

2023

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OPTICAL NETWORKS IN 2023: SCALE, SIMPLICITY, SUSTAINABILITY



Inevitably, with the new year rapidly approaching, it's tempting to speculate about the direction the industry will take in 2023, so we decided to ask three experts in their fields how they thought the next 12 months would unfold.

TERRESTRIAL FIBRE

Serge Melle, Director, IP-Optical Product Marketing, Nokia, says that going into 2023, a common trend that is expected to continue is network operators' need to further scale their optical networks. The industry is in the midst of major build-outs of high-speed access infrastructures; either Distributed Access Architectures (DAA) by cable operators, increased fibreisation and deployment of Passive Optical Networks (PONs) by CSPs, and continuing 5G roll-outs and mobile traffic backhaul. All of these will put continued pressure to sustainably and economically scale metro and long-haul optical networks.

He says, "Some new technology developments that will provide the next milestones in sustaining this need for bandwidth growth include the next generation of coherent optics becoming available and leveraging the now maturing industry eco-system for 5nm silicon integrated circuits. These new performance-optimised coherent photonic engines are expected to incorporate several new innovations, including tight co-optimisation of coherent modem digital signal processors (DSPs) and silicon photonic (SiP) modulators and detectors, integrated into digital coherent optic

(DCO) transceiver modules that operate at speeds of 120Gbaud or higher, and capable of wavelength speeds of 1.2 terabits per second (Tbps). This will enable more efficient coherent transport by reducing power per bit, and enable network operators to deploy fewer coherent optics for a given amount of network capacity; thereby further reducing network power consumption, and lowering total cost of operations (TCO)."

This trend of close DSP-SiP integration, he adds, will also drive the next generation of pluggable DCOs optimised for use in router ports, supporting speeds of 800Gbps per wavelength, which are expected to make their appearance later in 2023 or early 2024. Also leveraging 5nm silicon node technology, these will be optimised to leverage the gains of Moore's Law towards reducing power consumption, in order to fit into standardised transceiver form factors such as QSFP-DD800 or OSFP 4.0.

In other parts of the optical network, Melle says that another area to watch in 2023 is the ever-greater use of WDM optical line systems that support operation across C and L bands of the fibre spectrum. He explains, "These so-called 'C+L' line systems enable network

operators to double the capacity of their existing fibre optic networks, without incurring the significant cost and time delays associated with building new fibre optic cable infrastructures. Whereas C+L optical line systems were until recently used in a select few networks, they are now seeing ever-wider adoption across both long-haul and metro networks with network operators across the globe. One can expect to see new capabilities in C+L line systems that further simplify and facilitate their use in these applications."

PERFORMANCE

Fujitsu's CTO and optical expert **Rod Naphan** believes there are three key areas which will see development in the coming year; performance in long-haul networks, simplification in the network, and sustainability. Citing recent research by SignalAI which estimates long-haul will grow three times faster than Metro in the coming years, the said he believed this to be the case due to the growth of 5G, the move towards remote working in suburban areas, and the webscale companies pushing the envelope on bit rates. He added, "On performance, a lot of the bit rates today are 100G, in the long haul. but I think the new currency will be 400G. There's 800G systems today, but the higher 800G systems running in the 90-something baud rate

range only get a certain performance at 400 Gig and very little performance at 800 Gig. So I think what they really need is 400 Gig to go coast to coast. So, we're going to see technologies coming in to the network in 2023 that go from 100 Gig to 400 Gig to 800 Gig to over a Terabit, and that means that you can meaningfully do 400 Gig anywhere and you can practically do 800 Gig in most places."

SIMPLICITY

On simplifying the network, Naphan says while there are available technologies which can reduce cabling complexity in the network, automation will play an important role. He says, "In addition to massive cable reduction, I think you're going to see software play a central role in the next generation of subsystems. This includes things like zero touch provisioning, and open SDN controllers that are truly multi-vendor, depending on the API set, and even support for multiple different standard API's, for example, OLS and the open ROADM standards.

You need to be able to do so in a way that allows you to dial however much openness versus proprietary performance that the customer wants, which is about which API's you're using and what capability you have in the systems. This has been the promise for a long time, but I think what's now becoming very practical is to start using AI and machine learning algorithms in these systems for many different use cases. However, it's not just a software challenge, what we're going to see is hardware systems that are designed to be more cognisant, to have more sensors in place, to be able to provide more data points, and more aggregation of data into software systems to really understand the physics of what's going on in the network."

SUSTAINABILITY

"The carbon footprint of networks is becoming more top of mind for executives that are now really having to consider what their environmental social governance policies are for their companies," says Naphan. "I think we're going to see a lot of innovation in sustainability. One of the things about going to higher bit rates is it's enabled by adopting the latest geometries and silicon, which of course, has a power reduction per bit advantage. Also I think we're going to see technologies like those developed by Fujitsu's supercomputer business and the Fugaku computer systems. They have used liquid cooling capabilities for a long time and we've seen a lot of experiments in the optical and telecoms industries, but nothing practical so far. I do believe however that the time is right for closed

loop liquid cooling systems that can be designed in a way that are consistent with current operations and are reliable and will in some cases, improve the reliability of equipment. I think overall, we're going to see systems that are designed from the ground up much more consciously with sustainability in mind."

SUBSEA FIBRE

One of the big growth areas in fibre optics in 2022 was international subsea cables, with new contracts being announced almost monthly. **Philip deGuzman**, Director of Client Solutions at Pioneer Consulting, who has over a decade of experience in the undersea cable industry, says the evolution of wet and dry plant submarine cable system technologies continue to lead the way in the industry. He predicts that based on these technologies that have seen increased adoption over the last few years, 2023 will see further developments in two areas.

He says, "The first trend we'll see continue to gain traction is the use of space division multiplexing technology (SDM), which enables combining many optical fibres within a single undersea cable. Soon it will not be uncommon to see undersea cables installed with 32, 48, or even 64 fibres, where just recently a 24-fibre cable was considered to be a large number." He asks, "Is it crazy to think that 16 fibre pairs and 200 Gbps transmission rates with an undersea cable are considered "outdated" technology as 2022 comes to a close?"

The second trend deGuzman identifies, which has been at the forefront of almost all recent submarine cable projects is known as an "open cable" system. This is the complete separation of the supply of "wet plant" (cable, repeaters, branching units, etc.) from the "dry plant" (optical transmission equipment) and provides flexibility to cable system owners and operators

by allowing them to choose the transmission equipment vendor of their choice.

He says, "The combination of SDM technology and open cable systems has allowed recently completed undersea cable systems to transmit as much as 320 Tbps of data across 16 fibre pairs. Such a cable could transmit the entire Netflix database in a matter of seconds. Although this cable system may seem to have enough capacity, 2023 is sure to see this grow even further. Already, NEC Corporation has been contracted to build a 24 fibre pair undersea cable system across the Atlantic. In addition, HMN Technologies has completed development of a 32 fibre pair undersea optical repeater (amplifier) prototype, paving the way for a 32 fibre pair cable system to be contracted in the near future."

He explains, "When a high fibre count cable is combined with optical transmission equipment capable of transmitting data up to 600 Gbps on each line-card, it's exciting to think about the amount of data possible on these future cable systems. With open cable systems becoming the norm, cable owners and operators can have their pick from vendors such as Ciena, Cisco, Infinera, and Nokia. Although SDM technology and open cable systems have and will continue to dominate the subsea cable industry in 2023, many other innovations continue to be discussed between cable suppliers, operators, owners, and investors. I'm certainly looking forward to all the exciting things that 2023 has to offer!"

As Melle concludes, "The great thing about the optical networking industry is that the need for ever-more network bandwidth seems to never go away, and this continues to drive exciting new innovations into all parts of the optical networking ecosystem, and 2023 will be no exception." 🌟



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