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Building an Optical Network:

Which Type of Optical Fibre is Required for AI Computing Power Networks?

Abstract: As the digital economy enters a new era with computing power as the core productivity, establishing reliable optical network connections is the key to the development of computing power services and applications. New optical fibres have become essential for building the next-generation computing infrastructure. The success of China Mobile Interprovincial Backbone Transmission Network 400G OTN New Technology Experimental Network Equipment Centralized Procurement Project marks an important milestone of China's basic telecom carrier in new technology deployment. This article will delve into the G.654.E fibre's properties and two mainstream optical fibre technologies relevant to the future evolution of computing power networks.

Build an AI Optical Network.

New optical fibres to build the next-generation computing infrastructure are on the horizon.

Recently, China Mobile Interprovincial Backbone Transmission Network 400G OTN New Technology Experimental Network Equipment Centralized Procurement Project has concluded and the construction of the related network would ensue. This marks the latest advancement in Chinese basic telecom carriers' construction of new information and communication infrastructure since the era of 400G all-optical networks.

With the development of the digital industry and the digital transformation of industries in China, the digital economy has entered a new era with computing power as the core productivity. The supply and use of computing power are based on reliable network connection and optical networks are the key element for the development of computing power services and applications. In recent years, driven by the development of the "east data, west computing" project, the three major carriers have invested in high-speed all-optical computing power networks and achieved positive results. As the world's leading optical fibre and cable manufacturer and optical communication solution provider, YOFC has maintained close partnerships with the three major carriers in research on large-capacity and long-distance optical transmission technology. These cooperative efforts aim to promote the digital and intelligent transformation of optical networks, consolidate the development of the digital economy, and lay a solid foundation for the digital transformation and upgrading of traditional industries.

With the rapid development of the digital economy and increasing data traffic, what are the new requirements and challenges of high-quality computing power networks for optical fibres' key technological indicators, such as their performance and transmission capacity, in the 400G era and even the future 800G and Tbit era?

Development of Optical Fibres for Computing Power Networks

Name of Main Optical Fibre	Main Characteristics	R&D/ Commercial Application Progress
G.654.E fibre with ultra-low attenuation and large effective area	Larger effective area; lower attenuation; capable of reducing the number of repeaters; large transmission capacity; long transmission distance; supporting 400G systems	Commercial application and centralized procurement already launched
Multi-core fibre	Multiple physical channels for a single optical fibre; ultra-low crosstalk between fibre cores; low and consistent attenuation characteristics; large transmission capacity; supporting SDM	Test Stage
Few-mode fibre	Using different modes that feature relatively large mode field areas; capable of increasing the capacity of optical transmission systems; supporting SDM	Test Stage
Hollow-core fibre	Simple structure; hollow-core light guide; wide transmission spectrum; ultra-low loss; transmission rate close to that of light	R&D stage

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G.654.E, the Preferred Optical Fibre for Next-generation Computing Power Networks

In recent years, in addition to the ordinary G.652.D fibre, the G.654.E fibre has begun to appear more frequently in the three major carriers' centralized procurement of optical fibre and cable products. Industry experts believe that the commercial application of the G.654.E fibre has marked the beginning of the construction of next-generation all-optical backbone computing power networks.

The G.654.E fibre will become the main optical fibre selected for future trunk networks, Wei Leping, Director of the Science and Technology Committee of China Telecom Corporation Limited, said at the Emerging Next-generation Optical Network Technologies for Cloud-Network Convergence sub-forum of China Telecom's Conference on Integrated Development of Industrial Chains in Emerging Strategic Industries and 3rd Science and Technology Festival.

As the G.654.E fibre features an ultra-large effective area and ultra-low attenuation, it has significant technological advantages in over 400G backbone networks with large bandwidth, low latency, and long spans. Test data shows that for trunk networks whose transmission rates will be upgraded to 400G, the G.654.E fibre is expected to improve their transmission distances by 60%-80%.

Moreover, the industrial and academic communities have been taking a deep dive to further tap the potential of the G.654.E fibre. In terms of performance, the loss of the G.654.E fibre promises to be optimized to 0.15 dB/km in the future, and the transmission flatness of the entire C+L band may also be further improved. This will also increase applications in the C+L band.

With a strong track record of market experience and proven technology strength, YOFC has been working on G.654.E fibre development for more than 10 years to move forward the application of the G.654.E fibre and achieved remarkable results.

By now, YOFC G.654.E fibre has been successfully used in multiple national network infrastructure projects, including those undertaken by China Mobile, China Telecom, China Unicom, and State Grid. Meanwhile, YOFC has cooperated with carriers and equipment manufacturers to carry out innovative research on the application of the new G.654.E fibre. It has participated in many large-capacity, long-distance, and high-speed transmission tests and continues to make breakthroughs.

Additionally, in 2019, China Unicom and China Telecom took the lead in initiating centralized procurement of the G.654.E fibre cable for trunk networks, and YOFC won these bids by securing a significant portion of the projects. YOFC stood out by garnering the big slice of the pie during the two rounds of centralized procurement organized by China Mobile in 2022 and 2023. According to statistics, China Mobile purchased 1.56 million fkm G.654.E fibre in these two rounds of centralized procurement. Particularly, this year, China Mobile's G.654.E fibre centralized procurement scale has been 300% larger than that in 2022, making it the largest G.654.E fibre centralized procurement project in recent years. YOFC secured the largest portion of the two centralized procurement projects of China Mobile, staying ahead of the pack.

Developing New Optical Fibres for the Future of Computing Power Networks

People will never cease pursuing light. With the completion of the "east data, west computing" project on a large scale and the advent of new technologies like AICG, a batch of new optical fibres is gathering momentum.

According to YOFC, the industry continues to improve the performance of existing optical fibres by flattening wavelengths and reducing attenuation. However, what is more important is to identify the next-generation mainstream optical fibre with continuously increasing capacity for the next 20 years or more. From the perspective of technical schemes, space division multiplexing (SDM) and hollow-core fibres are two major technical routes. The industry has reached a consensus on this viewpoint.

SDM fibres adopt a multiplexing method to transmit different signals at different spatial positions. This method is similar to adding more lanes by building an overpass on a road to enhance traffic flow. The common SDM fibre types are multi-core, few-mode, and orbital angular momentum fibres. Hollow-core fibres, unlike ordinary silicon-based solid-core optical fibres, feature ultra-low loss, low dispersion, and a transmission rate close to that of light due to their hollow cores. This kind of fibre is an ideal medium for future ultra-high-speed optical transmission systems.

YOFC has been at the forefront of SDM and hollow-core fibre development for many years and has channeled significant energy into massive manufacturing and application of related products.

It is worth noting that from September to October 2023, YOFC, in collaboration with China Mobile, conducted the world's first existing network-based test on the application of four-core and seven-core fibres in the same cable in Jinan City, Shandong Province. This marked China's first four-core fibre trial cable and China Mobile's first multi-core fibre pilot cable under existing network conditions. This cable has played a demonstration role in the engineering application and promotion of multi-core fibres, showcasing YOFC's proven expertise and innovative capabilities in SDM fibre transmission.

In terms of hollow-core fibres,we adopt a forward-looking mindset and have been capable of independently developing a complete set of key raw materials, maintaining a high iteration speed. In 2022, 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, becoming one of the few enterprises globally that can manufacture kilometers level hollow-core anti-resonant fibres.

As a leading company in optical communication, YOFC has always been committed to pushing the boundaries of innovation and setting the pace for the optical fibre and cable technology over the years. Looking ahead, as core technologies for ultra-high-speed optical communication continue to deepen, YOFC will further enhance synergistic innovation across the industrial chain, foster closer cooperation with customers and industrial chain partners, and explore cutting-edge technologies for the development of next-generation optical networks. Through forward-looking R&D, YOFC aims to maintain its technological edge and provide higher-quality products for the sustained development of optic fibre communication.