A survey of WDM passive optical networks(PON) for networking support.

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Abstract. In, this paper, we investigate the WDM-PON networking architecture hybrid with different network fashions such as WDM-ROF-PON networks, TDM/WDM hybrid PON and Fabry-Perot laser diode with WDM-PON networks. Further context emphasis the importance of PONs in the access network as well as their role supporting other communication network technologies. Lastly, we conclude this editorial with future aspects of PONs in communication networks.

Keywords:WDM, PON, TDM, ROF, OLT

1. INTRODUCTION

A passive optical network (PON) is a telecommunications network that uses point-to-multipointfiber to the end-points in which unpowered optical splitters are used to enable a single optical fiber to serve multiple end-points. A PON consists of an optical line terminal (OLT) at the service provider's central office and a number of optical network units (ONUs) or Optical Network Terminals (ONTs), near end users. A PON reduces the amount of fiber and central office equipment required compared with point-to-point architectures. Business models with new technological approaches will play vital roles in the future smart grid communications infrastructures. Such future infrastructures call for innovative partnerships between the various involved stake- holders, such as utility companies, network operators, and network service providers, as well as integration of the involved utility and networking technologies [1].

In most cases, downstream signals are broadcast to all premises sharing multiple fibers. Encryption can prevent eavesdropping. Upstream signals are combined using a multiple access protocol, usually time division multiple access (TDMA). The optical fiber have large amount of merits and one of them is information-carrying capacity of fiber is well beyond any predictable access demands. Today, several Gigabit-per-second upstream and downstream bandwidths are possible and more is envisioned in future [1-3].

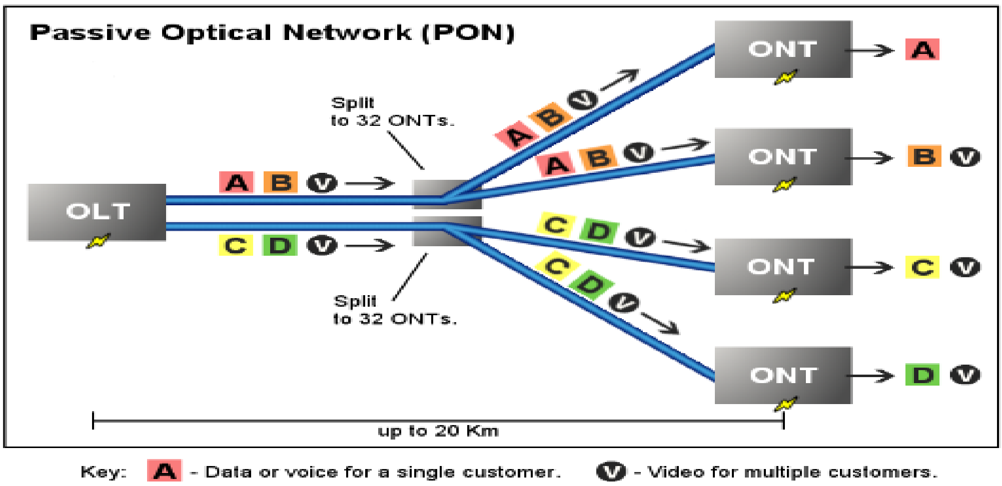

Fig.1. Basic block of passive optical network (PON)

PON is to devise a fair mechanism for users to share the feeder fiber bandwidth in the upstream direction. Three multiplexing schemes are possible: Time Division Multiplexing (TDM), Sub-Carrier Multiplexing (SCM), and Wavelength Division Multiplexing [2]. But in this paper our main focus in on wavelength division multiplexing(WDM)-PON. PON takes advantage of wavelength division multiplexing (WDM), using one wavelength for downstream traffic and another for upstream traffic on a single mode fiber (ITU-T G.652). BPON, EPON, GEPON, and GPON have the same basic wavelength plan and use the 1,490 nanometer (nm) wavelength for downstream traffic and 1,310 nm wavelengths for upstream traffic. 1,550 nm is reserved for optional overlay services, typically RF (analog) video. The multiple wavelengths of a WDM-PON can be used to separate Optical Network Units (ONUs) into several virtual PONs co-existing on the same physical infrastructure. Alternatively the wavelengths can be used collectively through statistical multiplexing to provide efficient wavelength utilization and lower delays experienced by the ONUs.There are different networks with WDM-PON discussed in this paper such as WDM-ROF-PON networks, TDM/WDM hybrid PON and Fabry-Perot laser diode with WDM-PON networks [3-5].Moreover there future aspects for networking support will provide reliable communication networking scenario.

2. NETWORKING WITH WDM-PON

2.1. Hybrid TDM/WDM-PON networks

The architecture of WDM/TDM PON as tree topology as shown in Fig.2. For downstream, there are w wavelengths (W1, W2,..., Ww) in the network and each wave- length is divided into several different timeslots (denoted by A1, A2, B1, B2, C1, C2, etc.) to avoid data collision among ONUs [6]. Every ONU can share a specific wavelength channel with a few others. Hence, data packets from different ONUs may contend with each other and happen to collide when they are transmitted simultaneously over the same wavelength. This approach helps to handle large data traffics with the help of different time slots called time-sharing for each wavelength. The protocol is based on two control messages: the REPORT message sent from ONUs to OLT is used for reporting bandwidth request considering its buffer space. The other one is the GATE message. Using it, the OLT collects queue requests, makes bandwidth allocation decisions, and then notifies ONUs when and on which channel to transmit packets. Such a request–grant-based transmission mechanism, we believe, is highly likely to be adopted in hybrid WDM/TDM PONs for consistency [4-6].

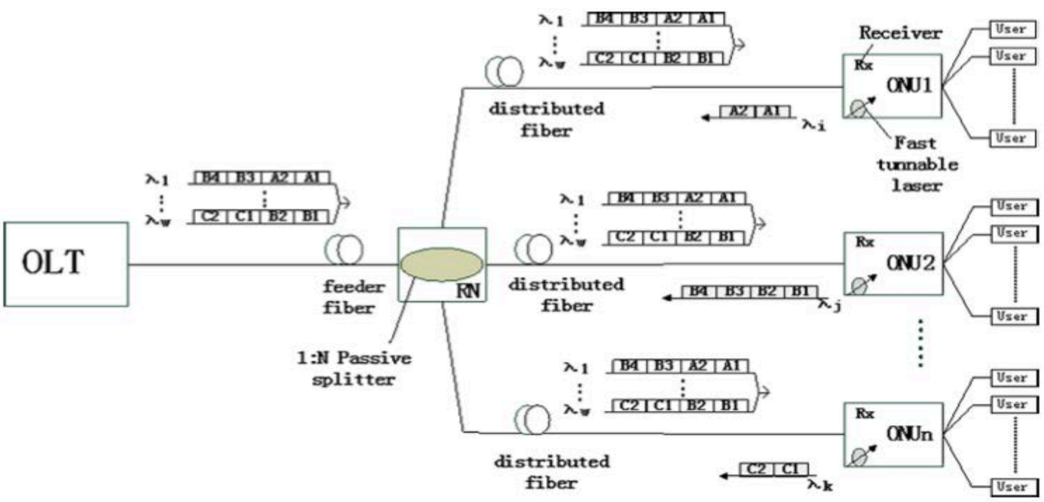

Fig.2. Architecture of TDM/WDM-PON

The data packets send from OLT via feeder fiber and each packet is distributed to particular wavelength. Afterwards packets fed to 1:N passive splitter that performs the distribution of the data in different fibers and optical network unit receives at particular wavelength adjusted by tunable laser.

2.2. WDM-ROF-PON networks

A new idea about PON/ROF Convergence is to convey the RF sub-carriers on the fiber plant of PON so that the baseband data stream and the data modulated RF signal can be simultaneously delivered to wire line and wireless users. Since optical quadrature differential-phase-shift keying (QDPSK) has become the modulation of choice to achieve high capacity without significantly increasing the system complexity [5].

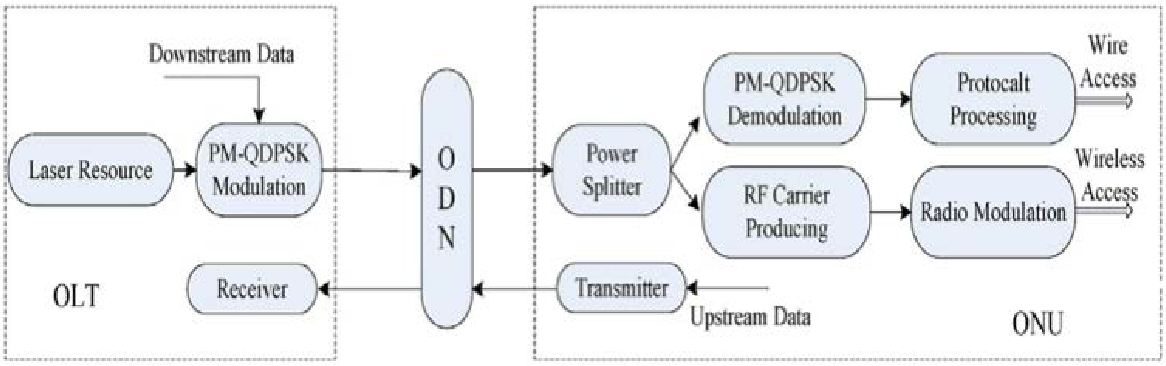

Fig.3. The structure of WDM-ROF-PON.

The structure of WDM-ROF-PON is shown in Fig. 1. It can be separated three parts: OLT, ODN, ONU and two directions: downstream and upstream. The downlink topology of a WDM access network supports wire-line and wireless services access. An optical line terminal (OLT) is composed of laser resource offering WDM wave- lengths for downlink. Two wavelength de-multiplexers operate as ODN (optical distributed networking) respectively. At the optical network unit (ONU) side, after a SMF (single mode fiber) link, the power splitter separates the downstream optical signal into two parts. A downstream receiver finishes demodulation and protocol processing then achieves wire access. RF producing and radio modulation is used to carrying the baseband signal, which comes from Protocol processing, and a transmitting antenna is employed.

2.3. Fabry-Perot laser diode with WDM-PON networks

Nowadays by the lack of economical techniques for the WDM transmitters. Recently, "colorless" transmitters, such as spectrally sliced light emitting diodes, injection-locked Fabry-Perot laser diodes (FP-LD), and wavelength injection reflective semiconductor optical amplifiers (RSOAs), have been reported and analyzed. In those schemes, RSOA-based ONU is easy to achieve colorless operation under different injection wavelengths by the centralized optical line terminal (OLT) . Furthermore, in order to reduce the cost for the current fiber access networks, the long reach (or extend reach) WDM-PONs have also been proposed and studied [6].

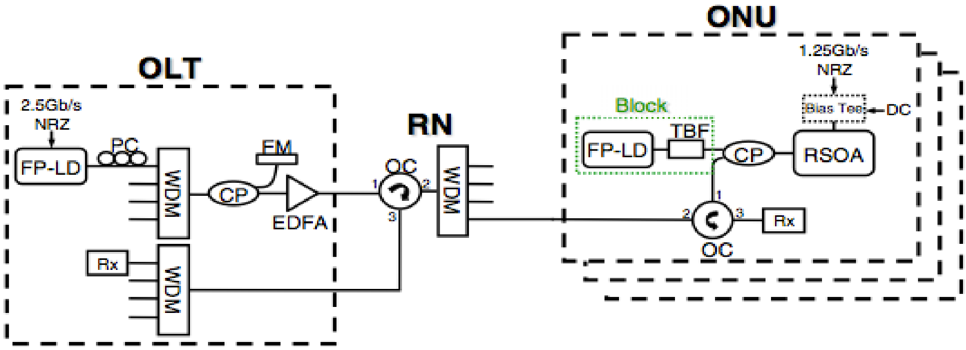

Fig.4. The structure of Fabry-Perot laser diode with WDM-PON networks

In this self-injected FP-LD laser and external-injected RSOA-based wavelength-tunable laser in OLT and ONU, respectively, acting as the downstream and upstream transmitters in the long reach WDM-PON system is illustrated in Fig. 1. Moreover, in remote node (RN), it is constructed by a 1×N WDM multiplexer and a optical circulator (OC), which is used to separate the downstream and upstream link to avoid the Rayleigh backscattering noise [7].

3. NEED AND FUTURE SCOPE OF WDM-PON NETWORKS

Passive Optical Networks (PONs) have been the focus of considerable research, development, and standardization efforts over recent years. Today, they are well positioned as the technology of choice for broadband access in the near future. Due to massive data traffic optical networks helps to overcome congestion problems because of its high transmission rate and less power consumption. A challenge in these hybrid access networks is to permit "anywhere deployment" of the active device that bridges the fiber and copper segments [1,2].

These systems could be thought of as the "generation after next". The tantalizing prospect of leap-frogging the 10 Gb/s generation has been entertained in many forums; however, the practical challenges for WDM PON systems are substantial. At the present time, such systems carry significant cost premiums. There has been progress on this front, but not enough to make it economical. Also, the current mass-market demand for bandwidth is not large enough to justify the capacity of WDM PONs. Therefore, most practitioners consider these PONs to be for future systems.

The demand for bandwidth, everybody agrees that Internet traffic is growing. However, access revenues are flat at best. The biggest question is what is the new bandwidth for? So far, bandwidth has little intrinsic value in the traditional sense. Rather, customers just want to buy a fast pipe, and they seem to buy the fastest pipe possible, provided it does not cost more than they are willing to spend. They do this even though they do not really have a use for the bandwidth. With this background, it appears that bandwidth seems predominantly a competitive tool to obtain market share. The network that can provide the faster access at the same price wins. The slower network provider ends up having to cut price to stay in the game. Total service capability also factors into the equation. For example, if one competitor can provide triple-play services, then they all need this capability. Of course, such integration can be tackled via business cooperative agreements (e.g., Telco-Satellite television). Virtualized PON also supports network function virtualization so that future PON systems will be much easier to operate and maintain [8].

4. CONCLUSION

WDM-PON networks support becoming essential part of future networking methodology because of its tremendous amount of advantages with optical fiber over traditional networking fashions. With the help of WDM-PON networks we can handle high data traffic rate and transmission bit rate for future scope. All Networking technics discuss in this have some characteristics to avoid congestions and collisions.The main motive of this work is to draw the attention towards the realization of future high performance integrated networks by studying the previous efforts in the area of ROF links.

REFERENCES

[1] Editorial, "Passive optical network (PON) supported networking," Optical Switching and Networking 14 (2014) 1–10.

[2] Frank Effenberger, Tarek S. El-Bawab,"Passive Optical Networks: Past, present, and future," Optical Switching and Networking 6 (2009) 143–150.

[3] Viyoma Sarup, Amit Gupta, "A Study of various Trends and Enabling Technologies in Radio over Fiber (ROF) Systems," Optik 126 (2015) 2606–2611.

[4] Anirban Kanungoe, Atri Mukhopadhyay, Goutam Das, Ratul Banerjee, Rabi Das, "A new protection scheme for a combined ring-star based hybrid WDM/TDM PON architecture," Optical Switching and Networking 18 (2015) 153–168.

[5] Wei Ji, "40 Gbit/s per wavelength channel in WDM-ROF-PON with polarization multiplexing and CSRZ-QDPSK modulation," Optik 125 (2014) 366–369.

[6] C.H. Yeh, C.W. Chow, Y.F. Wu, F.Y. Shih, S. Chi, "Using Fabry-Perot laser diode and reflective semiconductor optical amplifier for long reach WDM-PON system," Optics Communications 284 (2011) 5148–5152.

[7] Cuiping Ni, Chaoqin Gan, Wei Li, Haibin Chen, "Bandwidth allocation based on priority and excess-bandwidth-utilized algorithm in WDM/TDM PON," Int. J. Electron. Commun. (AEÜ) 69 (2015) 1659–1666.

[8] Ning Cheng, "Flexible TWDM PON with WDM overlay for converged services," Optical Fiber Technology 26 (2015) 21–30.

[9] T.S. El-Bawab, "Signs of recovery in the optical networking arena," IEEE SoutheastCon 2007, Richmond, Virginia, USA, 22–25 March 2007, pp. 715–719.

[10] Y. Xiao, J. Yu, "A novel WDM-ROF-PON architecture based on 16QAM- OFDM modulation for bidirectional access networks," Opt. Comm. 295 (2013) 99–103.