## FIBER BROADBAND 101 SERIES:

# Introduction to Passive Optical Network Splitter Architectures

(PON SPLITTING 101 – PART 1, DEFINITIONS)

Fiber Broadband Association
Technology Committee
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Fiber Broadband ASSOCIATION

*When fiber leads, the future follows.*

*The choice of splitter architecture for a passive optical network (PON) network can impact many aspects of a Fiber to the X (FTTx) network. Splitter architectures can impact fiber counts, splicing needed, numbers of fiber needed, and the customer on-boarding process.*

*Interestingly, as we polled various members, although splitting methods in general were relatively consistent, the names used to describe them were not, leading to some spirited conversations and confusion in the industry.*

*Since we were not aware of a standard for the names of different splitting methods/ architectures, we decided to provide a surface-level definition of various types of splitting architectures.*

## SPLITTERS

A "splitter" is a power splitter. A splitter is not a filter like a wavelength division multiplexer (WDM). Typically, but not always, there is one input in and multiple outputs. Rarely, there can be two inputs to provide potential redundancy of route.

Light power goes in and light power coming out of the various legs is reduced in accordance to the split ratio. For every 2X increase in split ratio, power is reduced by roughly 3 dB. In most cases, the power out of each leg is equal, but we'll discuss a version where the power coming out is unequal amongst legs.

Bandwidth is shared amongst customers in a PON, and the bandwidth received by a customer is not related to the power received at the optical network terminal (ONT) as long as the power is high enough so the ONT can operate.

**Figure 1:** Bare Splitters
Courtesy of CommScope and Lightel

Splits are most commonly factors of 2, such as 1x2, 1x4, 1x8, 1x16, 1x32, 1x64, etc. More recently, odd split ratios such as 1x3, 1x5, etc have found some use. A fiber broadband provider typically determines and overall split ratio for the network, such as 1x32 or 1x64, and uses combinations of splitters to meet that ratio with each PON port.

1x32 splits were common in North America for G-PON architectures. As XGS-PON continues to be adopted, some service providers keep the 1x32 split and some have chosen 1x64 splits.

## SPLITTING ARCHITECTURES

Where splitters are placed in the network can make significant impacts on fiber counts, network cost and deployment time and operational steps, such as customer onboarding and maintenance.

One important note is that splitting architectures should be seen as tools that can be mixed and matched to meet the overall requirements for the network.

Most of the confusion in the industry centers around the terms "centralized" and "distributed".

The FBA Technology Committee subgroup discussed the concept of centralized and distributed splitting in depth, and we were unaware of a standards document where they are codified. After significant debate, we've landed with the following definitions:

Centralized **– A centralized split has one or more splitters together at a centralized location. A key additional definition is a centralized split allows the customer/splitter assignment to be changed by using a jumper. Centralized splitting occurs often, but not always, in central offices or cabinets.**

Distributed **– A distributed split is a design where once the plant is built, addresses are not changeable by cross-connecting jumpers from the splitter. There is no selection via fiber jumper to a group, or geography of addresses. These are most often housed in closures or pedestals.**

Exploring further, there are different sub-characterizations of both "Centralized and Distributed" splits that are illustrated for your review.

### Centralized – Home Run Configuration

In this scenario, the splitters are located in the central office or OLT location, shown in the blue circle. This architecture is similar to a "point to point" network, since one fiber is needed for each customer throughout the network from the central office. (See Figure 2.)

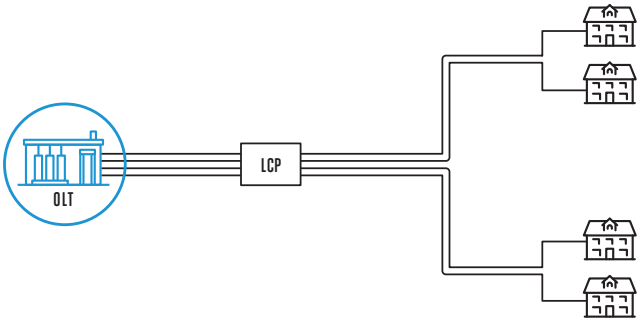


**Figure 2:** Centralized – Home Run Architecture

## Centralized – Fiber Distribution Hub (FDH) Configuration

In this configuration, typically more than one splitter is located in a cabinet some distance away from the OLT. Fewer fibers are used on the side of the network feeding the splitter. The FDH is also known by different names. Addresses are reconfigurable by jumpers in this configuration and the Home Run configuration. (See Figure 3.)

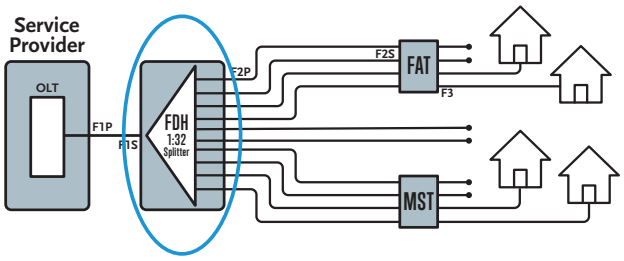


**Figure 3:** Centralized FDH Architecture

## Distributed

The configuration below has individual splitters at a central location, but addresses that are typically not reconfigurable by jumpers, so this configuration is a "distributed" split. The splitters are stand-alone, not co-located with other splitters. In this scenario, the splitter is most often located in a closure or pedestal in the outside plant. (See Figure 4.)

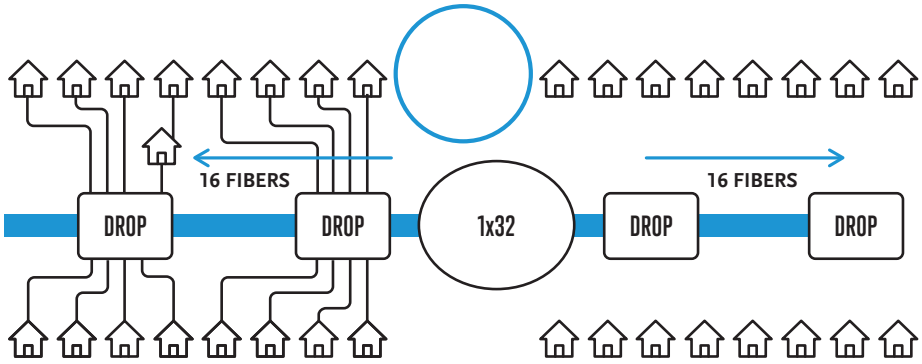


**Figure 4:** Distributed Split

**There are at least two other versions of this architecture:**
The first type is "cascaded" or "distributed cascaded" splitting. (See Figure 5.) This involves having 2 or more splitter combinations to arrive at the target split ratio. A classic example is the use of a 1x4 and 1x8 splitter to comprise a 1x32 final ratio. Other combinations are commonly used, including 1x2 and 1x16. A 3-level split example is 1x2 to 1x4 to 1x4.

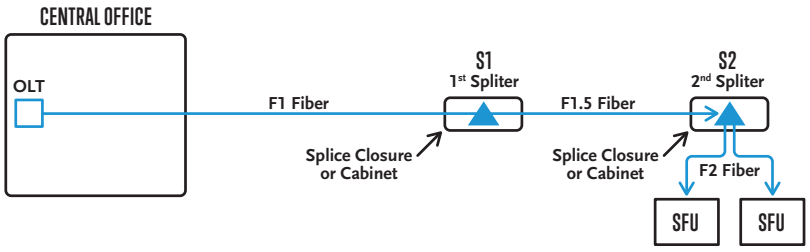


**Figure 5:** Cascaded or Distributed Cascaded

Another version of a distributed split architecture uses 1x2 splitters with unbalanced power outputs that then may connect to additional splitters. The power outputs are adjusted along the route. This version is known as "unbalanced splits" or "optical taps". (See Figure 6.)

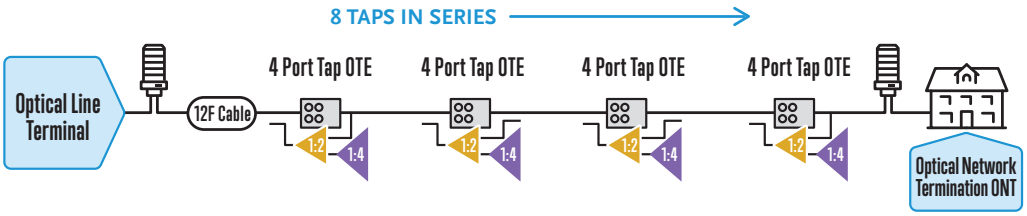


**Figure 6:** Unbalanced Splits or Optical Taps

## CONCLUSION

These various methods can be mixed in a network to best meet the performance and cost requirements for the network. The next document to be published on this topic will be a more comprehensive look at the various methods, including where they're most used and some pros and cons of the architectures.