

BendSafe enabled FTTH

in multiple application environments

1. What benefits does FTTH deliver?

Unlike current xDSL which has limited bandwidth, FTTH virtually has no bandwidth limitation and offers vastly superior range versus xDSL. It can bring voice, data, and video signals simultaneously to the household, and has proven itself to be the best solution for broadband service delivery.

2. Is FTTH available to everyone?

- There is no reason why Broadband service to the home should not enjoy the same ubiquity as running water and other common household utilities we take for granted. The service should also be available to every household, whether new or old.
- Recently the designation as “Fiber Broadband Building” has become a key selling point for new apartment buildings. However, around 97% of existing buildings are NOT yet enabled for FTTH service. This is due to the difficulty of installing legacy optical fiber cable through existing copper trays and conduits. But now there is an innovative solution : BendSafe fiber cable, which can withstand harsh environments, and also can be deployed through existing copper trays and conduits. Thanks to BendSafe products, FTTH can finally become a reality for new and old households alike.

3. Challenges in the FTTH market :

- Optical fiber cable requires low bending loss even as the cable undergoes a 90 degree bend. Legacy fiber cable is constrained by a 6 cm minimum bending diameter, and also by the need to avoid sharp 90 degree bends during installation.
- The lifetime of Fiber under harsh operating environments is another important issue determining the choice of fiber solution. The normal usage life for a building is more than 50 years, so the installed fiber cable should also have a product lifetime greater than 50 years. One of the challenges associated with fiber deployments is to ensure a long lifetime for installed cable under a variety of tight bending conditions.
- Most existing Multi-Dwelling Units do not have reserved conduits for optical fiber cable. In order to install extra optical fiber cable through the legacy copper cable conduits, the fiber cable should be small in diameter and lightweight.
- High pulling strength is also a required feature for optical fiber cable in these types of installations, since the fiber cable often must be pulled through congested conduits under high tension during installation.
- Optical Fiber Drop Cable further must serve both indoor and outdoor installations : The typical FTTH installation originates at the Fiber Distribution Hub (FDH), normally located outside the building, and extends to the optical outlets located in the rooms inside the building. Thus, the same cable must transition from an outdoor to indoor environment. To this end, the outdoor cable is typically filled and sealed for moisture isolation, which

makes it bulky, clumsy, and difficult to work with during installation. As indoor cable does not need protection from the elements, it can be made smaller. The tradeoff however is that as it can not withstand the harsh outdoor environment it is thus limited only to indoor installations. The ideal optical fiber drop cable should meet the requirements for both indoor and outdoor installations.

4. The BendSafe Solution for FTTH

- The BendSafe Solution for FTTH offers a revolutionary innovative advancement in the optical fiber itself. This advancement improves optical fiber strength in high temperature and high humidity environments. In doing so, it has given birth to a new class of optical fiber products ideally suited to FTTH installations.
- BendSafe saves the need to install extra optical fiber cable conduits : BendSafe optical fiber cable is well-adapted for use in existing copper cable conduits. This saves time and money otherwise needed to construct new conduits.
- BendSafe requires no change in the cable installation method : BendSafe optical fiber cable is small (3mm diameter), light weight (8g/m) and strong (67kg pulling strength). The installer can treat BendSafe optical fiber cable as regular copper cable. Wherever copper cable can be pulled, so can BendSafe cable be installed.
- BendSafe obviates the need to worry about future maintenance : BendSafe optical fiber cable is very durable. Its 90 degree bending lifetime is more than 100 years. Both customers and service operators can be assured of network integrity and minimum maintenance.
- Ideal drop cable : BendSafe optical fiber cable is well suited for both outdoor and indoor environments, making it the perfect choice for use as drop cable.
- Advancement in optical performance : BendSafe optical fiber cable not only uses high strength optical fiber, but also employs fiber with higher optical performance (satisfying the ITU-T G.657 bending loss insensitive single mode optical fiber specification). Its bending loss is less than 0.03 dB for ten 15mm bending radius turns.

5. How did BendSafe achieve such remarkable results?

The biggest challenge in constructing the FTTH network typically rests in the need to ensure network in integrity during the entire service lifetime. Instead of relying on bulky, inflexible, and costly cable jackets to protect the fiber inside, with BendSafe we put the protection on the fiber itself. This means greater flexibility and extended useful life.

- Leveraging special fiber surface coating technology developed by the 3M Corporation, we have developed a new class of GGP single mode fiber. The special P-Coating on the fiber surface resists strength degradation that occurs upon exposure to high temperature and high humidity environments, and thus helps make the

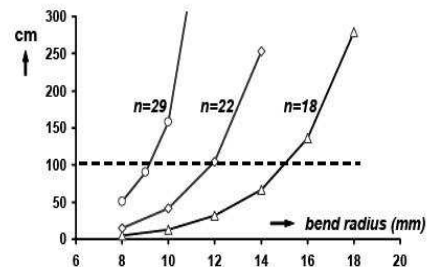


Fig. AI-2 Maximum storage length for a bent fibre and different values of the fatigue parameter n

fiber as strong as a copper wire.

- The lifetime of Fiber is determined by the bending radius and the fatigue value (n-Value). Improvements in the n-Value can greatly extend the fiber and cable lifetime. The fatigue parameter is shown at right in the figure (Fig. AI-2) and table (Table AI-1) : The n-Value should be larger than 29 under 9mm bending radius storage or 4 90-degree non-storage bending radius 8mm.

Table AI-1 Minimum value of non-storage bend radii

n-value	four 90° bends	single 180° bend
18	$R_{min} = 15.0$ mm	$R_{min} = 12.6$ mm
22	$R_{min} = 11.1$ mm	$R_{min} = 9.2$ mm
29	$R_{min} = 8.0$ mm	$R_{min} = 6.6$ mm

- POFC's BendSafe Cable adopts the structure of GGP fiber, using 3M's proprietary GGP Coating technology. This provides a fatigue parameter of 20 to 30 and increases the lifetime of fiber under 90-degree bending conditions as shown as Fig 5-2. As shown in Fig 5-2, the estimated lifetime of GGP Fiber reached over one hundred years with a bending diameter of 8mm.

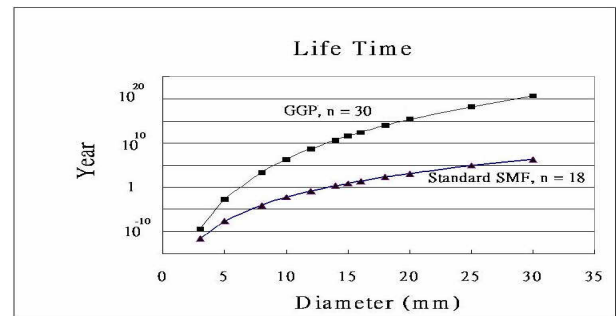


Fig.5-2: Bending lifetime estimation of GGP Fiber and Legacy Fiber

- The long lifetime and temperature insensitivity of BendSafe Cable : The coating material (P-Coat) imparts strong waterproofing, and temperature resistance characteristics to the fiber . Therefore BendSafe Cable does not require heavy exterior jacketing or other protection. The cable is thus characterized by small radius, and low bulk, while still offering the waterproofing, temperature resistance demanded in outdoor cabling installations. Through its superior structure, BendSafe Cable can save space to increase Kevlar number which improves the pull strength by a wide margin.

6. Application in Multi-Dwelling Units (MDU) :

- Point to Point (P2P) :

Cable distribution moves to P2P architecture. The point, one to one from communication center or integrated box, is connected the home distribution shown as Fig6-1, P2P Network Structure. This provides for simple, direct contact which in turn makes for ease of installation and lower installation loss-rates. The trend for P2P installation helps to speed the reality of ubiquitous FTTH deployment.

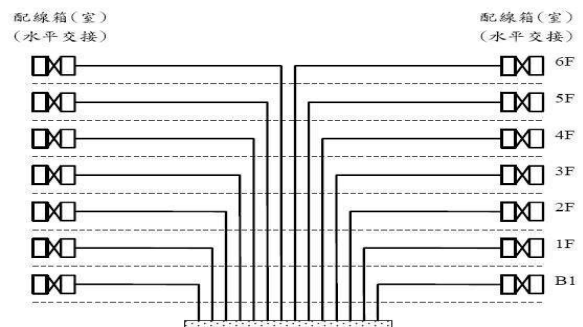


Fig 6-1 P2P Network Structure

➤ Passive Optical Network(PON)

The PON supports two kinds of connector types, single-layer and multi-layer floor. The structure of the PON is a cable from the communication center, connected to the splitter on each floor. The splitter offers 2, 4, 8, 16, 32, and 64 optical signal channels separately at the user-end. The benefit lies in lowering the number of cables needed and reducing the space required for installation. The figure is shown in Fig 6-2, depicts the PON Network Structure.

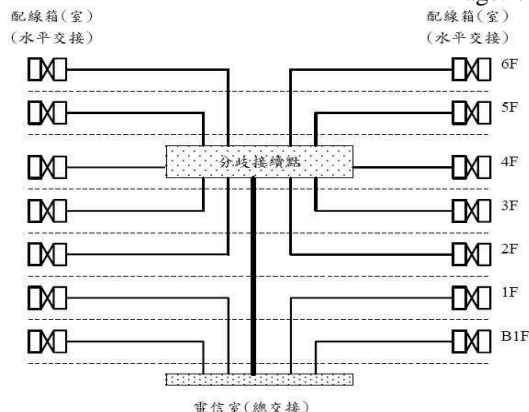


Fig. 6-2 PON Network Structure

Using BendSafe Cable, these two types of Main Cable Construction (P2P and PON) can be employed easily in Multi-Dwelling Units without extra effort or training .

7. Successful cases using BendSafe Cable in older buildings

Successful cases employing BendSafe Cable in existing Taiwan buildings. In particular, the So-Go building in Hsinchu received the prestigious Gold Award (FBB). For information on other cases please refer to the form below :

Building name	Location	Date	Model
Manhattan Community	Taoyuan	11.07	P2P
Hsinchu Community	Taoyuan	02.08	P2P
Brilliant Century	Taoyuan	07.08	P2P
Nanjing Building	Taipei	07.08	P2P
SO-GO Building	Hsinchu	08.08	P2P
Sin-Kang Building	Taipei	08.08	Horizon
Su-Po Building	Taipei	08.08	Horizon
Chin-Di-Tan Building	Taipei	04.09	P2P



8. The Prime Optical Fiber Company (POFC) offers high-quality and innovative products to meet customer needs in FTTH deployments:

- BendSafe Fiber : POFC provides all kind of bendable fiber including single and multi mode specifications.
- BendSafe Cable : For a variety of applications, POFC provides high-quality bendable drop cable suitable for indoor and outdoor and vertical and horizontal cabling to and within buildings.
- Passive Devices : POFC’s passive devices offer long lifetime, small diameter, and high bending capability, and include a variety of products such as patch cords, curl cords, fan-outs and splitters, among others.
- Passive Devices by customer request : POFC is also delighted to provide customized service in design and manufacture to meet specialized customer needs for particular

devices and configurations

9. How can POFC serve you ?

- To learn more about POFC's best-of-breed standard products: BendSafe Fiber, Cable, and Passive Devices please contact our sales department at sales@pofc.com.tw (+886-37-586999 Ext:122).
- For inquiries regarding ODM/OEM partnership opportunities using POFC's BendSafe know-how, please contact our customer service at tech@pofc.com.tw (+886-37-586999 Ext: 500). We provide ODM/OEM service for a wide range of optical applications. Contact us to find out how you can use BendSafe technology to upgrade your products and make your products truly outstanding.
- For information on integrated services for optical transmission, please contact our customer service at tech@pofc.com.tw (+886- 37-586999 Ext:130).

We provide passive devices for optical transmission to meet your individual requirements and we would be delighted to discuss how we can help you achieve your goals in fiber optics.