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Topic: **IIR WDM & Next Generation Optical Networking 2008 in Cannes -**

The trends, themes and positioning for 2008

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Issue:

IIR's WDM & Next Generation Optical Networking conference, held in Cannes between the 23th and 27th of June, is one of the better transport-related conferences worldwide.

This year's attendance was up significantly, around 500 people, accompanied by greater participation in the form of vendor booths and service providers. What were some of the primary ideas and issues of debate expressed by service operators and vendors at the conference this year, and what does this tell us about the state of the networking market in 2008?

Analytical Summary:

IIR's WDM & Next Generation Optical Networking included presentations offering facts, opinions, positioning, and hype - with strong service operator as well as vendor participation.

Hot topics from the conference

Topics receiving considerable discussion this year include 40G and 100G costs and implementation. The right ways to build the next-gen transport network and provide Carrier Ethernet based services were also very prominent themes. There was also

growing interest in colorless and directionless ROADMs driven by the increasing need of flexibility in networks, as well as for the importance of ASON/GMPLS control plane capabilities driven by the need of restoration/ protection and automatic discovery and provisioning.
Also evident was the growing interest in WDM-PON, and discussions on Submarine transport and national research and education networks requirements generated strong interest.
For those that fear that standard components have taken over and innovation is no longer part of the market, Infinera gave a detailed presentation of its PICs technology, supported by a customer presentation from Carphone Warehouse Networks that exalts the benefits of the solution in term of simplicity, flexibility and rapid service activation and fault detection.

40G delays and ramp up

Interest in 40G seems to be as high now for the metro as well as for the core, a reflection of the changing bandwidth mix moving toward a greater percentage of video traffic, and on the subsequent impact on metro bandwidth requirements. The availability of 40G router interfaces has been widely quoted as driving the demand for 40G, but this is not really true. The availability of the interfaces is a market enabler and creates interest, but these interfaces have been available since 2005, and the price point has been less than attractive. The delay in greater implementation of 40G has been about total cost both of 40G transponders and the router interface combined – not about availability. And to a lesser extent in long haul applications, the delay has been about the suitability of the installed base of fiber plant given the current transmission formats most often deployed. The real drivers of demand for 40G will be capacity requirements and the desire to manage fewer interfaces.

At the conference, presentation from **Alcatel-Lucent, Nortel, Ericsson** and Huawei dealt with 40G-related topics. They identified key features currently available in 40G WDM systems to support reach and fiber reuse, the requirements for signal regeneration, analyzed the total costs of ownership for 40G systems compared with 10G, and considered constraints such as power requirements, tuning and maintenance, and lifetime expectation.

The 40G business case

Capacity requirements will compel increasing deployment of 40G before the costs hit the magic, over-quoted, "2.5x the cost of 10G" price point. That historical expectation was based on Nortel's likely use of forward pricing to penetrate the 10G market years ago. It was also based on volume expectations, in a market where fiber constraints were far greater than they are today. Falling component costs for 10G have delayed a faster ramp up for 40G, but ultimately will not prevent it.

If capacity constraints exist and service operators want to reduce the number of wavelengths they have to manage, it seems like some CFOs at carriers are starting wondering if 4x the bandwidth for 2.5x the cost is a good deal, particularly when they also get to reduce the number of router interfaces and wavelengths to manage.

So that we can say this year 40G deployment is definitely ramping up in North America and in EMEA.

The cost of 40G may not yet be extremely compelling, but it is no longer prohibitive, particularly where capacity requirements are most pressing. Service operators are holding out for lower 40G costs, not because 40G is prohibitively priced compared to the installed base, but because they are aware of the price elasticity of demand - and want to have network costs that enable service pricing that helps them drive greater volume of demand for services.

The modulation format

A lot of discussions have been around the choice of the modulation format for 40Gbit/s transmission from Alcatel-Lucent, Nortel, Ericsson and Huawei
Today there have been two majors modulation formats and minor variants in use, such as DQPSK (Differential Quadrature Phase Shift Keying) and DPSK (differential phase-shift keying). But now other alternatives are being explored, such as DPQPSK (Dual Polarization Quadrature Phase Shift Keying) and coherent receiver technology, with an eye toward gaining validation for the technology at 40G in an attempt to gain lead to market at 100G.
The right modulation format for 40G transmission varies on a case-by-case basis depending on the parameter operators need to optimize such as spectral efficiency, long-distance transmission, PMD tolerance, and nonlinear effects robustness.
DPSK has proven to be effective for longer reach in 100GHz spacing, for compatibility with existing traffic at 10G in the same line and cost-efficiency. DQPSK is instead optimizing high-PMD regional distances in 50GHz spacing, but suffers from nonlinear impairments when it is transmitted in the same line with 10G traffic.
Nortel's DPQPSK modulation format helps overcome the effects of transmission nonlinearities, and Nortel has developed some advanced digital signal processing algorithms and is first to implement coherent receiver technology.
The advantages of this include greater potential distance to 2,000 km with reliable transmission at 40G, without the need for Raman amplification, regeneration or dispersion compensation equipment; and a potential leg up on development of 100G, where coherent receiver technology and more sophisticated modulation formats than DQPSK may ultimately be beneficial or required. The cons are that the cost of developing this technology might make it hard for Nortel to recover the costs with 40G sales given the window of market opportunity, and could make it difficult to

achieve strong margins – and proof points must be established. Nortel's significant investment in technology for 40G and 100G is its bid to create and leverage technology differentiation and time-to-market advantages to regain its once-dominant position in long-haul as transmission speeds increase beyond 10G.

100 G Positioning

Interest in 100G is today being driven by the requirements of the data center, not of the transport network, and standardization is still in the very early days now and focused on parallel interfaces. We do not expect to see 100G transport commercially deployed within the next 3 years, and bandwidth requirements will cause many service operators to deploy 40G before that.

Colorless and Directionless ROADM

The number of operators in EMEA talking seriously about metro ROADM this year is a significant change, and the commercial metro ROADM deployment in this region start to become true.

New applications are driving new features, like colorless operation, direction less switching, higher levels of integration, and smaller, lower-cost options for the edge network.

In fact, the most compelling requirement, in order to fully benefit from ROADM capabilities, is the need of a **more flexible optical network**, driven by new **mesh** applications (video-on-demand, HDTV, business Ethernet & mobile broadband) that can be achieved through:

- **Directionless ROADM** – The ability to have a fixed fiber port interface directed to any of the degrees within the ROADM node, or in other words, the ability for the ROADM to be reconfigured to drop any wavelength from any line side. Directionless switching extends network flexibility because channels can be re-routed to respond to network failures, congestions or maintenance, but while it extends network flexibility, it is not enough if wavelength is already in use.

- ➔ **Colorless ROADM** – The ability to change the wavelength aspects of lasers, multiplexers, demultiplexers, and receivers without moving any physical fibers, so that a Colorless ROADM can be reconfigured to drop any wavelength on any port
- ➔ **Control Plane** – Intelligence to Combine Optical Layer with Service Layer.

System vendors like **Cisco** and **Tellabs** are now relying on the component vendors to deliver the requisite integrated density (Tunable filters arrays, add/drop WSS and NxN WSS are key enabling technologies) to enable these new features. First modules are waited by the end 08/ beginning 09.

NSN announcement and ADVA situation

Nokia Siemens Networks introduced a metro-optimized version of its hiT 7300 WDM transport platform, offering features that are optimized for metro deployments, such as support for point-to-point, rings and meshed architectures, cards that support SONET/SDH, Ethernet and storage area networks (SAN) services at a full range of speeds (up to 40 Gbit/s), a planning and configuration tool, the ability to mix CWDM and DWDM on the same fiber, and even a small form factor version for customer premises deployment..

The SURPASS hiT7300 had given NSN strong entry into metro/regional DWDM, complementing the hiT 7500, with a solution offering up to 80 40G channels, but Low cost metro WDM/ROADM is the only major market opportunity where NSN was perhaps missing out.

It is evident that with the increasing market importance of Metro WDM, NSN wad potentially losing a lot more revenue now by maintaining an OEM with ADVA than it was when these products represented a smaller portion of market opportunity, so this move was well welcomed in the market.

ADVA managed to find compatible and non-competing relationships with Siemens (now NSN) in Europe, with Fujitsu in North America, and with Alcatel-Lucent in North America (via the Lucent/Movaz relationship prior the Alcatel/Lucent merger) – augmenting their direct sales figures significantly and substantially contributing to building the company's success.

But after years of success, ADVA may not be able to rely on OEMs to the degree it had in future because the non-competitive nature of its OEM partners is in the process of changing significantly. This could potentially be behind ADVA's downward trend in its Q2 2008 financial results and could also impact its future strategy

Service Providers' perspective

Level 3 made a presentation centered on requirements and trends impacting optical transport confirming that 10GE LAN PHY becomes the Standard for transmission. The company also discussed how it delivered its first 10GE LAN PHY across the Atlantic this year. Level 3 pointed out the changes that are occurring in the TCO evaluation from an operators' point of view. While it is true that Carriers are responding with renewed investment and expansion, facing a decline in equipment costs, operators' TCO is today more focused on improving Opex, seeking easy to deploy and manage equipment with advantages in power, density and footprint.

Deutsche Telekom's discussion also focused on Opex reduction, addressing the issue from the Network convergence point of view: affirming that converging all today's platforms above the lambda layer into a single one on short term is questionable due to operational and commercial constraints. DT highlighted the importance timing, and how a correct **migration strategy** would involve the economical phase-out of existing platforms.

The architectural cornerstones of a fully converged backbone are a **Single routing/switching platform** with Outdoor Access devices: DSLAMs, xPON…. with passive CWDM to the aggregation offices and CG-Ethernet aggregation and forwarding to the Core Edge, plus a **Flexible OTN platform** with wavelength services for business customers & Lambda rental and Interconnections between CG-Ethernet/MPLS aggregation and IP/MPLS core sites in a partially meshed topology.
At the same time Deutsche Telekom has already decided to rebuild its access network selecting what it calls "passive CWDM" with colored interfaces in the Access/Aggregation devices as the strategy with the lowest opex. This will enable the operator to reduce the number of central offices by the factor of 8-10 to a magnitude of about 1000, and to move business, residential and mobile backhaul services onto the same infrastructure. Deutsche Telekom is already choosing the sites for its new aggregation offices, but admits it has no idea how long the migration process will take. Immediate shut-down of many offices is neither feasible nor economical and operation of legacy platforms will continue for some years.
Belgacom ICS has managed to combine rebuilding its infrastructure for a cost saving issue while generating new business, being able to sell 1 terabit of capacity in 18 months. The carriers' carrier designed and implemented a ROADM-enabled network that is now facing the issue to expand capacity to meet the demand and to guarantee the right SLA with appropriate restoration mechanisms. Multi-degree ROADMs / PXC seems to be one of the best solution to enable restoration and double failure protection, but the operator underline the importance of saving money together with functionality. In Belgacom ICS' opinion, technology is great, but the price point must be always be kept in line first and foremost.

Telecom Italia, gave an overview of its network: the operator has three national backbone networks: ARIANNA, which is a 2.5 Gbit/s SDH ring network rolled out between 1999 and 2003; PHOENIX, another SDH network, but a 10 Gbit/s mesh deployed in 2004; and the national IP backbone, which is a double star configuration

from Rome and Milan, and is searching for a solution to **converg**e the network infrastructure in order to achieve significant opex savings.

The operator shared some interesting considerations on available technologies:

- On **40G transmission**, the issue is that many modulation formats are in competition, the commercial availability is partial or late in time, and the cost is still high compared to 10G, the performances are not guarantee or non compatible with 50 GHz grid as well the compatibility with 10G installed links. Telecom Italia sees inverse multiplexing (4x10 Gbit/s) as a good alternative today.
- **Multidegree ROADM**: the technology seems here to be mature for the deployment in the Backbone, however a strong requirement not clear to vendors is linked to robustness: the operators require that each direction must be completely independent from all the others, not only concerning traffic, but also concerning the control and the management of the node
- **Packet Transport**: Telecom Italia affirms that IP transit traffic can be conveyed over layer 2 or layer 1 depending on the flow capacity, reducing the IP layer cost, and that the actual benefit of router by-pass strongly depends on the IP layer structure, but the technology is not mature enough and consolidated standards are not available, so that it is not considered today by the operator

Telecom Italia wants to implement a network with a ROADM-enabled photonic layer (80Ch@40Gbit/s), and a separate bandwidth management layer, but it recognize that the migration phase of existing customers to the new network will be costly in terms of operational expenditure.

Conclusion

The proceedings at IIR's WDM & Next Generation Optical Networking conference indicate that the ROADM has finally taken off in 2008, both in the core and in the metro, and is evolving today towards new requirements such as colorless and

directionless capabilities following the need of a **more flexible optical network**, driven by new **mesh** applications.

Opex continues to get strong and deserved attention from service operators – giving vendors more ability to differentiate and price on software differentiation as well as on increasingly commoditized hardware.

The bandwidth glut is over, 40G is happening at last, with interest is now as high in the metro as for the core, but so far on a limited number of routes and with a slower ramp up than 10G enjoyed. This is presenting challenges for vendors in terms of achieving the volume needed to justify the pricing carriers want, and in terms of developing new modulation formats and active PMD compensation that are needed to increase the number of routes addressable. 100G will come, but not for at least 3 years, after standardization efforts mature considerably, and after new challenges of processing and/or physics are overcome.

GMPLS/ASON and wavelength services are back on the market's radar screen once again, as restoration is becoming a key part in adding resiliency, supporting SLAs, and offering differentiated services. Optical transport is increasingly being seen, by mobile as well as fixed operators as a key strategic asset capable not only of reducing costs and differentiating services, but of driving new service revenues as well.

Now with the capacity demands being generated as the bandwidth bottleneck is reduced and video traffic is growing, optical transport is extending its post-downturn recoevery. The bandwidth growth predicted in the bubble is really happening, but operators are taking a more cautious approach on spending now.

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