LIGHTCOUNTING

CHINA INTERNATIONAL OPTOELECTRONIC EXPO

The 25th CIOE

Information and Communication Post-Show Report

by Vlad Kozlov and Carol Cao

October 10th, 2024

Richer Link Technologies Co., Ltd.

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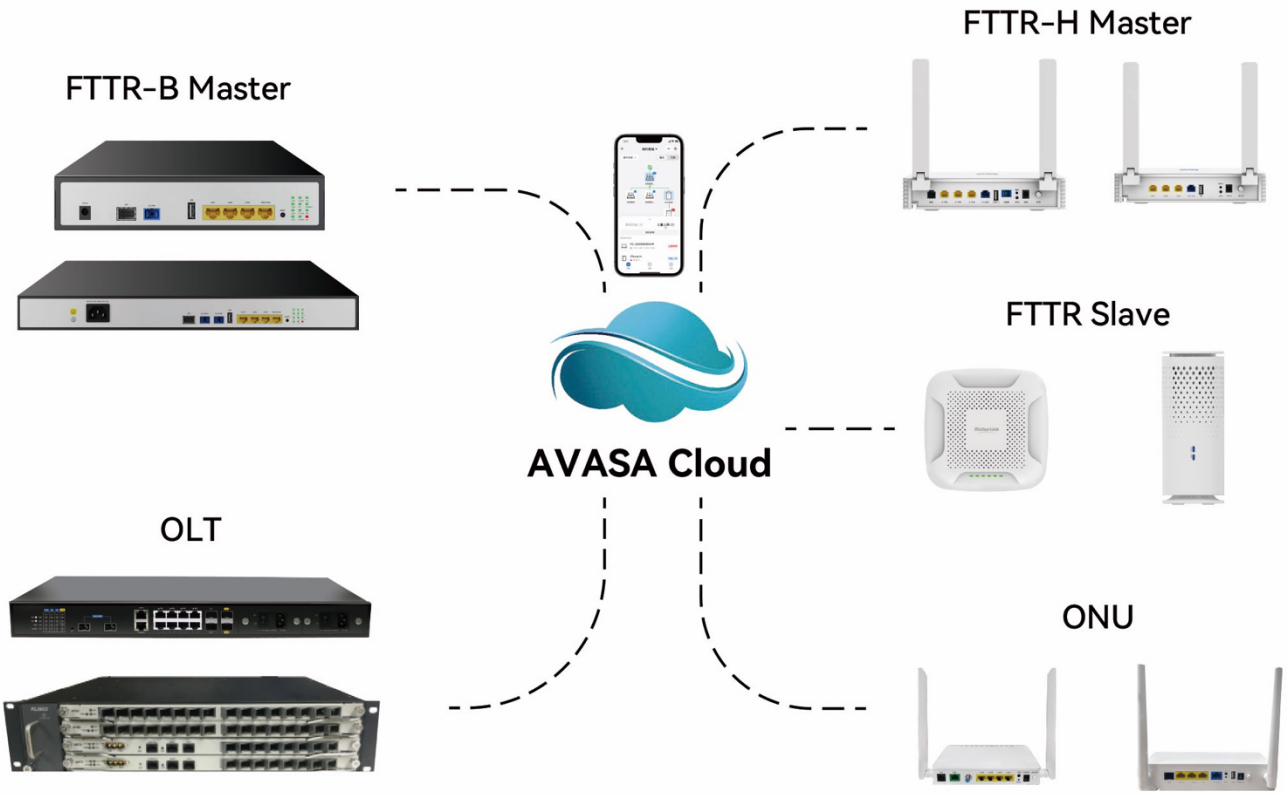

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Content

SUMMARY

The 25th China International Optoelectronics Exposition (CIOE) was held in Shenzhen from September 11 to 13, 2024. The exhibition attracted 121,458 visitors, an increase of 12% compared to last year. More than 5,000 overseas visitors attended the event, a year-on-year increase of 67%.

The information and communication portion of the exhibition hosted more than 1,000 manufacturers across four halls, brightened up by many live demos. The conference sessions featured presentations on intelligent computing centers, optical transmission networks, optical access networks, integrated packaging and other related fields.

The seminar brought together representatives from CAICT, Telecom operators, Internet Content Providers, and optical module producers to exchange insights on the latest technologies. Key topics of discussion included 1.6Tb/s optics, silicon photonics, LPO/LRO, and 3.2Tb/s optics. Participants expressed optimism regarding the development of pluggable modules. The commercialization of 1.6Tb/s pluggable optical modules is imminent, while the feasibility of 3.2Tb/s pluggable optical modules appears promising. There is a positive outlook for silicon photonics; as we transition into the 800Gb/s and 1.6Tb/s eras, its market share is expected to grow significantly. Although LPO/LRO presents an attractive proposition, it remains in developmental stages and requires further evaluation before practical implementation can occur.

50G PON is a hot topic for telecommunications access networks. As the deployment of 10G PON comes to an end, the era of 50G PON will begin. Asymmetric equipment is gradually maturing, and commercial equipment pilots have been launched. However, more complex symmetry schemes still have some problems to solve, and the supply chain for some key chips is incomplete, such as the 50Gb/s NRZ DFB lasers and burst driver chips, BM-TIA and DSP chips.

In terms of transport networks, the view expressed by experts is that 400Gb/s will have a long-cycle like 100Gb/s, and the evolution of transport network technology will be driven by data center interconnection scenarios. The 400Gb/s rate has been widely adopted for DCI and has since evolved to 800Gb/s. Looking ahead, rates of 1.2Tb/s and 1.6Tb/s are expected to be implemented. At this conference, Li Han presented a significant point for the industry: the current G.654E standard does not adequately address the future demands of broad spectrum optical communication. He emphasized that past fiber parameter designs focused on achieving large effective areas and minimizing losses, while for future systems, the fiber must also include spectral performance. He advocated the study of new types of optical fibers without changing the existing basic process engineering.

The most popular products at the exhibition were data center optical modules. Leading manufacturers are showcasing 1.6Tb/s optical modules based on the latest 200G/lane electrical ports DSP, as well as 800Gb/s LPO/LRO optical modules. Additionally, numerous upstream manufacturers of optical modules were present, highlighting the completeness of China's optical module industry chain.

AI

The demand for diverse connections driven by AI computing clusters was undoubtedly the most prominent highlight of this exhibition and forum.

Nearly all optical module manufacturers showcased 400Gb/s and 800Gb/s optical modules for data center applications. While AI drives the industry to prosper, competition has also become very fierce.

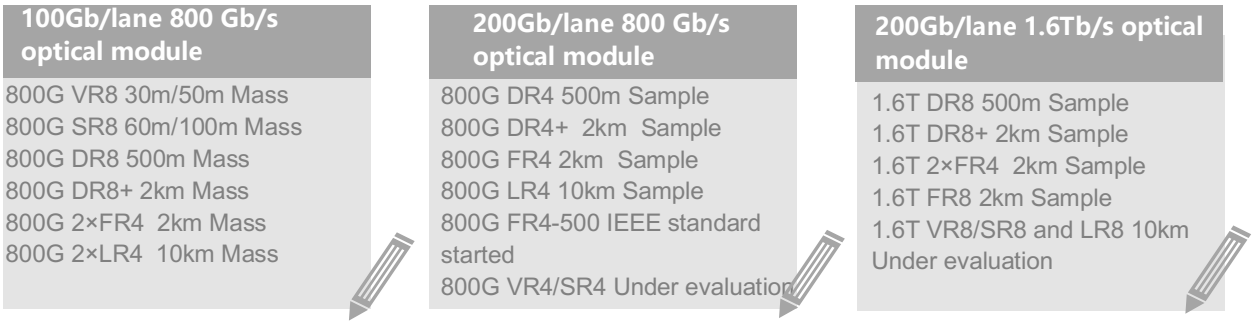
It was clear all the leading Chinese module vendors are now shipping 400Gb/s in volume, while moving to 800Gb/s and 1.6Tb/s. And with the launch of 200G/lane PAM4 DSP chips in 2024, the current research and development work has begun to shift to the 200G/lane electrical interface.

The demand for low power consumption in AI data centers is undoubted, cold plate liquid cooling solutions are already common in servers and switches, and optical modules are also in urgent need of reducing power consumption. However, the use of LPO is still not widespread, and the validation of LPO and LRO solutions is still in progress.

800G and 1.6T transceivers

In the AI Datacom seminar, an expert from CAICT Zhao Wenyu comprehensively summarized the status of 800Gb/s and 1.6Tb/s optical modules (Figure 1).

Figure 1: Status of 800Gb/s and 1.6Tb/s optical modules



Source: CAICT

Overall, 8x100Gb/s optical modules are basically mature, 4×200Gb/s optical modules are currently in research and development. 1.6Tb/s 500m and 2km optical modules will be available. 800Gb/s VR4/SR4 and 1.6Tb/s VR8/SR8/LR8 are under evaluation.

Zhang Jingshuang of Eoptolink introduced the progress of their products. Their 1.6Tb/s solution for 200G/lane electrical ports has entered the sample stage, and there may be 8x200G VR8 products in 2025. He thinks that because AI is currently facing a big problem of interconnection, the industry needs to accelerate the productive capacity of 800Gb/s or 1.6Tb/s and the development of 3.2Tb/s.

Zhao Wenyu and Zhang Jingshuang both introduced the progress in standards. In the IEEE802.3 standards group, the 802.3dj 100G/lane standard has been released in February 2024, the 802.3dj 200G/lane Draft 3.0 is scheduled for release in November 2025, and the feasibility of 400G/lane with EML and thin-film lithium niobate options is being analyzed.

Table 1: Progress in IEEE 802.3 standards

IEEE 802.3 B400G	Ethernet Rate	Signaling Rate	AUI(C2C/C2M)	MMF 50m	MMF 100m	SMF 500m	SMF 2km	SMF 10km	SMF 20km	SMF 40km
P802.3df 100G/lane (Feb 2024 Released)	400 Gb/s	100 Gb/s				400G DR4	400G DR4-2			
	800 Gb/s	100 Gb/s	800G AUI-8	800G VR8	800G SR8	800G DR8	800G DR8-2			
P802.3dj,200G/lane, (is scheduled for release in 2026)	200 Gb/s	200 Gb/s	200G AUI-1			200G DR1	200G FR1			
	400 Gb/s	200 Gb/s	400G AUI-2			400G DR2	400G DR2-2			
	800 Gb/s	200 Gb/s	800G AUI-4			800G DR4	800G DR4-2			
						800G FR4-500	800G FR4	800G LR4		
		800 Gb/s						800G LR1	800G ER1-20	800G ER1
	1.6 Tb/s	100 Gb/s	1.6T AUI-16							
		200 Gb/s	1.6T AUI-8			1.6T DR8	1.6T DR8-2			

Source: Eoptolink

In the OIF, the 200Gb/s electrical port standard is being developed, and the 400Gb/s electrical port has been studied.

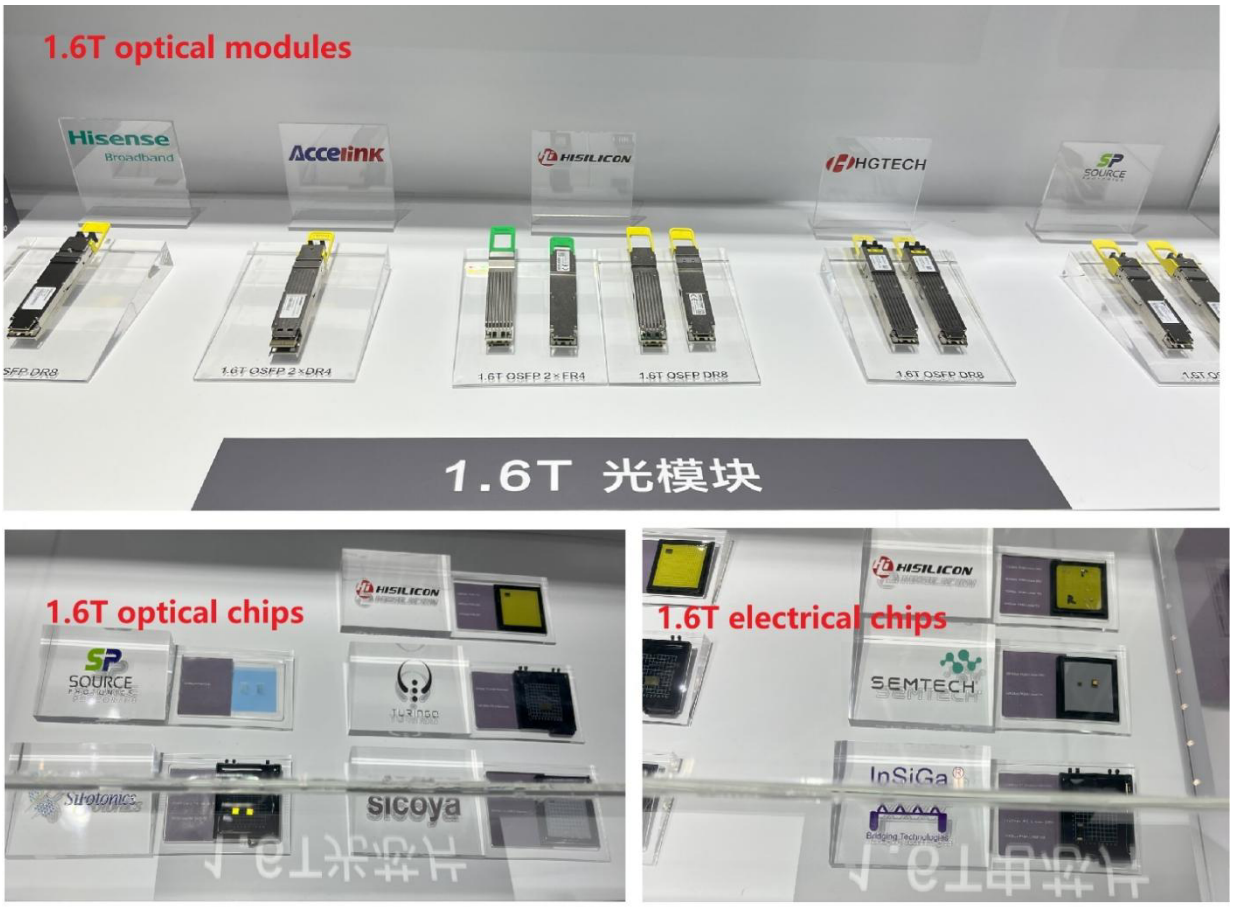
Table 2: Progress in OIF standards

OIF Project	Description	Finished Date
CEI-224G-VSR	Protocol for the 224G chip-to-module (C2M) interface to support It supports 200G/4000G/800G/1.6T optical modules with low power consumption, low complexity, and increased density	Feb, 2024 delayed
CEI-224G-Linear	Develop TP1/TP1s and TP4/TP4a electrical specifications that support 224G all-linear optical modules, which can be applied to LPO, CPO and NPO	Feb, 2026
OIF EEI-224G-RTLR	The implementation protocol IA of the 224G Retimed Transmit Linear Receive RTLR (Retimed Tx Linear Rx) optical interface is developed, and the RTLR scheme eliminates the receiving side digital signal processor (Rx DSP), which brings significant cost, power and delay saving potential.	Q2, 2025
OIF CEI-448G Framework	Develop a 448G electrical interface framework and explore key factors such as interface support, modulation schemes and test methods to address the challenge of achieving higher data rates.	Q4, 2025

Source: Eoptolink

IPEC (The International Photonics & Electronics Committee) collaborated with members to showcased optical modules and related chips centered around the theme of 1.6T high-speed interconnection (Figure 2).

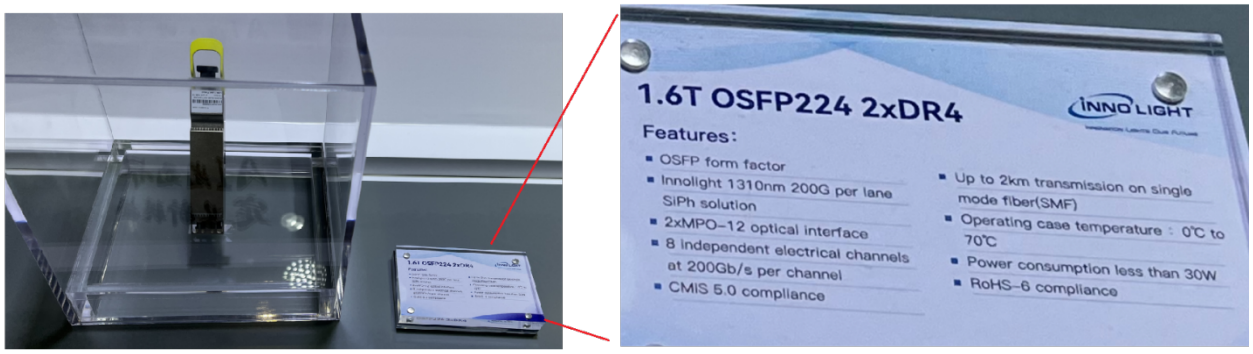
Figure 2: 1.6T optical module and chips on joint display at the IPEC booth



Source: IPEC

Innolight showed a 1.6Tb/s 2*DR4 data center optical module, having 8 independent 200G/lane electrical ports, using 1310nm silicon photon scheme (Figure 3).

Figure 3: 1.6T OSFP224 2×DR4 displayed by Innolight

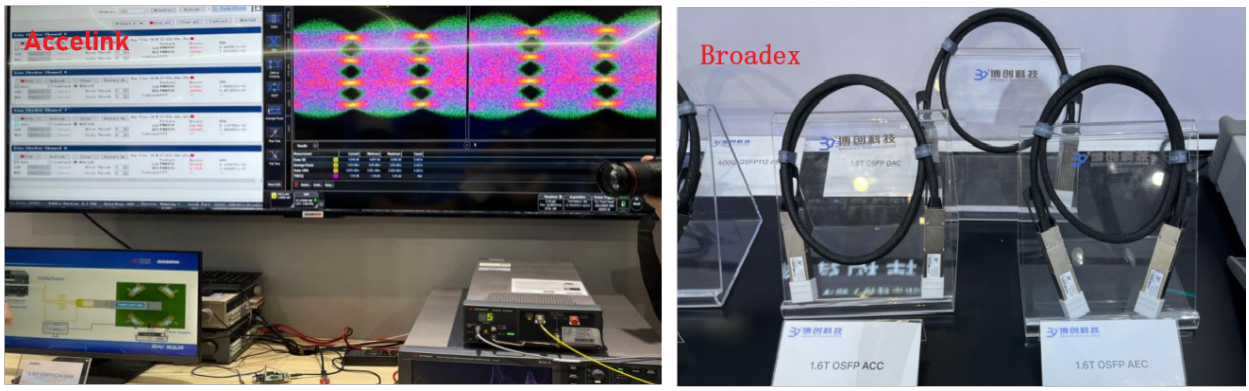


Source: Innolight

Eoptolink showed 1.6Tb/s OSFP DR8 and 800Gb/s OSFP/QSFP-DD DR4 series products.

Accelink had a live demo of 1.6Tb/s transceiver in their booth (left side of Figure 4). Broadex Technologies (a subsidiary of YOFC) showcased its 1.6Tb/s electrical connectivity products, including 1.6Tb/s ACC and 1.6Tb/s AEC (right side of Figure 4).

Figure 4: 1.6T OSFP224 DR8 demo by Accelink (left) and Broadex's 1.6T ACC/AEC demo (right)



Source: Accelink, Broadex

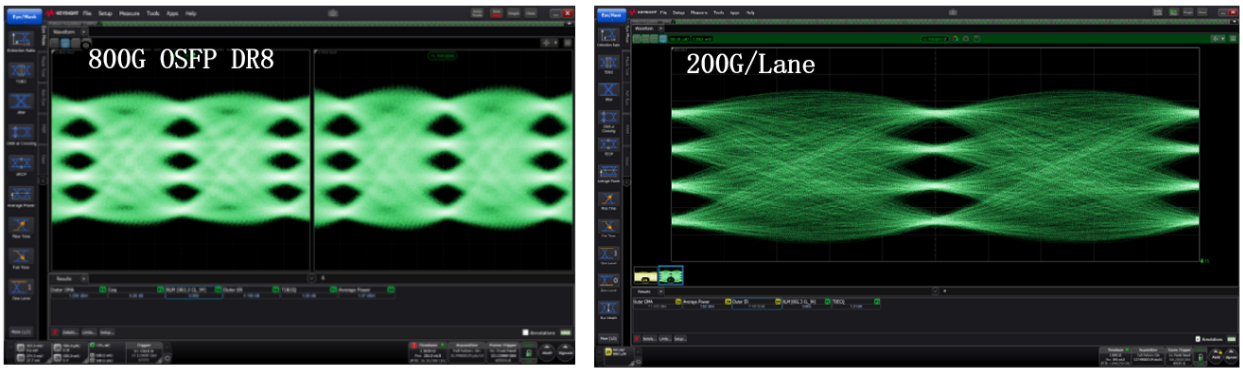
Linktel Technology showed 400Gb/s, 800Gb/s and 1.6Tb/s series products.

CIG showcased a 1.6Tb/s optical module sample using Silicon photonics and an EML, and an immersed liquid cooled 800Gb/s optical module sample. CIG also hosted several live demos of 800Gb/s and 1.6Tb/s products.

The 1.6Tb/s OSFP module products released by HG Genuine are equipped with self-developed 200G/lane silicon photonics chips, electrical port 200Gbps PAM-4 DSPs, designed to be compatible with thin film lithium niobate modulators and quantum dot laser solutions.

Source Photonics live demonstrated 4x200G FR4/LR4 using in house designed 200G PAM4 EML laser and the 400G/800G optical module supporting immersion liquid cooling.

Figure 5: Eye pattern of Xphor's 100G/lane (left) and 200G/lane(right) Silicon photonic chip



Source: Xphor

Xphor (founded in 2021) reported mass production of its silicon optical products and hosted live demos of 100G/lane and 200/lane products (Figure 5).

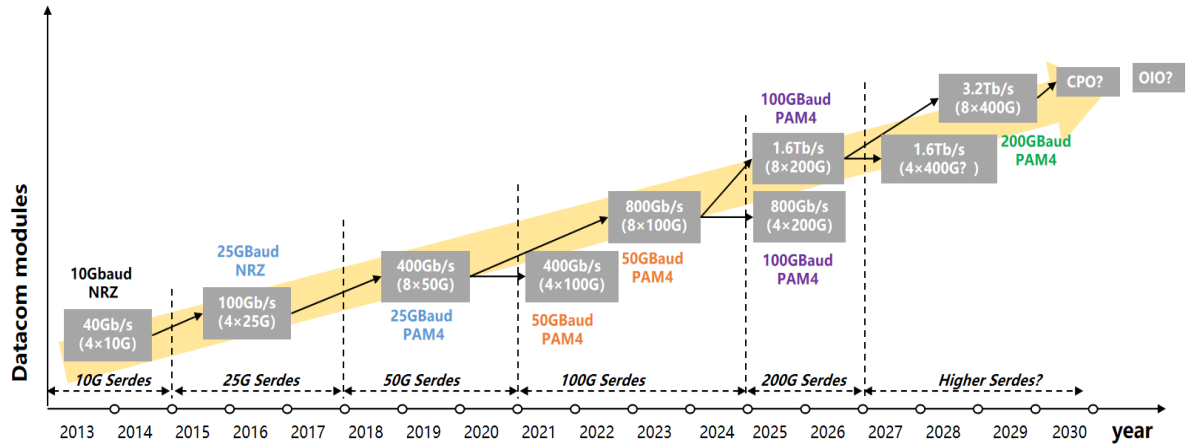
Sicoya displayed 1.6Tb/s DR8/800G DR4 200G/lane and 400Gb/s DR4/800G DR8/800G 2*FR4 100G/lane series silicon optical wafers, chips and engine products.

SiFotonics showcased 200G SiGe PIN PD and 4x200G SiPho MZM PIC for 800G/1.6T AI applications.

3.2Tb/s

Zhao Wenyu of CAICT discussed the development trends of optical modules and chips driven by AI. Currently, the rate stands at 800 Gb/s, with expectations to reach 1.6 Tb/s within the next 1 to 2 years. Furthermore, it is anticipated that a rate of 3.2 Tb/s will be scaled for AI application by the year 2029. In his trend chart, the rate of 3.2Tb/s is represented as 8×400G. The adoption of CPO and OIO (Optical IO) remains uncertain (Figure 6).

Figure 6: Development trend of data center optical modules



Source: CAICT

Eoptolink's report also discusses 3.2Tb/s transmission. The first generation features 16-electrical ports and 16 optical ports, while the second generation includes a 16 electrical ports and an 8 channel optical port.

LPO

At this seminar, some experts also expressed their views on LPO and LRO.

Zhang Jinshuang of Eoptolink believes that LPO/LRO brings lower power consumption, and 200G/lane solutions may require LRO.

HG Genuine believes that LPO is very suitable for AI applications, and he provided data on 1.6Tb/s LPO saving 20W of power consumption.

JD's Chen Cheng believes that LPO/LRO will help reduce the cost. He talked about how JD has done some early verification work on LPO, but it also needs to continue to verify and observe. Since the use of LPO involves not only modules, but also switch hardware design, the same switch may need to be compatible with both traditional optical modules and LPO.

IPEC's booth exhibited 800Gb/s DR8 and 800Gb/s 2×DR4 LPO from Hisense, ATOP and other manufacturers. Innolight exhibited 800Gb/s 2 x DR4 LPO. Accelink exhibited 800Gb/s 2 x DR4 /2 x FR4 LPO and 800Gb/s DR8 LRO. HG Genuine demonstrated 800Gb/s LPO and 400Gb/s LPO on a switch. H3C plugged 400Gb/s LPO into its switch for a demonstration. There are also many other manufacturers with products on display, not all of them are listed here.

Lightcounting's point is if 100G per lane LRO/TRO or LPO will capture even 1% of the market by the end of 2026, it will be a success story and a step in the right direction for the industry. NIC side interfaces seems to be the right market entry point for LPO, because of the low signal loss on the electrical side.

There will be more demand for 200G per lane LPO/LRO and CPO, as detailed in the September 2024 report titled "Ethernet Optics".

CPO/OIO(Optical IO)

Because CPO is mainly dominated by switching chip or XPU manufacturers, China's optical module manufacturers mainly focus on the external light source part of CPO. IPEC is developing external light source relevant standards. The industry has kept a close eye on the development of CPO and OIO, and users have also said that they are preparing to try optical IO and CPO.

Lightcounting thinks in addition to external light sources, Chinese companies also have a technical foundation in optical engines. However, large switch chip or XPU chip manufacturers also have their own silicon photonic technology. So it is true that very few optical module manufacturers can find an important position in the CPO industry chain. The good thing for them is that optical/electrical chip technology is still evolving, and there are still a lot of problems to solve for CPO and OIO right now.

Chips

In addition to the display of silicon optical products mentioned above, many other optical chips were on display at the exhibition.

- ✓ HiSilicon showed its data center optical chips, including VCSEL, EML, High power continuous Wave DFB, and SIP chips. At present, its single-channel 100Gb/s products have been mass-produced.
- ✓ Hisense presented the test results of its 112GBaud CWDM EML, showing that it is in the BETA SAMPLE stage in September 2024 and is scheduled for mass production in March 2025.
- ✓ Accelink also showed its 100G EML, VCSEL, PIN, APD and other chips
- ✓ Yuanjie Semiconductor showcased 70mW/100mW DFB Laser and 100G EML.
- ✓ AFR showcased 40 GHz IQ modulator, 70 GHz intensity modulator, 130 GBaud coherence modulator, and 800G DR8 modulator chip.
- ✓ Liobate field tested an 8-channel LNIO chip with a bandwidth of 110GHz and a Vπ of less than 1.5V.
- ✓ Eagle Semiconductor showed 100G VCSEL.

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From the perspective of LightCounting, China's capabilities in optical chip technology have seen significant advancements. The single-channel 100Gb/s optical chip has entered mass production, the single-channel 200Gb/s is currently in the sampling phase. Additionally, development efforts for the single-channel 400Gb/s chip are ongoing. In addition to HiSilicon, excellent chip manufacturers have gradually emerged.

PON

Although the telecom industry is currently experiencing a relative downturn, 50G PON & FTTR have become an important focal point to watch. As the development of 10G PON comes to an end, the call for the deployment of next-generation access networks is growing.

Over the past year, trials of 50G PON have begun. At CIOE, experts from the CAICT, China's three major operators, equipment manufacturers and optical module manufacturers held in-depth discussions. The seminar covered a variety of topics, including the current state of 10G PON, advances in 50G PON technology and related developments in FTTR, etc.

Development Status of 10G PON

An expert from CAICT provided an overview of the current status of 10G PON in China: Currently, there are 25 million 10G PON ports in operation, representing over 85% of the global total. In China, approximately 68% of all PON ports are classified as 10G PON. This indicates that nearly 30% of existing PON ports will need to transition from EPON or GPON to 10G PON. As for Optical Network Units (ONUs), China's PON infrastructure has reached more than 500 million users, with around 180 million utilizing 10G PON services—accounting for less than 30%. This suggests that operators face challenges in converting a significant number of users to become gigabit subscribers on their 10G PON networks.

The data clearly illustrates that while China's deployment of 10G PON is at the forefront globally and OLT construction is nearing completion, there remains a pressing need to enhance user adoption rates for 10G PON. Regarding the issue of slow user uptake, two primary factors have been identified by CAICT. First, there exists a bottleneck within family home networks, which is the rationale underlying the development of a Fiber to the Room (FTTR) solution. Another problem is the lack of sufficient support for high-bandwidth application scenarios.

Application scenario exploration

To enhance the penetration rate of 10G PON users and foster the development of 50G PON technology, addressing high-bandwidth application scenarios is essential. In recent years, both CAICT and operators have made numerous attempts to tackle this challenge.

Led by CAICT, the Guanghua Cup has emerged as a competition aimed at discovering innovative applications, and has been held for two consecutive years. In the first year it attracted over 3,000 submissions, and in the second year more than 17,000 entrees participated. This competition has unveiled many outstanding use cases across various domains including intelligent homes, smart manufacturing, telemedicine, digital government initiatives etc.

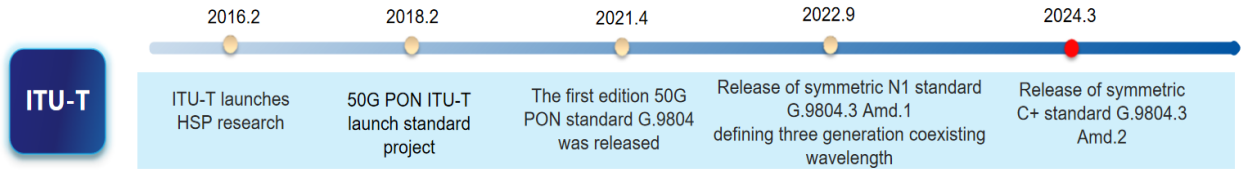
Among these scenarios, intelligent homes remain paramount. Potential developments within this domain include family storage solutions, fitness gaming experiences and home care systems among others. Experts believe that popular games like Black Myth: Wukong is an opportunity worth getting excited about. The computer configuration requirements for "Black Myth: Wukong" are notably high. Players need to use a computer worth more than 8,000 yuan to get a good

experience. Service providers like Huawei Cloud offer cloud computing services to meet these demands. Once processing power is migrated to the cloud, the need for bandwidth escalates dramatically.

50G PON

The work of international standardization of 50G PON begun in 2018, lasting 6 or 7 years, and the standard of 50G PON has basically matured in ITU-T from the requirements for the physical layer, TC layer, and module.

Figure 7: Progress of 50G PON standard



Source: China Mobile

Consensus reached:

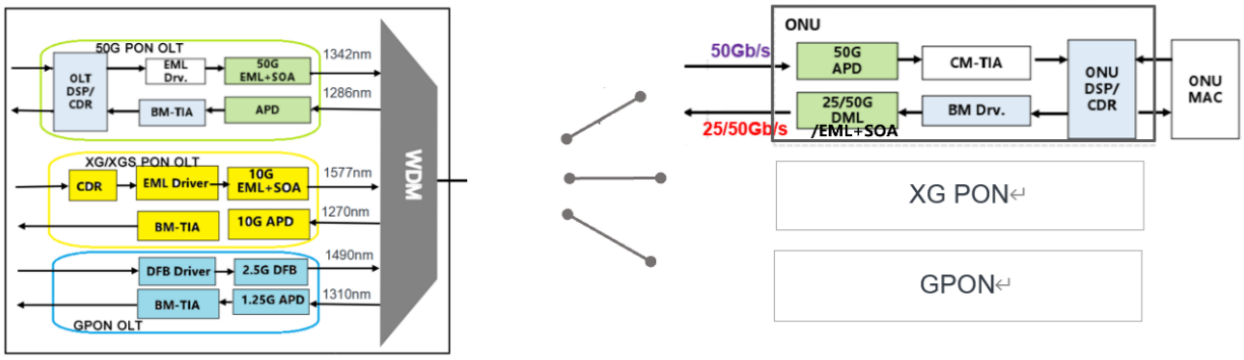
- To reuse the existing ODN, C+(32dB) and PR30 power budget levels are required.
- The upstream wavelength converges to 1286nm, and adopts the built-in combiner, supporting three-generation co-existence of G/XG(S)/50GPON; 10G EPON and 50G PON .
- The uplink rate gradually converges to 25G and 50G dual-rate reception，It is necessary to introduce DSP to reduce the influence of device bandwidth limitation and multi-rate signal transmission dispersion.

Along with these goals comes an obvious set of challenges.

- When the velocity increases by 5 times, the dispersion increases sharply and there are nonlinear effects. The power budget under multi-mode coexistence is a big challenge. SOA and highly sensitive APD had to be introduced, as well as DSP capabilities.
- The built-in co-wave MPM optical module is highly complex, requiring 30dB high isolation at a narrow pitch of 1288 to 1290nm. It is necessary to adopt high isolation filter and optimize module structure design.
- The DSP needs to be optimized to support dynamic multi-rate fast balancing.

Figure 8 shows the structure of the 50G PON optical module. As can be seen from the block diagram, the internal structure of the 50G PON OLT module with three modes co-existing is very complex. In addition to the difficulty of module packaging, the increase in device bandwidth to 50Gb/s also brings difficulties in chip design.

Figure 8: 50G PON Three-mode transceiver and ONU transceiver



China's three telecom operators have been conducting a variety of technical tests and pilot projects for 50G PON since 2021. These efforts encompass asymmetric and symmetrical configurations, industrial scenarios, and the coexistence of technologies spanning two to three generations.

After years of efforts, 50G PON has made significant progress on some key issues. OLT high-power Tx, high-sensitivity Rx, ONU high-power Tx, DSP, dual-rate reception and other core optoelectronic technologies have made breakthroughs. The asymmetric equipment has gradually matured, and pilot commercial equipment has been launched. However, more complex symmetry schemes still have some problems to solve, and the supply chain of some key chips is not complete, such as the 50Gb/s NRZ DFB laser and the required burst driver chip, BM-TIA and DSP chip.

At this seminar, Huawei announced the index requirements for six chips, with the aim of encouraging greater participation from suppliers.

Table 3: Huawei's requirements for several 50G PON chips

50G PON asymmetric	**ASP**: Low power High performance ASP PHY Power consumption <1.5W Interface 50G NRZ	**EML+SOA**: Low power consumption and high performance EML+SOA, Coupling TX>8.5dBm ER>7dB, TDEC<5dB	**APD**: Large bandwidth and high gain APD BW>15G, M*R>8A/W
50G PON symmetric	**oDSP:** Compact low power oDSP, Power consumption <2.5W, package <7*7mm² Interface 50G NRZ	**50G BM-TIA**: Low power High performance 50G BM-TIA, Coupling TX>8.5dBm ER>7dB, TDEC<5dB	**50G DML**: Large bandwidth and high power DML BW > 20.5 G, Coupling Tx>6.8dBm

Source: HUAWEI

LightCounting will update its forecast for 50G PON deployments in the November 2024 report titled "Access Optics: FTTx and Wireless". According to the current views expressed by operator experts, the 50G PON market will start with modest deployments in 2025, and the growth rate will increase in 2026-2027.

TRANSPORT NETWORK

Experts from CAICT, China's three telecom operators, and equipment manufacturers including Huawei, ZTE and Nokia discussed the optical transport network in the era of AI computing. Topics discussed included backbone networks, metro networks, cross-data center training, and new types of fiber optics.

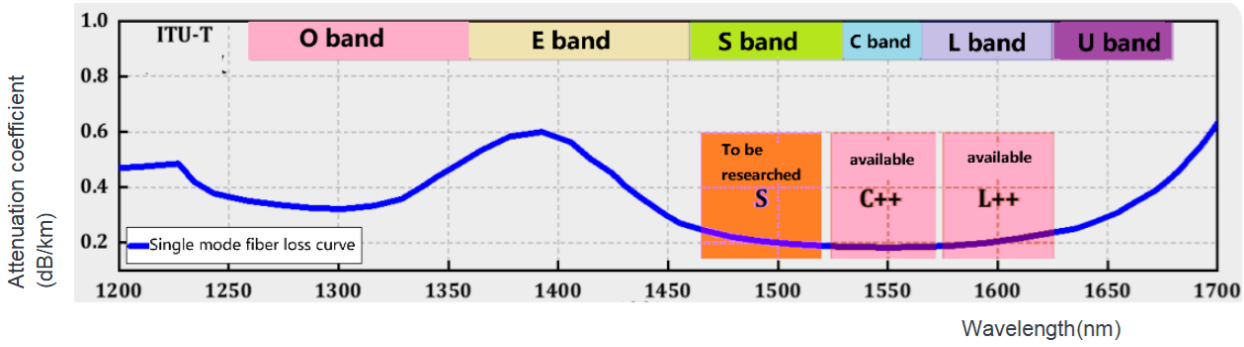
Large capacity transmission network

In 2023, 400Gb/s coherent technology marked the beginning of its large-scale deployment in backbone networks. By June 2024, the three telecom operators are expected to have deployed over 9,000 400G ports throughout their networks. 400Gb/s QPSK modulation allows transmission distances of up to 2,000 km, making it the mainstream choice for mainline transmission at that speed.

Li Han, Chief Engineer at China Mobile Research Institute, expressed his viewpoint that 400Gb/s will serve as a long-term standard rate for backbone networks. There is a general consensus within ITU-T regarding next-generation backbone network technologies that the 1.6Tb/s data rate is likely to be the dominant speed, while 800Gb/s and 1.2Tb/s may be the supplementary.

He also described the technical difficulties that 1.6Tb/s will face. The first problem is the need for higher baud rate devices. And the second is as the baud rate increases, the spectral width expands, making it essential to utilize a broader extended band. This represents a challenge for ITLAs, optical amplifiers, and optical fibers.

Figure 9: Single mode fiber loss curve



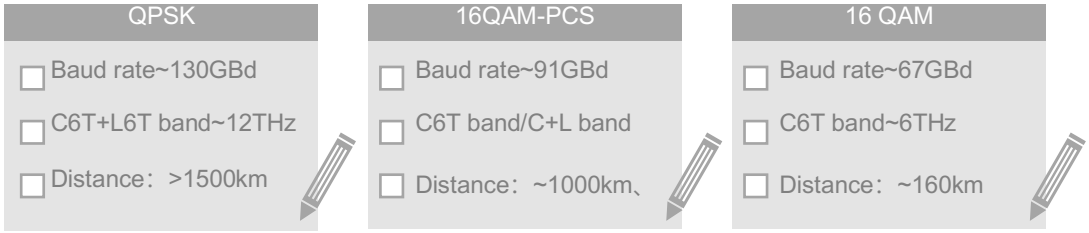
As the speed of the transmission network evolves, the width of the spectrum is indeed a very important issue. At present, China is based on 80-wave design, as the rate increases into 800Gb/s, 1.2Tb/s, 1.6Tb/s, the existing spectral width can not meet the requirements.

At this conference, Li Han presented a significant point for the industry: the current G.654E standard does not adequately address the future demands of broad spectrum optical communication. This shortfall is primarily due to two issues: limitations related to fiber cut-off wavelength and attenuation caused by water peaks.

Li Han emphasized that past fiber parameter designs focused on achieving large effective areas and minimizing losses, while for future systems, the fiber must also include spectral performance. He advocated the study of new types of optical fibers without changing the existing basic process engineering. This was the first time both ideas were proposed in the industry.

For the application of 400G in provincial long-distance transmission and metropolitan areas, choosing among the three modulation formats DP-QPSK, PCS-16QAM and 16QAM is a problem.

Figure 10: Three modulation formats of 400G transmission network



Source: China Mobile

At present, it has been agreed that different modulation formats should be implemented based on demand across various scenarios. Provinces with particularly large areas are encouraged to adopt QPSK as the primary technology, while small and medium-sized provinces may opt for PCS-16QAM due to its higher spectral efficiency and lower costs.

Regarding the choice of 16QAM and PCS-16QAM in metropolitan area, Li Han believes that the industry chains for 16QAM and PCS-16QAM are significantly different. One operates at 91GBd, while the other functions at 67GBd in optical devices. The mixed use of these technologies is not conducive to effective management, operation, and maintenance. Therefore, he tends to converge towards PCS-16QAM technology.

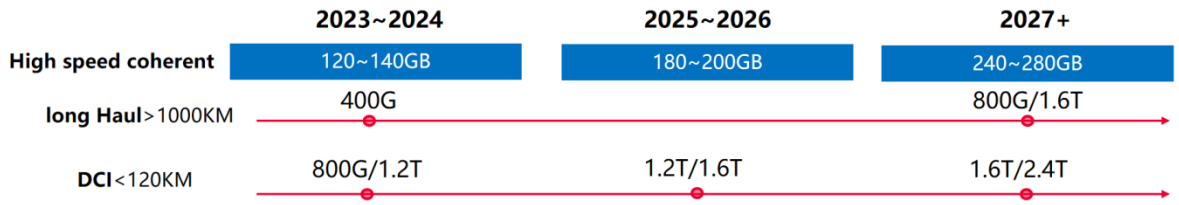
In summary, the convergence direction of 400G technology is QPSK for long and medium-long distances, and PCS-16QAM for medium-long and medium-short distances; 16QAM can be used for data center interconnection.

At this seminar, Ciena also presented its latest Wavelogic 6 Extreme, which achieves single channel 1.6Tb/s using 200Gbd devices. Recently, Arelion and Ciena jointly announced that they have successfully completed the world's first 1.6Tb/s transmission over a distance of 470km.

Data center interconnection

Compared to long-distance, large-capacity networks, data center traffic is experiencing rapid growth. Furthermore, the rate of interconnection in data center scenarios is advancing more swiftly than that of backbone networks. The 400Gb/s rate has been widely adopted for DCI and has since evolved to 800Gb/s. Looking ahead, rates of 1.2Tb/s and 1.6Tb/s are expected to be implemented soon. Below are the trends summarized by Huawei.

Figure 11: Evolution trend of high-speed long-distance transmission



Source: Huawei

With the development of AI Large models, a new data center interconnection scenario has been proposed, which is Large model training across data centers. This scenario has been studied by telecom operators. China Mobile has conducted an analysis of the communication requirements, characteristics, and network specifications associated with various parallel modes of large model training. (Table 4)

Table 4: Network specifications associated with various parallel modes of large mode

Parallel mode	Communication needs	Communication characteristics	Network requirements	Advice
Tensor Parallel	Inside the server	Huge amount of traffic (hundreds of GB), Communication times can't be covered up	Super high bandwidth, Ultra-low latency	No out server
Pipeline Parallel	Cross Server	Large amount of traffic (100 M-GB class), Correspondence time cannot be completely covered up	Medium bandwidth, Delay sensitive	In theory 100 km is feasible, needs to be verified
Data parallelism	Cross Server	Large amount of communication (GB class), Most communication time can be covered up	High bandwidth, Delay is acceptable	100 km feasible, Kkm to be verified
MOE	Cross Server	High volume of traffic, Communication times must not be covered up	High bandwidth, Delay sensitive	Single office address

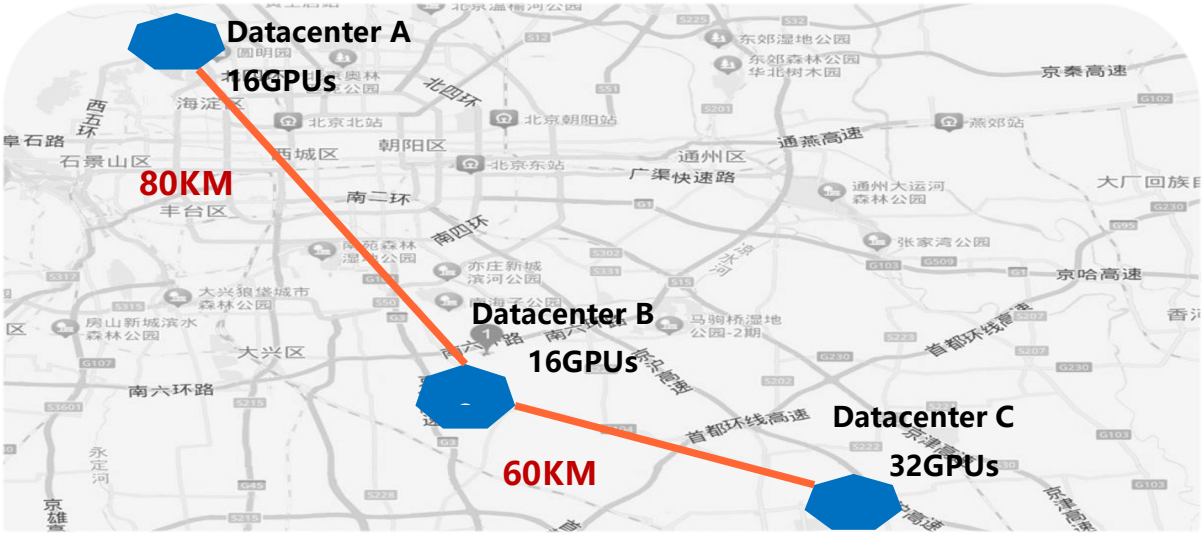
Source: China Mobile

- ✓ Data parallelism: the distance of one hundred kilometers is theoretically feasible, while a distance of one thousand kilometers remains to be verified.
- ✓ Pipeline Parallel: hundred-kilometer theory works, needs to be verified.

China Telecom has carried out a multi-location intelligent computing cluster networking experiment. This is the first small-scale attempt, 64 GPUs, 6.4Tb/s of bandwidth, which completed the experimental verification of distributed training in 140 km, across three remote data centers. (Figure12)

And the experimental results show that the distributed training performance of the 10 billion parameter model within 100 km with 6.4Tb/s bandwidth reaches more than 95% of the centralized training performance.

Figure 12: 800G multi-point cluster intelligent distance experiment



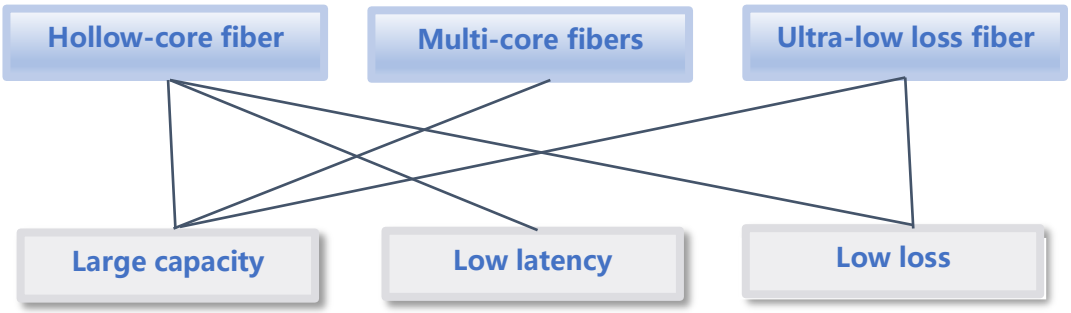
Source: China Telecom

In addition to cross-data center training, China Mobile Research Institute also summarized several other scenarios for the interconnection of intelligent computing centers, including storage separation, sample uploading and real-time reasoning. These scenarios require large bandwidth and low latency for DCI networks.

Optical Fiber

New fiber technology is expected to improve the performance of the interconnection network between intelligent computing centers.

Figure 13: Excellent performance of different optical fibers



Source: CAICT

As is shown in Figure 13, Multi-core fibers help increase communication capacity, low-loss fibers help reduce signal losses. Hollow-core fiber (HCF) exhibit excellent properties in terms of capacity, loss reduction, and latency.

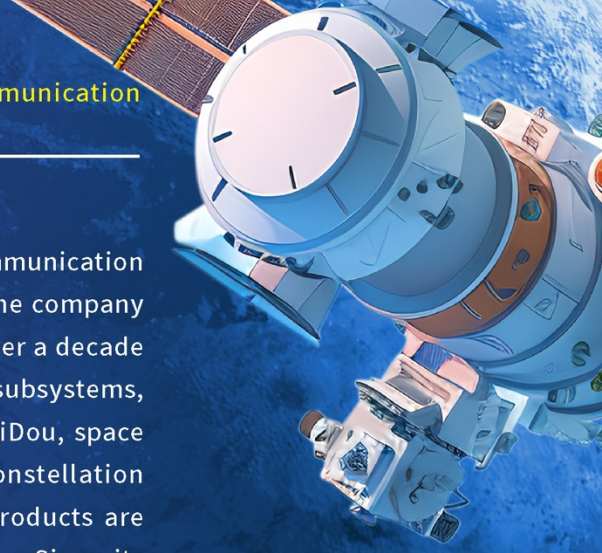
In 2024, the three largest telecom operators in China jointly conducted HCF transmission tests with YOFC. HCF is already being validated over long distances. At this exhibition, H3C showed its hollow-core fiber module 400G SR4, which is an attempt to use HCF inside the data center. The module has a good performance in jitter, dispersion and bit error rate. And the fiber latency was reduced by 30%. Li Han believes that HCF will be used first in these scenarios.

At present, HCF still has some problems. In the speech by Shen Shikui of China Unicom, he believes that HCF has a very good prospect, but still faces many theoretical, technical and engineering challenges with a long way still to go.

An innovation in optical networking is the utilization of existing telecommunications fiber for sensing purposes. Tang Xiongyan, vice president of the China Unicom Research Institute, on behalf of the IMT-2020(5G) promotion group, released the Blue Book of Optical Network Synsensory Integration Architecture and Key Technology Solutions Research for Multi-Scenario Applications.

上海聿凡领光通信有限公司
SHANGHAI YUFAN PHOTONICS TECHNOLOGY CO. LTD

Satellite laser communication solutions provider

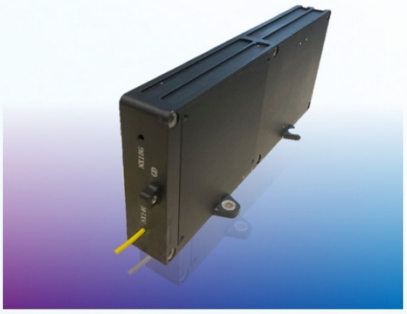


The company is one of the earliest teams in China to engage in laser communication projects within the commercial space sector. The products developed by the company have been successfully applied in aerospace missions. The core team has over a decade of experience in the field of fiber laser communication and transmission subsystems, participating in various major special projects, including the Tiangong, BeiDou, space station intra-and-extra-cabin communication systems, and the Rose Constellation mega-constellation. Currently, the company's space-qualified fibe laser products are primarily used in satellite laser communication, with mature technology. Since its establishment, the company has successfully completed multiple projects with on-orbit experience. Additionally, the company's products have extensive application scenarios in military radar electronics, oceanographic exploration equipment, and automotive lidar fields. The products boast high environmental adaptability and reliability indicators, meeting the diverse demands of various clients.

CORE PRODUCTS

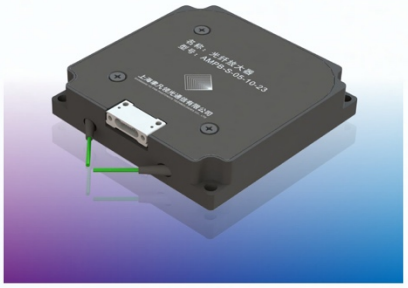
Transceiver integrated optical fiber amplifier board

- Output power up to 5W
- Radiation resistance class K30rad
- Low noise



Optical amplifier integrated board

- Compatible with XW boards
- Realize the integration of BA and PA
- Radiation resistance class K30rad



Local oscillator & signal integrated narrow linewidth laser

- ITU wavelength optional
- The line width is less than 3KHS
- Realize the integration of local oscillator and signal

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ARCTIC TEC

Arctic Ocean Industry: TEC provider

Access network	Bearer network	Data center	Backbone network	Vehicle application	Other applications
10G PON	100G	400G	100G DCO	Laser radar TO option	Infrared imaging
25G PON	200G	800G	200G DCO	Laser radar BOX option	Gas sensing
50G PON TO option · BOX option	Pumped laser	1.6T			

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Wechat contaction

The whole process self-research technology

460 employee

3000 million production

40+ R&d personnel

20000 square meters of company space

Career field cars•communication•Medical treatment•laser•infrared•Consumer•electronics•Stored energy•electricity

technology material technology →Device design→Scheme simulation→Reliability design→Automatic package inspection

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- PHOTONICS **INNOVATION** EXPO
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