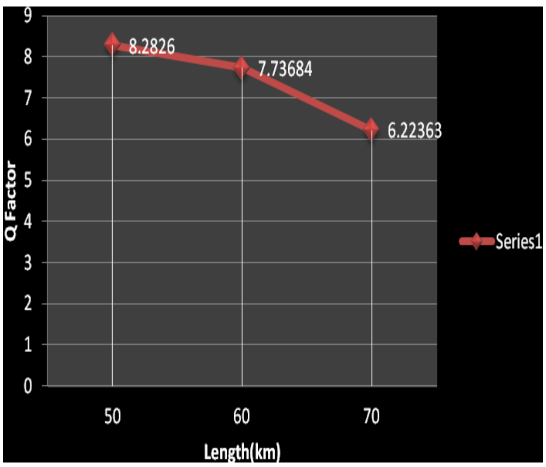
From obtained results, we can see that values of Q factors and Min.BER measured for 50 Km,60 Km and 70 Km with EDFA are better than without EDFA in link.

A. Quality Factor



B.BIT ERROR ANALYSER





5. CONCLUSION

From carried out simulation based work we have concluded that ROF link performance was enhanced using EDFA .Performance parameters of EDFA can be further tuned to have better performance by EDFA for the same purpose.

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