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FIBRE OPTICAL SPLITTERS

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ABSTRACT

In today's computer network infrastructure, fibre optics is the main media for communication. Due to the high speed capability of fibre optics, the technology has taken almost all sectors for network infrastructure implementation. Single fibre is capable of carry different services together, gives possibility of triple play services. The whole expansion of fibre optic networks is possible with the help of splitters which is very important part of expansion for the backbone structure of underground fibre or Overhead fibre, combined with other methods and devices termed as FTTX technology. Splitters use in the fibre optic networks for the expansion of the network in OSP and ISP. This paper will give most of the important features of different kinds of splitters, their advantages, disadvantages and comparisons based on their different characteristics in the internet network communication.

Keywords: FTTX (Fibre To The Next Generation), OSP (Outside Plant), ISP (Inside Plant), EPON (Ethernet Passive Optical Network), BPON (Broadband Passive Optical Network), GPON (Gigabit Passive Optical Network), FTTH (Fibre To The Home), FTTB (Fibre To The Building), FTTP (Fibre To The Premises), FTTC (Fibre To The Curb/ Cabinet), FTTN (Fibre To The Node).

I. INTRODUCTION

In today's optical network topologies, the advent of fiber optic splitters contributes to helping users maximize the performance of optical network circuits. Fiber optic splitter, also referred to as optical splitter, fiber splitter or beam splitter, is an integrated waveguide optical power distribution device that can split an incident light beam into two or more light beams, and vice versa, containing multiple input and output ends. Optical splitter has played an important role in passive optical networks (like EPON, BPON, GPON, 10GEPON, FTTH, FTTB, FTTP, FTTC, FTTN & FTTX) by allowing a single PON interface to be shared among many subscribers.

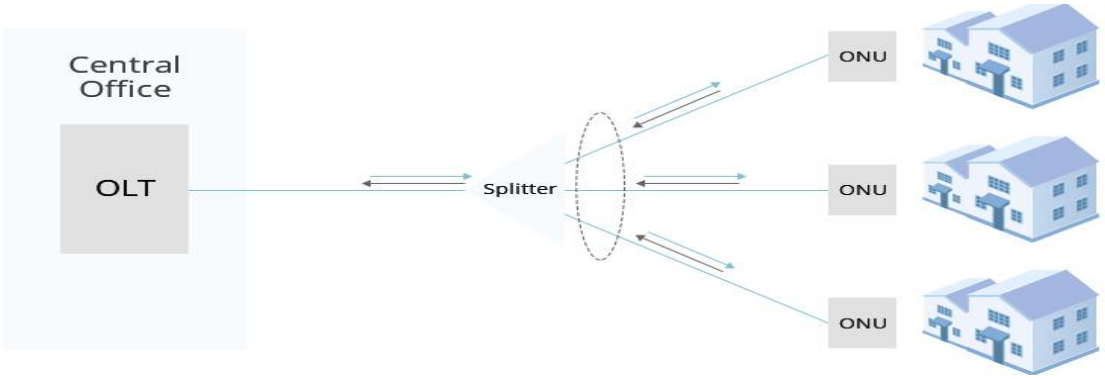

Figure 1: Single fibre input is split in to three distributed fibre outputs.

II. WORKING PRINCIPLE

Generally speaking, when the light signal transmits in a single mode fiber, the light energy cannot be entirely concentrated in the fiber core. A small amount of energy will be spread through the cladding of the fiber. That is to say, if two fibers are close enough to each other, the transmitting light in an optical fiber can enter into another optical fiber. Therefore, the reallocation technique of optical signal can be achieved in multiple fibers, which is how fiber splitter comes into being.

Specifically speaking, the passive optical splitter can split, or separate, an incident light beam into several light beams at a certain ratio. The 1x4 split configuration presented below is the basic structure: separating an incident light beam from a single input fiber cable into four light beams and transmitting them through four individual output fiber cables. For instance, if the input fiber optic cable carries 1000Mbps bandwidth, each user at the end of output fiber cables can use the network with 250Mbps bandwidth.

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Figure 2: Single fibre input is split in to four distributed fibre outputs.

TYPES OF OPTICAL SPLITTERS

Basically, there are two types of optical fiber splitter commonly used in PON networks classified by their working principle: FBT splitter (fused biconical taper splitter) and PLC splitter (planar lightwave circuit splitter).

FBT Splitter

FBT splitter is simple and old technology of welding different fibres together in a bunch from one side to other side with single fibre. The welded part is covered with cleave. Cleave is a protective layer for the welded part of fibres to save them from damage. Easy and simple method, cost effective for implementation. Cleave is glass tube made of epoxy, silica powder and stainless steel tube covers the inner glass tube and is sealed by silicon. Split takes place in unevenly distribution. Split ratio can be customized according to user needs. The possible maximum split ratio of FBT splitter is up to 1:32, which means one or two inputs can be split into an output of maximum 32 fibers at a time. Split ratios possible generally are 1:3, 1:7, 1:11, etc. Split requirement is of less than four splits, more split higher possibility of failure rate.

Figure 3: Cleave (used for protection of fibre joint)

Figure 4: FBT Splitter

Advantages	Disadvantages
• Made out of materials that are easily available and low-price, so it is cheaper. • Customized Splitter ratios	• Restricted to operating wavelength (850nm, 1310nm, and 1550nm). • The maximum insertion loss will vary depending on the split • Exact equal ratio cannot be ensured, the transmission distance can be affected. • Restricted to the number of splits in one coupling. High split rate high failure rate. Work stable under the temperature of -5 to 75°C.

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PLC Splitter

PLC splitter is built on planar lightwave circuit technology. It is composed of three layer parts substrate, waveguide, and lid. Signals split in evenly distribution; waveguide makes signals to split in equal ratios. PLC splitters are available in a variety of split ratios like 1:2, 1:4, 1:8, 1:16, 1:32, and 1:64. The possible maximum split ratio of PLC splitter is up to 1:64 - one or two inputs with an output maximum of 64 fibers. They are of different types, such as bare splitter, block less splitter, fan out splitter, mini plug-in type splitter, etc.

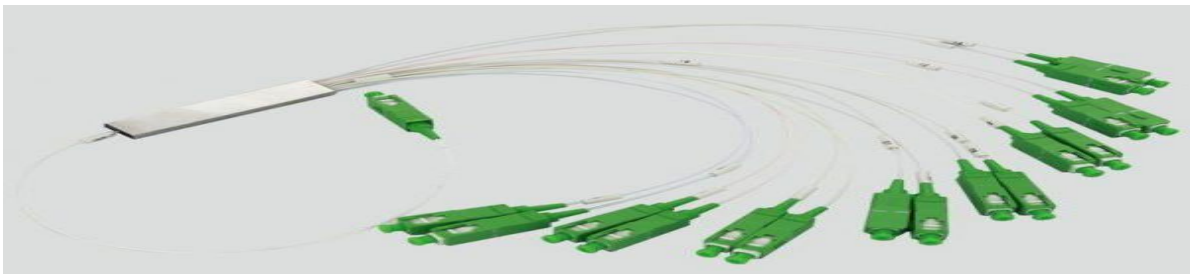

Figure 5: PLC Splitter

The following are five typical PLC splitter types use:

- Bare Fiber Optical Splitter – used for splicing in enclosures, splice trays.
- Blockless Fiber Splitter - it does not require fibre optic fusion during installation and is mainly used for different connections above distribution boxes or network cabinets.
- ABS Splitter – has a plastic ABS case, good protection, widely used for outdoor fibre distribution boxes for PON, FTTH, FTTX, GPON networks.
- LGX Splitter – equipped with rugged metal box, plug-and-play, and uses with patch panels.
- Rack-Mount Splitter – 1U and 2U are two available rack mount sizes for splitters on the market, provides an ideal solution for a high-density cabling environment.

Advantages	Disadvantages
• Suitable for multiple operating wavelengths (1260nm - 1650nm) adjustable range. • Equal splitter ratios for all branches. Compact configuration, smaller size, small occupation space. • Stable optical transmission. • Higher split rate with less failure rate Can work at a wider temperature range of -40 to 85 ℃. Good in extreme climate conditions.	• Complicated production process. Costlier than the FBT splitter in the smaller ratios.

Few comparisons based on different properties:

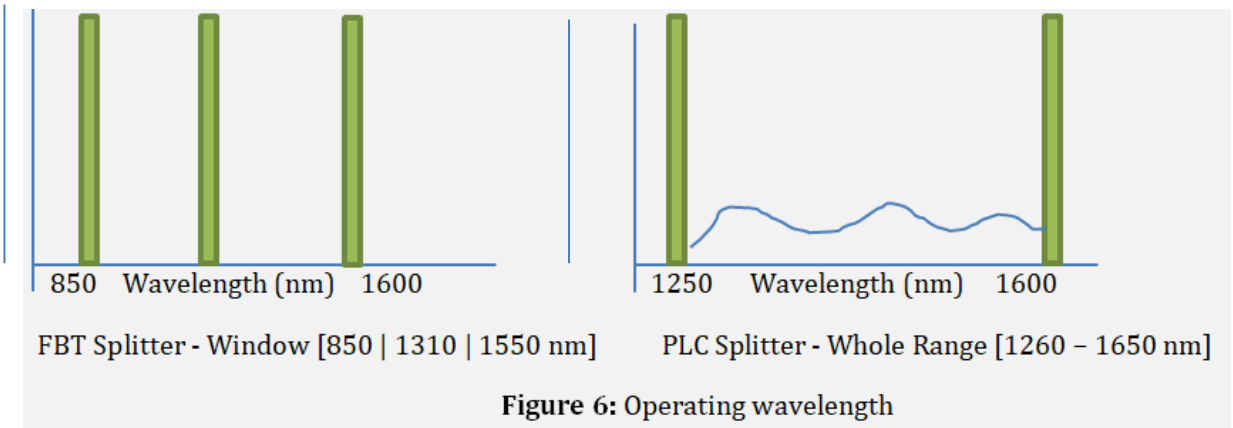

Figure 6: Operating wavelength

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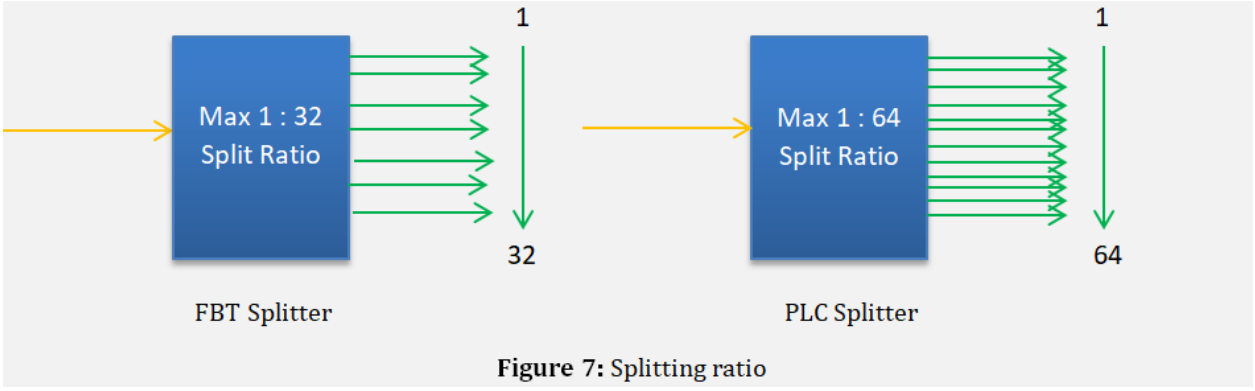

Figure 7: Splitting ratio

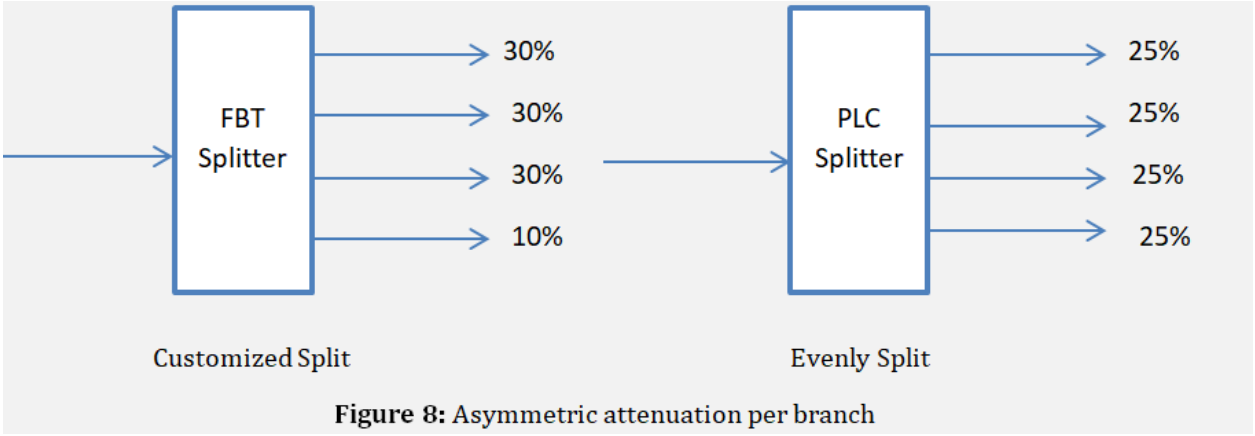

Figure 8: Asymmetric attenuation per branch

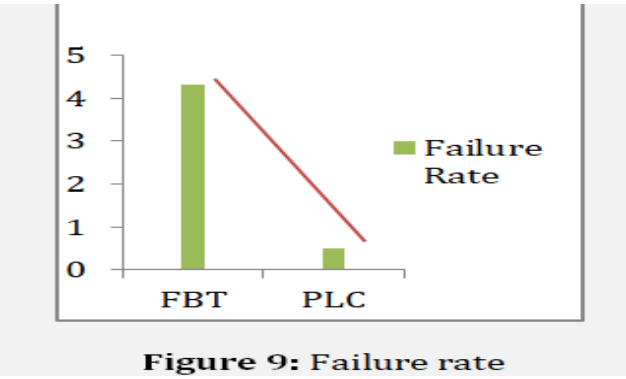

Figure 9: Failure rate

III. METHODOLOGY

Methodology of fibre optic splitters can be explained with the help of below diagram. How the network can be expanded further with the help of splitters? Method used here is based on the working principle of optical fibre splitters as explained in working principle.

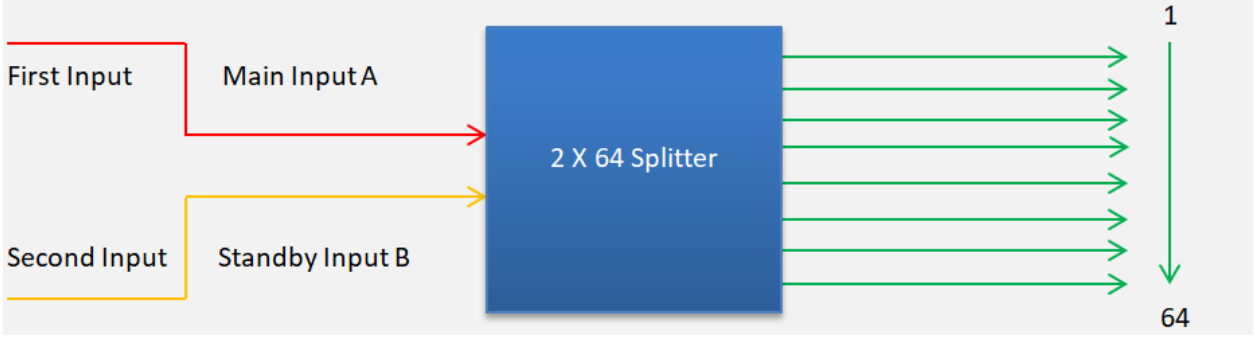

Figure 10: Two input fibres 1st the main input 2nd the stand by input.

In the above diagram 2 X 64 Splitter is used for connection. The concept of 2 X 64 splitters hers shows that 2 input fibre cables are here and 64 output fibre connections. The splitter will be functional from one fibre input

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at one time and the other input fibre will serve as the standby fibre. If first input fibre 'A' make live by connecting it with the live fibre, at the other end 64 distributed fibre connections will become live and input fibre B is the stand by fibre in the case. If fibre 'A' is disconnected due to break, cut or any other reason for disconnection. The connection is transferred to the input fibre B. The same 64 distributed output fibre connections will be live for services at the customer end for ONT/ONU or even for further split with the help of cascaded splitter method, the method can be explained in further research for fibre network expansion.

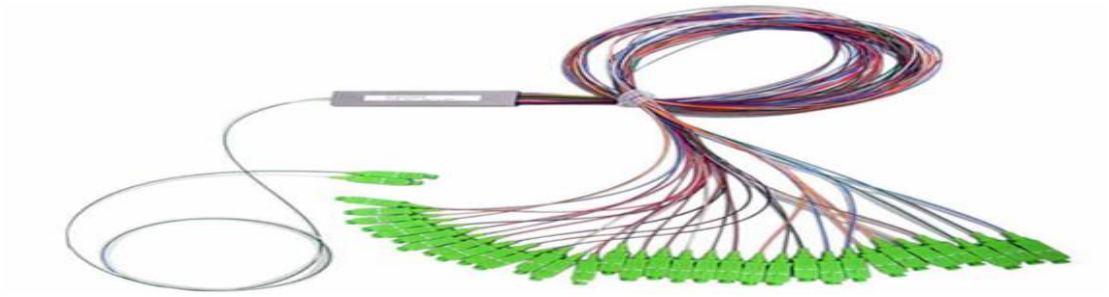

Figure 11: Two input fibres 64 output fibres connector based.

In the above diagram the 2 fibres are input fibres those are connector based, connected to 64 output fibres for distribution of connection. Here stand by concept as well as 2 fibre input for 64 distribution of network; both cases can be used based on the required need of the network connection. The splitter is SC connector based so the further connection is possible with the help of coupler (joins two connectors) and other side SC connectors to complete the live network.

IV. CONCLUSION

Optical splitters enable a signal on an optical fiber to be distributed among two or more fibers. Since fiber splitters contain no electronics nor require power, they are an integral component and widely used in most fiber-optic networks. With the help of optical splitters fibre network expansion is possible to the next level. Optical fibre splitter plays an important part for further division of the signals or expanding the single fibre network to the distributed network. Thus, choosing fiber optic splitters to increase the efficient use of optical infrastructure is the key to developing network architecture that will last well into the future for FTTx network expansion. With the rapid growth of FTTx network infrastructure worldwide, the requirement for larger split configurations in networks has increased to serve mass subscribers.

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