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IP Rated Outdoor Interconnect for Rapid FTTH deployment

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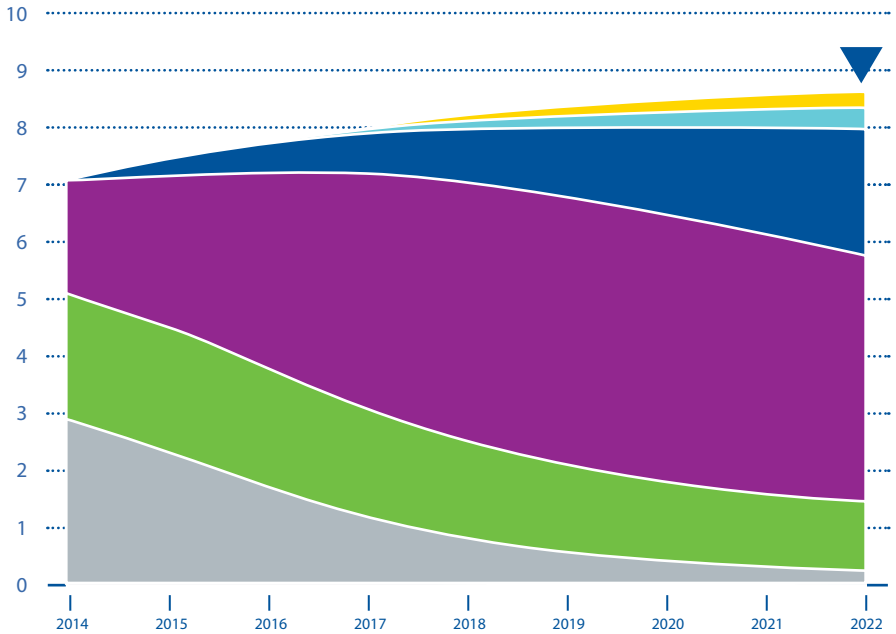
Introduction

Fiber-to-the-Home (FTTH), also known as Fiber-to-the-Premises (FTTP), networks are built to connect end customers such as a residential house or a business building end-to-end from the exchange with optical fiber. Today, optical fiber is the fastest and most reliable high speed broadband technology.

The number of global FTTH connections is steadily growing along with bandwidth consumption. Globally, bandwidth usage roughly doubles every two years with the increase in high-definition video streaming, cloud repository services, and remote working setups where video conferencing is becoming the new norm.

According to a study by Broadband Trends, It is estimated that by the end of 2022, there will be about 859 million high speed broadband subscribers with nearly half of them being connected through FTTH.

Global Fixed Broadband Subscribers by Speed



859 million

By the end of 2022, there will be about 859 million high speed broadband subscribers.

- 1Gbps+
- 500-1Gbps
- 100-500Mbps
- 25-100Mbps
- 10-25Mbps
- 0-10Mbps

FTTH/B Market evolution in ASIA-PACIFIC (APAC-21*)

FTTH/B Subscribers x 4.4

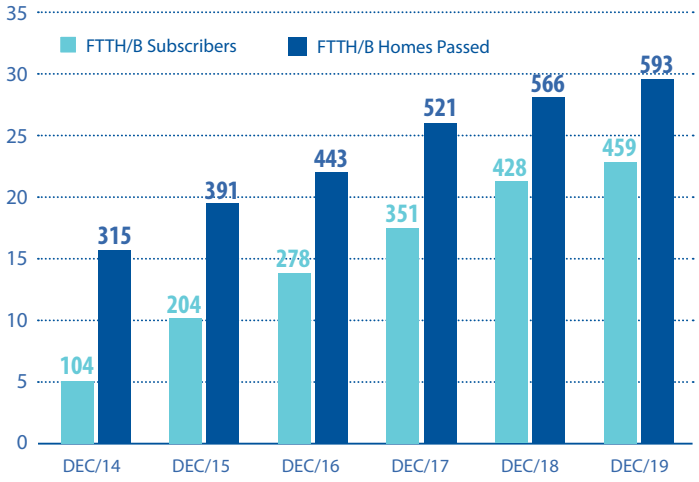
FTTH/B Homes x 4.4

***APAC-21: Australia, Bangladesh, Cambodia, China, Hong Kong, India, Indonesia, Kazakhstan, Laos, Malaysia, Myanmar, New Zealand, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam.**

The past decade has seen a high increase in the number of FTTH and FTTB around the world. In Asia Pacific, within just 5 years, the number of premises connected have increased by 4.4 times with 459 million FTTH customers connected and 593 million home passed

According to the FTTH APAC Panorama 2020 report, the country with the highest number of FTTH/B homes passed is China (425M), followed by Japan (52.1M), and Indonesia (27.1M). China is also the country with the highest number of FTTH/B connections, accounting for around 81% of all connections in APAC-21.

The country with the highest percentage growth rate in the number of homes passed is Indonesia at 21.3% (4.6M additional homes passed), while Myanmar has the highest percentage growth rate in the number of homes connected at 141% (12k homes connected).



Volume of FTTH/B Homes Passed

China	425M
Japan	52.1M
Indonesia	27.1M

Growth % of FTTH/B Homes Passed

Indonesia	4.6M 21.3%
Thailand	2.63M 21.0%
Philippine	1.27M 20.7%

Growth % of FTTH/B Homes Connected

Myanmar	12K 141%
Bangladesh	25K 125%
Laos	15K 101%

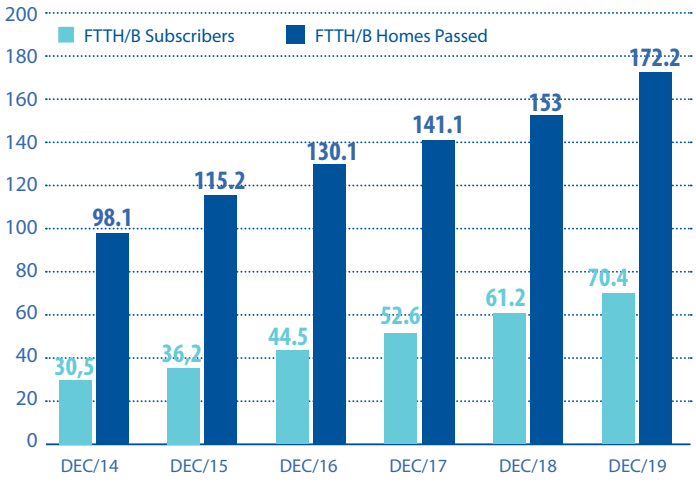
FTTH/B Market evolution in EUROPE (EU-39*)

FTTH/B Subscribers x 2.3

FTTH/B Homes x 1.8

*EU-39: Andorra, Austria, Belarus, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kazakhstan, Latvia, Lithuania, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom.

According to the FTTH Council Europe Panorama report, a similar growth trend can also be seen in the European market. As of December 2019, there are 70.4 million FTTH/B subscribers and almost 172 million homes passed. Russia leads Europe with the highest number of premises connected with fiber. Belgium is the fastest growing FTTH/B market with 307% increase in the number of homes passed and connected over a 5 year period.



Volume of FTTH/B Homes Passed

Russia	74.7M
France	53.6M
Spain	49.7M

Growth % of FTTH/B Homes Passed

Belgium	78K 307%
Ireland	289K 70.4%
Switzerland	1.2M 69.1%

Growth % of FTTH/B Homes Connected

Belgium	78K 307%
Italy	4.7M 72.9%
Ireland	289K 70.4%

FTTH/B Market evolution in LATAM-18*

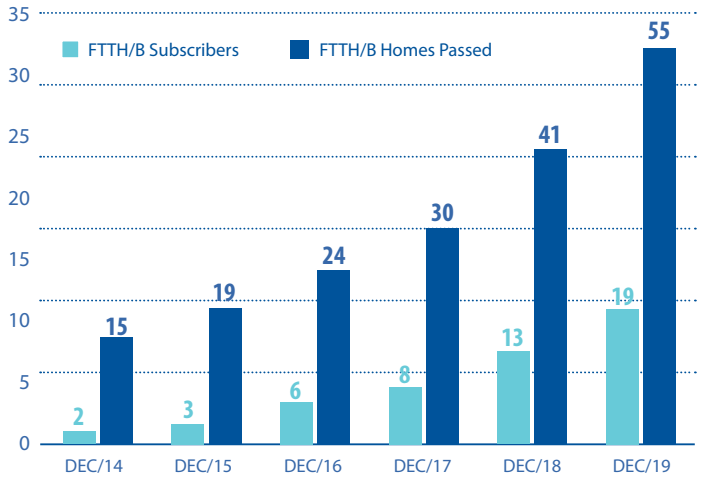
FTTH/B Subscribers x 9.5

FTTH/B Homes x 3.6

*LATAM-18: Argentina, Bahamas, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Jamaica, Mexico, Panama, Paraguay, Peru, Puerto Rico, Trinidad and Tobago, Uruguay.

According to the Fiber Broadband Association LATAM FTTH Panorama report, the growth in FTTH/B homes passes and connected have surged at an incredible pace. The number of homes passed has increased 3.7 times to reach 55 million and the number of FTTH/B subscribers has increased 9.5 times to reach 19 million in a 5-year span.

In some countries, governments have made fiber based broadband deployment a top priority to improve their competiveness in the digital market. Some of the governmental programs are the US Rural Broadband Act, the Brazil Structural Plan of Telecommunication Networks, and Australia's National Broadband Network.



Globally, more broadband subscribers are switching from copper-based networks to fiber-based networks. An example of this is AT&T in the US, where approximately 200K subscribers were switching to FTTH every quarter, leading them to discontinue DSL service in October 2020. In New Zealand, the Commerce Commission is undertaking an amendment to the Telecommunications Act to facilitate the transition from copper to fiber.

Volume of FTTH/B Homes Passed

Brazil	9.9M
Argentina	1.65M
Mexico	550K

Growth % of FTTH/B Homes Passed

Brazil	66%
Chile	44%
Argentina	42%

Growth % of FTTH/B Homes Connected

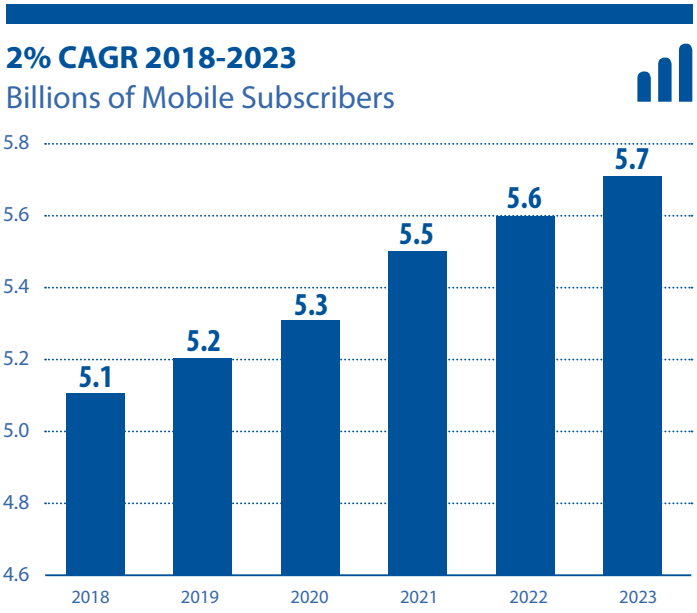
Bolivia	116%
Brazil	142%
Argentina	68%

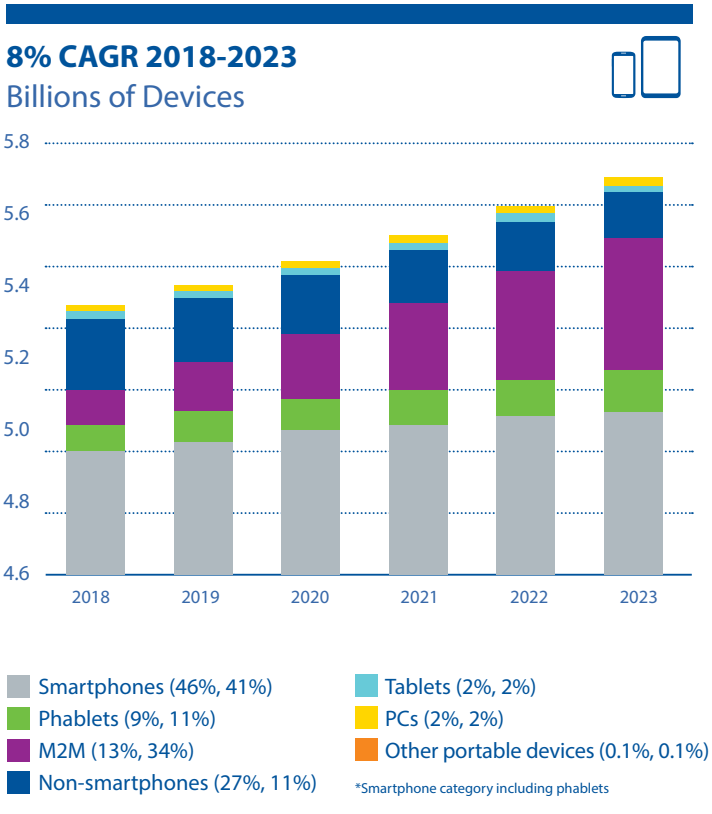
Fixed-Mobile Network Convergence

Mobile networks are growing in speed and density. According to an annual report by Cisco, over 70 percent of the global population will have mobile connectivity by 2023 with an average speed of 43.9Mbps.

One of the biggest growth in wireless connections is in Machine-to-Machine (M2M) connections such as GPS in cars, medical applications, and logistics tracking. Along with the advancement of optical fiber networks, many Mobile Network Operators (MNO) are deploying the latest in mobile technology, which is 5G.

5G is the next generation wireless network technology which has vastly increased performance compared to its predecessor. It uses a shorter microwave frequency (millimeter waves between 30GHz and 300GHz) which enables a much higher bandwidth of up to 10Gbps, and a shorter latency of 1millisecond. However, 5G cannot work without an optical network providing the fronthaul connection between the Remote Radio Head (RRH) and the Baseband Unit (BBU) that may be in the same location as the RRH or in a centralized location such as in an exchange or data center.





FTTH/B Network Deployment Challenges

One of the main challenges in deploying an FTTH/B network is the high number of optical fibers that must be installed from the exchange to the customer premises. The use of optical splitters reduces this number, however it is still a substantial increase. The higher number of fiber runs also means a higher number of optical fiber terminations. The two main ways of terminating optical fiber are fiber splicing and optical connectors. Optical fiber splicing is mainly done through fusion splicing with a smaller number using mechanical splicing. Fusion splicing requires the use of fusion splicers which are expensive and it also needs skilled technicians to prepare both ends of the optical fiber using specialist tools.
In comparison, optical connectors can be terminated by only pushing the connector into an adapter bulkhead. The main operation required by the technician is to ensure the connector hygiene. The complexity and equipment cost difference is more distinct with ribbon fiber splicing and multi-fiber connectors.

As optical connectors are operationally more efficient, there is increasing interest in plug & play network deployment to meet the speed of deployment. The use of optical connectors for fiber terminations can help speed up FTTH/B premises connection. This can be done by deploying cables that are pre-terminated with optical connectors like the SENKO IP-9.

	Fusion Splicing	Optical connector
Equipment required	Fusion splicer and fiber preparation tools. Approximately $5,000 for a low end single fiber fusion splicer and tools in addition to Fiber Inspection Probe (FIP) and cleaning kit.	Fiber Inspection Probe (FIP) and connector cleaning kit. Minimum about $1,500 for a FIP and cleaning tools
Operation time	Longer time needed: Fiber preparation, splicing & heating protection sleeve, managing fiber in tray.	Quick operation: Perform Inspect Before Connect (IBC), clean if necessary, and terminate.

Expected Time of Fusion Splicing Installation

	Cable size	Preparation	Splice and Coil	Total
1x Fiber tech per joint	4-fiber	20-min	10-min	30-min
	8-fiber	20-min	20-min	40-min
	12-fiber	25-min	30-min	55-min
	24-fiber	35-min	45-min	1-hr 20-min
	48-fiber	40-min	1-hr 20-min	2-hr
	Cable size	**Preparation**	**Splice and Coil**	**Total**
2x Fiber techs or a Fiber tech and assistant per joint	72-fiber	1-hr 30-min	4-hr	5-hr 30-min
	96-fiber	2-hr 30-min	6-hr	8-hr 30-min
	144-fiber	4-hr	8-hr	12-hr

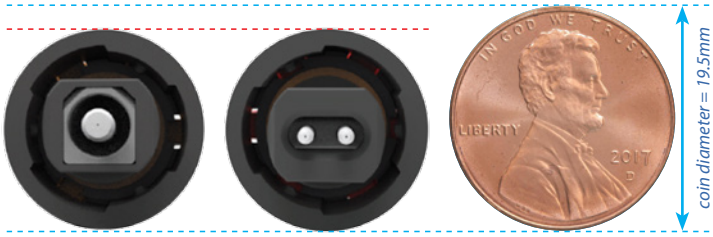
IP-9 Connectors

Senko's IP-9 connector is an IP68 (Ingress Protection code 68) rated outdoor bayonet style connector. The IP code classifies the degree of protection provided by the protective enclosure, in this situation, the casing around the optical connector. The two numbers in the protection code outlines the protection against solid particle protection such as dust, and liquid ingress protection.
IP68 indicates that the connector has complete protection against dust and continuous immersion in water. This indicates that the connector endface inside the IP-9 is totally protected against the elements and can even be installed in an underground pit.

The IP-9 connector can be supplied as an SC connector, field installable SC, an SN connector, and an MPO connector. This essentially allows the same IP-9 connector housing to be usable as a simplex, duplex, or multi-fiber connector.

The IP-9 connector has the smallest footprint of any outdoor connector with an outer diameter of only 17.3mm. The small connector size also allows for a smaller termination box, or double the port density, regardless of the number of fibers in the connector.

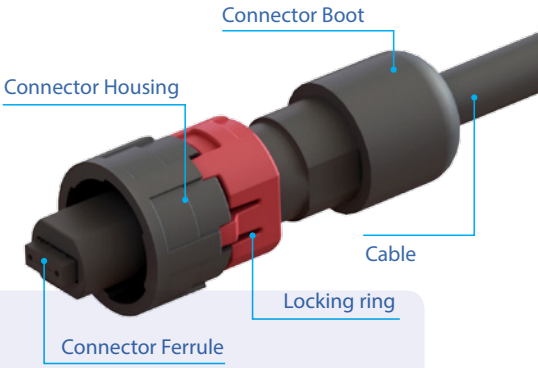
IP-9 series Weatherproof Connectors

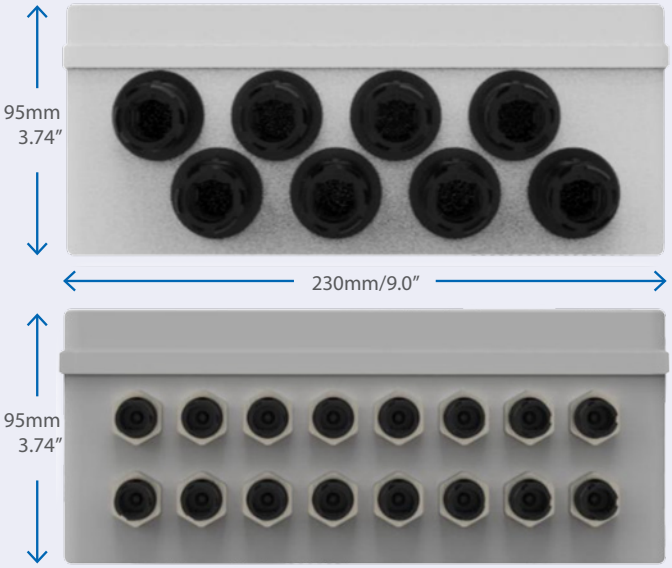


Single Fiber SC Field Installable

Duplex Fiber SN-2x LC Ferrule

4F, 6F, 8F, 12F, 24F MT Ferrule





Max 8x Connectors

- Single Fiber Connectors: Max 8x fibers
- Duplex Connectors: Max 16x fibers
- 12F MPO Connector: Max 96x fibers

Max 16x Connectors

Diameter of IP-9 Adapter: 20mm/0.79"

- Single Fiber Connectors: Max 16x fibers
- Duplex Connectors: Max 32x fibers
- 12F MPO Connector: Max 192x fibers

IP68 rated Connector

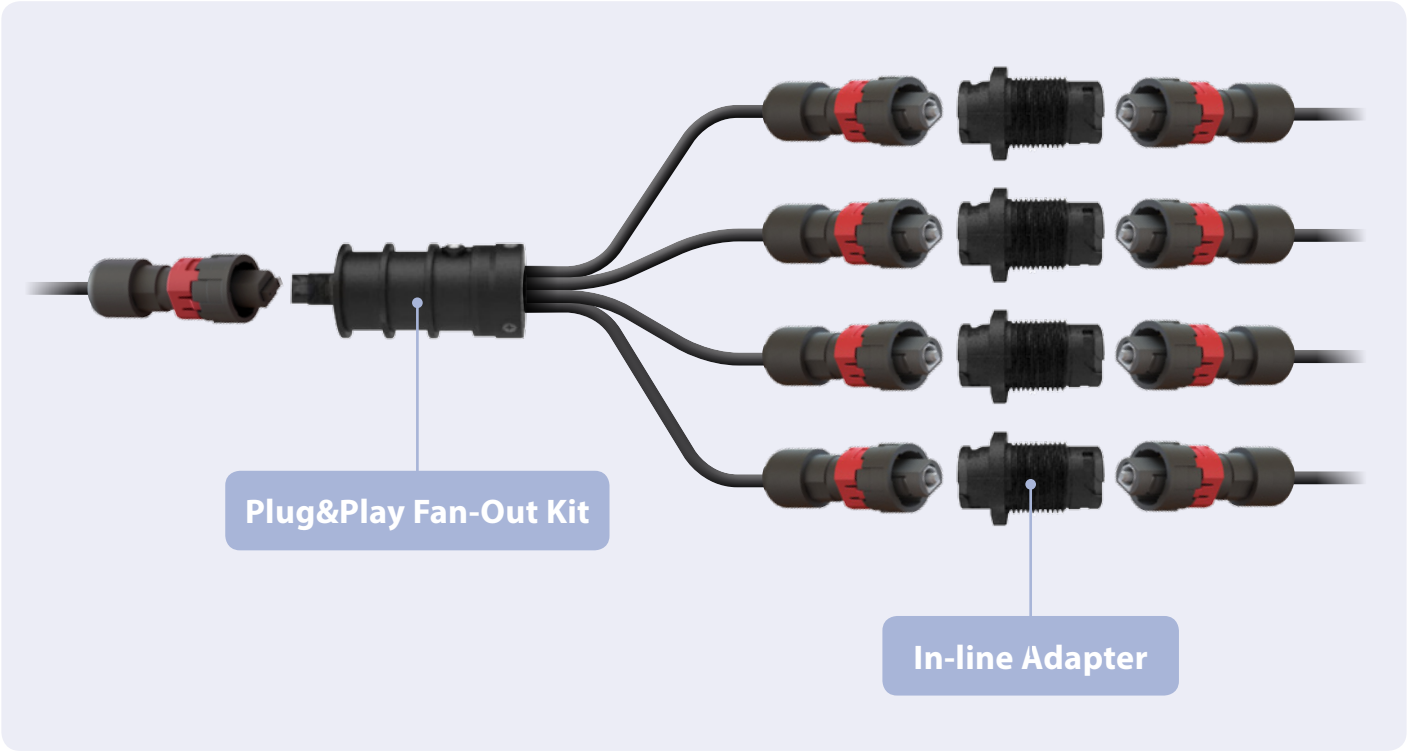
Another feature of the IP-9 connector is the safe lock ring. The connection mechanism requires a quarter turn on the connector housing to mate and de-mate. The safe lock ring, when engaged, prevents the connector housing from turning, thus preventing any accidental disconnection.

Historically, such outdoor rated connector solutions have not been widely adopted due to the risk of being locked into a proprietary solution. This limits the application of such connectors to a narrow solution set that is developed by the manufacturer. However, the IP-9 connector is a component that can be integrated to multiple optical network solution manufacturers.

IP-9 Connector Application in an FTTH/B Network

The IP-9 connector can be deployed as a feeder and distribution cable by using an MPO connector, or as a drop cable by using the SC or SN connector. The maximum cable size that can fit into the IP-9 connector boot is 5.5mm, which limits the maximum number of fibers that can be presented. Normally, a 5mm cable can have up to 24 fibers, which allows the IP-9 to be installed with an MPO-24 connector. However, if a larger fiber count cable is needed, a fan-out to multiple IP-9 connectors is also an option.

In situations where there is space constraints or even just as a cost reduction measure, the IP-9 connector does not need a termination box to perform a connection. In-line adapters can be mounted on a simple outdoor panel, thus eliminating the need for an enclosure. This feature also enables the capability for an easy network extension.



A high fiber count cable can be pre-terminated with the IP-9 MPO connectors as a fan-out on one end as the feeder cable from the exchange. These individual IP-9 MPO connectors can be distributed out in a star configuration to feed multiple downstream networks. Smaller fiber count cables with pre-terminated IP-9 MPO connectors can then be routed to other locations where fiber is needed.

In the example, some of the fibers can be routed to an MDU as the FTTB backhaul connection. Some of the fibers can be routed into an FTTH cabinet where the IP-9 MPO connector is connected to an MPO-LC fan-out to access individual fibers to be terminated to optical splitters.

For a long string of premises, such as terrace houses, a 12F cable with IP-9 MPO connector can be terminated into closures where one or more fibers are broken out to feed optical splitters. The output of the optical splitters can then be connected to customer premises through the IP-9 SC connector, if only one fiber is needed, or the IP-9 SN connector, if two fiber per premises is needed.

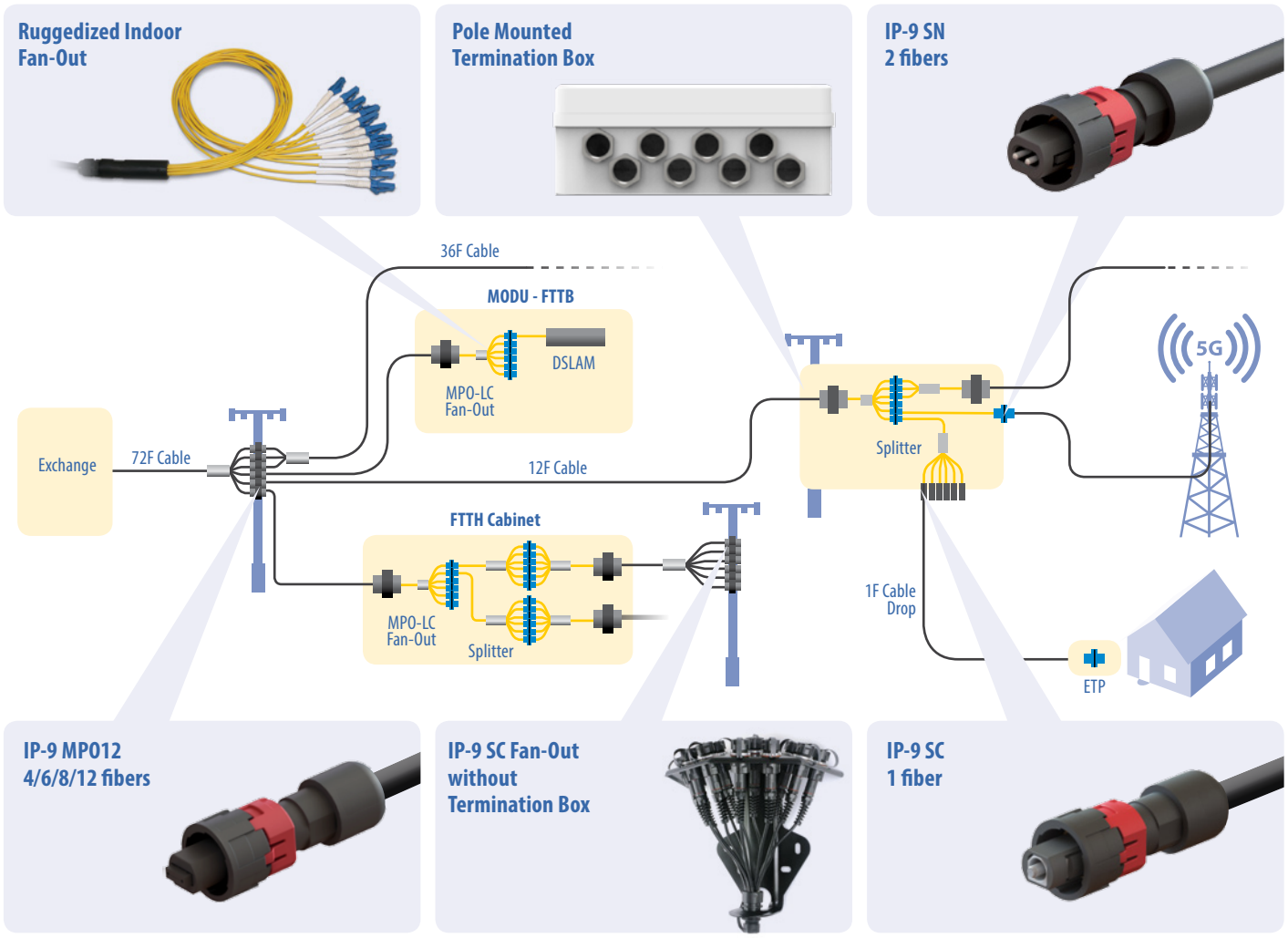
By using the IP-9 connector, the whole Outside Plant fiber network can be installed without the need for any fusion splicing, thus increases the speed of network deployment and removes the need for any high cost equipment and skilled technicians.

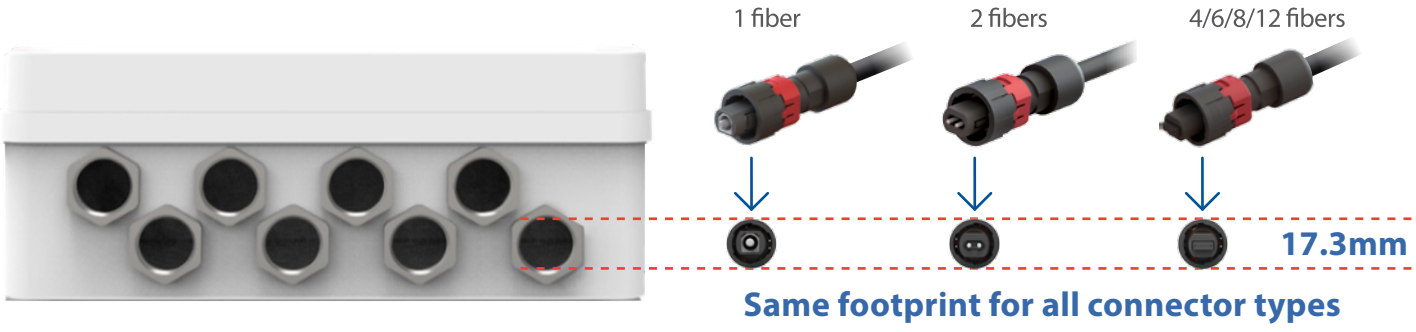
IP-9 Connector Application in an FTTA Network

As the IP-9 has the same connector footprint regardless of the ferrule type, it enables multiple deployment scenarios with just one closure type. The flexibility in closure configurations allows the optical network to be able to support both an FTTH and FTTA network.

One of the main differentiator of the IP-9 connector is the availability of a two-fiber connector in the same small connector footprint by using Senko's SN connector. This means that one connector in an existing termination box can be reconfigured with an IP-9 SN connector without replacing the whole termination box which reduces development time and cost, as well as simplify inventory management.

Here is an example of an end-to-end optical fiber network that can be deployed using only IP-9 connectors serving FTTH, FTTB and FTTA.





Summary

Senko's IP-9 connector is the world's smallest and versatile solution that enables a quick and efficient way to deploy FTTH/B as well as FTTA networks.

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Biography

Dr. Bernard HL Lee is currently the Director of Technology & Innovation at SENKO Advanced Components. He started his career in optical communications when he was appointed as a Senior Research Office for the European Union IST project known as DAVID in 2000. In 2003, he joined Telekom Malaysia R&D where he has held various technical and management positions there including the Head of Photonic Network Research and also Head of Innovation and Communications. Bernard then joined the parent company, Telekom Malaysia (TM) in 2010 as the Assistant General Manager of the Group Business Strategy Division where he oversees the company's business direction. Bernard obtained his RCDD accreditation in 2016. Bernard is also a member of the International Electrotechnical Commission (IEC), the Institute of Engineering and Technology (IET) and was also the Director of the Board of the Fiber-To-The-Home Council APAC. He is currently the Malaysia Country Chair for BICSI Southeast Asia.

Ron Kleckowski is the Director of Product Line Management at Senko Advanced Components. He has 32 years of the fiber optic experience focused on fiber optic connector innovation, new product development, and the introduction of new fiber optic solutions to support related applications and markets. Over his career, Ron has participated in various industry and conference events and holds more the 10 patents. He received a BSc Degree in Electrical Engineering Technology from Wentworth Institute of Technology.

Hunter (Shuntaro) Kanai is currently the Product Line Manager for Wireless market / Outside plant applications at SENKO Advanced Components. He joined SENKO in 2013 after graduating from The University of Tokyo and started his carrier in optical communications at SENKO's Fiber Optic Division in Tokyo, then in Massachusetts HQ in 2014. After working as a sales account manager in the Northwestern U.S. and Canada, he started his current position as a Product Line Manager for Wireless market / Outside plant applications in 2018. He supports many FTTA and FTTH related projects globally and is in charge of new product development related to wireless and outside plant applications at SENKO. Hunter currently represents SENKO at Small Cell Forum

Yohei Sato is currently the VP of Sales at SENKO Advanced Components. He started his career in optical communication after graduating from Rutgers University, when internet was through dial-up connection which his kids can never imagine. He has more than 20 years of the fiber optic experience mainly in Telecom and Data Center markets, focusing on new business development and fiber optic connector evolution. Yohei is keen in finding solutions for new application and markets through product innovation and advancement. He has been actively participating in multiple industry standard meetings and conferences.

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