# Pure optic fibre, thin as a strand of hair but with unlimited performance

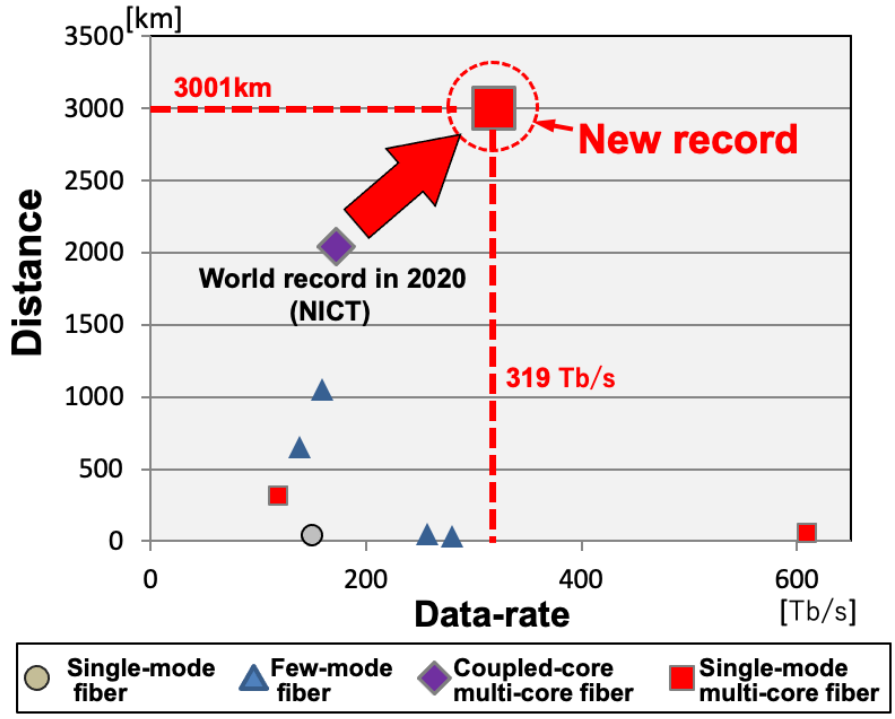
**Videos, gaming, digital television and home office. Just four of the many uses of the internet today. Bringing the conventional copper network to its limits. Fibre optic technology provides the remedy. Since its development, a good 50 years ago, it has ensured communication at the speed of light.**

The volume of data exchanged via the network infrastructure is increasing rapidly. Not just since yesterday, but already for many decades. Early on it therefore became clear that the limited bandwidth of the copper wire infrastructure would one day reach its limits. For this reason, researchers at the American company Corning began, in the mid-1960s, to look for suitable technologies to expand the available bandwidth. For four years they experimented with different models. Finally, in 1970, the time had come. The Corning scientists presented their solution: a hair-thin fibre, produced from high-purity glass. Unlike conventional copper cable, where data is transmitted via pulses of electrical current, the fibre optics used ground-breaking pulses of light. A technological revolution.

## Faster and faster through the internet, thanks to fibre optics

Since then, the technology has been continuously developed. For example, in increasing the power level and further reducing the attenuation of the light signals on their way to the receiver. When the first optical fibre was presented in 1970, the attenuation was still 17 decibels per kilometre (dB/km), today it averages 0.17 dB/km. A decisive improvement. Because the lower the attenuation, the more light - i.e. signal strength and thus more power - reaches the end customer. If the attenuation were 20 decibels, for example, only one hundredth of the original signal strength would reach the end user. Too little to cope with the immense data volumes of today.

The current world record is 319Tbit/s over a distance of over 3,000 kilometres. Or to put it differently: over 13.4 million UHD films can be streamed simultaneously. Researchers at the Japanese National Institute of Information and Communication Technology (NICT) achieved this record using optical fibres with a standard outer diameter.




(Graphic: NICT)

**As thin as a human hair**

Today, fibre optics consist of three parts: the core, the cladding and the outer sheath. The core, made of high-purity glass, transmits the injected light waves. This core (single-mode fibre optics) is only 8 micrometres thin, which is about the diameter of a human hair. The core is surrounded by a fibre optics jacket. This measures 125 micrometres in diameter and has the task of preventing any breakage of the glass. Additional protection is provided by the outer sheath. This coloured protective sheath is 245 micrometres thick and keeps the cable flexible.

Fibre optics are manufactured in specialised factories. Immediately after production, they are subjected to a thorough quality control. Among other things, the bending radius is checked. It measures the smallest bend that the fibre optics can take during installation without changing its transmission quality. This is an enormously important issue, as otherwise light could escape during bending and correspondingly less bandwidth would reach the customer.

The bending radius can differ depending on the application of an optical fibre. There are flexible and rigid conductors. The latter are often used for long-distance connections, where they are blown into underground pipes using air pressure. Flexible fibres, on the other hand, are used when the destination is close or in a confined space and thus requires a high degree of mobility.

Swiss4net already uses fibre optic cables with 1,008 fibres and a diameter of 20.1 millimetres for its distribution network.

**Not all fibre optic connections are the same**

In Switzerland, the expansion of fibre optics is in full swing. It is being carried out by various players who are relying on different development methods. These methods include:

- **F**ibre **t**o **t**he **H**ome (FTTH): Fibre optic connection to the end customer (home/business).
- **F**ibre **t**o **t**he **B**uilding (FTTB): Fibre optic connection to the building entry point. Within the property, the existing copper or coaxial lines are used.
- **F**ibre **t**o **t**he **S**treet (FTTS): Fibre optic connection to the nearest cable duct. The existing copper or coaxial lines are used for the remaining distance to the building entry point and within the property.
- **F**ibre **t**o **t**he **C**urb (FTTC): Fibre optic connection up to the neighbourhood distributor. The existing copper or coaxial lines are used for the rest of the route.

The most common model is FTTH, i.e. connection to every single home or business. With all other connection methods, the fibre optics are not pulled all the way to the end customer. Instead, the data is transported over the last mile through weaker copper or coaxial lines. The signal strength is increasingly attenuated over these lines with increasing distance and line length, which leads to lower speeds at the end customer.

In addition, fibre consumes up to twelve times less energy in operation than pure copper. A win-win solution in which customers and the environment benefit equally.

**Two different FTTH construction models**

FTTH construction is currently being implemented in Switzerland using different technologies. The two most well-known are the point-to-point model (P2P) and the point-to-multipoint model (P2MP).

The pure point-to-point model (P2P) is open in terms of technology for future FTTH developments and the individuality of the providers. Thanks to their own fibre optic connections from the central office to the end customer, providers can choose and use their preferred technology themselves. Even the already popular XGS-PON (10 Gbps Symmetric Passive Optical Network) is offered to end customers without restrictions via the P2P network. At the same time, all end customers benefit from maximum internet speed (synchronous, in upload and download) as well as best availability and security for the paid service.

For all its area-wide FTTH networks, Swiss4net therefore relies on a P2P model with 4 fibres per usage unit. This ensures that all end customers receive their own fibres and that the telecom providers can use the networks without discrimination.

**P2MP is not a single-fibre model**

The point-to-multipoint model (P2MP) has no continuous fibre from the central office to the end customers. A P2MP network carries only one fibre on the first section from the central office to the duct (in the street or in the building) and from this distribution point the fibre is split to 32 end customers by means of splitters. Thus, in the P2MP model with its tree structure, only 1/32 of a fibre arrives at the end customer and there is no individual, continuous fibre between the central office and a dwelling or a shop and can therefore not be called a "single-fibre model".

In addition, physical access to Layer 1 in P2MP is limited for telecom providers. A P2MP model is also susceptible to interference in the connections, since an entire P2MP tree (all 32 customers of a provider) is always affected at the same time. The telecom providers of the individual end customers are dependent on the P2MP technology that the builder has chosen for the fibre roll-out and providers have to build on this without having the freedom of choice themselves.

**About Swiss4net**

Swiss4net is the partner with the long-term all-round carefree package for point-to-point FTTH fibre rollout for municipalities, cities and utilities. Unlike other providers, Swiss4net takes care of everything from planning to construction and operation. Municipalities, cities and utilities incur no costs and assume no financial risks. The resulting environmentally friendly fibre optic network increases the attractiveness of municipalities and cities as locations and, through non-discriminatory access, increases the freedom of customers to choose their telecom provider. Swiss4net currently operates the point-to-point FTTH fibre network in Baden and Ennetbaden as well as in Chiasso, Vacallo, Morbio Inferiore and Balerna. In Ascona, Pully, Morges as well as Unter- and Obersiggenthal, the point-to-point FTTH fibre networks are currently being expanded and some are already in operation.

More information on Swiss4net: www.swiss4net.ch/en