Roshene McCool

FTTH – The Ultimate In Scalable Bandwidth Service

The demand for bandwidth seems without limit: the more bandwidth network the users have – the more they seem to consume (Cisco VNI Global IP Traffic Forecast). Network providers who are investing in network infrastructure can have confidence that if their installed infrastructure is scalable to the bandwidth needs of today and the future, their customers will have high quality of service over the lifetime of the investment.

The ultimate in scalable bandwidth delivery to the consumer is a fiber-to-the-home (FTTH) network. An FTTH network connects the network exchange and the home using a fiber optic link. The bandwidth of a FTTH network is not limited by the fiber connection but by the transmission equipment on the link. Operators can upgrade their respective FTTH networks simply by replacing the equipment at the terminals of the fiber lines.

Network download speeds offered by operators to consumers on FTTH networks are typically between 70 and 100 Mbps (such as Verizon Fios and BT Infinity Service) but can be up to 1 Gbps or more. A typical FTTH customer can download high-definition movies in minutes and can stream the highest resolution 4K movies with ease.

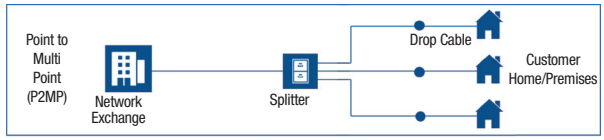
FTTH networks explained

The most common implementation of an FTTH network is a passive optical network (PON) architecture. A PON network is designed to allow bandwidth and infrastructure sharing through a point to multipoint architecture. This architecture uses optical splitters to share the signal coming from the network exchange amongst many users. Typically, the data stream from the network exchange is split between 32 users, but this could be as high as 256 users. The splitter is a passive optical device that requires no power or control. The customer is connected via a drop cable that provides the final connection between the network infrastructure and the customer premises. In scalable networks, this drop connection can be provisioned when customers sign up for network services, thus deferring some capital investment until a paying subscriber is guaranteed.

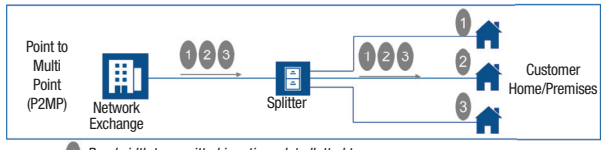
The available bandwidth of the network can be allocated between users by using time slots (Time Division Multiplexed) or optical wavelengths (Wavelength Division Multiplexed). In the latest PON standards, a point to multipoint architecture is combined with both time and wavelength multiplexed transmission schemes to provide the most efficient and flexible network possible.

Organizations such as the International Telecommunications Union (ITU) and the Institute of Electrical and Electronics Engineers (IEEE) develop standards that allow the telecommunications industry to deliver standardized products into FTTH networks.

Sharing Infrastructure In An FTTH PON Architecture

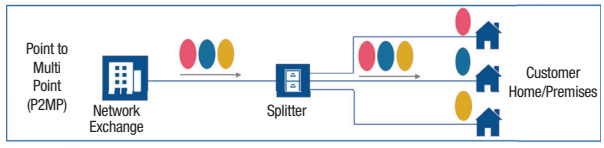


Sharing Bandwidth By Time Division Multiplexing



1 Bandwidth transmitted in a time slot allotted to a user

Sharing Bandwidth By Wavelength Division Multiplexing



Bandwidth transmitted on a wavelength allotted to a user

FTTH in India

India is the second largest telecommunications market in the world with a subscriber base of 1.18 billion (Department of Telecom – Annual Report 2017-2018). At present, the telecom industry is witnessing a rapid evolution due to an upsurge in demand for and provision of data services, with India being the largest mobile data consumer (Broadband 2022 Unlocking a Trillion-Dollar Digital Economy – EY).

Consumer trends witnessed by the Indian telecom sector resulted in a 7.8× growth in 4G data consumption in

2017. Around 250 million people viewed videos online and India became the second largest market for major social networking companies as of 2017 (Broadband 2022 Unlocking a Trillion-Dollar Digital Economy – EY).

All trends point toward an increasing bandwidth demand. To support bandwidth demand and evolving technologies, our industry needs to focus on the deployment of denser optical fiber networks that penetrate deeper into the network toward the subscriber, such as FTTH. At 0.1 km per subscriber (Broadband 2022 Unlocking a Trillion-Dollar Digital Economy – EY), fiber deployed in India is among the lowest globally. As we build access and FTTH networks closer to the customer, the customer experience will improve significantly.

At present, there are 1.25 million FTTH connections in India, accounting for just 0.5 percent of the total households (Broadband 2022 Unlocking a Trillion-Dollar Digital Economy – EY). With a population of over 1.3 billion people, the Indian market indicates a strong potential for future deployments. As there is a big drive to increase FTTH penetration, many telecom operators in India have announced significant investments in this sector. The draft National Digital Communications Policy 2018 mentions the *Fiber First Initiative* (Draft National Digital Communications Policy – 2018) which encourages FTTH deployments by enabling guidelines and policies for facilitating faster deployments.

India's macro-indicators are strong; growth is steady, and the market holds promise for the future.

Fibers for FTTH networks

When designing a network with many connections the following factors are paramount for providing bandwidth and connectivity to customers efficiently: (i) ease of installation, (ii) ability to seamlessly connect to existing infrastructure, (iii) efficient use of available space within ducts and street cabinets, and (iv) robustness and reliability

To meet these challenges and minimize the cost to the network provider, fibers need to be (i) tolerant to handling, (ii) resilient to low-cost installation techniques, (iii) compatible with existing network infrastructure and the relevant international standards, and (iv) available in small form factor cables, when space is a challenge in the network.

The legacy fiber deployed in most networks is standard single-mode defined by the standard Recommendation ITU-T G.652.D. This legacy fiber will experience loss when subjected to a tight radial bend. This loss is called macrobend loss. A key fiber specification is minimum bend radius, which is the tightest radial bend a fiber may turn around before some loss is encountered. Macrobend improved Recommendation ITU-T G.657 fibers have become popular in FTTH installations in recent years. Their tolerance to bend enables smaller and more dense cable designs and low-cost installation techniques with lower risk of signal loss due to macrobend.

The light carrying part of the fiber is defined by the mode field diameter (MFD). Macrobend improved fibers tend to be designed with a smaller MFD to contain the light within the fiber during bend. This can cause difficulties during installation. Additionally, splicing and network tests can take longer because of a mismatch between mode field diameters.

Corning's SMF-28® Ultra fiber is an example of a fiber that offers a blend of enhanced loss and bend attributes that are ideal for outside plant FTTH installations. It has a low loss profile across all the wavelengths of interest for the application and is tolerant to bend under the installation and operational conditions expected in an FTTH network. With a 9.2 µm mode field diameter SMF-28 Ultra fiber is compatible with the existing Recommendation ITU-T G.652 standard single-mode fiber found ubiquitously in legacy outside plants.

Fibers inside the building in FTTH applications

Once the fiber transitions from the outside network plant to inside a building, the environment changes. The indoor cable can be routed around door frames and wall corners, and positioned via staples or other methods which can introduce additional bends and tighter bends into the fiber path. Under these circumstances, fibers that are resilient to bends are best employed in the drop cable.

Fibers such as Recommendation ITU-T G.657.A2 fibers are resilient to bends of down to 7.5 mm in radius, and Recommendation ITU-T G.657.B3 fibers are *copper-like* in their bend performance, tolerating bends of down to 5 mm in radius. This additional tolerance provides higher resilience to bend in the environments found in connections within buildings and in the home.

Corning's ClearCurve® fibers are ideal for indoor drop cable installations in FTTH networks. ClearCurve LBL fiber is a Recommendation ITU-T G.657.A2 fiber and can be used when some bend loss can be tolerated within the network design. ClearCurve ZBL fiber is a Recommendation ITU-T G.657.B3 fiber and provides a solution with *copper-like* bend insensitivity for those seeking fiber installations with virtually no bend loss.

The demand for bandwidth across mobile and fixed line services in India continues to grow. Fiber networks, such as FTTH will deliver consumer bandwidth needs, today and in the future. Corning fibers deliver the optical performance required by both the network operator and the subscriber. ●

The author is Optical Fiber Market and Technology Development Manager, Corning Incorporated

Co-authored by Prutha Chaudhari, Product Line and Marketing Specialist, Corning Incorporated.