A COMPREHENSIVE REVIEW OF DIFFERENT FTTH CONFIGURATION AND FEATURES OF DIFFERENT PON NETWORK

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Abstract - FTTH(Fiber to the home) is an optical fiber network architecture that use dedicated optical fiber to the subscriber end. Due to its long distance high speed and it is widely used in corporate, commercial as well residential purpose. Because of PON Architecture it is cost efficient also.

Keywords- ONU, FTTH, RU, OLT, ASE, PON, AON.

1. INTRODUCTION

FTTH (NGPN) stands for fiber to the home(next generation play networks). As the name depicts it uses the optical fiber to the consumer end. As demand for expeditious web is the key reason for the recent retrieve technologies, however long established technologies like DSL (Digital Subscribe line) and wire modem technologies, commonly used for broadband access which have speed of MBPS and their speeds depends upon the various factors like how far it from the local exchange and the quality of the copper cable which cannot be fulfill today’s customer needs for high bandwidth application such as HDTV[1], fast web access,IPTV,video on demand, online gaming and distance learning etc.

This technology has a variety of advantages over the traditional technologies like it provides unlimited bandwidth and long distance reach. , it provides multiply services (data, video, voice etc) on a single fiber. Optical fiber cables have traditionally been used for long distance communication.

As the demand increase for the high speed internet and high bandwidth with stability by the businesses and by the education department and by general households works in recent years the need of optical fiber cable has increased.

1. FTTX(FIBER TO THE X)

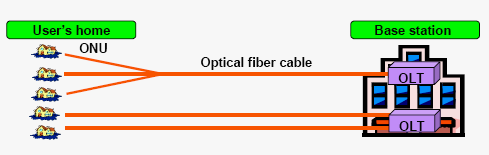
Fiber network can be placed in various varieties, depending upon the fiber network[2] i.e. Active Network (Point to Point) and passive Network (point to multipoint) and depending upon the termination point like building (Fiber to the Building),homes(Fiber to the Homes),Curb(Fiber to the Curb)etc.

So, there is various type of FTTX architecture to take into account FTTH, FTTB and FTTC each one have their different configuration and characteristics.

*A* .FTTH(Fiber To The Home)

FTTH is the best and cost effective substitute to the conventional technology i.e DSL. In the fiber to the home technology a communication path is provided over optical fiber cable extending from OLT(optical Line terminal) unit situated in telecommunication operators switching equipment(exchange) to an ONT( Optical Network Terminate) at customer premises[3]. It provides communication path for carrying telecommunication traffic to subscribe for one or many series like data, voice, video etc.

As shown in fig 1. OLT situated at base station (exchange) is connected to the ONT situated at customer end via optical fiber cable. The output from the ONT is connected to customer’s PC via LAN cable.



**Fig. 1 FTTH configuration**

1. FTTB(Fiber To The Building)

In the fiber to the building architecture, communication path is provided over optical fiber cables between OLT (optical Line Terminal) located in Base station (Exchange) to an ONU (Optical Network unit) or RT (Remote control) located at the frontier of the apartment, building or office enclosing set of subscribers[5].

In this structure, optical fiber terminate to ONU or RT units located at the frontier of the building, office and apartments and copper cable other than optical fiber is used as the physical medium which provide the access path to the subscribe. As shown in figure 2. Optical fiber cable is installed up to the metallic cable installed within the building and a Ethernet cable can be used to connect to the subscriber.

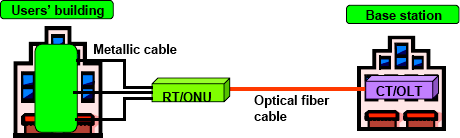
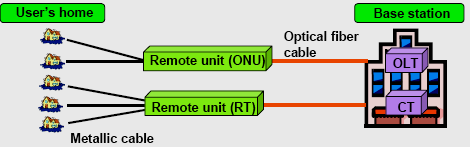


Fig. 2 FTTB Configuration

*C.* FTTC (Fiber to the Curb)

In the fiber to the curb/cabinet architecture, an optical fiber is used from the Base Station (Exchange) to the remote unit (RO)/ optical network unit (ONU)[4] installed outside near the curb or on street cabinet. Finally copper cable or coaxial cable is used between the remote unit (ONU) and the subscribe end as shown in figure 3.

**Fig.3. FTTC Configuration**

1. TECHNOLOGY OPTIONS FOR FTTH ARCHITECTURE

In the current scenario, there are various technology options are available for Fiber to the home Architecture. The Architecture can be installed in various networks

1. Active optical network (AON)
2. Passive optical network (PON).
3. Active optical Network

AON (Active optical network)[17] is commonly known as Active node. It mainly use a point to point (PTP) network Architecture and every subscriber or customer are provided with a committed optical cable and the distribution points are handled by active optical equipment.

Active optical network[12] can be setup in two architecture

1. HOME RUN Fiber (Point to Point )
2. Active Star Ethernet

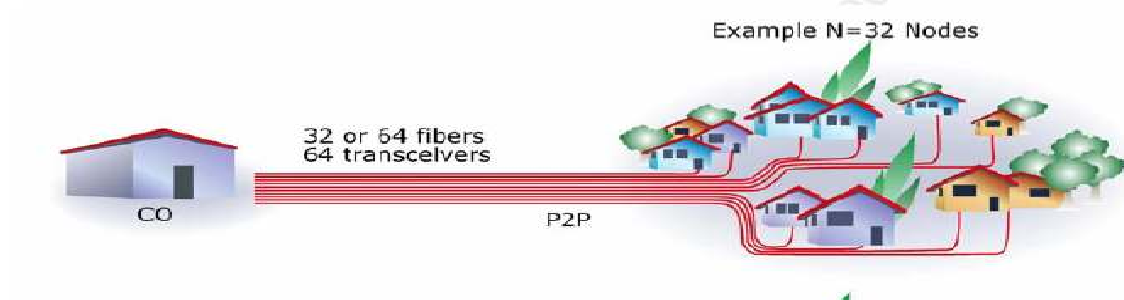
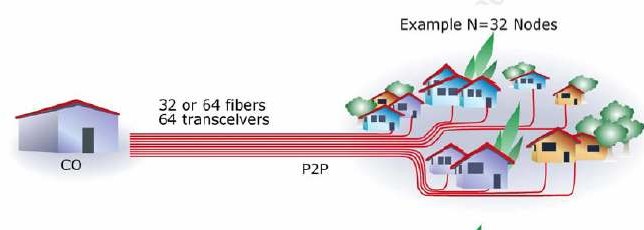
*1).*Home RUN fiber (Point to Point) Architecture

In this architecture, a devoted fiber line is connected between the ONT (optical network terminal) located at local exchange office to the OLT(Optical Line Terminator) equipment situated at the subscriber end.

In this, both devices ONT and OLT are active, powered device and each one is equipped with an optical laser. This technique offers unlimited bandwidth for the subscriber and therefore it has greatest potential for growth.

It is the most flexible architecture but Home Run fiber requires much more fiber because a dedicated fiber is provided to each subscribe end. So, it is very costly and become less attractive.

The figure of home run fiber architecture is shown in figure 4.



P2M

Point To Point User’s Premise

CO

P Switched

Ethernet

CO

**Fig. 4 Home Run Fiber (Point-to-Point) architecture**

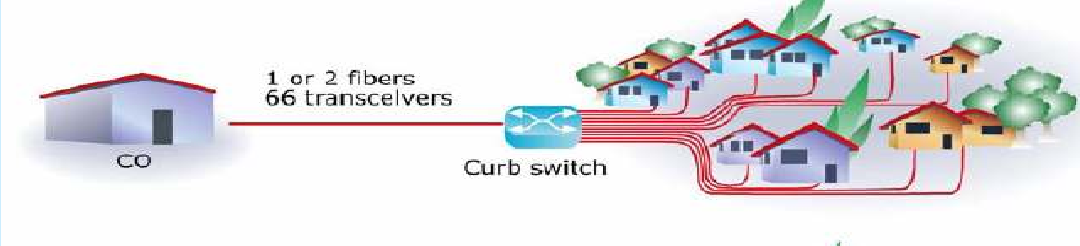
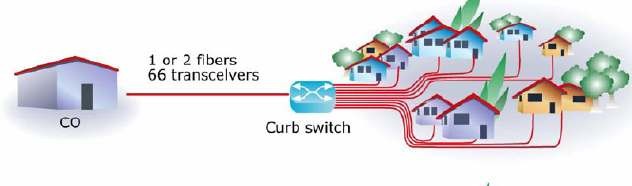
*2).* Active Star Ethernet (Point to Multi point) architecture

Active star Ethernet (ASE)[18] Architecture is point to multipoint architecture in which Ethernet switch is used between the exchange (CO) and the subscribe premises. In this, multiple subscribe share one feeder fiber connected from the exchange (CO) to one end of switched Ethernet and other multiple end of switched Ethernet is connected to multiple subscribe premises.

In the Active Star Ethernet Architecture[19], end user get a dedicated fiber, the fiber runs between their location and Ethernet switch like home run fiber and every subscriber is provided a dedicated pipe that provides full bi-directional band width.

Active Star Ethernet reduce the amount of fiber .So, it is cost effective.

The figure of active Star Ethernet is shown in Fig 5.



User’s Premise

CO

P2M Switched Ethernet

**Fig. 5 Active Star Ethernet (ASE) architecture**

1. Passive Optical Network (Point to multipoint) Architecture

Passive optical network is a very cost effective optical fiber based access system for providing multiservice (i.e voice, data, video etc ) to both business and residential customer.

A passive optical network is based on the point to multipoint architecture.

A passive optical network (PAN)[23] use optical fiber and optical power splitters to connect the optical line terminal (OLT) situated at the local exchange to the optical Network unit (ONU) situated at subscribers premises.

Passive splitter can split the fiber signal up to 32 or more time( which means that they split the bandwidth and shared between the users) over a maximum distance of ten to twenty km. passive splitters are generally located downstream from the local exchange.

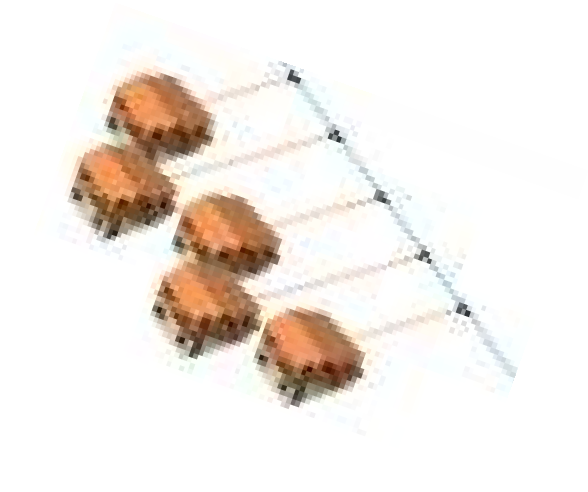
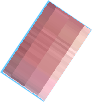
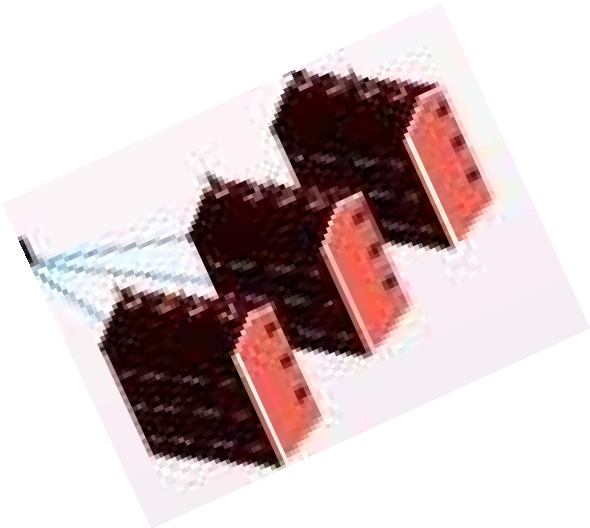
This architecture is also known as passive because all the splitters and other equipment located in intermediate between the local exchange and the Optical Network unit is passive that is they does not require separate power and there is not active electronics..So, by using this architecture, it simplifies the network maintainance and operation and reduces the cost and another advantage is it requires less fiber than Home Run technology.

There are two common splitter configuration are used for Passive optical network architecture

1. Centralized Approaches
2. Cascaded Approaches (as shown in Fig.6)

1).Centralized splitter approach

It generally uses a 1\*32 splitter which means bandwidth can be shared between the homes or subscriber. As shown in the fig 6. Optical splitter is concentrated in a single location from which all 32 optical network terminals (ONT) located at all 32 subscriber /homes are connected.



1X4

1X16

1X4

1X8

1X4

Splitters PONs

1X2 1X16

Splitter

1X32

1X32

Central Office

**Fig. 6 Centralized and the Cascaded Passive Optical Network architecture**

2). Cascaded Splitter approach

When the passive optical network (PON)[26] employ cascaded splitter approach to increase the number of homes/subscriber from a single fiber. This approach use more than one splitter of different capacity located in the pathway from the local exchange to customer/subscriber end, like a network may have 1\*4 splitter leading to a 1\*8 splitter further downstream in four different location. Standard splitter format range from 1\*2, 1\*4, 1\*8,1\*16 and

1\*32. Ultimately, there would be 32 fiber reaching to the ONTs of 32 homes.

There is Various PON technology

1. APON
2. BPON
3. EPON
4. GPON

GPON delivers gigabit per second bandwidth and offer low cost and high reliability

|  |  |  |  |
| --- | --- | --- | --- |
| *.Features* | *BPON* | *GPON* | *EPON* |
| Responsible  Standard body | FSAN & ITU-T SG15  (G-983 Series) | FSAN & ITU-T SG15  (G-984 Series) | IEEE 802.3ah |

|  |  |  |  |
| --- | --- | --- | --- |
| Bandwidth | Down Stream up to 622 Mbps  Up Stream up to 155.52  Mbps | Down Stream up to 2.5 Gbps  Up Stream up to 2.5  Gbps | Down Stream up to  1.25 Gbps  Up Stream up to 1.25 Gbps |
| Downstream ג | 1490 nm & 1550 nm | 1490 nm & 1550 nm | 1490 nm |
| Upstream ג | 1310 nm | 1310 nm | 1310 nm |
| Layer-2  Protocols | ATM | ATM, Ethernet, TDM  over GEM | Ethernet |
| Frame | ATM | GPON Encapsulation  Method | Ethernet Frame |
| Max. Distance  (OLT to ONU) | 20 km | 20 Km (supports logical  reach up to 60 Km) | 10 and 20 Km. |
| Split Ratio | 1:16, 1:32 and 1:64 | 1:16, 1:32 and 1:64 | 1:16 and 1:32 |

**TABLE 1 FEATURES OF DIFFERENT PON NETWORKS**

1. NEED OF FTTH

FTTH is a multiply -service communication access which concurrently handles several phone calls, TV/Video streams and internet users in the home/office. This technique have various advantages over other traditional access technologies (DSL) as given below:-

1. This technique provides multiply (i.e. Voice, videos and data etc) services.
2. FTTH Provides wide range of communication, entertainment services and many other new services to the end users.
3. FTTH technology deploys a fiber optical cable to every premise which will provide unlimited bandwidth (i.e. very high speed) as compare to DSL technology.
4. FTTH technology has a prospect to increase the average revenue per user (ARPU) and to reduce the capital investment. FTTH has the feature to deliver multiple services which result in less operational expense.
5. FTTH technology requires local battery breakup and low power consumption.
6. FTTH technology is trustworthy, scalable and vulnerable, trustworthy and it is potentially productive and future ready Architecture.
7. CONCLUSION

The desire of multiply services (i.e. Voice, data, and video) and heavy application like distance learning video application, best picture quality, video conferencing and video phone is expected to continuously increase and some observer already believe that there is already a demand in world wide today also.

FTTH is a new leading technology which uses optical fiber to provide unlimited bandwidth for new generation of bandwidth application.

As this technology uses passive network component so, it requires less maintenance and less power consumption which results in economical than active network technology.

Many countries like China, Japan, Korea, Taiwan and many others has already is in use of this technology and even in India also it has gained a reputation very quickly because of its high performance, low cost and higher constancy.

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