YOFC's Expert Provides Insights into the Development Prospects of the Next-generation Mainstream Optical Fibre Technology

Where will R&D on next-generation mainstream optical fibres head?

The rapid growth of the digital economy demands a high-quality optical communication network that can keep pace. Consequently, what are the prerequisites for optical fibres' performance and transmission capacity in this new network? Furthermore, what are the current research and development trends in the industry with regards to next-generation mainstream optical fibres?

At the OptiNet China Conference 2023 on June 14, Zhang Lei, Manager of the Advanced Research Department of YOFC, delved into the evolution of next-generation mainstream optical fibres and domestic and international industry players' R&D progress in new optical fibres.

Zhang Lei Advanced Research Department

Manager Zhang Lei from YOFC's Advanced Research Department called for collaborative enterprise-academic research on the next-generation communication fibres for win-win results. He emphasized openness in path selection and urged confidence and patience in product and technology R&D.

Generally, the process of researching and developing a new optical fibre, and its subsequent large-scale commercialization are a time-consuming endeavor. According to Zhang Lei, it typically involves three main stages.

The first is to complete theoretical validation and get the academia, the industry, upstream and downstream industrial chains on the same page.

The second is to foster industrial production capacity and conduct tests under laboratory and existing network conditions.

The third is to finalize product types, achieve industry standardization, and initiate large-scale applications in the existing networks.

Take the G.654.E fibre as an example. In 2010, YOFC initiated R&D on optical fibres with ultra-low attenuation and large effective areas. By 2014, prototype samples were completed and received laboratory transmission tests. In 2016, it launched a land application experiment on the first G.654 optical cable under existing network conditions. In 2017, ITU-T organized the release of standards for the G.654.E fibre. From 2018 to 2019, all three major telecom carriers and State Grid completed the verification under the existing networks' service loads. In 2022, the large-scale application of 1-millionfkm G.654.E in the existing network.

Given the lengthy R&D cycle of new optical fibres, the industry needs to anticipate the evolution of optical networks over the next 20 years, as well as new application scenarios. According to Zhang Lei, in terms of R&D progress, the optical communication industry continues to improve the performance of existing optical fibres by flattening wavelengths and reducing attenuation. However, more importantly, the industry needs to identify the next-generation mainstream optical fibres with continuously increasing capacity for the next 20 years or beyond.

The academic and industrial communities are on board that the next-generation optical fibres need to feature high performance, large capacity, and low costs. Based on these characteristics, space division multiplexing (SDM) and hollow-core fibres represent two major technical routes.

SDM refers to a multiplexing method for the transmission of different signals at different spatial positions, similar to adding more lanes to a road to enhance traffic flow.. The common SDM fibres include multi-core, few-mode, and orbital angular momentum fibres.

Hollow-core fibres, also known as hollow-core anti-resonant fibres, differ from conventional fibres as they are hollow inside. It is widely known that light travels at a speed of 300,000 kilometers per second in a vacuum, much faster than that in glass. Hollow-core fibres leverage this characteristic of light transmission to significantly reduce the conduction loss of optical signals within them, thereby achieving lower latency and higher bandwidth.

Currently, existing network-based tests on SDM fibres have got off the ground in foreign countries. A Japanese manufacturer, in collaboration collaboration with its European partner, has deployed the world's first SDM fibre in Italy, and also has made significant advancements in multi-core fibre submarine cables. In the realm of hollow-core fibres, Microsoft in the United States announced its acquisition of Lumenisity, a leading hollow-core fibre startup in the industry, at the end of 2022, and this move accelerated the industrialization of such fibres. Domestically, several Chinese manufacturers have also worked on R&D on both SDM and hollow-core fibres.

YOFC has been actively invested in R&D on relevant new optical fibres. During the 13th and 14th Five-Year Plan periods, YOFC, based on national key R&D programs and other technology projects, worked extensively with entities such as relevant universities, institutes, and carriers to advance massive manufacturing and application of related products. Especially last year, YOFC undertook the fibre preparation project of the first national key R&D program on hollow-core anti-resonant fibres during the 14th Five-Year Plan period, making it one of the few enterprises globally that can manufacture kilometers-level hollow-core anti-resonant fibres.

In terms of hollow-core fibres, Chinese companies have preliminarily developed the capacity for batch production of various specifications of glass tubes and capillary tubes. However, there is a need to develop the capacity for online testing of the geometric parameters of capillary tubes, precision welding and accurate tapering. Currently, YOFC has been capable of independently researching a complete set of key raw materials, maintaining a high iteration speed. It has limited the typical attenuation value of 1-kilometer fibres to around 1 dB/km. Next, it plans to address challenges such as mass production, unified testing methods and parameters, and difficulties in coupling and splicing.

Finally, Zhang Lei called for cooperation between industry and academic communities in the next-generation communication fibres for win-win results. He emphasized openness in path selection and urged confidence and patience in product and technology R&D.