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Technical, Technological and Operational Feasibility of FTTH in Afghanistan

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Abstract

Many scholars have given comparative analysis and unbiased opinions and arguments to prove that FTTH and specifically, FTTH is a better discussing the security, technological reliability, speed and ease of access. On a contrary, scholars have also discussed the challenges FTTH may have during or after the implementation phase. This research discusses the exact scenarios and feasibility of FTTH in Afghanistan, its progress through the span of republic government, the challenges and proposed solutions. FTTH can enhance the demanding needs of today's internet usage, cloud computing, IPTV, HDTV, Video and Voice

communications, however, the population of Afghanistan can hardly afford ADSL, which is broadly used now. In order to enable the population to switch to FTTH, as well as, in order for the government to address the challenges of the implementation of FTTH, a detailed literature has been cited from all over the world and has been put together to address the challenges and make FTTH feasible in Afghanistan. On the other side, the technical and technological advantages of FTTH have been discussed and a technical and financial comparative analysis has been presented to support the findings and conclusion of the research.

Keywords: FTTH, OFC in Afghanistan, FTTH in Afghanistan, Feasibility of FTTH in Afghanistan

1. Introduction

In order to accommodate the applications of today's world as well as, the future technologies, Fiber Optic can be considered as a great solution. With a vivid rise in the cloud-based computing, IOT and smart cities, a high bandwidth, lower latency and future proof networks are the need of the day (FTTH Fundamentals, Commscope, 2018) ^[5]. Afghanistan has not yet met the demands of the existing generation, whereas, tomorrow's networks face unprecedented and growing demand for speed and bandwidth, where the demand on OFC networks is seen much more than now looking at the demands of video broadcasting and other demanding applications. Here, Optical Fiber has proved to be of tremendous importance since its appearance from around 1960 (Joni Welman Somatupang, Mia Galina, Christoforus Williemo Lumoindong, 2020) ^[9].

As compared to the traditional Digital Subscriber Line, twisted pair or coaxial networks, FTTH can be a faster way of transmission with low attenuation and high bandwidth transmission (Sashna M. B. F, 2019) ^[6]. The telecommunications networks have been advancing with a vivid speed in all levels of network be it in core networks, regional networks, access networks or customer premises networks. In order to dig reach the demands of the society, a faster network is supposed to be designed and offered to the public of all sectors, both for the entertainment and educational purposes. In Afghanistan, the traditional way of getting internet through VSAT is still an option and in some areas of the country, it is the only option to connect to the internet. VSAT is secure and reliable, however, it is way more expensive than what an ordinary Afghan can afford.

To overcome the challenges of connectivity as well as to take part in the digital inclusion of all (ITU, 2022), FTTH can offer feasible, reliable and fast connectivity to all premises in the country. The project may face challenges due to the geographical structure of the country, however, the end results are worth implementing FTTH in Afghanistan. Keeping the economic state of the population in mind, the cost effectiveness of FTTH (Fiber to the home) might not be affordable for most of the population, however, if subsidized, the project can take a very active role in the advancement and technological reach of the country.

2. Background

Optical Access Networks are implemented all over the world, since, the transmission capacity of the copper networks does not suffice the needs of the day (FTTH Principles, Seppo Marttila, 2015) ^[15]. In developed world, high speed broadband subscription might have increased. In some countries such as Spain, the share of FTTH has surpassed the share of legacy broadband technologies subscription (Broadband Commission, ITU, 2021). Along with high-speed transmission of bandwidth, OFC can cover a longer distance, immunity to electromagnetic interference and security. MCIT has been struggling to connect

the population through SIM subscriptions and has been successful in it up to some extent, however, challenges pertaining to ease of access and cost have remained the same as tariffs are higher in south Asian region (Sriganesh Lokhanathan, 2012) [8]. Implementing open access is a complex task. Beyond concerns such as signaling a stable and effective policy and regulatory environment (in the current context and more importantly in the future), there are myriad ways for a dominant player owning a critical infrastructure to abuse its position (Administrative Office of the President, Arg, The Presidential Palace of Afghanistan 2012).

On the other hand, the Afghanistan Telecommunication Regulatory Authority, which was an independent authority in Telecommunications and is currently working under the supervision of Ministry of Communication and IT has been given limited resources and technical capacity in order to implement open access. These limitations have been a hurdle in the way of implementing FTTH (Fiber to the Home) in Afghanistan. In this research, the technological, administrative and social aspects of FTTH project have been discussed in details.

3. Statement of Research Problem

The growing demand for a high-speed bandwidth is the need of the day. In Afghanistan, the only sources for the internet connectivity are VSAT, 3G/4G (GSM) and ADSL priced very expensive, expensive and reasonable respectively. Access to internet is not only necessary for entertainment purposes, but also for educational and research purposes. Therefore, it is considered socially vital to connect everyone to the required speed of internet at a reasonable cost. FTTH has proved to be a rational and equitable option in order to address the problem.

4. Research Objectives

1. To study the technological and social feasibility of FTTH in Afghanistan.
2. To study and compare OFC to copper networks.
3. To study the historical background of OFC network in Afghanistan.
4. To propose a solution for the feasibility and possibilities of implementing FTTH in Afghanistan.
5. To address the importance of high-speed internet for the society regardless of age, gender, religion or other discriminations so that no one is left behind (International Telecommunication Union).

5. Research Methodology

There has been very minimal literature about FTTH in Afghanistan. The subject has been of great importance in the meetings, conferences and the agenda of Ministry of Communication and Information Technology, however, very few scholarly articles can be found that addresses FTTH in a broader way, exceeding the technological aspects of FTTH. Therefore, the research has been purposely written as descriptive.

5.1 Articles and Books Selection

The research papers, articles and books reviewed for the research have been selected from two aspects. The technological aspect of OFC and FTTH and the administrative aspect of FTTH and its feasibility in Afghanistan. No exact material was available in regards to

the subject for Afghanistan, hence, a number of articles, research papers and books have been reviewed in order to get a broader image of the subject and conclude it for Afghanistan.

5.2 Government, UN and World Bank Policies and Publications

Looking at the limited scholarly data available for the subject, a number of government-published policies, International Telecommunication Union (ITU) reports and the World Bank published reports and articles have been reviewed for getting closer to implanting the subject for Afghanistan. These organizations have done years of research work and have published a number of documents detailing the subject.

5.3 OFC Manufacturers Manuals and Implementation Plans

Technologically, finding the exact demands of the research, all the technical and technological aspects of the research have been referenced from the manufacturers' manuals and installation guides of different manufacturers of OFC and accessories cited as and when required.

6. Procedure

The literature has been reviewed and proper analysis has taken place in order to present valid arguments for discussion. All the government policies and plans have been studied and all the Tending and bidding documents and solicitation documents have been reviewed for the purpose. Where possible and accessible, the tender responses and presentations have also been studied. FTTH has been overseen from the initial decree of the Economic council of Afghanistan and material has been researched in order to get to the desired conclusion.

7. Limitations

Access to most of the data from the government of Afghanistan was near to impossible due to the restrictions implemented in the current regime of the country. Data has only been taken from the internet, where available, or through phone calls and social media communication with ex-authorities of the Islamic Republic of Afghanistan.

8. Literature Review

Fixed Access Network have been a vital part of the technical and technological developments in broadband access networks of Afghanistan. The long distance from the Digital Subscriber Line (DSL) to FTTX (Fiber to the X (a destination)) has neither been easy, nor has it been feasible for the geographic structure and the monetary resources of the country. Fiber to the Home can be defined as an access network architecture in which the ultimate connection to the home of the subscriber is Optical Fiber (FTTH Council, Version 3.0, 2011). The wired fixed access networks have been dependent upon the relevant demands on network infrastructure including bandwidth adequacy, cost and lifeline of services (Krzysztof Borzycki, 2018) [1]. According to Infrastructure Transparency Initiative, Afghanistan, Ministry of Telecommunication and Information Technology has had the lowest project disclosure level (CoST, 2019) [2]. This fact has led to lack of information in the industry, fear of private sector investment and feasibility and implementation challenges both for the government and

private sectors.

8.1 Comparison with Copper

To compare the definition and technological aspects of Fiber and Copper networks, both of them are prominent communication links used in modern communication. However, focusing on the market of the region and country, copper is prioritized due to hardware compatibility and ease. However, the advancements and innovations in the technology of Optical Fiber has made it to be a new

approach in the communication systems (S. Babani A. A. Bature, M. I. Faruk, N. K. Dankandai, 2014) [4]. In the comparative analysis between the Fiber and copper, cost analysis is also meant to be one of the biggest challenges for developing countries like Afghanistan because the cost of fiber is usually higher than copper, as well as, the relevant hardware and passive networking equipment. Yet, each of these technologies have their own pros and cons depending the infrastructure that they are used in.

Table 1: Technical Comparison with Copper Cable

Feature	FTTx	Copper
Bandwidth Support	Upto 1 Gig	Upto 40 Mbps
Customer Premise Equipment (CPE)	ONT (Optical Network Terminal)	Modem
Customer-end Power requirements	AC Supply	AC Supply
Protection	Linear between OLT to ONT (in building linear)	Linear between DSLAM/RSU to customer location
MTU Support	Max 2000 bytes	Max 2000 bytes
Test supported	RFC 2544	BERT
Contention Ratio for Carrier Deployments	1:01	Difficult to achieve
Throughput	100%	100%
Interface	1000 Base LX/1000 Base T/100 Base T/E1	E1/100 Base T
Bandwidth Commercials	Aligned to present pricing on Fiber	Could be higher going forward
One-time charges	Significantly less cost to connect	High upgrade cost

8.2 History

In Afghanistan, Fiber to The Homes (FTTH) project was initially meant to provides triple-play (voice, data, and IPTV) services directly to individual buildings and premises from OFC rings. The speed would have been 20Mbps, which is ten times faster than the other ISPs in the market, with a monthly price of USD: 26 only (Afghan Telecom Extension Plan, 2020). It was planned to be implemented in 3 phases. Before FTTX, the digital subscriber line as well as the GSM services have been utilized to provide internet throughout the country.

generating good revenues, despite no practical vision towards FTTH.

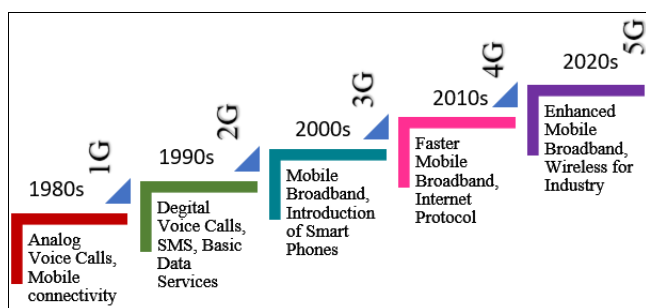


Fig 1: Development of the GSM Services, Institute of ICT Professionals, Ghana

The figure cannot exactly address the situation in Afghanistan, since, 4G could be launched in 2018 and 5G has not yet been commenced for implementation in Afghanistan, yet, pen access backbone of optical fiber cable was supposed to potentially offer significant revenues for Afghanistan (Afghanistan Fiber Ring, 2012). According to the Ministry of Communication and Information Technology, the existing operational links are already

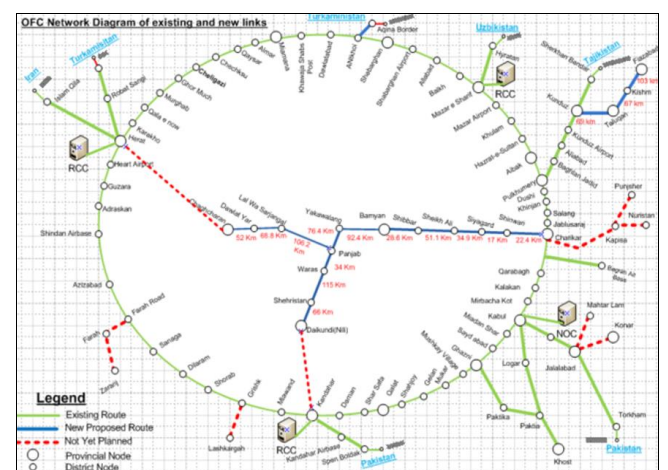


Fig 2: OFC Network Design of existing and new lines, World Bank

8.3 Structure

Optical access network can be defined as an access network, that consists of optical fiber cables and other optical fiber components extending from the access node to the optical termination point at the premises of the end user. There are several installation methods considering the structure of optical access networks, however, looking at the descriptive nature of the research, the technical aspect of the structure has not been discussed in details. An initial overview suggests that the structure of the OFC for FTTH can be typically defines as follows (FTTx Principles, Seppo Marttila, 2015) [15].

Table 2: Recommended Minimum No. of Fibers in OAN (Seppo Marttila, 2015)

Building Type	Cable Section	No. of Fiber in cable
Single Family House	Drop Cable	4 or 6
	Distribution Cable	2 x N + 24
	Feeder Cable	2 x N + 48
Row House	Drop Cable	24
	Distribution Cable	6 x N, min. 24
	Feeder Cable	6 x N, min 48
Multi dwelling unit (MDU) (Multi-Floor building)	Drop Cable	24
	Distribution Cable	6 x N, min. 24
	Feeder Cable	6 x N, min 48
Commercial or office building	Drop Cable	24
	Distribution Cable	6 x N, min. 24
	Feeder Cable	6 x N, min 48

N=Number of buildings served by a feeder cable

8.4 Official Launch

Pursuant to decree of the High Economic Council of Afghanistan dated 23-October-2018, the FTTH project was officially approved and launched by Ministry of Communication and Information Technology through a series of open and closed tendering processes. The project

was initially meant to be commenced as FTTX and provide bandwidth, IPTV, HDTV, Video Sharing and voice services to the home/office premises through fiber (MCIT Presentation, 2018). The concept of the project was made with the help of FTTH Council Europe.

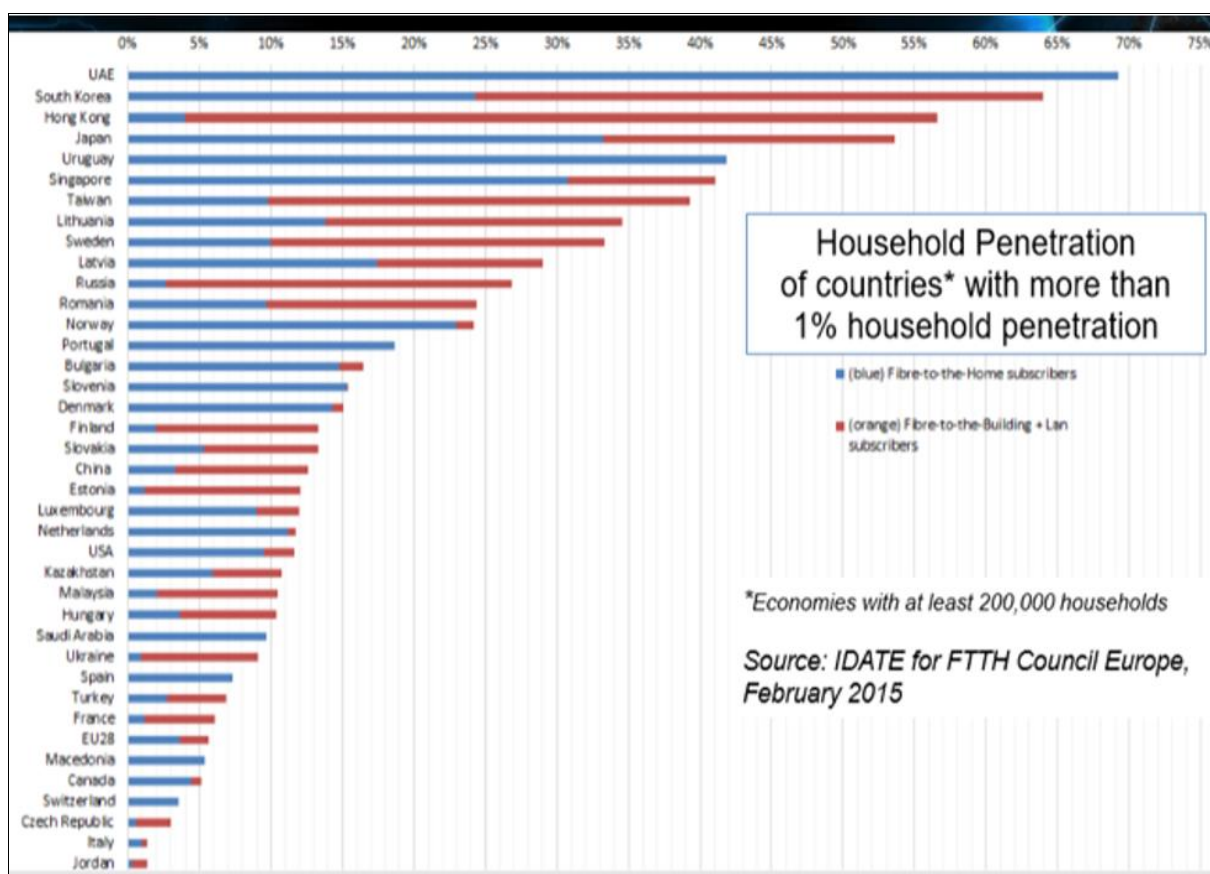


Fig 3: Household Penetration of Countries, * with more than 1% household penetration

In order to implement the project, the following points were considered by government, be it a privatization contract or a PPP agreement (AFTEL, 2020)

- Ascertain the area for the deployment with the help of AFTEL for creating fiber infrastructure
- Undertake detailed Survey and study the landscape of the area for deployment.
- Design the Optical Distribution Network (ODN) network in accordance with Site Survey.
- Integrate & manage the FTTH network with existing network of AFTEL.

- Replicate the deployment of fiber infrastructure in all the cities of Afghanistan
- Train local resources to Equipment installation / Maintenance and after sales service.
- We have the expertise and technology to leverage the existing copper infrastructure.

Afghan Telecom, under the direct supervision of The Ministry of Telecommunication and Information Technology of Afghanistan issued a request for expression of interest in order to commence the project and go with privatization or public private partnership models in order to

start implementing FTTH in Afghanistan. The reason for this tender was that FTTH had been globally adopted by many countries to overcome the many limitations appeared in copper networks (REOI, MCIT, 2019). Quite a few companies participated in the tender, however, the project could not be implemented as it had been shown in the plan SOW section of the REOI.

8.5 Current Status

Two companies have recently been contracted for the implementation of FTTH project. One of them is entitled to pilot the project in district 12 of Kabul and the other one is entitled to pilot it in Herat province. The following table demonstrates to the proposed business model canvas that is supposed to be selected for FTTH project (POPS, Extension Plan, 2020).

Table 3: FTTH Business Model Canvas, POPS, 2020

Key Partner	Key Activities	Value Proposition	Customer Relationship	Customer Segment
DABS & Kabul Municipality	Procurement and Networking	High Speed tri-play network and low-cost services	Personal Assistance and Communities	Government and Non-Government
	Key Resources		Key Channels	
	Financial, Human and Technical		Direct and Indirect Channels	
Cost Structure			Revenue Streams	
Marketing and Sales People Operations			Charging each connection Monthly subscriptions	

8.6 Challenges

Significant progress has been made in the communication technology sector in Afghanistan, however, there are still a vivid number of obstacles that can challenge the implementation of FTTH in Afghanistan (Walida Sardari, 2020) [14]. These challenges include but are not limited to physical security, high cost of internet, because internet is imported from and transited through the neighboring countries due to the fact that Afghanistan is a landlocked country; power sources and resources and economic state of the population.

8.7 Demand

In this era of time, cloud computing, internet of things and smart homes have changed the demand and use of internet throughout the world (Haider S. Zaeer Dham, 2019) [17]. The limitations of existing communication networks in Afghanistan, as well as, the cost paid per mbps has been dramatically high as compared to other countries of the region. In order to address these demands, the World Bank Policy Recommendations state that in order to create more favorable enabling environment, implementing the infrastructure-sharing policy and issuing the passive infrastructure regulation is vital. Passive infrastructure sharing within the sector and cross-sector will be critical to reduce duplicated network deployment and lower costs for operators, including the deployment of FTTH networks (Priorities for inclusive development in Afghanistan, World Bank, 2020) [20]. Where the last miles to homes and premises

continue to rise, the broadband speed is expected to rise more than double because of the implementation of FTTH globally (Broadband Commission, ITU, 2021).

8.8 Technological and Social Feasibility

There are two major types of systems that can make FTTH feasible technically i.e., Active Optical Networks (AON) and Passive Optical Networks (PON) (Green, P. E., 1996). FTTH networks belong to the family of FTTX transmission systems that can transport larger data (Bushra Jahfar Hamd, Naaz Talaat Mawlwd, 2020).

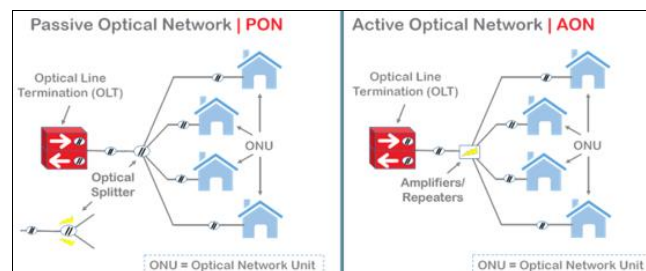


Fig 4: PON/AON, Monica Galler, 2015

Passive Optical network had been proposed for FTTH by the Ministry of Telecommunication and Information Technology. Initially, 5350 subscribers were estimated in different areas and a detailed survey was proposed to be conducted in those areas (FTTH, SOW, AFTEL, 2019). The project couldn't prove to be feasible due to the security issues of the country. On the other hand, the cost per connection estimated for the project was not feasible for the population. Many similar projects were tendered (DBFOT, AFTEL, Version 3, 2020) in different times in order to implement the project, however, the project didn't seem feasible due to security. Furthermore, the cost of FTTH was not affordable by the population.

9. Discussion and Conclusion

FTTX has proved to be one of the best network solutions for implementing and corroborate the Digital inclusion for all and ensuring that no one is left behind in an equal access to the internet with a reasonable speed, security and reliability. On the other hand, based on the comparative studies between copper and OFC, OFC has given better outcomes in terms of technological reliability, security, speed and ease of access. FTTH can be a great option to start this. Years of efforts have been put into implementing FTTH in Afghanistan, however, the project has not proved to be feasible due to high cost of internet and low buying power of the consumers.

Consequently, FTTH can prove to enhance the speed of internet, the ease of connectivity, network reliability and enhance the quality of life in Afghanistan, however, the project is not yet feasible to be implemented throughout the country. It is not even feasible to be implemented in the zonal provinces either, because most of the IT sector in Afghanistan has been backed up by international funds and donations, which have decreased tremendously. If the feasibility of FTTH is studied in details, all the mentioned aspects are addressed properly and a proper implementation plan and expansion strategy is developed, it is very likely that FTTH will change the way of life in Afghanistan from the social and technological aspects.

10. Recommendations

1. To calculate all the budget spent by all ISP and government for the internet connections, take an average and allocate it to FTTH, rather than spending huge amounts on VSAT, P2P, microwave and other technologies of communication.
2. To involve private sector as privatization or PPP in the OFC ring of Afghanistan and provide proper maintenance in order to increase link reliability.
3. To work on literary material regarding FTTH in order for the public awareness of FTTH so that investors get interest in the project.
4. To opt for ICBs (International Competitive Biddings) and encourage international companies to invest in FTTH, so that the Return on Investment is planned in a longer span and the cost of each connection is reduced.

11. Scope for Future Work

FTTX and specifically FTTH can be considered as an revolution in the network infrastructure of Afghanistan, hence, no adequate literary material, scholarly articles or books are available that target Afghanistan. Most of the work done in the area is purely technical. Researchers may work on the procurement, administrative and implementation phases of FTTH. This material will help investors and government get a clear pathway of their mission and vision for implementing FTTH in Afghanistan.

12. Acknowledgment

In the fulfillment of this research paper, we present our deepest gratitude to the team of Afghan Telecom and Elam International for providing us necessary literature and information for the study. Secondly, all the information has been cited from valid sources and copyrights have been taken into account.

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