

# Change in the air at OFC 2009

**Bill Ring of WSR Optical Device Solutions reports from March's OFC 2009 event in San Diego which, despite the economic slowdown, saw much innovation reported in high-speed data transport and photonic integration.**

**T**his year's Optical Fiber Communication conference & exposition/National Fiber Optic Engineers Conference (OFC/NFOEC 2009) in San Diego, CA, USA (23–26 March) saw a downturn in both vendors exhibiting their wares and feet pounding the floor. Attendance was down from 13,000 for last year's event to just 9800. Similarly, the exhibition floor shrank from more than 600 vendors to just under 400 as the economic downturn has throttled the industry and seen many firms give up the opportunity to display their products. If there is an upside to this environment, however, it was that attendees of the show were more focused on doing business and understanding the path forward for next-generation networks.

## Trends in network development

The conference kicked off with three interesting plenary discussions and insights on the global trends in information exchange and network development.

Shri Goyal of Indian public sector telecom company Bharat Sanchar Nigam discussed the changing environment in India and their plans for fiber-to-the-home (FTTH) networks. The presentation gave an insight into what is currently the world's fourth-largest economy in terms of gross domestic product (GDP). A growth rate of 7–9% per annum is being driven by the service sector, with the number of telephone lines increasing to almost 400 million in 2009. In contrast, the expansion of fiber for television is happening slowly, as only 50% of households have TV sets and 100 million homes do not have cable TV. With broadband penetration at less than 0.4%, Bharat Sanchar Nigam is expecting to add more than 1 million customers per year as it rolls out its Gigabit passive optical network (GPON) infrastructure. Consequently, India is definitely a growth opportunity for FTTH companies.

The second speaker, Philippe Morin of Nortel Networks, was more generalized in his approach to new network trends, classifying the major changes as 'mega trends'. He discussed how the Internet has changed the business mode, and how these new business models are accelerating bandwidth demand. Connectivity has

moved from being 'nice to have' to being a 'necessity'. Nortel (which is currently in bankruptcy) cited high-definition TV, which will generate the next wave of bandwidth growth (including 'virtual' trade shows), as well as the news and print media going online.

A key mega trend for the company is that data-center consolidation will occur and will be driven by virtualization, tele-working and tele-presence. Morin presented an example of the change in media by citing the Oprah New Earth show, which was streamed in 139 countries. Following time division multiplexing (TDM) then wavelength division multiplexing (WDM), Nortel believes that the next technology steps for greater bandwidth in communication network infrastructure is coherent transmission. Companies developing components now need to be thinking about Terabits per

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wavelength, as 100Gb/wavelength capacity is almost here. The emphasis should be on Terabit signaling and transport rather than Terabit Ethernet.

Morin concluded with several key issues faced by the industry. Consumers do not want to pay for bandwidth by the amount consumed. The current revenue stream from services provided by carriers therefore remains flat, but the network is costing more to run and upgrade. So, there is a major issue about how the new technology will be funded to enable the next generation of network requirements. For the Internet to continue to grow, the access infrastructure needs to be ten times cheaper than it is today, he reckons. Nortel believes that the cost points cannot be driven lower by volume, as the volume does not exist. Instead, cost reduction must be driven by innovation.

The final plenary speaker, Lawrence Lessig of Stanford Law School provided the most media-interactive session. The talk consisted of the idea that society had moved from idea generation and an interacting state to a stale consumptive state but, with the

advent of YouTube and other elements, that society is generating ideas and content again. Lessig's talk provided an insight into the influence that YouTube and other Internet social networking sites are having upon society today, and the different values that the 21st century Internet-savvy generation perceives.

### Market watch

During OFC there were several market-watch sessions on topics ranging from the state of the industry to photonic integration. Within the current economic climate, the state-of-the-industry session provided an interesting twist, considering all the downsizing that component vendors had been making shortly before the event.

The session was aptly named, considering the drop in attendance at the conference. Several key players discussed the positive outlook for the future, including the increasing level of data transport, new services such as FiOS (Fiber Optic Services), and the increasingly always-connected society. On the downside for the optics industry is the price erosion for components. The representative from Corning highlighted this, stating that there have been three major price declines for the industry: the first in 1993, the second in 1998, and the last in 2001. He points out that price, performance and capacity are all factors for companies today, but components are currently in a period of low price stabilization. Financially, Corning finds that its fiber preform plant utilization is running at 85%, and that the economics of the business are such that no new plants can be built, since the plants that it was forced to close can be re-opened. One key point from Corning is that China remains a location with strong demand for fiber due to its continuing fiber-to-the-home (FTTH) build-outs.

The overview on the state of the industry from market research firm Ovum was not optimistic. The market projection for the telecom sector has had to be revised down to \$15bn or 0% growth between 2009 and 2010. For carriers in the long-haul space, the fixed-line revenue is currently flat and less than mobile revenue. However, due to upgrades in the wireless handset market from 2.5G to 3G, back-haul of traffic is increasing substantially. Ovum reported that T-mobile realized a 300% increase in traffic when they up-graded to a 3G network. This is against the backdrop of fixed pricing in the wireless service market, where 75% of traffic is still voice (although this will decrease as more mobile applications appear). New services such as IPTV have been introduced and are generating revenue. However, they are not yet profitable.

Verizon's view in this session was principally that technology for higher-capacity networks is becoming more challenging but is necessary. The constraints that carriers see for their existing networks is that new



**Infinera's InP-based photonic integrated circuits.**

equipment needs to meet several of the requirements of both 2.5Gb/s and 10Gb/s systems, i.e. the wavelength spacing should be 50GHz and sources must be able to tolerate 10Gb/s chromatic dispersion and polarization mode dispersion limits. Verizon needs to be able to transmit 10Gb/s and 40Gb/s signals over the same fiber without interference or issues. As the firm does not develop technology but only uses the technology, it requests component vendors to consider a single technology for new equipment that, of course, is low cost.

### Photonic integration to meet cost demands

This issue of low cost and low-volume applications is a key concern for many of the component companies that were in attendance. Many believe that photonic integration is the only solution to the problem (similar to the issue of the discrete transistor versus the integrated circuit that the silicon industry had to face). To discuss this topic, the market-watch session on photonic integration brought some of the key players together to discuss the opportunities and issues.

The session began with the comment that R&D in photonics has been hit by the component industry being unprofitable. Despite this, the idea of CMOS photonics as a solution in telecom networks has been realized. Lightwire, a small startup company based in Pennsylvania, provided in-depth details of their CMOS photonics development and the advantages of integrating CMOS electronics with optical functionality. The firm stated that devices can be made in 130nm CMOS on standard fabrication lines and provide an advantage in terms of Volts-mm compared to lithium niobate modulators, providing a reduction from 100V-mm to only 2V-mm in the CMOS devices. A key element of this technology for the company is the reduction in total power budget. For a 4 x 10Gb/s CDWDM link, the transceiver consumes less than 2.5W, even with a CDR (clock and data recovery) function. One area where Lightwire expects CMOS photonics devices to have a large impact is in the area of active cables. To reduce power consumption further, 45nm CMOS can be employed for future devices. ➤

Similarly, John Bowers from University of California Santa Barbara (UCSB), whose work on integration for Intel has been widely published, stated that a flip-chip III-V device on CMOS circuits enables the first stage of CMOS photonics, e.g. the solution adopted by Luxtera Corp. But integrating the III-V material into the semiconductor process by either wafer bonding or growth would enable better devices to be made. Bowers believes that better devices than InP devices can be made by using CMOS photonics. This, he pointed out, was definitely true for existing work on avalanche photodiodes (APDs), where CMOS photonics have a better gain-bandwidth product.

Infinera Corp of Sunnyvale, CA, USA discussed its approach of fully integrated photonics circuits on indium phosphide and stated that, in dense wavelength division multiplexing (DWDM) systems deployed today, 45% of the 10Gb/s systems are PIC-based and developed by Infinera. The main discussion centered on the reliability and yield that the company achieves, and their view that photonic integration will enable the future development of systems for Terabit transport and beyond. Advantages provided by the PIC approach include moving to 25GHz wavelength spacing and enabling complex modulation schemes on a single chip. Infinera stated that the Shannon limit (the maximum data transport rate for a single channel) will be reached by 2015 for C-band frequencies, so the solution is to extend the number of wavelengths that are used as well as the wavelength window. To achieve 100Tb/s systems, other wavelength windows outside the C-band will be necessary. Clearly a leader in the photonics integration field, Infinera is viewed as being a few years ahead of its competition and a success story for the current telecom industry.

The theme of photonic integration is clearly the 'future' for component vendors to enable the lower-cost solutions with low volume that the industry needs in telecoms. Whether silicon CMOS photonics or InP photonics or a hybrid solution is best for photonic integration is still not clear. Evidently, integration will become more prevalent, but will need to displace hybrid and discrete solutions that are the mainstay today in the low-cost data-center area.

Several major companies in this sector did not have an exhibition booth for their products but had private conference rooms for customer demonstrations and meetings. This provided a different scenario for exhibition visitors and marked a change for some companies, including Avago Technologies Inc of San Jose, CA, USA, which is a major player in the data communications space.

### OIF project goals for 100Gb/s transport

- 100Gb/s long-haul DWDM framework and architecture
- Photonic integration of the transmitter and receiver modules
- Forward error correction using DP-QPSK in DWDM
- Module requirements for 100GE DWDM

### 100Gb/s standardization

The final market-watch session of the week concerned the '100Gbit standard update'. John D' Ambrosia, who is the current chair of the 802.3ae task force, discussed the state of the standard and posed the question, where next? Ambrosia believes that Terabit Ethernet will be the next evolution (agreeing with the statement by Bob Metcalfe at last year's OFC 2008). Some participants considered 2015 as the date when Terabit Ethernet will be required, based on the repeated discussions of carriers on the doubling of Internet traffic every year.

For the long-haul 100Gb/s market, Joe Berthold of network equipment maker Ciena discussed the current ideas that the Optical Internetworking Forum is pursuing for long-haul transport. This included the current implementation agreements that OIF is developing to enable dual-polarization quadrature phase shift keying (DP-QPSK) modulation devices for 100Gb/s on a single wavelength. The OIF believes that it can play an active role for long-haul systems and liaise with both the IEEE and the International Telecommunications Union (ITU) to enable low cost solutions for the DWDM market. Through its implementation agreements and projects the OIF hopes to enable systems to be brought to market in a timely fashion through industry collaboration.

Several product releases were on display at the exhi-

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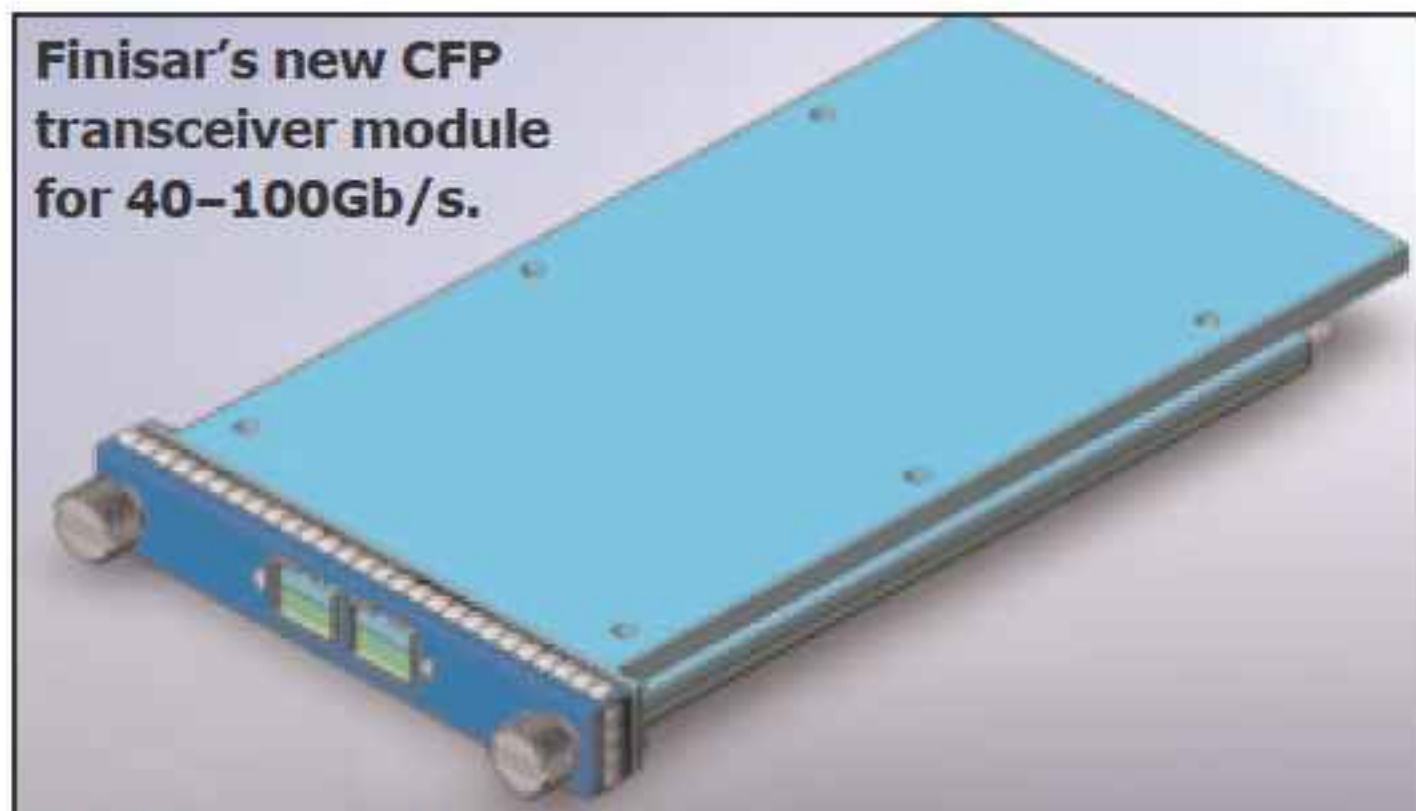


Opnext's 16G Fiber Channel SFP+ module.

bition, including for the next Fiber Channel data rate of 17Gb/s. Opnext provided a live demonstration of their long-wavelength transceiver module for Fiber Channel applications, Finisar demonstrated its short-wavelength 17Gb/s (16x) Fiber Channel module and its new CFP transceiver modules for the 40–100Gb/s MSA. In addition, the CXP multi-mode module for Infiniband applications was released for view and is targeted at 12 x QDR (quad data rate) applications. Agilent Technologies released a new analyzer for 16x Fiber Channel and several companies provided new releases for test equipment, including a Yokogawa transport analyzer.

As OFC is a busy conference with multiple parallel sessions, choosing the right topic can be difficult. Overall, the technical sessions were well attended. This was highlighted by the standing-room-only audience for digital signal processing, which has a key role to play in coherent detection for long-haul telecom applications. Several papers discussed the modulation formats for 100Gb/s. A personal favorite was the higher-speed laser session, which discussed pushing the current distributed feedback (DFB) edge-emitting technology using direct modulation up to 25Gb/s and 40Gb/s. These devices would be advantageous for high-speed Ethernet transceivers to enable lower cost. The discrete devices demonstrated show that InGaAlAs ridge waveguide devices are preferred and can potentially provide a solution. Meanwhile, the silicon photonics papers were more concentrated on the receiver side of the technology and waveguides rather than transmitter technology and light emission. Several papers discussed avalanche photo-detectors (APDs) for high-speed interconnects operating around 10Gb/s, which is perceived to be a key area for the computer interconnect market.

**Finisar's new CFP transceiver module for 40–100Gb/s.**



### Challenges ahead

The Optical Fiber Communications conference remains the principal show for optical component vendors. It is definitely a place to catch up and get to grips with the latest directions in the industry. The lower number of attendees this year was a reflection of both the economic climate and the difficulty that component vendors have had in attaining profitability since the bust of 2001.

The need for more speed and the ability to transport more data remains unabated. To this end, Terabit Ethernet is starting to be discussed, while 100Gb/s is being planned. The general trend to more photonic integration is clearly becoming more prevalent in the photonics industry. Whether it is eventually based on CMOS photonics or InP photonic integrated circuits remains unclear long term. Both exist today and are finding homes for products.

Overall, considering the business environment, OFC 2009 was a success, and San Diego remains a great place to visit. As long as people increasingly want to use cell phones and play games and use the Internet, the optical industry will need to meet this challenge through innovation and technology development. ■

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