A Review of immigration obstacles to PON-FTTH and its evolution around the world

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ABSTRACT

The require a bandwidth of every person will be increased from 16 Mbit/s to 50 up to 100M bit/s in the next 5 years in most of the growing counties. To solve this problem, FTTH may be the appropriate solution in a wide range. We experimentally investigate the deploy of PON-FTTH based on different kinds of passive optical network technology (E-PON, G-PON and VCSEL) and study the Obstacles of PON-FTTH Immigration after comparing it with older service (XDSL). Then analysis the reason on why these technologies chose by some country not others and why the technological need in Europe different with need in Africa and America. We discussed the solutions in telecommunications networks and or the economic aspect of projects all over the world, we found that GPON is more appropriable for accomplishment PON-FTTH than other networks. Thus GPON has been chosen for Europe, America and middle east. Choosing GPON techniques is decided by many factors include the infrastructure that was made before, the people demand for service and how much service they need because the need in Europe different with need in Africa and American and so on. Finally, we will suggest the appropriate solution in the energy savings, cost effective, higher security, and side of service transparency over other access networks for the future demand.

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1. INTRODUCTION

In the near future networks need to maintain increasing their bandwidth and services widely to keep up with emerging technologies such as cloud services, 4K/8K ultra-HD video, virtual reality, smart home, 5G mobile systems and internet of things (IoT) [1, 2]. These massive bandwidth requirements will dedicate for each user with wireless access and digital subscriber line (DSL). These two types of accsess for business and public users become a bottleneck in very big wideband services, mainly duo to valuable infrastructure for existing service provider [3, 4].

Currently, many of the transmitted digital data is transported over fiber optic cables, forming the bulk of the telecommunications infrastructure around the world [5-7]. Expectations that optical fiber will pave the way for home and business customers in the near and medium term and penetrate them. The optical fiber stricter demands for larger capacity and more flexible extensibility are raised to optical access network (OAN) [8, 9]. Which is one of the extreme significant technological jobs for telecom operators that can easily achieve any growing at an unprecedented rate so OAN act as a space of the next generation can provide bandwidth with several hundred times bigger than what the copper can offer [10]. As a result, many governments invest a huge money in the fractional or full change in the conventional access networks established on copper, and replaced with fiber to the home (FTTH) [11].

The deployment of FTTH is currently growing rapidly around the globe [12]. Promising schedule for a large range of services in the past few years is provide by optical access networks, several approaches have been identified for the deployment of generation access networks (NGA) different fiber to X (FTTX) like FTTH, FTTB, FTTC.... Required various fiber endpoints in the optical distribution network (ODN), as shown in Figure 1 for example, in fiber to the cabinet (FTTC) solutions to support front transport local exchange for upcoming 5G ultra-dense radio networks as a valuable substitution to fiber optical. In [13, 14] or for the living space boundary in FTTH solutions [15]. The name of any type of FTTX is defined by the location of the optical network unit (ONU) like fiber to the curb (FTTC) when ONU location is on the border, FTTH when ONU location is at end users and finally when the ONU in the building called fiber to the building (FTTB) [16].

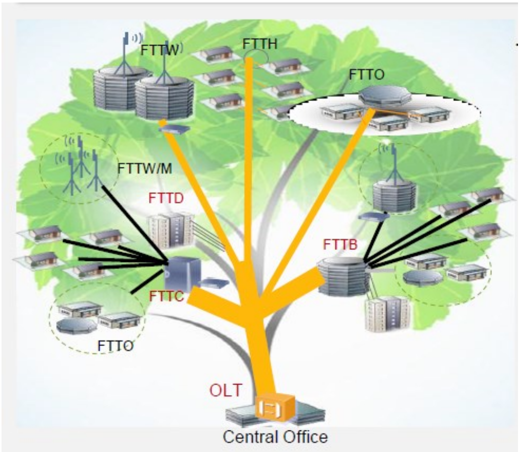

Figure 1. Fiber to the x (FTTx)

FTTH OAN represent in two type first physical channels from the CO to each user premises, called point to point P2P but this is a very expensive and less popular used, since there is no physical infrastructure to share. Second is point-to-multiple point (P2MP) networks that require electrical, optical, and switching of media access control (MAC) and optical conversion into the remount node (RN) [17-20]. In the last ten years at various FTTH network architectures have been sophisticated, depending on the electricity. Therefore, we can divide to two type active optical network (AON) which is the electricity is necessary and passive optical network (PON) which all the component from optical line terminal (OLT) to ONU is the passive part.

Even when AON reduce both deployment time and user costs, especially in new environments. This infrastructure will ultimately not be able to meet the future power requirements. According to Gartner Research: “In 2015, 4.9 billion connected devices used, and reach 20.8 billion by 2020". This growing demand for higher capacity will lead to unavoidable power. Therefore, AON is much less well represented in literature than PON because of its use is limited in a real context due to they are lower complex in the opinion of the optical domain specially because they are based on single wavelength two-point communication lines [21-26]. In 1980 PON was developed. Due to the continuously increasing request for the internet bandwidth and other services. Passive optical networks become very necessary for this reliability operation, especially for FTTH access networks [27, 28] PON are receiving attention since it is due to the lack of active elements in the ODN which means lower operating costs, easy maintenance, small power consumption, and bigger reliability. Therefore, it is utilized as a cost-effective process for participation fiber infrastructure to home, business premises and curb. The passive optical power splitter used in the PON is not restricted to bandwidths, therefore makes it possible to raise economic effectiveness due to aftertime, improve with higher bandwidth, a bigger number of subscribers and longer coverage. To facilitate networking installation procedure, simplify maintenance work and develop service availability PON monitoring is required due to the utilize of exclusive passive components in the network, an insufficiency in the transparent router cannot be detected by the network equipment itself. Comparing PON to point-to-point architectural is usually led to minimize the amount of central office equipment and optical fiber used as shown in the Figure 2 [29-35].

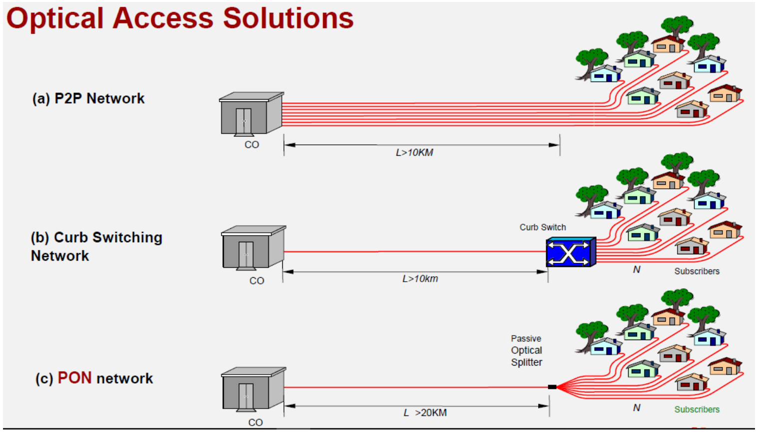

Figure 2. Optical access show; (a) to point-to-point architectural, (b) curb switch network (AON), (c) PON

PON that deploy with fiber architecture called point-to-multi-point (P2MP) was firstly launch by the cable-television operator in some urban areas so PON technology architecture in most of the network is a point to multipoint (P2MP), commonly recognized as a tree topology and in another architecture called the star topology, and if we utilize a mutual infrastructure, then it called the tree trunk [36]. Moreover, in some rural areas, using a cohesive policy with a multiplicity company can operate with multipoint architecture (P2MP) in open access network, it is for sure that a P2P settling can supply greater bandwidth for each household than what P2MP can provide [37].

On the other hand, equipment existing in the RN usually have multiplexing and demultiplexing tasks, so they can be powered dividers or more sophisticated devices, but strictly “passive”. The RN may be the perfect area to install an optical amplifier in a long reach (LR-PON) [38]. RNs as shown in Figure 3 divide an ODN into two or more pieces of fiber:

– Feeder fiber is what connect to CO with first separation stage;
– Distribution fiber is one that leaves each gateway of the first separation stage;
– Drops are an optical connection that reaches each individual user and is usually included in straight cables internal premises [39, 40].

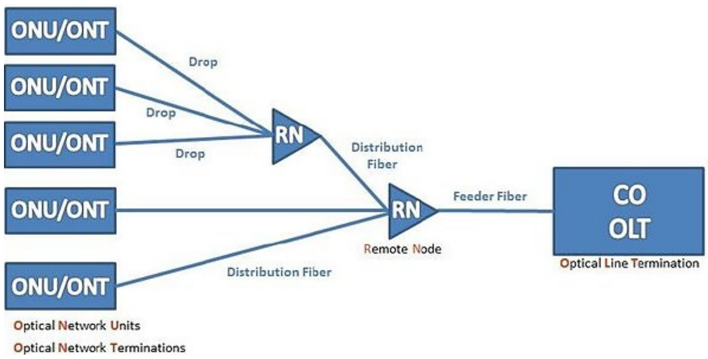

Figure 3. Schematic representation of a PON

A common PON service provider tree consists of OLT located in CO and providing an OAN interface on the network side that is connected to the N optical network units through an ODN. PON is a shared network in which the OLT sends one downstream traffic that all ONUs as shown in Figure 4, provides an interface on the side of the user. In a situation like FTTH networks, each ONU coincides with the ending of the ONT, every ONU examine packet contents that are addressed to it only the of those and neglecting the rest. By relying on user port function downlink signals are broadcast to all rooms with multiple users. Encryption can prevent eavesdropping. Therefore, in the optical access network, PON considered as the most ultimate and economical solution, a combination of PON, appear as promising series of technologies for broadband access networks, which display tremendous feature when deploying homegrown fiber (FTTH) networks in scenarios [41, 42].

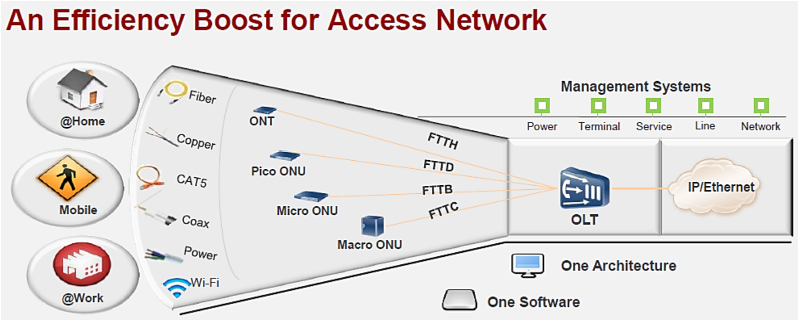

Figure 4. FTTH for access network using PON

Infrastructure sharing of the PON is the extreme usefulness, meaning that we must combine the signals at the physical level before transmitting it through the fiber by using different type of multiplexing [43]. Therefore, a technique developed in the mid-nineties of the last century by service access network group (FSAN) that created the foundation of ITU-T standards. Broadband PON (BPON) was the first perfect criterion know by ITU-T in 2001, 622.08 Mbit/s in the bitrate in the upstream direction and 1244.16 MB/s bitrate in the downstream direction with radius approximately 20 km and up to 64 ONU. After 2012 it became a new generation that combines the TDM and WDM in a single system call TWDM which allow to use TDM on a multiple wavelength. As the new technology and standard becomes grown, next-generation PONs with preferable achievement are anticipated. Several methods have previously suggested to accomplish smooth development. The most common decisions that assign a time interval for each downlink and uplink channels is GPON (as we will discaused it brifly in the method part) we used for downlink to each user (time division multiplexing (TDM)) and we use for uplink for each user (time division multiple access (TDMA)). To date TDM-PON has been the only PON, pattern fully combined by ITU-T, since the else potential already have been presented, optimized, calculated, examined and will be standardized in the future as shown in Figure 5 [44-46].

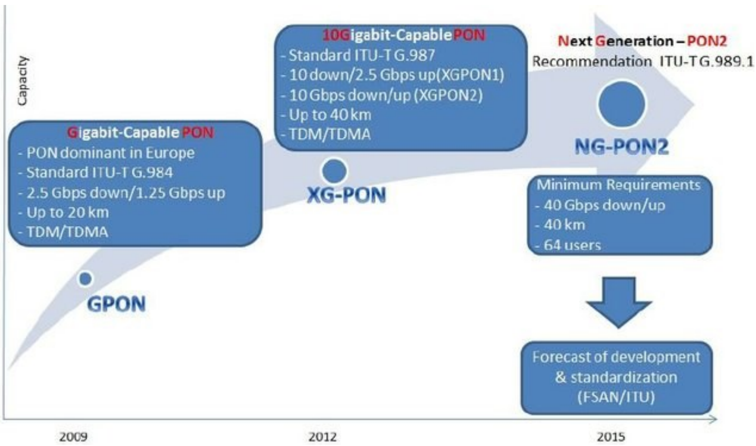

Figure 5. FSAN evolution roadmap [47]

The large-scale deployment of FTTH, which is expected to occur in the future in various area, is probably to be carried out not only with the current use of GPON, VCSEL or EPON technologies, but also with different suitable and more sophisticated criterion such as NG-PON2 and ITU-T XGPON [48]. In following years, the preferable nominee for the next generation NG-PON1 resolution is XG-PON. The following move will be the NG-PON2 resolution, whose framework demand has previously been standardized in 2013 by ITU-T G.989.1. NG-PON2 should maintain a total throughput of at least 40 Gbit/s and bigger than 10 Gbp is on the upstream side, with an ultimate, radius of action of the passive fiber of 40 km and up to 60 km, ultimately utilize extension extent, and more than 64 ONU are linked to such networks. Furthermore, NG-PON2 solutions should include harmony with inheritance GPON and XG-PON systems and with present

ODNs, while preserving investments in the infrastructure for long term, suitable with conventional ODNs is not compulsory, and thus perfectly creator decisions can be made to overcome conventional TDM. In the in the near future may be known, by NG-PON3 [49, 50]. The purpose of this article is to offer an enhancement framework for redeploying PON technology in a vast area with a great number of users, with various data transfer speeds, served by number of CO, accordingly what can occur in some big cities which is planning an enormous, show in the FTTH technology utilize PON.

2. FTTH AROUND THE WORLD

In recent years the broadband network is trending globally duo to quickly raise the number of IPTV service provider (SP). It was reported that DSL technology seem to be approaching its end, and since functional distribution of data rates that near 1 Gigabit per second (Gbps) cannot be achieved even if we used the state of the art of XDSL. Therefore, we go with the modern access networks, that led to the emergence of optical fiber networks not only to businesses but to individual homes also like home/business (FTTH/B). FTTH connections still constitute a minority, making up 9% of 271 million only in a fixed wired worldwide. 33% of actual users of FTTH have switched from ADSL, and 50% have switched from dial-up and ISDN. Unfortunately, it is noted that most of the world-wide fiber is not lit because about 18% of the world submarine fiber is used only and 80-90% of the world's built-up fiber is not utilized. Even that the number of FTTH consumer is promising to keep going, in February 2006 there were 46 joint ventures in Asia, 87 joint ventures in Europe, 213 joint ventures in the North America and 24 joint ventures in others country [51-53]. Below we will discover some country and how the FTTH is growing:

2.1. Africa

Fiber optic communications with homes are currently deployed in main African cities, like the Cape Town capital of, Harare capital of Zimbabwe, South Africa, Lagos capital of Nigeria, Mombasa capital of Kenya, and others. But putting the developing countries of the third world in the railway of fiber to the home (FTTHut), need a special specifically designed for the African continent. Because countries in Africa yet distinguish by minimum income, unwell infrastructure and scattered inhabited settlements. Furthermore, developed countries have a high income for each person due to inhabited domestic complexes. In Figures 6 and 7 shows illustrations of various cases of FTTH and FTTHut networks are established depending on PON technology [54-57]. For the specialty of Africa, we chose vertical cavity surface-emitting lasers (VCSEL) because of the unique and tremendous advantages that are of great interest in the recent past which fit our purpose. High data throughput, cost effective and high data rates, unlike classical DSL technologies that were applied to transport the information over connected telephone [58].

2.2. North America

In 2011 North America has 9.7 million subscribers, and in 2016 there are about 13,400,000 FTTH/B subscribers. According to a recent research study that support by Fiber Broadband Association in North America, over 400,000 fiber routes has been deployed in 2019, meaning that a 16% growth and almost 7,500,000 new fiber connectivity. Now these houses become more than 46.5 million compared to the 50,000 homes in 2002 [59].

Figure 6. Domestic residence in developed country [57]

Figure 7. Domestic residence in Africa [57]

2.3. United States

In 2009 the United States of America stepped up its aspirant agenda called, "Connecting America: National Broadband Plan," to supply 50 Mbit/s upstream and 100 Mbit/s downlink connections for 100 million American domestic and 1 Gbit/s to regional communities by 2020. Providing Gigabit access has befitted as an objective, since 2013 Google's initiatives influenced the momentum significantly, because followed by private sector operators and particularly a several cities. At the federal standard, the city ministry and the federal commissions committee have declared new scale in associate of cities rollouts. [60, 61].

2.4. Asia

In the first half of 2009 dominates this market in Asia with roughly about 78% of the world's FTTH user. With 54.3 million subscribers in 2011. In December 2018 across the APAC (Asia-Pacific countries), there were 427.7 million FTTH/B subscribers). Overall fibre now take-up rate 77.6% higher than 2017. The gtowth expectation in 2023 is 35%, in another word FTTH can reach ~576 million subscriptions. Growth will be mainly in the highest populated countries, like China and India as shown in Figure 8. Looking ahead, the main focus areas of the FTTH Council Asia-Pacific will be best practices, smart cities and 5G- a keyfactor for fibre promotion. Other countries such as, Sri Lanka, Philippines and Thailand have also experienced strong growth, increasing homes passed by more than 25%. In addition, there is counties that just start new ptoject to catch up the FTTH rais like New Zealand (NZ) that currently working on a high speed FTTH project called ultra-fast broadband (UFB) initiative. Which is expected to end by 2019 [62].

Figure 8. APAC ranking as at December 2018[62]

2.4.1. Japan

In 1986 Japan began using optical access services. In the premature level of services were introduced to business subscribers and involved a high speed rented line. The first FTTH service was launched in 1997 with the CATV video transmission service. ADSL services have become devilishly obtainable since mid-2000. Since that time, the ADSL service has grown at an unbelievable pace. In December 2004 the number of ADSL subscriber overrides 13 million. Speed of ADSL was initially 1.5 Mbps. The ADSL service supplier is suggestion more and more high-speed ADSL services, for example 12 Mbps, 24 Mbps and 40 Mbps, consistently over the final several years. There has been no killing application for ADSL with high-speed services until recently. Even with the strong race from new competitors [63].

In addition to telecommunications operators, is likely to be a factor in market growth, in January 2007 the connections of FTTH has exceeded that with ADSL. As a consequence, a new service with higher speed ADSL have been successively excessively deployed lately, FTTH users tripled in a recent year the market which that led to high-speed internet access that expanding very fast, exceeding 2.8 million in March 2005. In turn led to an even faster Internet service produce by FTTH. In June 2016 the number of the subscriber is reach 28,000,000 FTTH/B. Although the ADSL still played a leading role in the provision of high-speed internet access services. In the time the FTTH market is spread very fast. ADSL development has decelerated led to broadband access transform from ADSL to FTTH, driving to FTTH. B-PON has been coming in with a great scale to display since 2002. In [64-66] response to these demands and others for the future Gigabit PON will saturate these requirements. Many different Contributors have participated the FTTH market. But the most used are G-PON from ITU-T and GE-PON from IEEE which they are using Ethernet products. We are seeing a sharp decline in prices for media converters, which can be achieved through the exchange of technologies and products in the local network. The decision behind developing the next generation FTTH system (GE-PON as) has come from the need of high-quality IP phones and IP videos are becoming conclusive for FTTH core services [67-69].

2.4.2. Korea

FTTH with WDM-PON and E-PON diffused in Korea. Since January 2008 FTTH infrastructures have been diffused with 1.2 million subscribers. On June 2016 the number of the subscribers reaches up to 14,726,396, use real FTTH/B services [70, 71]. Recently, the growth in the number of new users for every year has been intense. This is a consequence of high contest between some telecommunications, ISP and several system operators. Subsequently ISP is working on some attempt to provide more bandwidth to subscribers and not to other providers. Therefore, for the first time in the world an access network technology was implemented with 100 Mbps and called Giga WDM-PON.Wavelength division multiplexing (WDM-PON) with colorless fabry perot laser sources (FP-LD) with injection blocking in some area test sites in a new apartment with five hundred subscribers in Yong-in [72-75]. Making a test for two reasons, firstly accomplishment of GW-PON as an FTTH solution for apartments with high internet, IP-TV and VoD for FTTH services. Secondly, to test its convenience for supply HD video services, since the ratio between the flat and inhabitance intensity is very big [76]. As shown in Figure 9, the high-performance OLT not only reduces capital costs by reducing the expense of installing optical cables, however, leads to Operation expansion savings due to relocation and reduction of central offices and efficient operation [77].

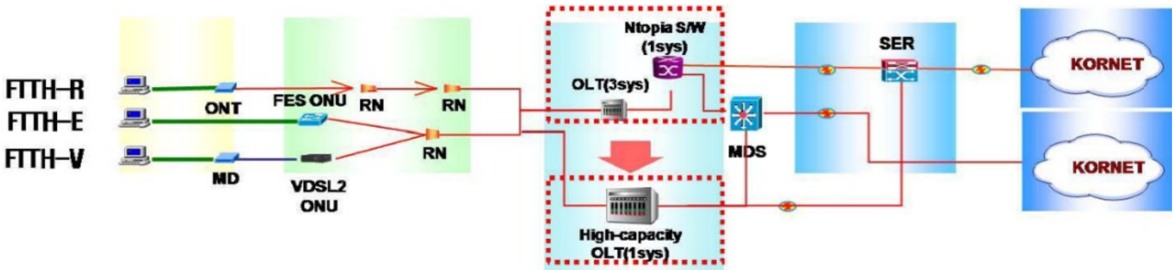

Figure 9. FTTH Network diagram using high OLT capacity during the deployment [77]

2.4.3. China

As the largest country in the world, Chinese players is the leader of the market for the next decades. In 2015 the number of FTTH/B user has been increased significantly. In the contrast to its eastern countries, Japan and South Korea, FTTH improves is overdue, but fixed in China. To understand the status of FTTH in China [78]. As shown in Figure 10 China Has the second ranks in the number of subscribers in the world and dominate as the first worldwide in the new subscriber broadband per year. User accessibility is yet restricted (annual per capita income is about $2,249 in 2007) in expression of the price of access services broadband. Even their broadband users have the second number in the world. One of the most occupied technologies is wireless access that has almost 27% of marketing, number one is access network technologies is for cable access. FTTH is just starting in China with a minimum penetration, average of less than 0.02% [80-83]. Despite this, xDSL is the first choice in China, with a mark of 58.38%, as shown in Figure 11

It is expected that the growth rate will be continued in the next few years. Now the growth is 167%. It is predictable that the amount of FTTH subscriber will increase faster as usual. Large grain the bandwidth exhaustion of each FTTH subscriber on access networks can lead to the exhaustion of bandwidth on metro networks. According to the study, the development of FTTH will be brilliant. Technological advances and political support will facilitate the deployment of FTTH. In addition, in 2008 some appropriate element is also useful for the deployment of FTTH. Consequently, to supply FTTH users with cost-effective protection it should be mutual with wireless access. Such an appropriate factor gives the ability to raise FTTH penetration [84].

In a sophisticated metropolis (like Shanghai, Beijing), high level wireless access networks will intersect with FTTH deployments. Therefore, wireless access can be connected to FTTH, to ensure the protection of FTTH subscribers in a cost-efficient manner. Clearly, the FTTH penetration increase as wireless package increase. The FTTH connected homes market grew from 11 million at the end of 2006 to almost 86 million at the end of 2011.

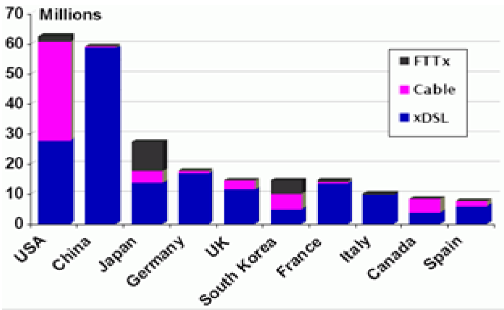

Figure 10. Broadband subscriber distribution number and the ratio of adopted access technologies [79]

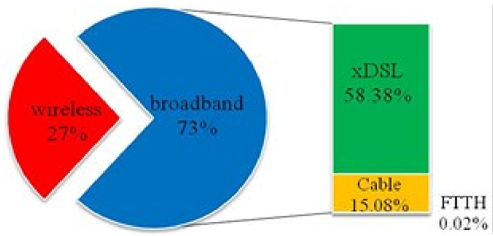

Figure 11. Technologies of Access marking in China in 2007 [83]

On June 2016 it reaches up to 151,380,000 subscribers. It is exemplifying 5% of all households in the world and 14% of the overall constant broadband market, in the time where 22% the broadband GPON connections. A project called fiber convergence-China (FC-China) was launched, in which the number of FTTH subscriber from 2008 to 2017 may increase approximately 153.75 times and in 2017 is expected to take 50% Proportion of broadband marketing [85], as shown in Figure 12. At 2007, the marketing of FTTH providers is estimated at $43.73 billion.

Figure 13 construction of FTTH investment costs compared with the marketing of the FTTH service provider in the period from 2008 to 2017 (the price in dollar.) To understand the various among China and the remain of the world during the development of FTTH, we first monitor the socioeconomic status in the world was in China [86]. In addition, each year China has sat on the first number of new users in the world. Therefore, this leads to an increase in consumption in access networks and throughput [86].

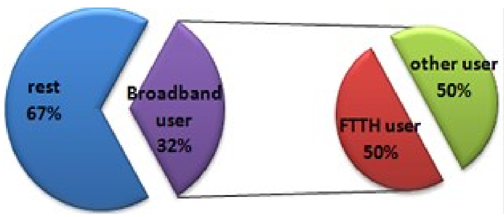

Figure 12. Access technologies in 2017 shows the population penetration rate [85]

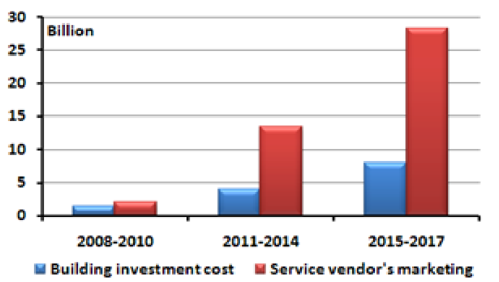

Figure 13. Penetration rate of access network technology to the population in 2017 [86]

2.4.4. Taiwan

Taiwan's growth was 25%. There are various ways to combine wireless networks with fiber-based access.). It is a reference technology for multipoint deployment, providing a maximum throughput rate of 1.25 Gbit/s in the upstream direction and 2.5 Gbit /s in the downstream direction, shared by a maximum of 64 users (ITU, 2008b) [87]. And in south west Asia countries like UAE Has a 1.52 million FTTH/B subscribers. The main players are implicated in FTTH/B market, with an increasing market portion of 87% with a national, concealment operators have a finish 100% fiber optic network) led to take up rate (subs/HP) is 88,8%, which emphasize the large merchant accommodation of FTTH.

While in Saudi Arabia Has more than 684 K FTTH/B user their merchandise dynamism certain for each year with 3.9% user development between Sept 2015 and Sept 2016. In addition, Qatar Has an increasing merchandise with 279K FTTH/B user, the inhabitant FTTH coverage: spread in 2014 A affirmative increasing in the number of users with 13% sep2015-2016 and in the number of homes passed +9% - Sep 2015-2016 they persuasion its subscriber to transformation to FTTH.

2.4.5. Iraq

One of the FTTH projects in Iraq for is Al-Ghad FTTH network based on GPON architecture that represent as a project of Iraqi telecommunications and the postal company (ITPC). Using the present fiber infrastructure resources like CO, and PDN networks [88]. The CO can serve 6000 subscribers by deploying two OLTs located on a total area of about 32 km^2 with the ability to process at least 115,000 lines in the future. This network has two types of service to represent a voice service (VoIP) and high-speed internet (HSI). Through two types of topologies which they are:

As shown in Figure 14 the ring topology used to deploy a passive FTTH network, offering protection for an ODN. His job is used as feeder cables which connect fiber terminals (FDT) to the CO by splitting the first 2:4 levels [89]. Star topology used to connect several fiber allocation terminal (FAT) to every FDT by splitting the second level 1:16 to have a spare capacity by 20% to meet future needs [90, 91].

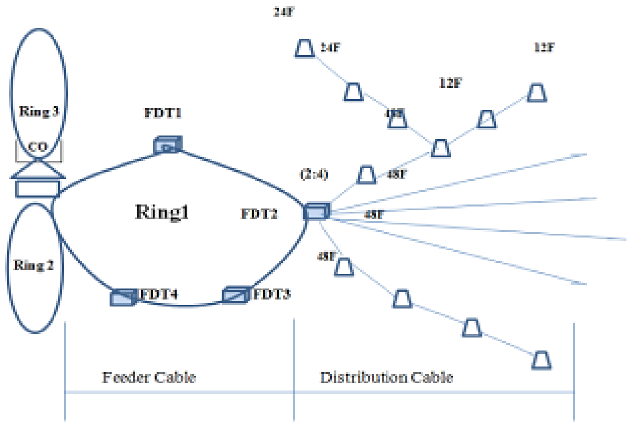

Figure 14. Penetration rate of access network technology to the population in 2017 [91]

2.5. Europe

In September 2016, nearly 148 million FTTH/B homes passed in EU39 and more than 44.3 million FTTH/B subscribers end users are transformed to FTTH networks. But the transformation to FTTH/B connection is not organized until now and so, there is yet a great space for communication with operators. Acquiring to in all EU28 countries' requirements, the local authorities and governments are entering to obtain digital agenda (DAE) DAE sets Europe's connectivity targets: which consist of, urban, suburban or village subscriber that should have access to connectivity displaying a download, with speed of at least 100 Mbps, for 50% of European households and 30 Mbps for all at least. Which can be improved to 1 Gbps by 2020 to keep up with a peak data transfer rate in the European requirement for a growing population. But still These appear preparation very humble goal when compared to existing, technological possibilities, and the running speed of the Gigabit competition [92]. The conquest of all European fiber optic infrastructure and its, running proved to be additional cost-effective than employing the 10 Gbit S service (depending on SDH) synchronous digital hierarchy and refers to a multiplex technology used in telecommunications) supplied by a conventional telecommunication operator. The National Research and Education Network (NREN) supply a link for the education and research community in a particular European country.

Mostly in the countries of eastern and central Europe, when it came to providing communication for scientists, the situation with green fields was discovered. In addition, at that time, the national telecommunications, communications runner did not have an infrastructure that could provide the expanded services necessary by the community. Thus, NREN began to obtain dark fiber and light it themselves Overwhelmingly, 1 or 10 Gigabit Ethernet was applied to work immediately over fiber, much like a local area network concealing the whole country. To maintain low costs, not the SDH framing or linear amplification was applied. Consequence such as 1 Gbps Ethernet transmission over 300 km without integrated amplifiers were completed. Currently, most of the 30+ NRENs in Europe use fiber optic backbones. These national fiber optic backbones are connected through GEANT2, Research conducted in this area is always aimed at improving the services provided. The flagship project GEANT is actually the seventh generation of collaborative research networks across Europe. GEANT, was an important milestone in providing communications for scientists by deploying a great scale like 10 Gbit S service all over Europe, beating any other research network in the earth. and took the lead in its wide availability throughout Europe. Currently GEANT2 as shown in Figure 15 marks another milestone because it is largely established on the dark fiber infrastructure, that is explained and administer by the research community herself to response the expanded services needed by the community, and not by the telecommunication operator. Which also provides international connectivity. GEANT2 uses the framing SDH and DWDM system and for transmission, while SDH interfaces and Gigabit Ethernet are available for NREN to connect. Since each of the NRENs has prevailed its own broadband technology, inter-domain communication and administration in such a diverse environment is necessary [94]. In addition, the scientific community is awaiting the provision of comprehensive services. The Lard Hadron Collider at CERN in Geneva will requirement separate 10 Gbps channels for approximately 10 lines 1 location in Europe and around the earth. With NREN and GEANT2, this connectivity is now a potential across Europe

The test obtained in supplying low-cost fiber-optic solutions also finds good use in emerging economies (for example, in the Balkans) to allow them to jump through intermediate technological procedure and directly diffuse the ability of a Gigabit network [95]. 0.52 million in Eastern and Europe 5.7 million in Europe. In addition to what mention, some small counties like Slovenia has ot is oun FTTH project providing an active FTTH connections apromaxitly 813,531 households in 2006 as shown in Figure 16 [96].

2.5.1. Spain

Since 1998, licenses have been granted for the deployment of HFC (Hybrid fiber-coaxial) networks, and it is planned to cover many cities. Now days, modern operators, have centered their effectiveness only in big cities, going away the remainder of the network to the ADSL which dominating 70% of the broadband market. The existing operator with a broad coverage has, 0.4 million wireless lines, 5 million HFC lines and 20 million copper lines [97].

2.5.2. Latin America

In Latin America the FTTH market has grown significantly. 2012, the number of subscribers reached 741,000, and about 5.5 million homes were commissioned in December. In one year, the subscriber increased by 112%, and returned 31%. Various types of solutions are discussed: Field assembly x Hardened mortar. Hardened mortar, pre-assembled at the factory, proved that it was good, but costly with regard to local needs. Thus, because proprietary solution of one supplier led to easy to install, but for different lengths inventory it is difficult to manage.

The optical access solution established on minimum contact optical cable-optic butterfly (NTT specifications) turned out to be very interesting in the area because of the listed main reasons, such as, economical, open solution with many suppliers and ease of installation. The decision is made by many telecom operators in Brazil, Uruguay, Chile and Colombia. Such a solution is widely used in the Asian market, which ensures that the price of this resolution will significantly drop in the near future. In several countries, such as Chile, Bolivia, and Argentina, the community has established Telecommunication cooperation to provide to the poorest people these services. Telecommunications cooperatives have also selected the FTTH network in state of wireless, due to future demand. In Latin America the deployed architecture -FTTB-13% and FTTH with 87%. Most of the separated technologies are PON with 87% and point-to-point Ethernet is only 13%. EPON was selected by Incumbents and GPON. In December 2011 small country like Argentina has 5.5 million users, collecting about 4 million homes and Mexico 246 thousand FTTH/B subscribers. With breakthrough average is 18.1% and finally the Uruguay and Colombia, which their Project is reaching up 49K subscriber and 64 thousand subscribers respectively [98, 99].

2.5.3. Brazil

Brazil with 124,000 subscribers, in one year the number of subscribers more than doubled. which Telefonica company dominated the market. In Brazil, poor attendance by large telecom operators (occupying this position) of broadband services has led to the emergence of hundreds of internet service providers (ISPs), small telecom operators providing a high rate of quality services and speed. The providers of these small telecom operators have begun to invest in low-investment wireless technologies, concentrating on service quality. Internet providers were qualified to get an acceptable basis for face difficulties and attracting customers. In the time where existing employees come with higher broadband speed service. To gain a competitive edge the only solution is found by internet service providers by their investment in FTTH technology. Now days, FTTH is already used by hundreds of small ISP operators [100].

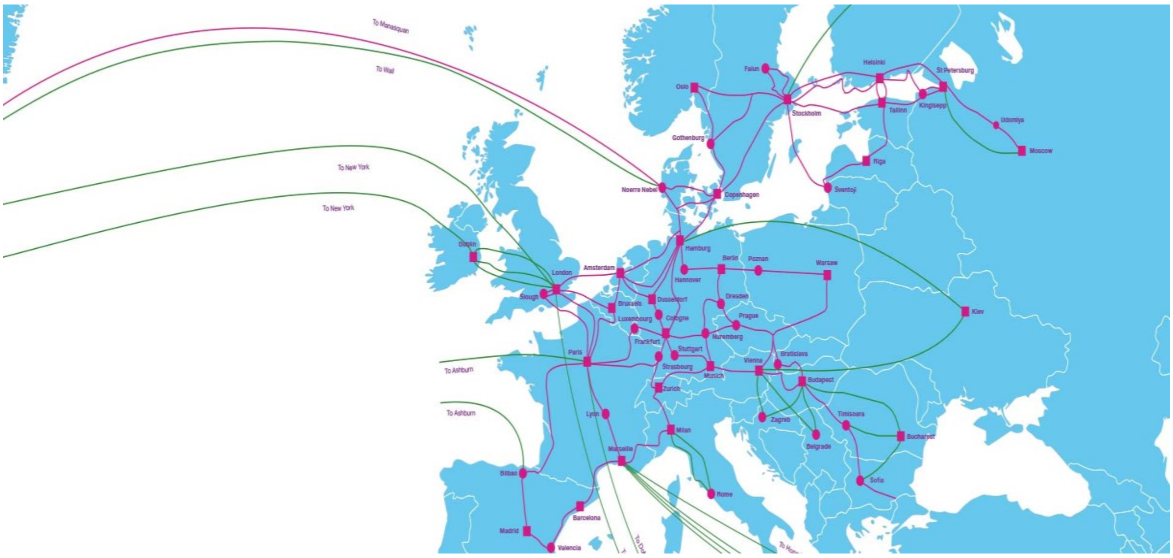

Figure 15. number of wavelengths lit at GIkANT2 topology network launch [93]

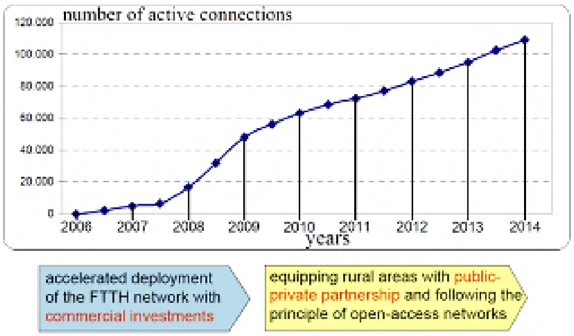

Figure 16. FTTH active number connections in Slovenia [96]

3. MATERIALS AND METHODS

There is an urgent need to simplify the installation of fiber optic networks to distribute signals among multiple users, providing a high degree of reproducibility and limiting installation costs due to interruption of fiber optic communications. Different approaches are used to overcome the termination problem. Most of them require complex procedures and the employment of qualified personnel.

In order to provide cost-effective services with increased capacity in the future, telecom operators need to reduce unit costs per bandwidth with a speed significantly exceeding 70-80% of the training curves commonly used by optical and electronic technologies. Simplify the network is done by decreasing the number of nodes, equipment interfaces and network elements. Another way to achieve simplicity is long access. The project of long-range access is to utilize a high-capacity, high performance PON with a distance of up to 100 km to join the metro and optical access into a single system. The central office will contain a few numbers of low power physical layer repeaters, like optical amplifiers. The PON equipment will be existing in a few numbers of localize big service nodes.

Laser diodes are generally utilized as optical sources; they are usually preferable to LEDs because they let high power radiation (usually up to 100 mW) and the chance of direct modulation at high frequencies (usually up to 25 GHz). TDM-PON uses traditional Fabry-Perot lasers because they are the inexpensive way. They are not appropriate for WDM-PON due to their multimodalities and high gain bandwidth. Distributed feedback lasers (DFB) may be superior in these networks because of their excellent high-speed modulation characteristic and to their small bandwidth (minimum than a few megahertz). Unluckily, they are yet very expensive and should request a thermo-electric cooler (TEC) module needed to recompense for a move in wavelength of around 0.1 nm/°C. VCSEL (lasers with a vertical surface cavity) must be probably more appropriate for minimum - cost large production, however sources of type like this sending at 1550 NM are still not commercially obtainable, since their thermal and optical characters at this wavelength are not yet sufficiently developed.

In spite of that, some semiconductor lasers can be modified up to 40 GB/s, systems working at 10 GB/s or higher must utilize the external modulation. In fact, the impact of twitter will not become more insignificant and will cause the broadening of the spectrum. This aspect, in combination with the fiber group velocity dispersion (GVD), must restrict the obtainable range. You can use both the electroplating modulators and Mach-Zehnder LiNbO3 interferometers to increase both the passband and attenuation coefficient and thus decrease the insertion loss.

APD (avalanche photodiodes) or PIN photodiodes can be used Optical receivers in the PON. The demand for developing the total sensitivity of the receiver is done by designing tens of impedance amplifier bandwidth generally to be 0.7 times bigger than the bit rate, which is an acceptable compromise among intersymbol interference and filter suppression because of limited restricted. The most common system is:

3.1. Gigabit passive optical network (GPON)

Gigabit passive optical network (GPON) is one of the most common PON technologies. Standardized by (ITU-T) Telecommunication Standardization Sector named in a series of recommendations called G.984 and chosen by many of the telecommunication providers in the Australasia, Europe, Middle East, and North America. In the downstream direction the traffic is asymmetric with a speed of 2.5 Gbit/s and 1.25 Gbit/s in the uplink as shown in Figure 17.

GPON consists of three major parts: first an optical line terminal (OLT) is it connected to the backbone network and existed in the central office. Second an optical distribution network (ODN) located between the OLT and ONT and consist of splitter and sometimes an amplifier and the third an optical network terminal (ONT), ONT is attached to all network devices in the house which is existed there to service many applications like game consoles, voice over internet protocol (VoIP) telephony, wireless access point (Wi -Fi), home security and others. Between the start and the end of the passive optical distribution network all the infrastructure is passive, so it can work without any power supply. Optical splitter that is located almost among the OLT and the ONT is the extreme significant section of the ODN. An optical signal pass through optical splitter can combine and divide to serve up to 64 users. In GPON criterion the maximum limits of the ODN length is 20 km, which is enough for most network access. Using time division multiplexing (TDM) Data is transmitted from the OLT to the ONT in the shape of broadcast mode, on the other hand time division multiplexing (TDMA) used in the upstream direction access. 1490 nm (data) or 1550 nm (overlaying analog video) wavelength is allocated for Downstream transmission, while in upstream direction we used 1310 nm for data transmission.

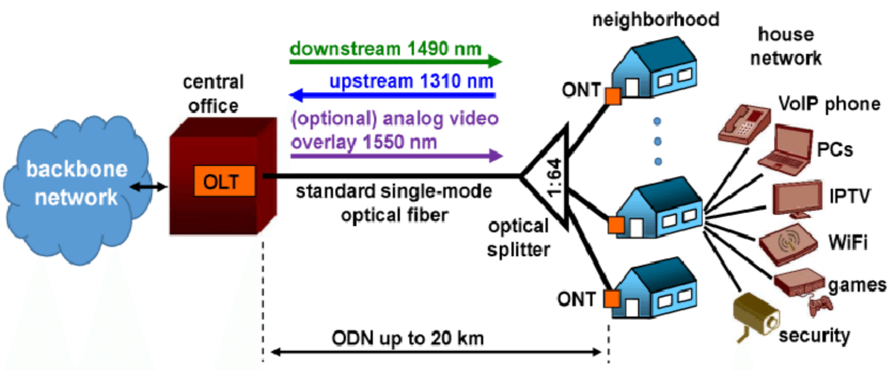

Figure 17. An optical access network in GPON

3.2. EPON

In 2006, a task force of the IEEE 802.3av was created to develop a PON standard with a speed of 10 Gbit/s. EPON was invented and is widely used After the success in Asia. EPON initially transports Ethernet frames. This is primarily a semantic difference, since GPON GEM also encapsulates Ethernet frames at lower costs than imposed by IEEE 802.3.E As an outcome, EPON network operators must specify a new specification belong to them. Two groups of management methods are present (optimized by non-SNMP and SNMP) are defined to adjust the reality of employing various management ways over millions of EPON lines. But the open question of, when and how to update the existing EPON network to a newly specified control specification is still unknown.

3.3. VCSELs

VCSEL offers single-mode broadband performance for convenience of energy efficiency and direct modulation in the C-L band wavelength tuning and at low excitation currents. VCSEL is perfect for high-speed optical communication networks at relatively short distances, recently reported; 40 Gbit/s at 1550 nm, 12.5 Gbitps at 1310 nm and 71 Gbitps at 850 nm It has been clear that these technological modern growths in VCSEL have contributed to the efficiency of the future applications, thus achieved in all transmission windows. However, the operation of a VCSEL is restricted by chromatic dispersion and the chirp at the wavelength. Experimentally dissect 4.25 GB/s 1550 nm VCSEL with a concentrate on optimizing communications to improve the reach of remote users.

4. RESULTS AND ANALYSIS

The constructing of a lot of optical networks was majorly started between 2002 and 2008 let the word inters in to what call internet bubble ware the growth rate exceeded 100% even There has been no killing application. Despite of growing was relatively strong and the bandwidth demands were greatly exaggerated, consequently FTTH has slowed slightly since 2008 because the market was flooded with unnecessary capacity. For example, the cost per bandwidth of 10 Gbps per month between New York and Miami the coast minimizes from $75,000 in 2005 to less than $30,000 at the end of 2008, as well the price of connections at 10 Gbps/c among London and fell. 80% from 2002 to 2007. As a result, customers such as corporations and banks consume large data for transformation have started to use their own optical networks and buy cheap dark fibers. Similarly, the monthly rental costs for fiber optic connections have dropped significantly. Generally, replacing electrical cables with optical technologies solved the traffic jams that was exists about 10 years ago in access networks, but it is unreasonable to anticipate users to pay for additional bandwidth provided by FTTH, which they may not be necessary in some cases, in addition XDSL currently can meet user bandwidth requirements at minimum price. In the near future XDSL technology seems to be approaching its limits, and effective delivery of data rates that near 1 Gbps is cannot be achieved. Consequently, selecting FTTH network architecture must be accomplished in the near future.

4.1. Operative issues

4.1.1. The first set cost (IFC)

In the begging stage of the FTTH market. We should step up efforts to present user friendly technologies, even if they require some loss of productivity. Easy installation technologies will allow us to display FTTH services in an extremely large market and quickly. In addition, the major motivation is to reduce the amount of optical cable needed for the distribution and removal of fibers, which ensures a minimum primary expense of an external cable system when accomplishing the FTTH network. The SP sets a service charge depending on the predictable level of use of the PON. If the existing PON using average override the expected stage, the FTTH service is considered as profit.

We will focus on PON as a model. Deploying FTTH need a huge investment in fiber-optic infrastructure, in addition to that the small number of subscribers and the big cost-effective method of providing FTTH for such economic and technical assessments. Lied to make the density of request started level of the FTTH market is minimized. Therefore, the using PON in these makes are weak and leads to higher price, this led the FTTH provider not be able to encourage demand, generating a case with chicken and egg, so an expansion in the use of PON is significant. It is shown that the cost of deploying a fiber-optic infrastructure is the dominant component of capital costs is the digging trenches is cost (~70%) for the implementation of underground infrastructure, the remaining cost (~30%) depends on the selected technological solutions.

In addition, the cost of deploying FTTH may vary in various parts of some countries. For example, operating costs (OPEX) and capital costs (CAPEX) in village territory are much more than in cities. Thus, as we have already mentioned, developed cities will become the most preferable for the deployment of FTTH. For village territory, FTTx plus xDSL can be the main approach of broadband access technology. We reached our first goal with the cost of the product. The following preference is increasing the PON using average and reducing construction costs.

4.1.2. Speed

The speed is very dependent on the location of the optical splitter. When the single stage separation is used, and the optical splitter is positioned next to the user, the PON usage, average will be depressed in the beginning level of the FTTH market. On the other hand, if the optical splitter is located close to the CO in a single stage separation architecture, this distribution increases the level of PON usage, however, at the same time increases the length of the optical fiber allocated for each client, which leads to higher prices. A two-stage separation architecture, in which one optical splitter is located close to or in the CO, and the other optical splitter is located next to the client, can decrease first set cost in the beginning stages of the FTTH market.

4.1.3. Service

The competition in speed has already been established, now FTTH providers are starting to implement the Gigabit PON system, but we must execute it counting in our head redoubling and our efforts to achieve economics so can be distributed. Gigabit-PON (GPON) and Ethernet-PON (EPON) are the most two popular PONs in which GPON is widely deployed in America while EPON in Asia. Compared GPON to EPON. GPON is more advantageous, more robust, offers more capacity and has higher profitability. We observed a sharp decline in median prices for services, high quality IP Telephone and IP video are becoming critical basic FTTH services. The relatively cheap VCSEL-based high-speed optical network is designed for the FTTHut scenario. Ensure error-free transmission in the optical network High WRC values and dispersion control must be obtained. Using a single Raman pump in any scheme can obtain a transmission of about 80 km in length. The bidirectional scheme is a great solution for longer coverage extending beyond 100 km. Thus, the use of VCSEL with disperse control based on Raman scattering is vital and suitable for a network with long access in the African scenario.

5. DISCUSSION

5.1. The problems

5.1.1. Administration problems

The above observations show us a clearer picture of the problems of FTTH worldwide, which is:

- It is necessary to develop a low-cost fiber optic network architecture, since it is directly related to the accessibility for users and penetration rate of FTTH.
- A great number of FTTH subscriber may lead to a massive bandwidth exhaustion in metro networks.
- Service reliability must be taken into account, since the failure of broadband services can lead to a big data loss.

5.1.2. Technical problems

FTTH service is increasing rapidly all over the world, but we meet an issue when providing a service. In other mean, we have issues of keeping up with the requirement. To prepare the FTTH service after registering a user, it takes several weeks and sometimes several months. This delay can be explained by three reasons.

- We must start with the main cable installation step in case the optical cables were not installed in the new user zone.
- It requires several days to extract the needed network elements, like distribution cable, feeder cable, OLT and splitter, because the distribution of network elements is done manually and separated across several departments.
- What called “bottleneck in the first mile” or some time called the “first 100 m”, namely the installation of the drop cable and internal wiring, is the biggest bottleneck for a quick and widespread deployment of FTTH. An internal cable and output cable are connected and stacked in an optical cabinet. Internal cable is installed inside the pipe or laid on the wall and is connected to an optical access. The ONU connects to an optical outlet using an optical cord. These optical cables should be handled with more care than metal wire.

5.2. The solution

5.2.1. Administration solution

The governments payoff for installing lower class FTTH networks. But relying on the private sector, which is unlikely to happen, on the other hand, there are a few exceptions related to the deployment of FTTH, in order to correspond to the lower strata of the population in the region by:

- It is necessary to develop a suitable business model, since it is directly related to the level of FTTH penetration and accessibility for users.
- It is necessary to take into account the reliability of the service, since the insufficiency of broadband services can lead to huge data loss.
- A great number of FTTH subscriber may lead to a big bandwidth exhaustion in metro networks., we are learning how to resolve these basic problems associated with the introduction of FTTH in China.

5.3. Technical solution

In some countries like china and Iraq when deploying FTTH, each type of operator (cable networks, telecom operators and wireless communications) created its own metro network infrastructure. To avoid bandwidth exhaustion in metro networks and a cost-effective, immediate solution by allowing cable operators to take part in the access business. To accomplish the large-scale FTTH deployment, we must enter the FTTH era by:

- Create attractive services.
- Develop technology to ensure future value.
- Development of technologies for a quick and very wide range of services.
- Development of technologies for simple and cost-effective upgrade services.
- Develop technologies to bridge the digital divide.

The main reasons for such a low level of penetration are: the obstacle of providing the service to all users, since they are existed in the far distance. Government incentives are fateful for getting services in outside urban centers and poorer places.

6. CONCLUSION

FTTH infrastructure is the extremely costly in the installation and deployment, but still the best in performance among other technology. To accelerate FTTH penetration we need a business strategy come up with successful investment in the new building. In many real-world contexts, and further incentives have emerged to offer new solutions and explore new features in order to maximize network effectiveness and decrease finance and maintenance costs. We discussed the solutions in telecommunications networks and or the economic aspect of projects all over the world, we found that GPON is more appropriable for accomplishment PON-FTTH than other networks. Thus GPON has been chosen for Europe, America and middle east. Choosing GPON techniques is decided by many factors include the infrastructure that was made before, the people demand for service and how much service they need because the need in Europe different with need in Africa and American and so on.

Europe and America as we know is the source of the civilization now days, so they need to keep up with the most advance technology in all over the world and to do so, they need a reliable and technological network that provides these services with any cost. Choosing the cheap and long life, it does not matter as the strong, fast, reliable and effective network service, therefore they go with GPON. And so the wealthy country in the middle east that the money does not matter to them, they need the best system that can be developed easily and keep up with the source of the civilization (Europe and America). Africa on the other hand, with their limited recourse they want to establish these techniques (VCSEL) to champ from the store age they live. Therefore, the most hit techniques not necessary for them all matters are the main techniques that cover their territory with low cost. Asia goes with EPON because of his economic benefit for the long life and cheap, thus they can cover their large territory with acceptable cost. (Except some company in South Korea are used GPON).

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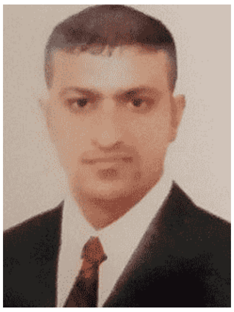

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