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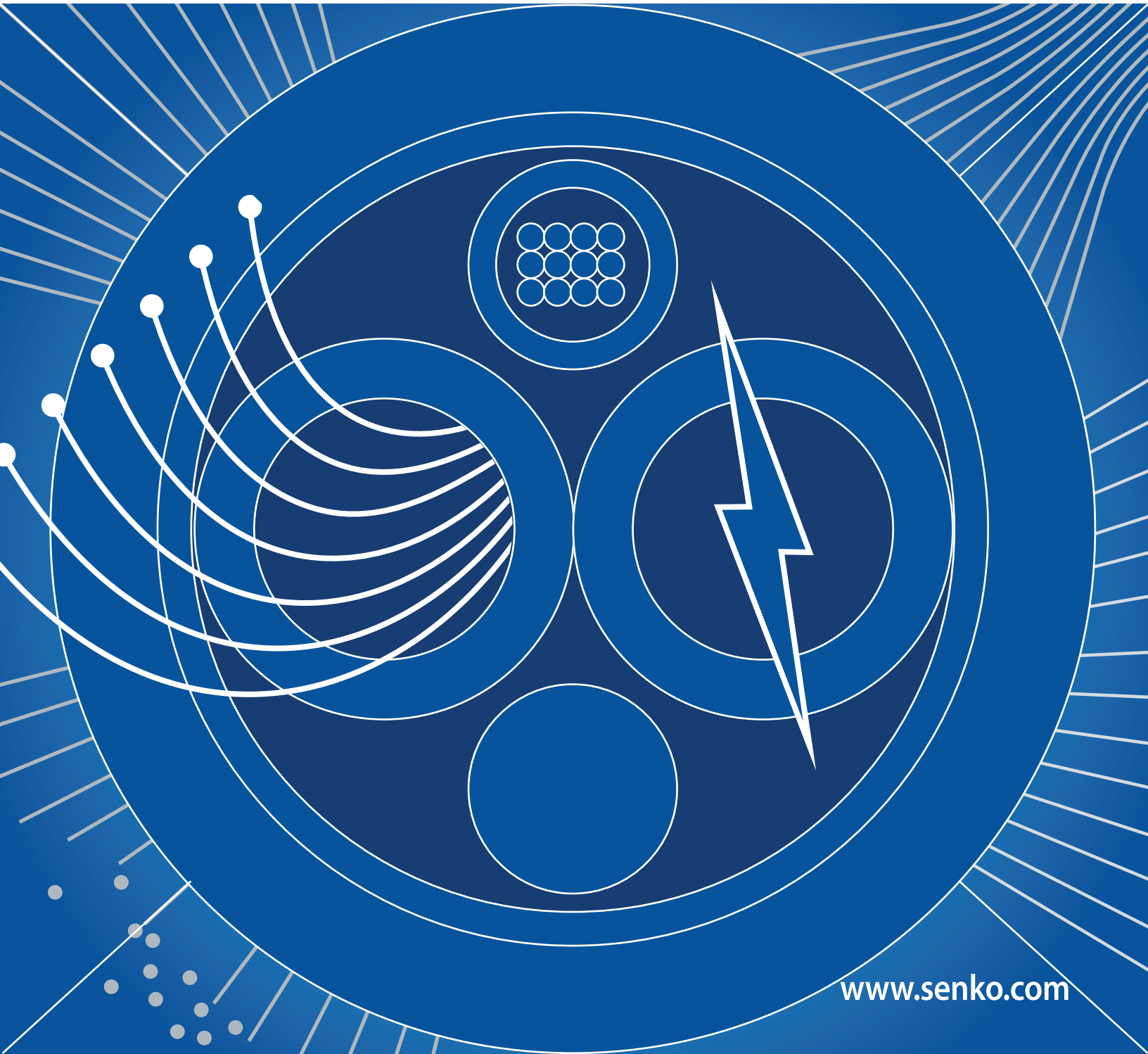
Hybrid Connector Solution: Empowering 5G

Dr. Bernard Lee, Hunter (Shuntaro) Kanai



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Hybrid Connector Solution

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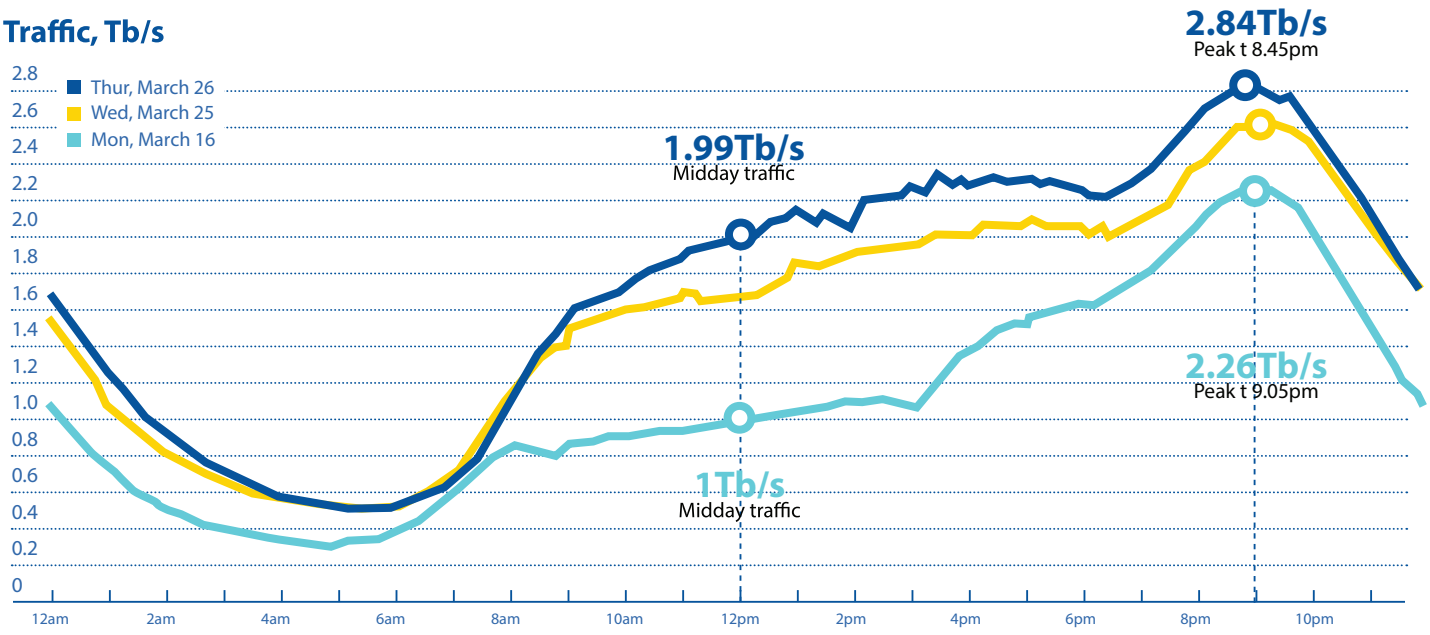
Introduction

The number of connectivity, its density, and speed performance of fixed and mobile broadband networks have continued with an upwards trajectory. Demand for high speed broadband connection is fueled by more businesses adopting cloud based services, more 4K video streaming consumption, digital education, and the normalization of people working from home.

This is evident during the Covid-19 pandemic where governments encouraged remote working. Chorus in New Zealand, who have recently completed their Ultrafast Broadband deployment, saw a dramatic increase in network traffic within a single day. High network traffic increased during office hours, is attributed to more video conferencing calls, remote education, and video streaming. This has fueled higher demand for FTTH connections for higher bandwidth and a more reliable connection.

Chorus Network Traffic

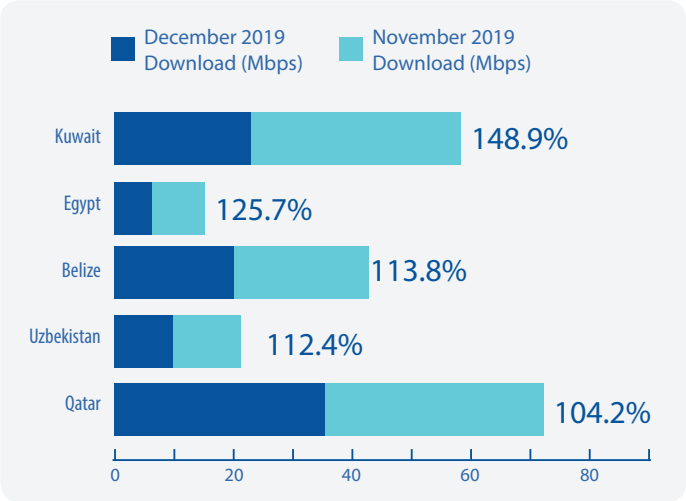


Source: Chorus

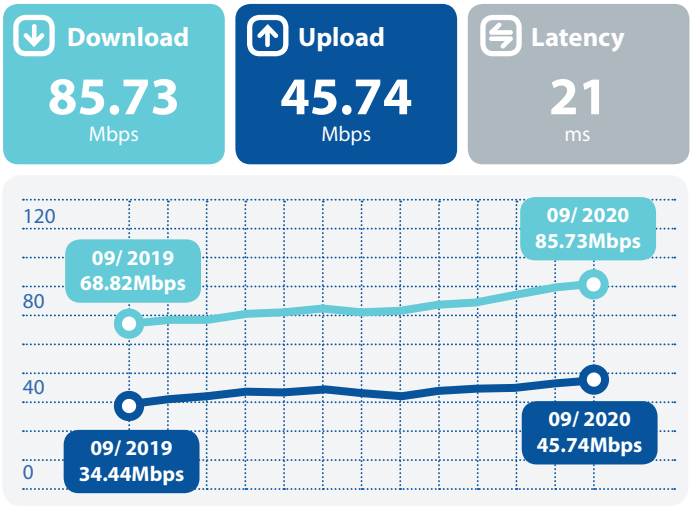
According to an Ookla report, within the 1 year period from December 2018 to November 2019, the global fixed broadband download speed has increased by 31.7% with the global average download speed hitting 71.55Mbps and the average upload speed being 38.91Mbps. The country with the most improved download speed is Kuwait with an increase by 148.9%, while the country with the fastest download speed is Singapore at 226.6Mbps.

Top 5 most improved Countries - Fixed Broadband

Speedtest Global Index™



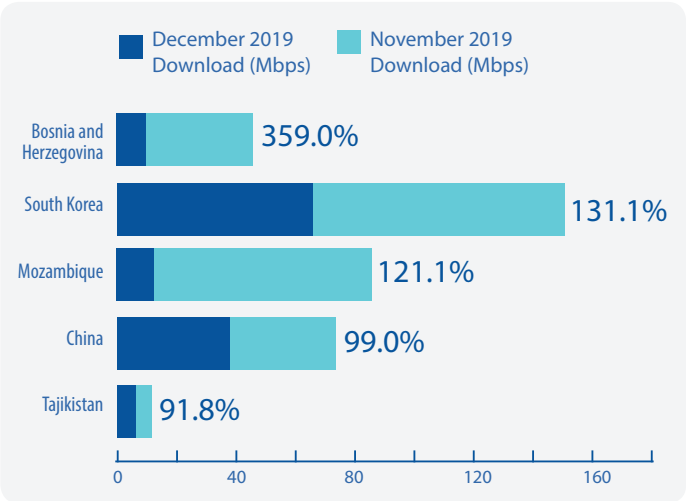
Global Average



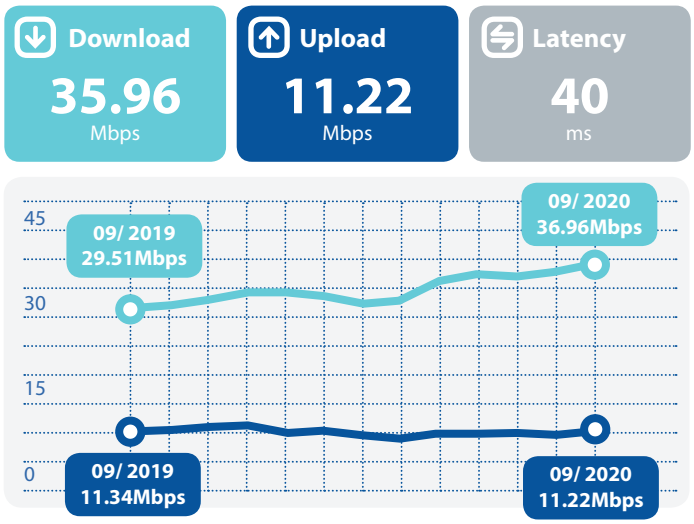
The global mobile speed has increased by 23.4% with the global average download speed of 30.93Mbps and average upload speed of 11.8Mbps. The country with the most improved download speed is Bosnia Herzegovina with an increase by 359%, while the country with the fastest download speed is South Korea at 121Mbps.

Top 5 most improved Countries - Mobile

Speedtest Global Index™

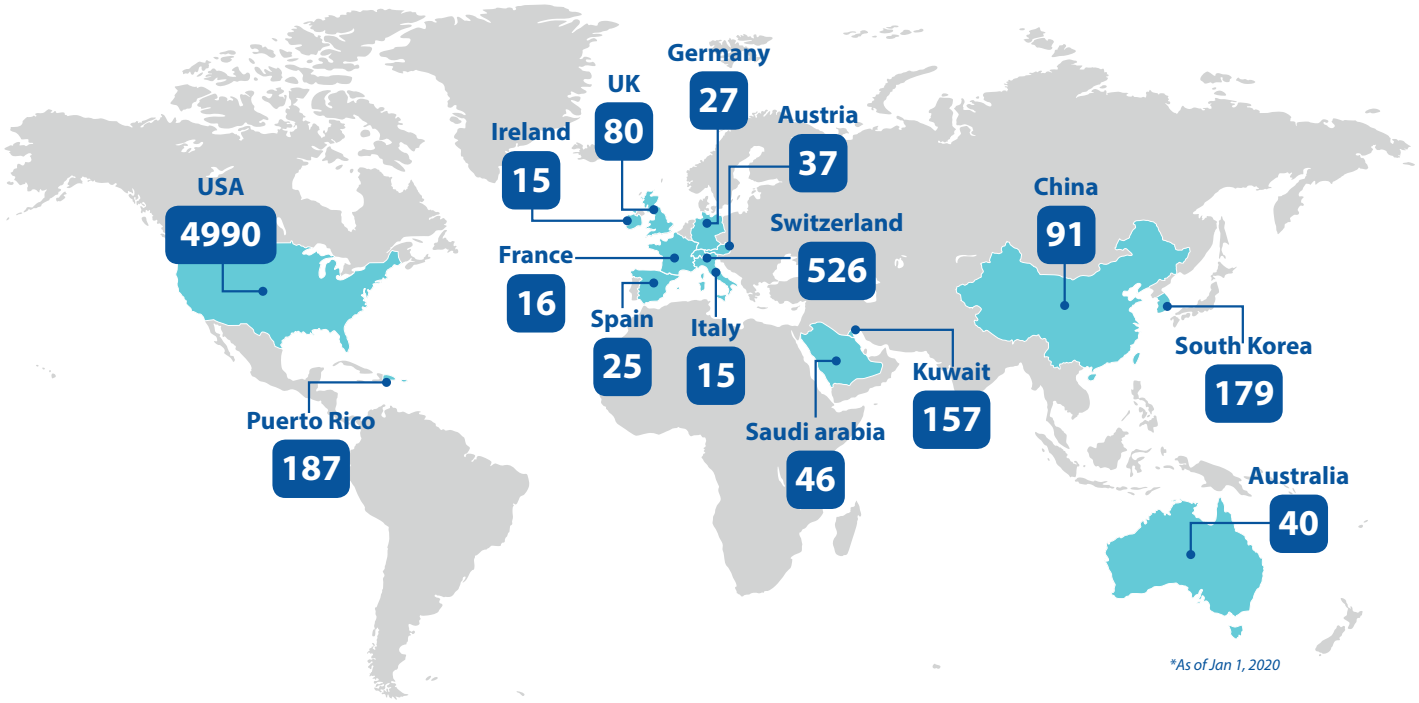


Global Average



Countries with the most 5G deployments*

Ookla 5G Map™

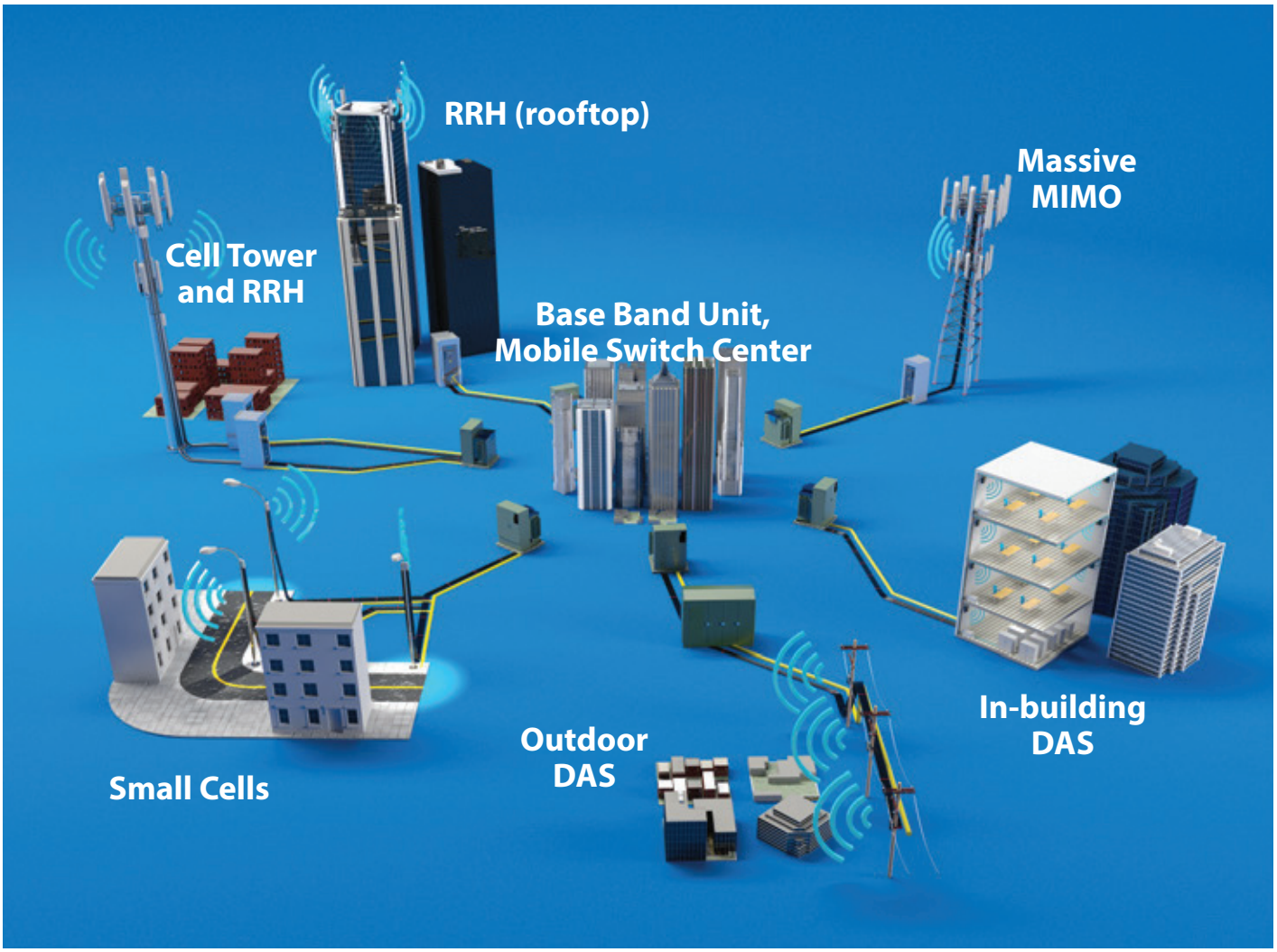


Similar to 5G, Wi-Fi 6 (IEEE 802.11ax) also promises faster speeds, less latency, and more capacity, with new features such as MU-MIMO, and OFDMA. Adoption of Wi-Fi 6 has already began since early 2019 with the introduction of Samsung Galaxy 10 which is the world's first Wi-Fi 6 capable device. More networking solutions and devices such as mobile phones, tablets and laptops have since been released.

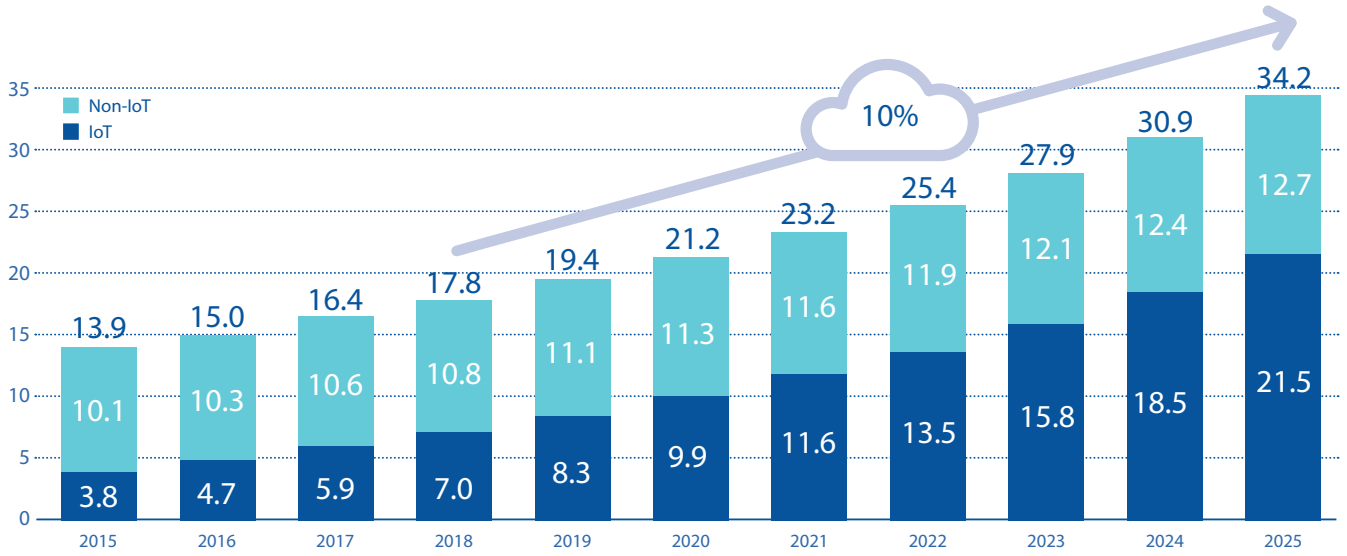
The adoption of 5G and Wi-Fi 6 is further developed through the OpenRoamingTM consortium which is under the Wireless Broadband Consortium. One of the main objectives of OpenRoaming is to create a federation of networks to enable automatic roaming and user onboarding to enable users to seamlessly roam between cellular networks, including Wi-Fi 6 and 5G.

Need for connectivity and power

We now live in a society with an increasing number of connected devices. It is no longer constrained to mobile phones but almost anything can be turned into a connected device from trucks to your home food blender. According to a report by IoT Analytics Research, the total number of active devices is expected to achieve 34.2 billion by 2025.



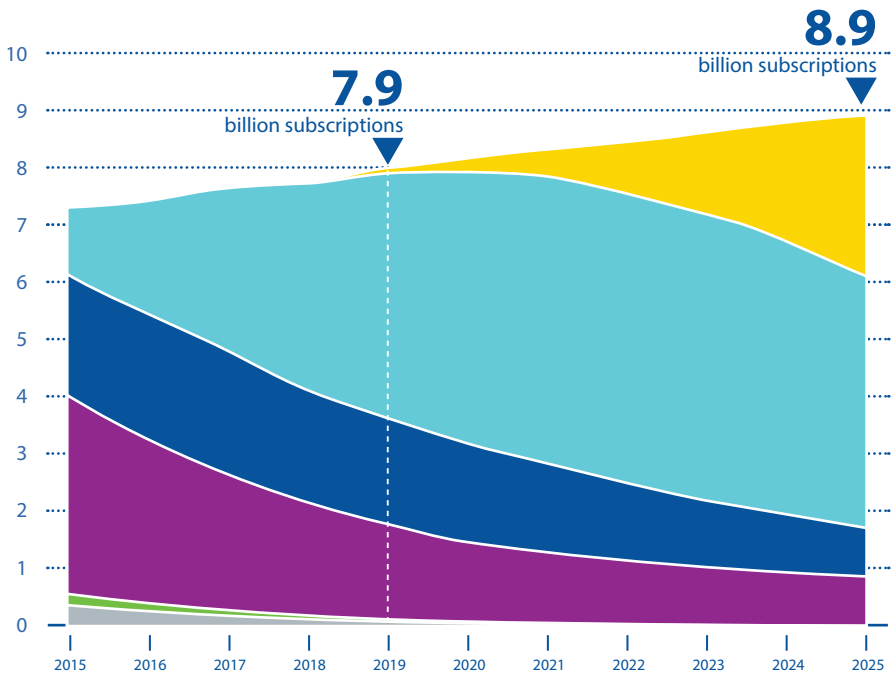
Total number of active device connections worldwide



Note: Non-IoT includes all mobile phones, tablets, PCs, laptops and fixed line phones. IoT includes all consumer and B2B devices connected - see IoT break-down for further details. Source: IoT Analytics research 2018

The latest wireless technology that is actively being deployed by major mobile network operators is 5G. An Ericsson mobility report indicates that in 2025, the number of 5G subscribers is forecasted to reach 2.8 billion, which is about 30% of all mobile subscriptions.

Mobile Subscriptions by Technology



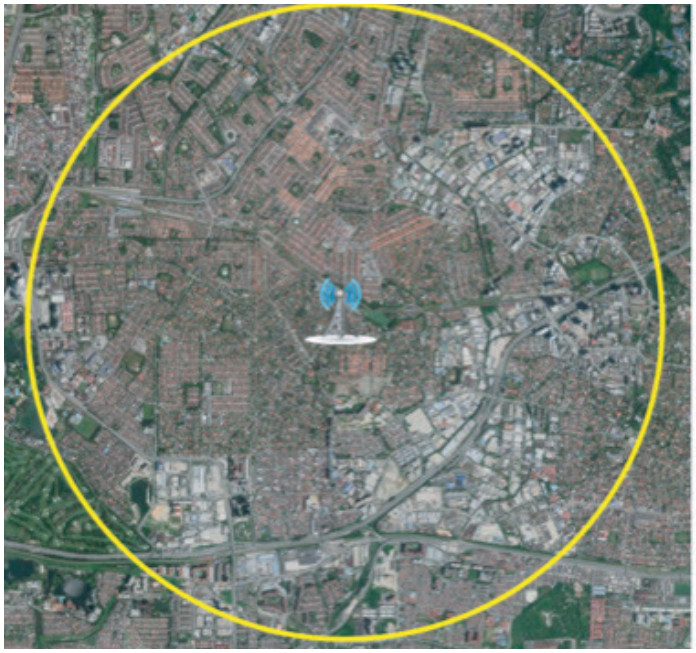
2.8bn

In 2025, 2.8 billion 5G subscriptions are forecast

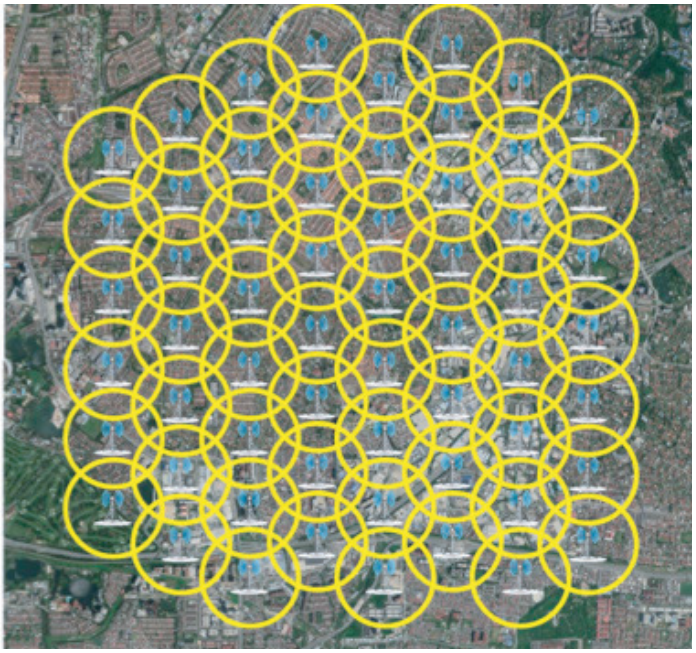
- 5G
- LTE (4G)
- WCDMA/HSPA (3G)
- GSM/EDGE-only
- TD-SCDMA (3G)
- CDMA-only (2G/3G)

note: IoT connections are not included in this graph. Fixed wireless access (FWA) connections are included.

As the number of connected devices increases, so does the number of access points that require connectivity and power. Unlike 4G networks where a single macro cell can have a coverage of up to 25km2, 5G networks uses millimeter waves that have a much shorter coverage area of only 0.04km2, which means that 60 small cells are required to have the same coverage area as a 4G macro cell. This also means 60 times more connectivity and power cabling.



4G Network Cell coverage - 25 km²



Equivalent 5G Network Cell coverage - 60x0.04 km²

The high number of small cells needed creates a new problem. Where are they going to be located? A typical macro cell that has a large coverage area and, to a certain extent, have some leeway in the placement of the tower. However, the coverage area of a typical small cell limits the mounting options. One way of implementing such high numbers of small cells is to mount them onto existing street furniture such as street lamps, telephone booths, and bus shelters. Local power source may not be available in such locations and aesthetics may be a requirement as municipalities or local governments must be convinced to such deployment methods.

Auckland rubbish bin is secret cellsite

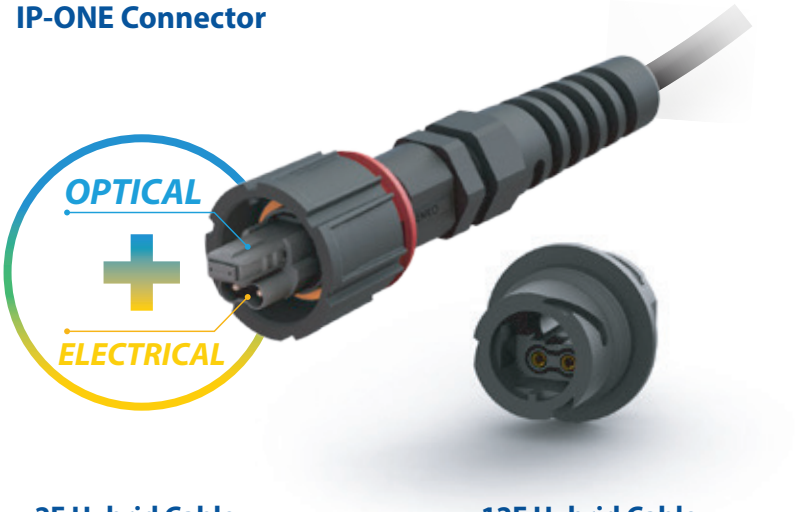
Outdoor Rated Optical and Electrical Connector Solution

Together with a hybrid power and copper cable, the IP-One connector is a solution that provides connectivity and power to small cells within a single IP68 rated connector. The connectors support 1-12 fiber and up to 2/12 AWG conductors in a low profile outdoor rated connector housing. This solution removes the need for two separate cables that may either require two separate trips to install the fiber and copper.

The single hybrid cable and connector solution is less intrusive to the surrounding, which is crucial for locations that places high importance on aesthetics.

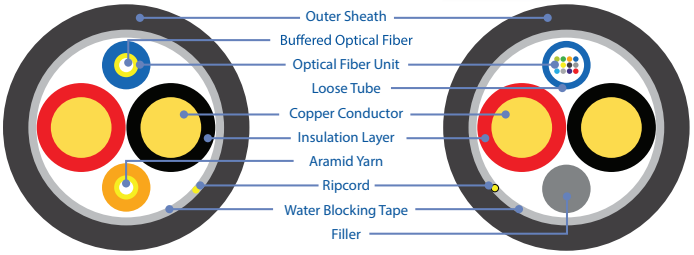
As power and fiber networks may not always be available at the same location, it may be a challenge to get power lines company, municipal approval, or agreements with building owners to access local power sources. The IP-One connector enables a more flexible access to power sources which shortens the time to access local power sources.
The plug & play feature reduces installation time which then increases the rate of service turn up. The quick network connections is beneficial not only for large scale network deployment, but also for one-off events, network changes and extensions. Shorter installation time is key to reduce deployment cost, while a faster service turn up allows network operators to generate revenue earlier.

IP-ONE Connector

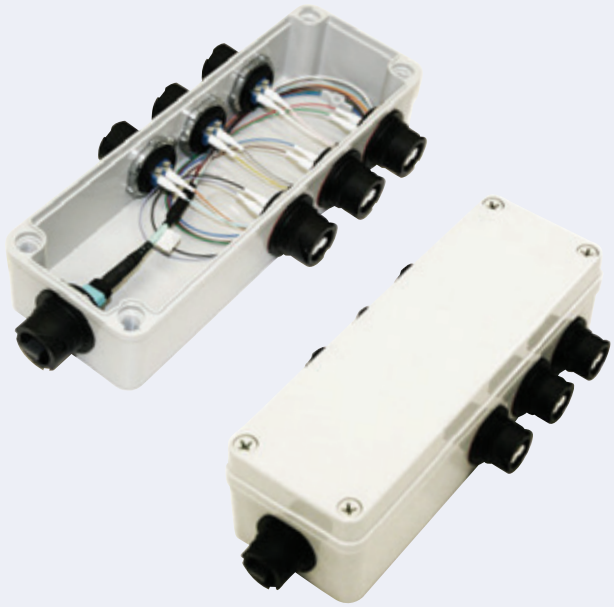


2F Hybrid Cable

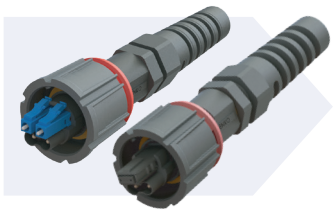
12F Hybrid Cable



Breakout Termination Box



The IP-One connector is versatile and is deployed in multiple different network designs.



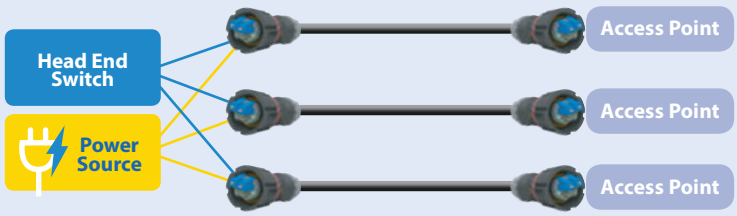
LC Duplex or MPO + 2x 12AWG (4mm²) 9.3 AMP

LC Duplex or MPO + 2x 8AWG (10mm²) 30 AMP

LC 4 Fiber + 2x 6AWG (16mm²) 40 AMP

Point-to-Point (P2P) Network

A P2P system is where all the access points are directly connected to the head end device and power source. This type of design requires the highest number of cables and connectors. This is usually deployed in small coverage area that is local to the head-end device such as in an office

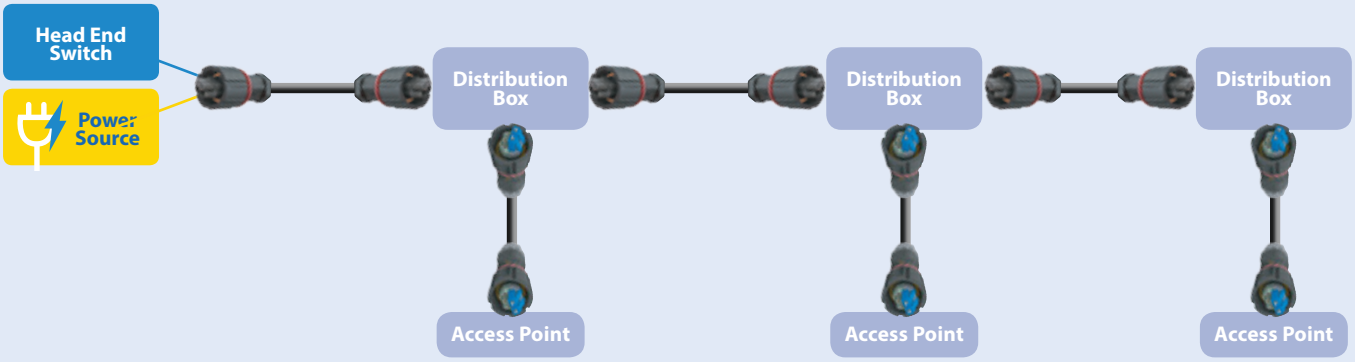


Star Network

A star network is where the head end device is located in a centralized location and a distribution device, such as a multi-port media converter, is located in a remote location to serve a cluster of access points. Such a network design reduces the number of cables and connectors, but will require the use of a remote distribution device. Where the remote cluster is too far away to be powered from a central location, it is possible to boost the power by using a power injector at the distribution device.

Daisy Chain Network

A daisy chain network is deployed where the access points can be connected in a sequential link. A series of patch cables and distribution boxes are connected to link the access points along the route. This type of deployment is suitable in the situation where the ability to install multiple cables is limited. An example is the installation of access points onto a series of lamp posts.



IP-ONE Deployment Case Studies

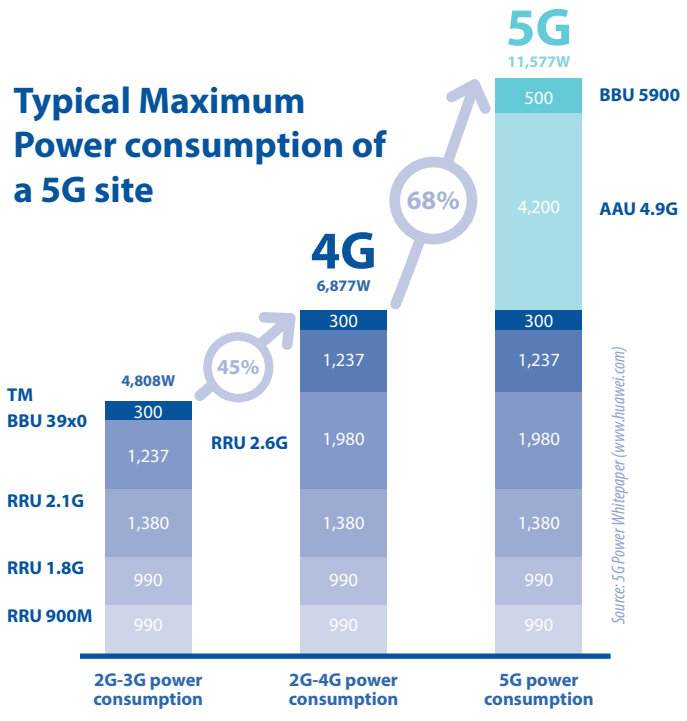
The IP-One connector is flexible and is utilized in a large macro cell or in an Indoor DAS. Here are some case studies of the benefits in using the IP-One solution.

CASE 1
Macro cells

One method of deploying a macro cell is to install the Baseband Unit (BBU) at the base of the tower and the Remote Radio Heads (RRH) at the top. The RRH is connected to the BBU by using an optical fiber cable and powered by a separate power cable which increases the lease cost for cable space.

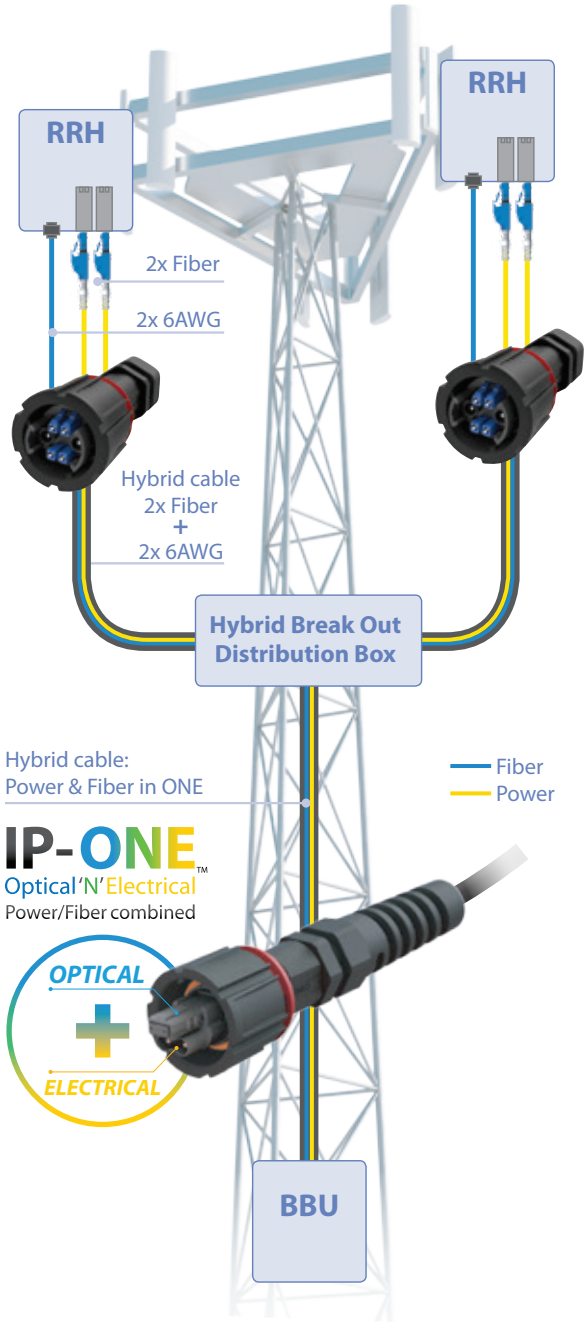
AC powering system also requires a certified electrician to terminate the power cables. The IP-One solution together with a hybrid power and fiber cable uses DC power which simplifies the ease of deployment without the need for a certified electrician, thus further reducing the deployment cost.

In addition, the typical maximum power consumption of a 5G site is about 11.5kW, which is about 68% more than a 4G macro cell. The IP-25 is developed with a 6 gauge wire can provide up to 4kW to supply the power requirement of a 5G macro site with the connectors being routed to each of the RRH mounted on the tower sectors.



Benefits:

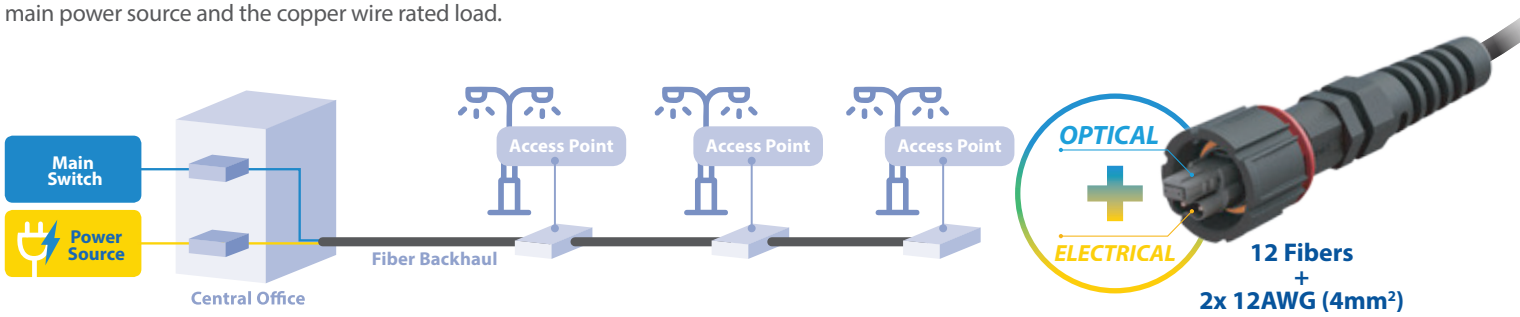
- Reduce leasing fee by minimizing the number of cables on tower
- Save installation time by making it Plug & Play



CASE 2

Small Cell & Distributed Antenna System (DAS)

Unlike a macro cell, in a small cell and DAS network, the access points are usually lower power devices. A daisy chain network design can be deployed with a high fiber count cable with a small gauge copper wire as the main backhaul cable while a higher gauge copper wire with low fiber count be used as a drop cable. The main backhaul cable is terminated in a series of distribution boxes where the required number of optical fibers can be terminated to the drop cable. To enable a longer distance power distribution, a higher voltage is applied at the central office. At the distribution boxes, a tap off from the main copper cables is made and then terminated into a step down power converter to a DC voltage that is suitable for the access point. This simplifies the network power management as the designer only needs to ensure that the total power consumption of all the access points to be within the limits of the main power source and the copper wire rated load.



Benefits

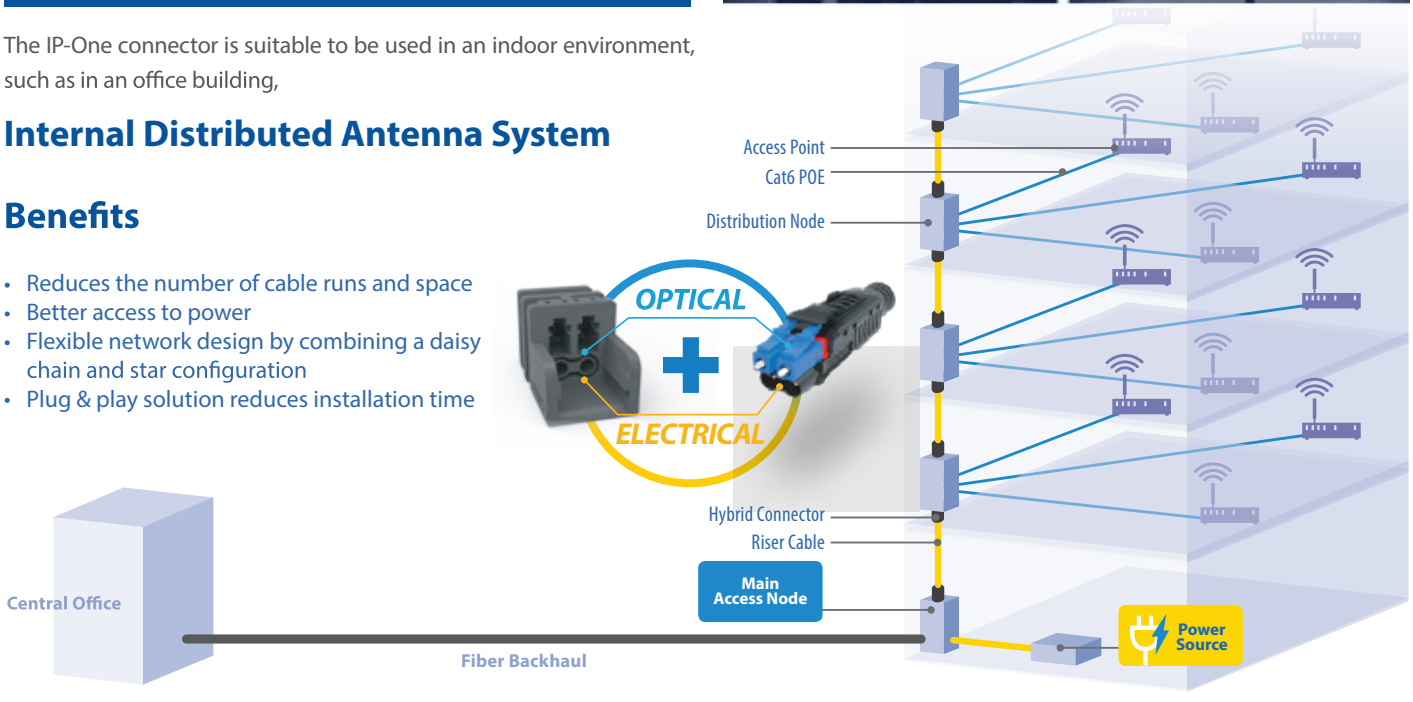
- Low profile that can be blend into the environment and be less intrusive to surrounding
- Flexible location of power source and reduce service turn up time
- Plug-and-play solutions reduces installation time

The IP-One connector is suitable to be used in an indoor environment, such as in an office building,

Internal Distributed Antenna System

Benefits

- Reduces the number of cable runs and space
- Better access to power
- Flexible network design by combining a daisy chain and star configuration
- Plug & play solution reduces installation time



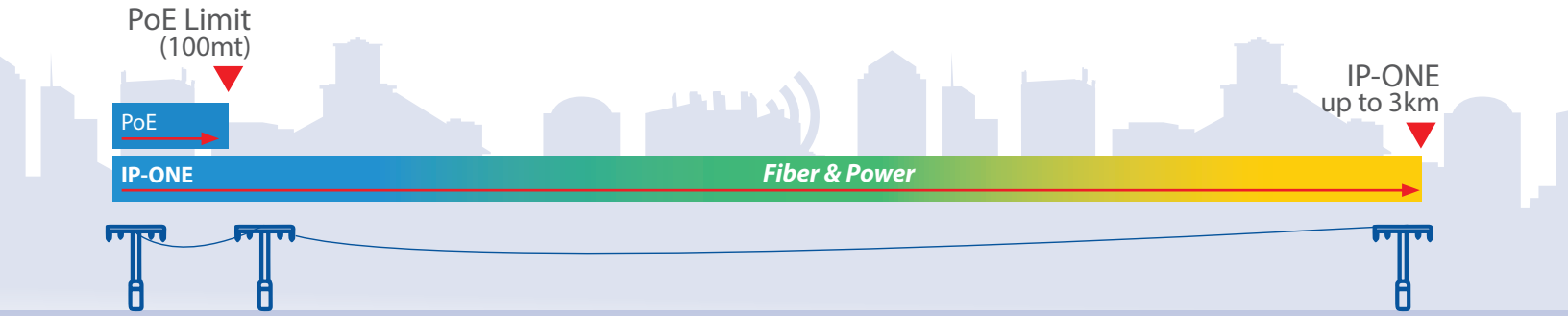
CASE 3
Mining Network

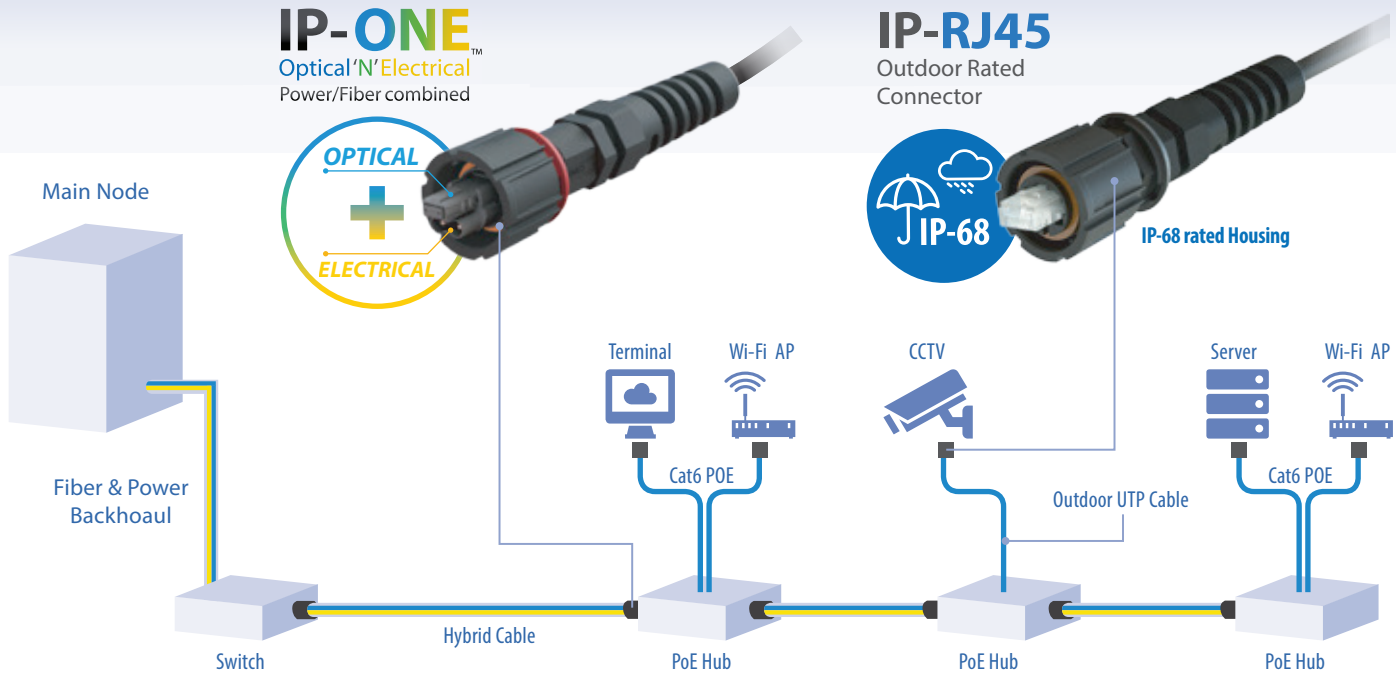
Since its introduction in 2002, PoE technology has improved to be able to provide up to 100W of power over 4-pairs of twisted copper in a UTP cable. This is sufficient to power large devices such as computers, monitors, and high power wireless access. However, PoE over UTP cables is limited to a maximum of 100m. In addition, there is limited power that can be fed through a UTP cable with a max of 22 AWG where only 2 copper pairs are used for power transmission. One method to extend the reach of a POE network over 100m is by using POE media converters with optical fiber as the link back to the main switching hub. However there is a limitation of deploying fiber, which is its inability to transmit DC power to the POE media converters which are usually located in remote sites.

A hybrid power/fiber cable pre-connectorised with the IP-ONE connector is the ideal solution to provide the required fiber to provide date transmission to the POE media converter.

In addition, the capability of the IP-ONE connector of transmitting up to 930W of power is essential as there may be multiple devices feeding off the POE media converter which also need a power source. The use of the IP-ONE solution eliminates the need to run separate power cables to feed such devices. The use of a hybrid cable extends the power distribution reach to over 3km.

As the IP-One connector that has a 12 gauge copper wire that can provide up to 930W, it can be used as a backbone network to be connected to distribution nodes, such as a PoE hub. For more devices and higher number of devices, the IP-25 with a 6 gauge wire can provide up to 4kW of power.





Summary

The demand for powering network infrastructure has been increasing, however, it is not without some challenges. Hybrid cables together with hybrid connectors, such as the IP-One, offer benefits for operators to tackle these challenges including extending reach, reducing lease fees, and provide power access flexibility. The evolution of hybrid connectors enables massive deployment by reducing installation cost and time through a plug & play installation process. The IP-One connector is suitable to be used in an indoor environment, such as in an office building, as well as in extreme environments such as in a mining site.

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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 currently the Malaysia Country Chair for BICSI Southeast Asia.

Hunter (Shuntaro) Kanai is currently the Product Line Manager for Outside plant / Wireless market 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. He started his current position in 2018 and have been supporting many FTTA and FTTH related projects globally and is in charge of new product development, focusing on solving customers' challenges with components design. Hunter currently represents SENKO at Small Cell Forum.

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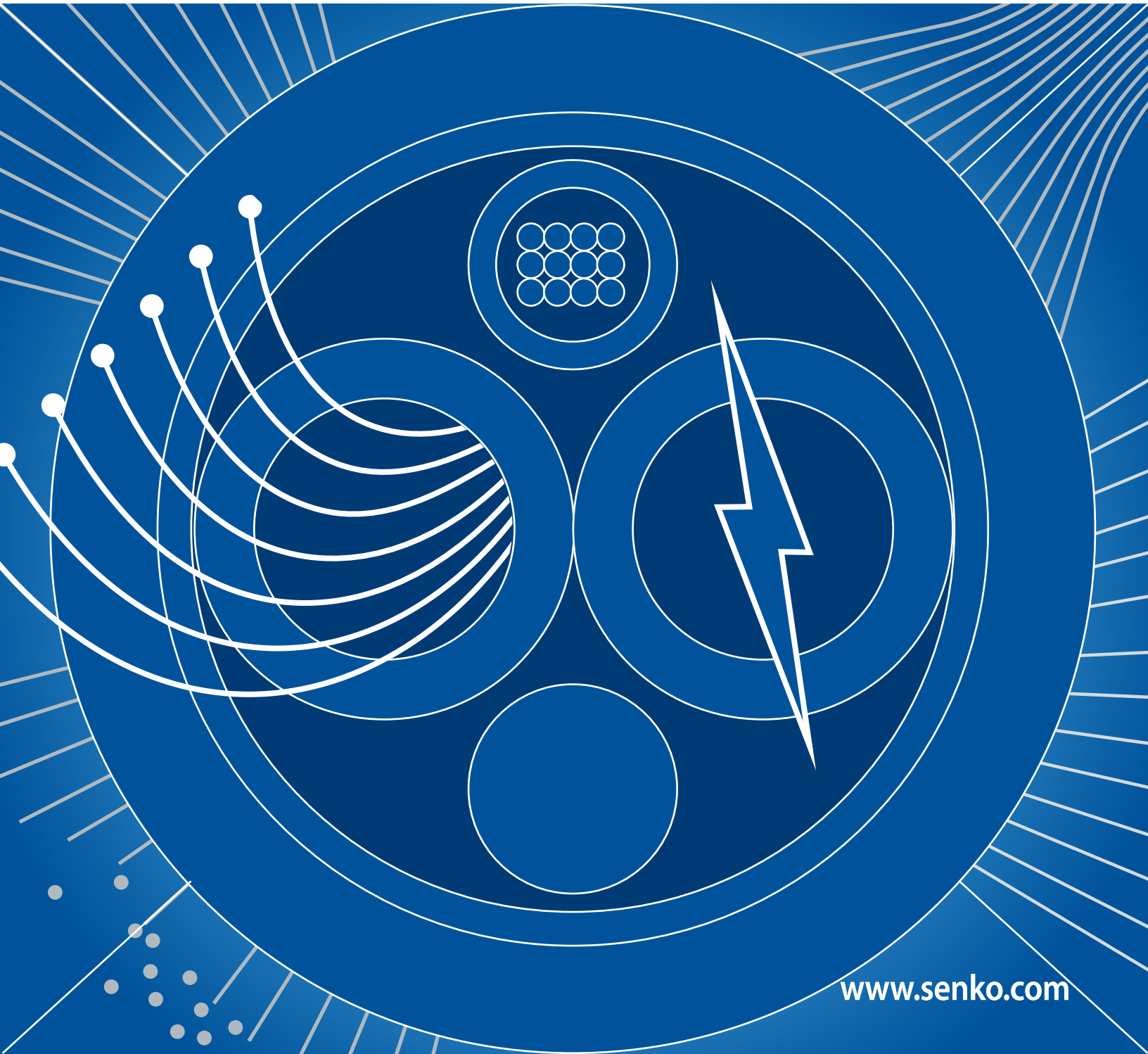

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