

## **IIR WDM & Metro Optical Networking: Trends, themes, and positioning for 2007**

July 6, 2007

### **Issue:**

IIR's WDM & Metro Optical Networking conference, held in Cannes between the 25<sup>th</sup> and 29<sup>th</sup> of June, is one of the better transport-related conferences worldwide. This year's attendance was up significantly, accompanied by greater participation in the form of vendor booths and advertising. 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 2007?

### **Analytical Summary:**

IIR's WDM & Metro Optical Networking conference was, like most conferences, a mix of fact, opinion, positioning, and hype - and in this case, was also a well organized event with strong service operator as well as vendor participation, and some excellent networking opportunities thrown in for good measure.

### **Hot topics from the conference**

Topics receiving considerable discussion this year include 40G costs and implementation, **ECI's** win in deploying the first major meshed metro deployment of ROADM technology in the EMEA region at **CoreNet**, and growing interest in metro ROADM by fixed and mobile operators alike. There was also some renewed carrier interest in wavelength services, discussion of the growing interest in FTTP in Europe, and a surprising amount of discussion surrounding 100G transport. The right way to build the next-gen transport network and provide Carrier Ethernet based services were also very prominent themes, there was renewed interest in wavelength services and the use of GMPLS, and for those that fear that innovation and startups are things of the past, **Matisse Networks** rounded out the show with a presentation on its packet burst approach to building a WDM system.

### **Debate over the timing of 40G and 100G**

The collective feedback from service operators and vendors alike was that the bandwidth glut is coming to an end. There was a bit less consensus on the timing of the need for 40G transport, with a couple of operators threatening to wait for 100G if the price does not come down to 2.5x the cost of 10G, and others indicating it will definitely be a requirement soon.

The threat of major operators waiting to see the progress on 100G is not one that should be taken seriously in most cases. 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 4 years, and bandwidth requirements will cause many service operators to deploy 40G before that. But it will be selective deployment, a mix of 10G and 40G, which will create problems for vendors in terms of volume. It is difficult for vendors to drive down costs without volume. Service operators expect 40G prices to fall like 10G prices fell – but 40G will not have comparable volume as it will not displace as great a percentage of 10G in the transport network as quickly as 10G displaced 2.5G. Nonetheless, 40G deployment is definitely ramping up in North America in particular this year, and this ramp up will follow, though more slowly, in EMEA.

### **But 100G will come – just not that quickly**

100G will come, it just is not likely to see commercially deployment sooner than late 2011. Very early standardization efforts have begun by the **IEEE** 802.3 Higher Speed Study Group, and the **ITU-T** Study Group 15. The ITU-T's studies include both serial and parallel transmission, as well as mapping 100G onto OTN.

Parallel transmission of nx10G, nx20G or nx25 bypasses or reduces the major problems with PMD that serial 100G transmission will encounter – but this will require signal reconstruction and related processing that will create potential cost issues. 100G serial transmission will have a lot of problems with physics to overcome – problems that are not fully yet worked out at 40G.

The ITU's beginning work on 100G makes sense, although it seems odd that we are already working on 100G standardization and figuring out how that will fit into the OTN multiplexing hierarchy, when we still have not addressed the OTU-0 (GbE transport construct).

### **40G delays and ramp up**

Interest in 40G seems to be as high now for the metro 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, but these interfaces have been available since 2005. But they have been available at a less than attractive price point. 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, 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.

## **The 40G business case**

Capacity requirements will compel increasing deployment of 40G before the costs hit the magic, over-quoted, and relatively baseless “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. Pricing and expectation management are a volatile mix. Once expectations are created about pricing within a carrier, the debate takes on religious overtones...and repetition of “2.5x the cost of 40G” mantra at carriers has begun to sound like the recitation of a Gregorian chant.

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 might start wondering if 4x the bandwidth for 2.8x the cost is a good deal, particularly when they also get to reduce the number of router interfaces and wavelengths to manage. Vendors still remain hard pressed to break the 3x the cost of 10G barrier, but we think they may not have to make it all the way down to 2.5x the cost. The cost of 40G may not yet be extremely compelling, but it is far from prohibitive. Service operators are holding out for lower 40G costs, not because 40G is prohibitively priced compared to the installed base and lacks a business case, 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.

## **Volume and cost issues**

Part of the volume problem with 40G is that there are still many long haul routes on which fiber will not support 40G; 4x the bandwidth also comes with 4x the PMD. And although development alternatives such as transmission formats like DQPSK exist for vendors to increase the addressable number of routes, they have a potential problem. 40G deployment will definitely ramp some volume well before 100G is available, but how long will the window of opportunity be to recover costs on 40G development that begins now? That’s a question vendors are having to seriously consider before leaping into greater development.

## **The non-threat of 100G – for now**

Vendors such as **Nokia-Siemens** were already looking to build mindshare regarding their future market position in 100G, but for now, interest in 100G is primarily driven by 1) the data center, and to a much lesser degree 2) by a couple of carriers that are likely to wield the dubious threat of deploying 100G transport in the long haul network in the next couple of years. This is a propaganda tool in the war to get vendors to drop the cost of 40G to 2.5x the cost of 10G, and not something vendors need to take seriously. 100G will happen. But not before 40G sees moderate deployment, and as mentioned previously, will not be commercially available soon. There is a window of opportunity for 40G. Those vendors pushing 4x10G solutions as an alternative are ignoring the fact that routers do not efficiently handle 40G packet streams as 4x10G, resulting in wasted capacity and somewhat defeating the purpose. The window is long enough for more

serious vendor development – but possibly not large enough to make recovery of development costs for a large number of vendors possible.

### **FTTx Interest and Bandwidth Requirements of the Residence**

Optimism in EMEA regarding the amount of access bandwidth required to the home seems now almost to rival that of North America – representing a huge change in expectations over the past two years. But some of the calculations supporting this very positive outlook seem to 1) completely ignore enhancements in compression technology, 2) assume universal 7x24 addiction to video content, 3) expect usage patterns that indicate video content will never be a shared family experience, and 4) predict that school children will be downloading research for a school paper, listening to streaming audio, and watching two channels of streaming video at the same time. We might agree with the fourth assumption, but the first three seem less grounded. We expect 60 Mbps will on average accommodate the needs of the majority of residences for now.

### **The price of copper?**

**BT** has reportedly been reconsidering its position regarding the use of copper-based broadband equipment in 21CN, and was quoted as saying the business case for FTTx may be different now when they made the decision regarding broadband access infrastructure due to the price of copper. So does this mean that the business case has changed now for all of Europe? No.

The varying price of copper as a commodity is not the real issue here. Regulatory impacts that take away cost advantages BT has had in the past compared to the free market are a more likely factor. And changing perceptions about how much bandwidth will be required to the home are another. BT may be more comfortable blaming external factors like commodity market pricing for potential additional changes to their initial 21CN plans, rather than admitting to second-guessing their initial market planning.

21CN was a huge, marketing-driven initiative that put BT on the “bleeding edge” in its quest to differentiate itself as an innovator with its next-gen network in its brutally competitive home market. But moving on such a huge undertaking that quickly has its costs, and expectations regarding bandwidth requirements to the home have changed dramatically in the EMEA region since BT did that planning.

### **The return of the wavelength service**

**Level 3** was the most vocal of the several operators that brought up a topic that has had relatively less discussion over the past few years – wavelength services, and indicated that it sees advancements in the optical layer as being a critical enabler of growth. They also said something very true that most operators ignore in their slides these days: bandwidth demand is highly elastic. Which of course means that service operator demand will remain highly elastic, too...and this is one of the root causes in carrier insistence on getting price points (such as for each 40G channel) down to targeted point.

Even if they can make a business case at today's pricing, they would have a better business case – in both margins and the size of demand they can address – if they can get the price down further.

### **The promises and potential pitfalls of all optical transport**

Vendor **Xtera** made its case for a larger role in more next-gen core builds, which would increase its addressable market beyond the festoon applications which have provided much of the company's success to date. Xtera is promoting all-optical transport leveraging Raman amplification, using a wavelength ID and embedded optical spectrum analyzers to provide performance monitoring at the wavelength level in the core pushes performance monitoring at the service level out to the network edge, where digital processing can be done. The lack of performance monitoring in the core was an issue that prevented a number of all-optical switching vendors from gaining deployment a few years ago, when carriers thought they would need the equipment but many could not accept the impact on the network management model. But Xtera is gambling that service operators intent on building an efficient next-gen core may be willing to change their minds on this issue now, as more of them are considering become less tied to SDH/SONET in the long-term.

### **The potential benefits of regen – if at the right cost**

**Infinera** positioned the benefits of its digital DTN solution as an alternative to analog ROADMs, bringing up the advantages of OEO conversion at each node in order to provide performance monitoring capabilities and efficient grooming. The argument has some merit, depending on how cost effectively the OEO conversion can be done. Infinera has a good go-to-market story and a growing customer base, but needs to prove that it is selling its systems profitably and not relying on subsidization from venture capital, and that effectively scaling 40G PIC production will not present a potential major hurdle. In the right applications at 10G, this is a competitive solution – and Infinera received a very strong endorsement from customer **Interoute** at the show. The cost benefits of its solution are dependent on how many nodes are involved, and the percentage of those nodes requiring add/drop capabilities, and wavelengths scale 10 at a time – perhaps more of a minor issue for smaller operators with less rapid bandwidth growth – and not an issue for larger operators and carrier's carriers. Infinera has exerted considerable market impact in Tier 2/3 carriers in particular, and remains worth watching closely for proof points on profitability and scalability. Infinera is one of several vendors proving there is still very much room for differentiated startups in this market.

### **Real metro ROADM deployment for the EMEA market**

One vendor that was kind enough to hand out ROADM blades for an MSTP to many research networks and universities throughout Europe led to claims of significant deployment of this technology over the past few years. But when it comes to real commercial deployment, **ECI** has scored a first with its meshed deployment win at **Corenet** in Finland. CoreNet's expectation of strong demand for full-rate GbE and

wavelength services were at the heart of its decision to invest in this next-gen network; it was driven by needs for new protection options and performance monitoring to match SLA requirements, faster provisioning, and bandwidth bottlenecks.

An end-to-end OTN network with full optical meshing, this network includes WSS ROADM functionality in all nodes (the network will be expanded to include 40 nodes by 2005). A phased implementation will be undertaken, initially incorporating 1 and 2 degree ROADMs, with that expanding to 3 and 4 degree nodes (and a few 5 degree nodes) over time. Part of the plan is also to extend the network out to large Enterprise locations using a ROADM.

### **The metro ROADM – it's not just for North America anymore**

The other major change this year is the number of operators in EMEA talking seriously about metro ROADM. For the most part, this interest was confined to the future. But the interest is real, and the future perhaps not far off. 2008 may be the year in which early rumors of substantive commercial metro ROADM deployment in this region start to become true.

### **Both fixed and mobile operators get into the act**

**Sky** is another operator early on the ROADM deployment curve in EMEA, though it has deployed 2 degree ROADMs today rather than a full meshed deployment such as CoreNet has begun.

**Telecom Italia** talked about the planned new architectural requirements for its network, with the use of ROADMs and PXC's initially enabling speedy provisioning of new optical channels without the need for 3R regeneration, with a second phase adding more capacity in the photonic layer to enable complete restoration at the optical layer.

**SFR** expressed interest in using the ROADM, GMPLS, and OTN to increase the capacity and flexibility of mobile backhaul. This operator's network is ready for 10G on all links; like many operators, it is having to test to see whether key capacity-constrained routes (in SFR's case, such as Paris-Lyon) have PMD characteristics that will enable future upgrades to 40G where potentially needed.

### **Cost optimizing the ROADM to achieve greater deployment**

**Transmode** made its case for slotting in cost optimized ROADM functionality into metro WDM, trying to help induce operators in EMEA - where the cost advantages have been less clear - to embrace the technology. Transmode just announced this micro ROADM, which it is positioning as part of an Ethernet/L2 aware optical edge solution, at NxtComm 2007 the week prior to the IIR WDM & Metro Optical Networking conference in Cannes. Interestingly, a couple of mobile operators at the show talked about their growing interest in metro WDM, potentially incorporating ROADM functionality, at the show

## **Bouygues among mobile operators reconsidering the role of optical in its network**

**Bouygues Telecom** is among the many mobile operators rolling out HSDPA services this year (the roll out is scheduled to begin soon), though as with many operators, initial deployment will be selective – targeting the densest and most lucrative market opportunities first.

Like many mobile operators, Bouygues has been paying increasing attention to the transport network as a strategic asset – and has significant design issues to overcome due to the need to support TDM for 2G services, Frame Relay for GPRS and EDGE backhaul, ATM for 3G access and NodeB to RNC connectivity and in regional backhaul, as well as IP/Ethernet in the core.

Synchronization is the biggest issue to be overcome by mobile operators interested in migrating to an all-IP network, and PWE3 has strong interest from Bouygues and many other operators as a means to enable a migration to such a network. But questions remain as to whether this technology has a long-term future in the network, or is simply a short-term bridge to the next-gen network. They also plan to implement Ethernet switching in the WAN.

## **GMPLS/ASON**

**Bouygues** is also interested in deploying GMPLS-ASON, initially for optical path reconfiguration to increase resilience, and potentially also to enable automatic provisioning someday, assuming constraints of an appropriate signaling interface can be overcome.

**Nigeria Telecom** indicated that they expect future implementation of ASON could increase their profitability, both due to their ability to increase revenues by charging more for services with higher QoS, and due to decreased costs associated with higher bandwidth utilization. They plan to roll out one of the broader portfolios of services in the market, offering 5 different service levels with associated SLAs.

## **PBB-TE, T-MPLS, and BT**

**Nortel's** mission from BT to develop PBB-TE appears not to have been for nothing. T-MPLS still seems to be driving greater interest in the market, but BT's backing helped make PBB-TE standardization efforts (IEEE 802.1ah) a reality nonetheless. That in itself is helping drive more carrier interest in discussion and trials of the technology. At the moment, the IETF's T-MPLS appears positioned to score more wins if number of trials to date count, but PBB-TE has the chance to gain a significant if not majority position in the market in a split decision.

It appears that T-MPLS did not have enough of a time-to-market lead to close the window of opportunity for PBB-TE, which has the opportunity to make its case with substantial trial activity now and renewed operator interest thanks to BT's decision to deploy, Shanghai Telecom, and the IEEE standardization efforts. Nortel and Alcatel-

Lucent have been perhaps the most vocal proponents at the opposite ends of this debate (Nortel pro-PBB-TE, Alcatel-Lucent pro-MPLS) - though neither is alone...with Ericsson, Fujitsu, and Tellabs being Tier 1 vendors among the supporters in the T-MPLS camp, but Nortel being joined by Nokia-Siemens as well as Extreme, Worldwide Packets in the PBB-TE camp – with Meriton supporting both.

### **The case for Carrier Ethernet Transport**

**Meriton** talked about how the value of the transport infrastructure will be changed in the 21<sup>st</sup> century network, as transmission of bits gives way to the switching of wavelength and sub-wavelength connections, as closed OADM rings are replaced by multi-ring access and multi-degree metro switching, and as the separate optical domain and Ethernet aggregation layers converge. Meriton made a case for its Carrier Ethernet Transport solution, including separating Ethernet services from Ethernet transport, and complementing wavelength switching with sub-wavelength switching at the GbE level with connection-oriented tunnel switching, providing L2+ transport over the optical network.

Encapsulation technologies used in Meriton's Carrier Ethernet Transport solution are agnostic between T-MPLS vs. PBB-TE. Meriton is among vendors that have not decided support for only one of the technologies is a mandate. For those (like Meriton) that have BT as a customer, that is doubly important, and it has been common for those vendors not large enough to fancy themselves as able to influence the market direction.

**ADVA** discussed how triple play services, led by video traffic, are focusing operators on the need for scalable and efficient Ethernet transport in the second mile, citing GbE will be the base unit of transport. ADVA positioned the integration of L2 switching on a blade as being more CapEx efficient than having separate devices, indicated that although a black link solution might be CAPEX effective for delivering a single unprotected GbE to a node, a GbE ADM provides lower CapEx for a protected (or multiple) GbEs, and recommended transport-centric networks as a simpler, more OAM-friendly solution than Carrier Ethernet – indicating that an Optical+Ethernet solution offers the best bandwidth forecast tolerance, lowest cost due to packet aggregation efficiencies and transport scalability, flexible optical layer protection, and high resilience due to flexible protection options in the optical layer. ADVA just announced ITU-T G.709 support, GMPLS support for its ROADMs, and additional multi-service transponder options enabling Ethernet, storage, and SDH/SONET services to be offered from the same muxponder card on the FSP3000 at NxtComm 2007.

ADVA's new multi-service transponder options and G.709 capabilities provide it with some response to competitive threats from vendors like Ciena, which has already been leveraging its G.709 and Flexiport capabilities and making greater market inroads into ADVA's home turf and market leading position in metro WDM in EMEA, as has Transmode to a lesser degree with its OTN support.

### **Carrier Ethernet in the mobile network**

The **Metro Ethernet Forum** has been working on RAN backhaul, having started a Mobile Backhaul Working Group to work on resolving the technical and marketing issues. They're working on key issues such as synchronization and clock distribution, and defining the service attributes, performance requirements, and OAM requirements needed to ease mobile operators' transition to greater deployment of carrier Ethernet solutions.

### **Opex reduction in the next-gen network**

**KPN** stated a sentiment that all service operators agree with these days: that Opex reduction and a flexible network capable of triple or quad-play services are key drivers for next-gen builds, and that fixed/mobile solutions with personalized services are key service criteria for driving future revenue streams.

KPN sees the WSS ROADM and 40G as being key technologies, and discussed the use of adaptive optical PMD compensation and new modulation formats as being the options vendors have to best increase their prospects for overcoming the PMD issues at 40G.

### **Carrier SAN in the MAN**

**Telekom Austria** is one of the more aggressive of the telecom service operators worldwide when it comes to pursuing storage area networking extension and disaster recovery solutions. They are offering a web-based "accountant certified" archiving service, providing not only off-site storage, but also a full search engine.

The barriers to entry for carriers wanting to cash in on SAN applications are large, but the potential market opportunity here is quite large as well. Why take on such a huge undertaking, which stresses the core competence of an incumbent vendor considerably? Market pressure. Telekom Austria sees getting into the ICT market as a potential means to cope with decreasing fixed voice service revenues.

Telekom Austria's presentation this year was quite a bit less aggressive regarding how quickly they will be able to gain a significant position in this market than it has been in the past...and they admitted that to date, they have had more success getting into the mid-sized Enterprise than with the large Enterprise. No matter, they are moving forward innovatively, have live services to offer and reference customers, and deserve a lot of credit for taking on the effort to develop a new core competency.

To date, the focus of the SAN business has been on the large Enterprise – and there solutions vendors like IBM have a major hold on the market. But with the growing volume and importance of data, the value will be seen to justify off-site storage and recovery services for an increasing number of mid-sized and eventually small Enterprises as well. And in this market, there is no incumbent vendor...and potential opportunity for traditional telecom service operators willing to add appropriate staff and ramp up the substantially different skill sets required to make a success of it.

## **Conclusion**

The proceedings at IIR's WDM & Next Generation Optical Networking conference indicated that the ROADM has a bright future ahead, both in the core and in the metro – and 2008 may be the year in which its use begins to ramp a bit more in the metro in EMEA – following ECI's landmark deployment at CoreNet as an important first meshed metro implementation. Opex is finally getting the attention it always deserved from service operators – giving vendors more ability to differentiate and price on software differentiation as well as on increasingly commoditized hardware. Service operators in the post-boom era feel the pressure to innovate as well as cut costs – as Austria Telekom is doing in offering web-based backup and restoration services.

OTN remains strong in the plans for of operators in EMEA. The world is moving toward more carrier grade Ethernet transport, and PWE3 has gained strong interest in enabling migration from TDM and ATM/FR to IP...though questions remain as to how large a role the technology will have in the long-term and where it should be deployed in the network, slowing deployment. Questions of Ethernet OAM are gradually being resolved – but the key issue of synchronization has not yet been resolved from the standpoint of the mobile operators.

The bandwidth glut is over, 40G is happening at last, with interest as high in the metro as for the core, but on a limited number of routes and with a slower ramp up than 10G enjoyed – presenting challenges for vendors in terms of the volume needed to justify the pricing carriers want, and development of new transmission formats and active PMD compensation that are needed to increase the number of routes addressable. 100G will come, but not for at least 4 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. Fully automated provisioning in the core remains a dream, but one that is back on the radar screen. And 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.

For those having survived the slow period for optical during the downturn, these are exciting times. Not like the bubble, where the talk was about what could happen if money were no object and demand were limitless. Now freed from the shackles of the bandwidth bottleneck, bandwidth requirements are growing almost as fast today as hype incorrectly indicated they were during the bubble. But this time, operators are taking a much more sane and business focused approach to dealing with the opportunities.