

Topic: The Carrier Ethernet World Congress 2008 in Review

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IIR's Carrier Ethernet World Congress 2008 highlighted the maturation of Ethernet services and some key trends in the industry. The following is a short review of our thoughts on what the conference indicated about industry trends, followed by an alphabetized, selective synopses of some of what we heard discussed by operators and vendors:

Industry Trends:

Ethernet has matured significantly over the past year, with Ethernet demarc devices and enhancements in OAM stemming from ITU-T Y.1731, IEEE 802.1g and 802.1h having helped establish an increasingly strong place for Ethernet services among carrier class networking services. Operators are finding good use for both L2 and L3 VPN services now, though VPLS services seem to be gaining an increasing component of the market's attention this year. FR and ATM data services are increasingly capped, as more operators look to bring new sites online using Ethernet services.

The industry is changing, with the focus on software and services as key sources of differentiation continuing to increase. For the Enterprise, the focus in the future will increasingly be on managing the network resources as part of an application, and on being able to manage, monitor, and plan which applications and users require what class of service and bandwidth resources, when, and what underlying quality of service attributes are required. We heard one operator say that the portal is a valuable tool for helping operators plan capacity upgrades, and agree.

But as Telecom Strategy Partners' Dave Dunphy pointed out in his presentation Thursday, we believe that there is much greater revenue opportunity in the portal.

As bandwidth is increasingly commoditized, network operators need to work on becoming a partner with the Enterprise in helping them evaluate, plan, and optimize their use of network resources in innovative ways.

Operators like BT continue to push toward providing greater multimedia content and software. At the same time, new players with a background in media are trying to become telecom operators. And we see strong opportunity for Software as a Service in future. If BT can achieve the transformation to become a services company with strong competencies and assets in networking, they will potentially create a huge market opportunity and competitive advantage.

For this reason, many competitors will be watching BT's progress. But in general, we think that the majority of operators would have great difficulty in achieving the transformation. Sometimes being in the same organization can be more of a hindrance than a help. Good fences make good neighbors when it comes to collaborating across different functions - and we think there is no better fence than a close partnership between different entities. And achieving the links between media companies, advertisers, broadcasters, and network service providers may be absolutely critical if the commercialization of multimedia mobile broadband services is to be achieved to the full extent possible.

The lines of distinction between varying hardware lines continue to blur. The interest in converged packet/optical transport platforms remains very strong, though the initial uptake ramp has been more cautious. Alcatel-Lucent is trying to change that now, this week having announced new platforms in its 1850 TSS to provide a broader product range. The trend toward greater integration of formerly separate NEs continues, and now with packet microwave systems we expect to see increasing integration of microwave, packet switching, and perhaps pseudowire offered by more vendors in 2009.

The E-NNI is still a major gap that needs filled if the true marketing potential of Ethernet services is to be won. The complexities and costs associated with offering international Ethernet services that require leveraging a wide selection of local access providers is still a key challenge for the industry to overcome.

Mobile backhaul has become a driving force in revenue opportunities, fueled not only by the growth in mobile data requirements, but also by operators that expect they will need to significantly increase not only capacity per cell site going forward, but also that expect the number of cell sites under LTE will have to increase perhaps 2.25 - 2.75 times. Every vendor wants a piece of this sizable and sustained market. That the Node B will require at least a partial mesh access network for backhaul is clear, but the best transport protocols with which to build it is still in debate.

Getting consensus on packet transport protocol issues have caused the ITU and IETF to jointly pursue **MPLS-TP**, with T-MPLS having been scrapped. It will likely take 18-24 months to get an official standard for MPLS-TP in place. What does this mean with respect to the ability of MPLS proponents to get a less expensive transport-oriented version in place? On the good side, strengthened OAM capabilities and full compatibility of it with MPLS. On the bad side, potential delays in market availability.

Vendors like **Alcatel-Lucent** are positioning that MPLS-TP is so closely related to T-MPLS that operators can deploy T-MPLS, will gain a lot from the lessons learned in the process, and then can migrate to MPLS-TP with a simple software upgrade and be in a better position as a result. Positioning from **NSN** has been more of a "why deploy until the MPLS-TP standard has firmed up"? Positioning of various vendors may be positively correlated with the amount of time and money they have spent on T-MPLS and their market position in MPLS today.

But as always, the final decision on what to do is in the hands of the operators. In conversations with operators, there were mixed feelings. As one said "it is never just

a software upgrade," indicating some skepticism. But operators that have been interested in potential T-MPLS deployment should let vendors make their case for the value of deploying T-MPLS now. If they have interest in the potential value of deploying T-MPLS as a learning experience, they can consider negotiating with the vendor to ensure that there is no undue expense or risk to the operator associated with undertaking this learning process while waiting for the MPLS-TP standard to mature.

Nortel's recent announcement that it plans to divest its **Metro Ethernet Network and Optical** was a hot topic at the conference. Nortel's motivation behind announcing this publicly seems to have mystified many in the industry, as making this fact public was not required for Nortel to start looking around for options but did have potential to cause operators concern that might impact their willingness to make additional purchases in the interim. Nortel has been taking some long-term strategic gambles to reassert itself in the carrier business. Its development of new modulation formats and receiver technology was a major short-term investment that gave Nortel a potential major advantage as the 40G market fully ramped and transitioned to 100G, but it was going to be a difficult investment to recoup in the short-term. Such long-term strategy requires either deep pockets or a willingness or need to take risk. The economy made such risk a problem, though Nortel had started to do well with the technology.

The **U.S. economy** was another frequent topic of questions at the conference. The markets have been propped up in the short-term by government intervention, but the long-term costs of those actions and the printing of money to enable them will in themselves tend to have a depressing impact on the economy in future. This intervention will moderate the depth of the down-cycle caused by the housing finance crisis, but the full extent of that crisis will be felt...just to a lesser degree each period, extended over more periods. The full extent of impact is not yet fully known, but an economic downturn could accelerate the process of industry consolidation -

potentially compressing what could have been another 4 - 6 years of consolidation into a shorter 18 - 36 month cycle.

Ciena's announced a win for PBT in Sprint, somewhat deflated the hopes of MPLS vendors that Nortel's recent announcement that it plans to divest its MEN and Optical assets would take PBT out of contention.

Packet microwave is a hot emerging trend, and we think represents one of the few areas where revenue potential may be under-represented by analyst projections.

Synchronization remains a key issue, and the strong fundamental belief in the value of Synchronous Ethernet is undermined in the short-term by the need to deploy it at intermediate nodes. In the installed base, this is not practical, and that has led to the interest in 1588v2. 1588v2 has been viewed as not quite mature, but NSN's announcement of test results for commercially available. Many Tier-1 vendors have been indicating that 1588v2 is not mature while they continue to develop it, and some of the smaller players like **RAD** and **Axerra** have had relatively more expertise in packet synchronization. But Tier-1 vendors have been catching up, and the 1588v2 capabilities developed by NSN (via its partnership with Symmetricom) are key.

And it seems we have another wait ahead to see how cost effectively MPLS can be made for metro transport as MPLS-TP development unfolds. The debate over L2 vs. L3 in the RAN is far from over; QoS, resiliency, scalability, and increasingly security will be key elements of the argument.

Cisco seems to think it is prime time for IP/DWDM. We have to disagree with them on this. We think IP/DWDM will find shorter-term opportunities on a point-to-point basis in the Enterprise. But for carrier networks, transport is simply not yet that easy.

Conclusion:

Ethernet services show strong promise now. With many of the issues of OAM behind us, defining the protocol for reducing cost for MPLS for packet transport in the metro is still before us, and the lack of the E-NNI remains a critical issue of the day. In addition, more substantive work on a packet ring standard is needed.

The market is in transition, with the future increasingly defined by software and services. There is going to be increasing competition among service operators, but whether the invasion of the content providers will succeed, or whether operators will mount a strong defense and transform themselves into offering more content and services is a battle yet to be fought and determined. We think well crafted and stable alliances between the two will bear the most fruit in the long-term.

Selected presentations of interest:

(Alphabetized by vendor/operator)

Vendors:

ADTRAN highlighted how achieving scalable service delivery requires lowering the cost of deployment with things such as good traffic management, simplified service provisioning, and integrated test and diagnostic functions. ADTRAN suggested that Ethernet over copper and TDM is still required to provide ubiquitous Ethernet services with high bandwidth off the fiber network, and discussed its Total Access 5000 and Netvanta 800 products and the design objectives.

Alcatel-Lucent discussed evolution in the mobile transport market that will occur as operators move to LTE, and stated its beliefs that LTE will drive bandwidth requirements for mobile data up to 100 Mbps peak rates by 2010 and that initial deployment will start in Asia in 2009/2010 and initially be focused on "hot zone" areas targeted at high data users.

Alcatel-Lucent also discussed how mobile services under LTE are going to require increased tiered-level QoS support, how a complex partial mesh topology will provide resiliency and load balancing, discussed how a partial mesh of eNodeB's is likely because scalability will likely require eNodeB's to connect to a hub site using ELine services. It was suggested that IP Sec will be the best method for providing encryption from the eNodeB to a trusted aggregation point to enhance security. Alcatel-Lucent stressed that key takeaways included that it is critical for operators to design a highly flexible backhaul network given that the LTE backhaul network will evolve over time, that because LTE is transitioning us to use of a shared/public network and eNodeB's and femtocells are going to be deployed in low security areas, security is going to be absolutely critical if operators are going to prevent outages, and that achieving scalability for a growing LTE backhaul network will require.

We think the security issue is going to be critical for LTE. This is a central issue in the battle between L2 and L3 backhaul solution advocates - with L2 advocates taking the counter position that the inherent security benefits of a switched solution will prove compelling.

Ciena stated that Carrier Ethernet services will be the de facto standard of new business services, proclaimed that Carrier Ethernet standards and technology is now ready to support managed business services, and suggested that those operators that will be most successful will be those that offer a variety of differentiated Ethernet services driven by customer applications. Identifying key trends in service consolidation, application virtualization, and ubiquitous service delivery, Ciena suggested the time is right for Carrier Ethernet and managed Carrier Ethernet services - and discussed the importance of service stratification, service assurance, and service automation for operators looking to maximize their competitiveness.

Cisco stated that the IETF work to integrate transport requirements into MPLS will ultimately widen the MPLS application space. Predicting a 10-20 year transition for Ethernet to fully replace SDH/SONET, Cisco noted that the overall operational and

functional requirements of Carrier Ethernet are closer to IP and ATM than pure transport.

Cisco proposes an IP NGN architecture based on an Optical /ROADM layer and IP/MPLS service layer, with the Optical/ROADM layer using an IP/MPLS control plane, offering optical awareness in switches and routers, providing support for dedicated point-to-point high bandwidth services, and providing the underlying transport layer for IP/MPLS.

Cisco proposes IP/DWDM and the integration of optics into transport, leveraging DWDM, G.709 FEC, reducing the cost of optics by leveraging LAN PHY, reducing OpEx by reducing equipment and power requirements, and fewer devices in the network and IP/MPLS awareness in OTN will provide resilience.

It's hardly surprising that Cisco is proposing IP/DWDM yet again; Cisco in our opinion had all but exited the optical systems market (without announcing it) as the installed base of the 15454 aged and as no migration path was evident for it due to its architecture. We think the inability to drive much success in the optical switching market following the Monterey acquisition and a more operator-friendly migration path in ANSI markets for a transition from MSPP to more scalable optical switching from Fujitsu and stronger optical switching platforms from Alcatel-Lucent helped reduce Cisco's momentum for a broader optical solution in its home market, and Cisco's preference to invest only in markets where it can be a fairly dominant number 1 or 2 player did not mix well with its resulting position in optical. But the past is the past - and Cisco is now looking to the future. So is it time for IP/DWDM and integration of optics into switch/routers? We think it is still quite a bit early for this proposition as a replacement general transport solution in most networks today, though it might see initial use in some simple point to point applications in the foreseeable future. But we think it will be quite some time before IP/DWDM plays a big role in the transport market.

Ericsson discussed how operators can develop attractive wholesale Carrier Ethernet backhaul services. Ericsson indicated that fiber will increasingly be used in addressing

future fiber requirements, but suggested microwave will still enjoy a bit of slow and steady growth through 2012. The company predicted that copper access should be used primarily as a transition technology implemented as a precursor to microwave or fiber.

Ericsson positioned that NTP and IEEE 1588 are the two synchronization options most viable for use with leased Ethernet services today - though noted that 1588 has a ways to go yet to attain full maturation. Ericsson suggested that operators will have to pursue a migration path to all IP over Ethernet, and suggested that basing backhaul on standardized services was the way to go.

Foundry recommended a build as you grow approach to cost effectively scaling Ethernet service delivery, suggesting PBB or PB can provide simplicity and scalability at the network edge while an MPLS core can continue to provide strong resiliency and traffic engineering capabilities. Foundry also highlighted the importance of security requirements now for Carrier Ethernet

Huawei proposed the need for a **dedicated Ethernet Transport Network (ETN)** with simplified MPLS to provide business services. Huawei noted that using GFP to transport Ethernet over SDH is too expensive for use outside of very critical PTP applications due to the lack of stat muxing and limitation to use of P2P circuits, and that IP/MPLS services based on PWE or MPLS lower quality and reliability compared to MPLS, resulting in higher OPEX and equipment cost and are not reliable enough for mass deployment in the enterprise. And Huawei stated that using IP/Internet will not be a suitable long-term solution due in part to factors including delay, latency, and jitter issues.

Huawei proposes that Ethernet Services targeted at business should be offered using an **L2 MPLS network with a simplified version of MPLS-TP**, using transport-like OAM and a management plane but no control plane. EoMPLS pseudowires, with backup pseudowires for redundancy, would be used to run EPL and EVPL services.

It is interesting to see vendors begin lobbying their arguments regarding the best direction to take with MPLS-TP (as if backing down from T-MPLS now was not enough)! But this is a very important topic for MPLS proponents to resolve quickly now, because very timely delivery of MPLS-TP standardization is critical to their cause. So if there is any contention about its direction, the sooner those issues can be raised and resolved one way or another, the better.

MTN Nigeria examined the role of Carrier Ethernet Backhaul in Mobile Network Evolution. The MTN Nigeria mobile network covers over 250 towns and cities, and over 10,000 villages in the 36 states of Nigeria. In addition to the 2G, 2.5G and EDGE networks, MTN Nigeria has commercially launched its 3.5G network in the major cities of the country, with about 500 3G sites already operational carrying commercial traffic.

The provider has grown from less than 400K subscribers at its inception in Dec 2001 to over 18.5 million subscribers as at June 2008. The **transmission Network** is composed of SDH and PDH Microwave, plus a DWDM optical fiber backbone network, and an IP/MPLS backbone.

The evolution towards an efficient Carrier Ethernet backhaul is driven by the increasing data demand, and by the need to decouple the capacity growth from the OPEX and CAPEX evolution in the transport network while supporting smooth transition from Legacy TDM network.

MTN Nigeria is strongly committed in the evolution towards a Carrier Ethernet backhaul for its network, but it recognizes that the issue of **Synchronization** needs to be considered with top priority

MTN Nigeria is presenting itself as a strong innovator in the African region. Emerging countries represent strong growth markets, and due to their rapid enrollment of subscribers their networks are even more exposed to issues of evolution and scaling. The evolution towards Carrier Ethernet backhauling can be even more important for emerging markets than for mature ones.

Nortel positioned that today's metro networks need a scalable packet-based solution, and suggest that MPLS is clearly not it - but that PBB, PBB-TE, and PLSB are instead the answer. Nortel indicated that these technologies are compatible with the IP/MPLS core which is a clearly established element of market direction at this point, and that carriers need PBB, PBB-TE and PLSB to achieve scalability. Nortel positions that PBT improves as well as interoperates with VPLS, reducing control plane requirements at the edge of the network, creating a smaller core and therefore reducing PW requirements, and and eliminating C-MAC learning in the core. It also positioned that PBB-TE and PLSB leverage the strengths of PBB, but remove the dependency on STP.

Nortel positioned that the scaling issues of VPLS, even when supplemented by H-VPLS, end up simply replacing one set of scaling issues with another (because VPLS requiring a full mesh of PWs edge to edge, the inefficiencies of edge nodes needing to perform all replication for multicast/broadcast traffic, and inefficient bandwidth utilization in the core due to multiple copies of the same packet existing on one physical link, while with H-VPLS the core nodes must learn CMACS and the N-PE is potentially subject to MAC explosions). Further, Nortel positioned PLSB as providing a more robust control plane for delivering E-LAN services, and as offering lower opex due to its having a single control plane, lower capex due to using Ethernet as the data plane, more efficient multicasting given its use of native Ethernet multicast, more efficient bandwidth utilization since it always uses the shortest path and unblocks all ports, guaranteed performance due to the use of pre-determined paths, and fast restoration that can calculate and install an alternative route within 100s of ms.

Omnitron Systems talked about the challenges, technical initiatives, logistics, business and operations of Out-of-Franchise services. The Wholesale Access Interconnection Group (WAIG) is working to define Standard template and procedure for ordering wholesale Ethernet services between service providers, in order to enable efficient communication of network capabilities between service providers and prospective wholesale partners
Initial publication is forecasted in October 08 during the next MEF meeting in Malta.

The definition of the WAIG is an important supporting element in the continued evolution of Carrier Ethernet services as they move from the LAN to the MAN and towards regional and international multi-provider networks.

RAD discussed the need for an evolution toward business-focused VPN services, as well as the technical and implementation issues associated with making that happen. L2 VPNs and L3 VPNs were positioned as being complementary, with L2 VPNs focused on Ethernet access and transport evolving to include smart demarcation, and L3 VPNs focused on best effort IP having evolved toward IP VPN with QoS and now to IP VPNs that are application aware. The next step RAD predicted in the evolution of the VPN was a focus on the “Business-Aware VPN” - a technology-agnostic VPN defined in terms of Quality of Experience per application and performance of the business processes being supported rather than by whether it is being delivered over a L2 or L3 VPN. And RAD suggested the proper formulation for a VPN SLA will be to define it in terms of application performance and Quality of Experience.

We very much agree with RAD's assessment of the need for greater focus on application and performance. But we think the main impact that traffic awareness and customer management will be In our opinion, the impact of added value functionalities, like traffic awareness and self-management will not have their main effect on CAPEX and OPEX reduction as RAD states, but will be mainly determinant for Service Providers' profitability

A similar presentation was given by **MRV**: strong focus on Demarcation Solutions MRV OS900 Series as the enabler of Service Performance Measurement, Cost Savings and Convergence

Soapstone discussed business challenges of service providers in terms of needing to offer strong QoE over multi-vendor networks, and suggested that both good intra and inter provider quality management is required to deliver a differentiated service to

end users. Soapstone discussed current service assurance and fulfillment requirements, and how a standards-based resource abstraction layer could help integrate resources an operator requires to offer the end-to-end service through connection to capacity and quality management systems. The NNI was positioned as being primarily about automating the business-to-business transaction between operators, which was something Soapstone indicated must contain quality metrics and monitoring. Soapstone positioned that NGOSS Contracts helps overcome many challenges by letting operators take a big step towards plug and play management solutions.

Tellabs gave its vision on how to build an Ethernet-centric Optical Transport NGN, analyzing the options for Scaling Capacity (in particular the ROADM benefits), the Sub-lambda Ethernet Options, the Benefits of Integrating Optical and Ethernet and the benefits of Integrating the Control Planes.

Concerning the Sub-lambda Ethernet Options, Tellabs analyzes the four technologies available (IEEE Ethernet, IETF MPLS, NG-SDH and OTN), stating that each has its advantages and disadvantages, and that the optimal transport solution will offer multiple options.

Tellabs did not take any clear position in its presentation, stating that optical transport with multiple sub-lambda grooming and control plane options is key to scaling next gen networks. We were waiting for a clearer position from the company, in particular after Nortel's announcement

ZTE noted problems that it feels standard Ethernet switches, QinQ switches, and VPLS impose on the evolution of fixed/mobile networks, and suggested an evolution is required to increase bandwidth, provide multi-service multicast capabilities, and ensure the evolution of carrier Ethernet. ZTE highlighted its IEEE G.8032-based Ethernet Smart Ring Protocol (ESRP), which it positions as an innovative hierarchical way to simulate any type of topology.

For mobile backhaul, ZTE highlighted its ESRP along with L3 VPNS, IEEE 1588 synchronization, and OAM. For fixed networks, it highlighted ESRP along with PBB, L2/L3 multicast, and Ethernet OAM.

IEEE 802.17 RPR has seen limited niche applicability, being deemed too expensive for general applications...though Verizon has indicated it will add this technology to its Dedicated SONET Ring (DSR) services that have been popular in the health care market as a means to dedicate part of the ring bandwidth to oversubscribed packet services for best effort traffic.

But standardization of a lower cost packet ring technology is needed at this point.

Operators:

BT gave an update on the evolution of 21CN, and how a converged MPLS/Ethernet platform will help them move beyond the focus on bandwidth. BT is focused now on delivering new services based on customer requirements as quickly as possible, and estimates that it will increase its broadband services footprint from 1 million to 10 million homes in the 12 month period ending April 2009, and increase the number of Ethernet POPs that it has in the UK from 106 to 600 POPs during the same period. BT is now offering Global Ethernet services in over 174 countries.

In some ways, BT may have bitten off a bit more than anybody could chew with their aggressive original plans for 21CN, but they have continually adapted and are continuing to push real innovation here - and we think that their focus on software as a service and on customization to the requirements of the customer is right on target with the direction required for service operator profitability in the future. A lot of other operators are watching BT's progress closely, but at a safer distance behind the bleeding edge - and may opt to follow in BT's footsteps in future...and BT's change in position on PBT this year makes that strategy look wise.

BT Openreach discussed its service delivery strategy and its Ethernet portfolio transformation as part of **Project Eden** - which spans TDM access and backhaul product strategy, off-net Ethernet access and aggregation services, on-net pre-built backhaul services, and migration of the installed base to this new portfolio. BT has been concentrating on reducing service provisioning times, on providing root cause analysis of failures rather than simply fault management, on proactively forecasting and planning customer demand to accommodate peaks, and on making enhancements to its automated systems.

Openreach's new "Ethernet Backhaul Direct" (EBD) services are based on a shared backhaul infrastructure offering uncontended GE bearers (with 10GE bearers planned next year), reducing backhaul costs in dense traffic areas by offering pre-build infrastructure over WDM.

Next steps in BT's access plans: more bandwidth, "green" communications, reduced lead-time and increased remote configuration, synchronous Ethernet, and "PON technology enhancement." Stay tuned.

Openreach is deploying next generation access technologies and plans to spend £1.5bn to ensure it will support Communications Providers' Next Generation Network strategies and demand.

Belgacom discussed how to develop a compelling Ethernet service portfolio, and showcased its Belgacom Explore as an example. Belgacom is moving to one converged network, and is offering both L2 (VPLS) and L3 VPNs, backed up with a suite of security, infrastructure, collaboration and application services. It discussed how it is structuring its approach to addressing the challenges of the migration.

We think Belgacom's application related services (monitoring and reporting functionality, performance management, and performance monitoring guarantees) are key potential areas that provide opportunity to serve as sources of more long-term differentiation.

Cable & Wireless related that it now has 87 NGN POPs, 225 Access Network POPs, 802 unbundled exchanges, and has extended fiber to over 16,000 business premises. They discussed how they are focused on next gen

COLT now has a 25,000 mile fiber ring that connects over 100 cities, 15,000 buildings, and 18 of their data centers in Europe. COLT noted that Carrier Ethernet services are now the fastest growing form of data service, though IP VPNs are still strong. In 2008, they introduced Ethernet over MPLS to provide access to all IP and data centre managed services.

COLT's Next Generation Solutions platform consists of the Next Generation Network (next generation intelligent network, next generation softswitch, and multiservice platform) and the Next Generation Managed Services (based on grid computing and virtualization).

COLT services: **COLT's Multiservice Platform** is offering non-contended Ethernet over MPLS L2 services in the metro with QoS, high resilience, "four 9's" of availability, and 1-5 ms lower latency than with SDH by deploying Ethernet First Mile (EFM) over both copper at up to 40 Mbps symmetrical (using 8 pairs) and on fiber (using COLT fiber rings). In the core, COLT is providing an L2 transport network running MPLS to offer uncontended services, fast provisioning, and low latency for Ethernet services, and running a separate router-based L3 IP/MPLS core network for IP VPN, Internet, and VoIP services.

We think COLT has had some strong innovation in offering Ethernet Services, and they have been one of the most aggressive European operators in rolling out EFM over copper - which they are now offering at over 100 POPs.

Ntl:Telewest talked about the evolution of SLAs and QOS and of the importance of giving the customer high control of the network. The initiatives of the provider include a clear definition of SLA with the customers, as well as a more complete online service management experience as part of a collaborative relationship with the provider

Orange considered packet microwave as a means of mobile backhaul, looking at ADSL2+ for potential HSPA offload and planning G.SHDSL use for 3G microcell lub interfaces. Orange indicated it is now complementing 1+1 STM-1 links and optical backhaul where on net with GbE. Orange recommended that operators should invest in microwave systems that support Ethernet while ensuring that they can also handle native TDM and potentially ATM. Support for QoS, synchronization, and PWE3 were also mentioned as important highlights.

Telecom Italia discussed how to best optimize multi-service aggregation of 2G/3G R99 UMTS and HSPA Ethernet traffic on a converged backhaul infrastructure. Telecom Italia has been deploying pseudowire access gateways at the edge of the metro GbE network to collect nxE1 NodeB traffic delivered over PDH/SDH and to map ATM onto MPLS/Ethernet for transport over the metro GbE network using PWE3, terminating the PW at the backbone gateway which is collocated with the Radio Network Controller (RNC).

Telekom Polska presented an analysis of when service operators should build one Carrier Ethernet network vs. when two or more might be more appropriate. They concluded that building one network is right for “green field” builds, rural areas, and when operators are first on the market, particularly when services are revolutionary and directly competitive alternatives are not available. But for incumbents in highly competitive and urban areas that are supporting legacy services, TP predicted there will be a split in strategy between those consolidating and those following service specialization and traffic structure changes.

TERAGATE discussed its core network in Germany, which now consists of a 4500 km fiber backbone and 24 metro fiber rings - and it now has over 850 active GbE connections for customers. TERAGATE also discussed its progress in penetrating other markets regionally in the U.K., Europe and Russia, and its participation in a Global Ethernet Services Alliance to leverage the EXPONENTIAL-E backbone in the U.K. and

RELIANCE's backbone in the U.S. TERAGATE offers VPLS services, and also the TERAWEB WAN management tool. Noting the increasing security requirements on the network from the perspective of many verticals, TERAGATE discussed how it is offering multipoint L2 encryption that includes VLAN specific encryption on certified and WAN agnostic encryption devices.

THUS has grown its fiber network to 10,600 km, and now supports over 15 metro area networks and 190 Ethernet Access POPs - and it boasts of having over 6200 installed circuits carrying Ethernet services. THUS described its vision of a converged network, of the relative benefits of L2 Ethernet vs. L3 MPLS IPVPN services. It went on to discuss the need for L2 NNI standards to make it easier to rely on third-party carriers, and discussed the advantages of EFM OAM.

Verizon examined the challenges of using local Carrier Ethernet access services to deliver a consistent global network service, noted that a complex ecosystem of off-net providers is involved in offering global services, pointed out that this can introduce significant complexity in rolling out services, and suggested the need for certification programs for access providers to help overcome performance challenges and clarify and streamline the ordering process.

The extension of Ethernet services' beyond the national network of a service provider is a recurrent theme of this conference, and Verizon states at the end of its presentation: "Service names do not tell what you buy". A need for a more precise classification and standardization of the offering, beyond the classical MEF definition is arising.

Consortia:

The **Metro Ethernet Forum** talked of its promise of a Carrier **Ethernet for Mobile Backhaul specification** for January 2009, and talked of how now that Ethernet services are ramping up their work has evolved toward driving initiatives in the period 2008 - 2010 that will help drive operational scalability of Carrier Ethernet as the world's

next-gen network. They also indicated their expectation that after achieving that operational scalability in the next couple of years, the MEF expects **Carrier Ethernet revenues** will exceed \$30 billion before the close of 2014.

The MEF Mobile Backhaul initiative continues to move forward on defining an Implementation Agreement for Carrier Ethernet services in mobile backhaul networks which will define common terminology and establish UNI type, Ethernet services types, classes of service, and Ethernet OAM. The first phase of the project will address a single domain network, define Ethernet services, address the GSM, WCDMA, CDMA2000 and WiMAX 802.16e standards, and provide

*The MEF 20 UNI Type 2 is in our opinion is one of the more important projects underway at the MEF right now, as it promises greater automation of service management and increased visibility into performance at the service level. Perhaps even more important: completion of the MEF's work on **definition of the E-NNI**, slated for 2009. The absence of the E-NNI has been a critical constraint on wider roll out of multi-vendor, international Ethernet services - and once that is out of the way, a key floodgate to greater revenue possibilities will be opened at last. The Implementation Agreement v1 document will be available in November 2008.*

The EANTC (European Advanced Networking Test Center) showcased the Multi-vendor Carrier Ethernet Interoperability Test 2008 at the conference. This involved 28 participating vendors in hot staging of 110 devices, 16 racks, and 80 engineers. MPLS, PBB-TE, and T-MPLS technologies were tested.

Over the past year, the number of microwave, MPLS, and access and CPE platforms involved in the EANTC's testing skyrocketed, while PBB-TE platforms decreased slightly and T-MPLS platforms simply leveled off. This year's test included clock synchronization for adaptive clocking, adaptive clocking with RTP, IEEE 1588v2, and Differential clock over radio. 17 vendors participated in E-Tree testing, and applicability to UNI 1, 2.1, and 2.2 were tested.

Also heard at the conference:

- a) **Operators on vendor positioning:** A couple of the many operator personnel we spoke with at the conference indicated similar viewpoints in terms of wishing that they did not have to spend so much time filtering out some of the baseless hype and mudslinging that some vendors use on occasion to try and to gain a foothold in the market for their technology at the expense of their competitors.

As one of these people said, *"Eventually we will learn the truth anyway - why can they not just save us a lot of time and present the facts and roadmap, and position reality as positively as they can."*

- b) **A call for more operators to offer aggregated NNIs, and for broader industry support of the recent Y.1731 standard** in order to enhance operational efficiencies was issued by COLT.
- c) Operator (anonymous) on concerns over investing in T-MPLS now as a stepping stone to MPLS-TP with the promises of a future software upgrade between the two: *"It's never 'just a software upgrade'"*

Best conference quote:

"The agenda today is in the hands of the customer"
- Tim Hubbard, BT

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