

The Carrier Ethernet World Congress 2007 in Retrospect

Telecom Strategy Partners
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Over 570 people attended the Carrier Ethernet World Congress 2007, with more than half of those attendees coming from fixed and mobile service operators augmented by a strong contingent of vendors, followed by regulators and broadcasters. It was an upbeat event, due to the strong demand that operators are seeing for Ethernet services, and their increasingly optimistic forecasts for the years ahead. The vendor exhibition area was sizeable, augmented this year by the EANTC (European Advanced Networking Test Center)'s demo room showcasing interoperability of PBB-TE amongst 9 vendors.

OAM support for Ethernet, a historic pain point in the past, has been significantly upgraded over the past year. Ethernet may not yet provide fully comparable fault management and performance monitoring to that of SDH/SONET, but it has gotten much closer now - close enough to help unleash the floodgates of demand for Ethernet services by giving operators a greater comfort factor in rolling them out. The ITU-T's Y.1731 standard has brought much needed performance monitoring support, and the IEEE's 802.1ag standard has helped bolster fault management capabilities.

Integration of L0 and L2 network devices continues, being led with particularly strong interest in the integration of WDM, WSS ROADMs, and L2 switching in North America. Packet aware transport is becoming an increasing objective of the NGN globally, as deterministic, connection-oriented performance combined with Ethernet economics and network convergence have become key objectives. **Carrier Ethernet** solutions increasingly take center stage, obscuring very premature talk of potential future IP/DWDM solutions...as operators currently favor a more manageable transport layer and something closer to their existing OAM model.

T-MPLS, PBB-TE, and VLAN-XC are now offered to bring a connection oriented nature to Ethernet services, and the MEF has taken a strong role in defining bandwidth profiles and Ethernet CoS and QoS.

IPTV has become a major driver of network design, and has had a major effect on speeding up the migration from ATM to Ethernet DSLAMs - in turn driving bandwidth requirements and Ethernet interface requirements and helping fuel

greater migration from TDM to WDM in the metro. Efficient multicast and high scalability in the metro have become key requirements as a result.

PBB and PBB-TE made dramatic progress over the past year, with the Nortel driven Metro Ethernet ecosystem now having grown to 15 members including equipment vendors Extreme, Meriton, ANDA, Axerra, and RAD among others. PBB-TE gaining standardization momentum from the IEEE in IEEE P802.1Qay, Nortel having scored public wins beyond BT (Shanghai Bell), and PBB-TE gaining valuable Tier 1 vendor support from Ericsson and Nokia Siemens Networks. The EANTC interoperability demonstration at the show highlighted the amount of progress that has been made. That said, T-MPLS is alive and well, it merely has more substantive competition from PBB-TE this year in the quest to dominate next-gen packet transport. Alcatel remains the staunch supporter of T-MPLS, Telecom Italia is among major operators having deployed it, and vendors such as Ericsson have decided to support both T-MPLS and PBB-TE. Meanwhile, BT, which started the PBB-TE ball rolling, is deploying it in its backhaul network and plans deployment outside the UK.

PWE3 support has taken off amongst vendors over the past year, more so than with operators to date as deployment so far has been fairly limited. But interest is growing, and fixed/mobile operators and mobile operators dealing with multiple generations of radio technologies profile will probably have the most to gain by implementing PWE3. Telecom Italia fits that profile, and is helping lead the way among Tier 1 vendors in recognizing the value of this technology and deploying it as part of a convergence solution.

For mobile operators “**HSDPA offload**” of mobile 3G data traffic onto DSL has been a major strategy for dealing simultaneously with the needs to offer new data services without destroying the cost model of a network designed for voice requirements, particularly in Europe. **WiMAX** deployment plans of many alternative operators and municipalities in the North American market is driving opportunity for packet-based backhaul solutions. **Synchronization** remains the key obstacle to migration to an all-IP RAN for more established operators that see its benefits, particularly in Europe and the Americas - though packet-based clocking solutions are on the horizon, and their maturation may open up greater opportunity.

The **E-NNI** is a much-awaited development in support of wholesale service deployment and for multi-operator end-to-end networking and SLA support. With all the growth in Ethernet services, operators are already anticipating future **100 GE standardization**, though with that likely remaining years out, are turning to **10 GE LAG** as the short-term solution and a more cost effective alternative to POS.

Ethernet demarcation devices at the UNI to provide testing for troubleshooting and monitoring for preventive maintenance and SLA support -

and are getting a lot of operator interest these days. ADVA took an early position in this area through acquisition, and vendors including Ciena took note and followed suit. Expect to see significantly more vendor activity and heightened competition in this area soon.

100 GbE interest is strong in some major operators such as Level 3, though in the short term operators must satisfy themselves with 10 GbE and LAG. But the bandwidth demand only rumored during the bubble is now upon us, making some of the perennial “hockey stick” market projections that were not realized over the past few years due to past operator concerns with Ethernet OAM seem more feasible now.

Interest in L2 VPNs grows, with the inherent security making for a strong position. In North America, large Enterprise comfort with providing their own L3 expertise makes this a somewhat stronger short-term market opportunity, but L2 VPNs are poised to take an increasing role globally.

Point to multipoint services will also begin to take on a larger role; point-to-point access and private line services were the “low hanging fruit” and “easiest sell” for early market penetration by Ethernet services, but there is increasingly rapid migration now from FR and ATM now, and a tendency by some enterprises to want to replicate the hierarchical logical topology previously employed. A growing number of operators have been offering increasingly rich Ethernet service offerings.

SLAs are becoming more application oriented, and detailed reporting of network performance represents an increasing revenue opportunity for service operators, particularly now as Enterprises converting to Ethernet services want that bit of extra insurance policy in terms of SLA enforcement - documentation for their management teams proving that moving to Ethernet was not the wrong move. The MEF has played a key role in standardizing the concepts of traffic management in support of Ethernet service SLAs.

Ethernet technology has passed the third of a century mark, but not without significant evolution along the way. Its flexibility is what enabled this evolution, and that has undoubtedly been a root cause of its success.

Led by OAM enhancements, a UNI and soon NNI, substantive SLA, and stronger Carrier Ethernet options, Ethernet services now really have the very bright future for 2008 that has been projected for them over the past several years.

Selected highlights/commentary on selected conference presentations:

Vendors

ADTRAN positioned Ethernet over Copper is an important complement to fiber given the slow fiber build-out, reminding everyone that Ethernet roll outs are not all about fiber, but frequently have to be provided via copper using technologies dependent upon the distance and the service rate required.

ADVA discussed how to deliver end-to-end SLAs for both local and global services, recommending a clear service description based on interface specification, bandwidth profile, and bandwidth profile parameter, as well as transparency, protection options, and OAM requirements. ADVA positioned sharing of network resources and controlled overbooking of those resources as necessary for operators to achieve a favorable business model, and predicted a future where local access providers independent of core providers will be part of multi-operator end-to-end service offerings. ADVA suggested that an intelligent demarcation device and end-to-end monitoring are critical components of a solution to support services based on the CoS / QoS definitions of the MEF with good performance and strong SLAs.

Alcatel-Lucent highlighted how new services are creating the need for network transformation to a converged packet network, and made its case for the value of a flexible platform that can support any mix of packet and TDM traffic as a means of reducing investment risk and enabling cost optimized network consolidation. Alcatel-Lucent promoted T-MPLS as optimal for connection oriented transport, and MPLS Pseudowire as the technology for connectionless networking - together forming the basis for tomorrow's converged packet network...and offered case studies of implementations with fixed and mobile operators.

Ceragon reviewed the capacity requirements of mobile backhaul services, discussed the value of Ethernet point to point microwave systems, and highlighted the benefits of Adaptive Coding Modulation in providing the greatest capacity for data services, higher availability, and graceful link degradation and recovery.

Ciena discussed the drivers for convergence, suggesting that the ideal solution involved L2 over WDM enhanced by OTN support to eliminate stand alone L2 switches and integrate traffic management, enable transparency, provide support for 10 GE LAN Phy, and offer efficient grooming of multiple Ethernet services onto wavelengths - with the final step to fully converged Ethernet networks involving an automated control plane for Ethernet (PBT), the mesh capabilities of ROADM, and greater L3 intelligence and routing capabilities.

We strongly agree with Ciena's positioning of the value of distributing packet awareness to the metro transport layer. We think that The slide on its presentation discrediting IP/WDM as a current option was self evident; from an operations standpoint, this degree of reduction of network layers does not make sense at this time. Ciena's statement about the need for Ethernet management to be tightly integrated into the existing OSS model at operators was an on-target and realistic assessment of market requirements. The positioning of OTN was squarely targeted at Ciena's home region in the U.S.; the value of OTN is finally gaining some recognition there, but not yet to the same degree as in EMEA.

Extreme Networks cited carrier interest for PBB-TE stemming from deterministic network behavior, resilient network design, and CapEx and OpEx improvements...notably, no need to staff up with L3 expertise. Extreme highlighted the EANTC demo, of which it was a key participant, citing that VPLS tunnel termination (PBB-TE/VPLS gateway functionality), interoperability of Provider Backbone Bridging frames and configuration fault management (per IEEE 802.1ah and IEEE 802.1ag), and the demonstration of dynamic configuration of services across a multi-vendor network (in conjunction with Nortel and Soapstone) were key achievements.

Having multi-vendor interoperability and multiple suppliers will undoubtedly help enhance PBB-TE's chances in the market.

Ericsson examined the key features it believes are required in a packet transport network, concluding that connection orientation is a must in order to support traffic engineering, establish resource control, and support QoS and SLAs. After reviewing the potential roles that T-MPLS and PBB-TE can play in the next-gen transport network, it concluded that both have merit - particularly given the amount of standardization work to improve OAM. Ericsson also discussed the value of operational transparency, keeping separate instances for the control system of Packet Transport and the OTN layers separate.

Foundry cited scalability as a key requirement of Carrier Ethernet networks, citing Link Aggregation Groups as a means of addressing the gap between fast growing bandwidth requirements and the as yet unfulfilled need for 100 GE. Foundry talked about how oversubscription practices of the past have led to inflexibility in being able to cope with rising bandwidth needs. Citing the need for L3, MPLS L3 VPNs, and Carrier Ethernet to coexist in the network over the next few year, Foundry made its case for providing operators with the freedom to concurrently deliver multiple services.

Huawei argued that EoMPLS solutions have issues with VRRP (Virtual Router Redundancy Protocol) scalability and inefficient multicast, and suggested that terminating user VoIP, video on demand, and broadcast TV sessions and

distributing ARP/VRRP processing at the L3 aggregation edge, while using PIM-SM/SSM for multicast efficiency, was the right solution. Huawei suggested that both L2 and L3 are required in the data plane and is employing PWE3 and advocating that the clock accuracy of Synchronous Ethernet and ACR meets mobile operator requirements. It has branded its metro Carrier Ethernet solution as EoMPLS+.

We do not believe that mobile operator comfort factor with existing L3 synchronization solutions is as high as Huawei suggests it should be, though that comfort factor is perhaps higher in its home region than globally at present.

Matisse suggested that Ethernet over DWDM and IP over DWDM are simply two approaches that glue together packet intelligence with circuit transport, and recommended its optical burst switching as a more purpose-built packetized optical transport solution with the kind of deterministic behavior, resilience, bandwidth efficiency, and service connection transparency service operators need.

It is good to see some startups out there innovating, and Matisse has technology differentiation going for it - but is taking on an uphill battle right now in representing critical inefficiencies in the packet aware Carrier Ethernet solutions which are gaining mindshare and proof points with a number of operators. And operators typically prefer having second suppliers for most new technologies, which will present Matisse with another challenge - though it is nice to see this kind of startup innovation still going on.

Meriton Networks provided an overview of the options for converged packet optical transport, and outlined an evolution for the NGN by 2008 and beyond that includes agile WDM, G.709, and evolution to 100G at the transmission layer, GFP/OTN and E-SWS for circuit switching; PBB-TE, T-MPLS/PW for connection-oriented packet services, and IP (MPLS-TE), 802.1 for connectionless packet traffic. Meriton stressed the need to abstract the connection between the Service Layer and transport topology as a key advantage of Carrier Ethernet and its Carrier Ethernet Transport solution.

Nokia Siemens Networks discussed how it foresees PBB-TE as an essential part of Carrier Ethernet transport. NSN cited PBB-TE's scalability, availability, reliability, hard QoS, and growing SLA monitoring capabilities as factors in its decision to support the technology.

Nortel gave a presentation on the benefits of PBB-TE, discussed how PBB-TE has progressed to support point to multipoint services, and the wide variety of service types it now supports.

Nortel's point that customers want service attributes and an SLA rather than a technology was well put and in many respects true. Enterprise customers are

buying service attributes (availability, bandwidth profile, and some level of QoS) and an SLA, not technology...but for larger enterprises, a comfort factor with the underlying technology is also an important precursor to that sale. Establishing that comfort factor is now critical for Nortel in its quest to gain market share for PBB-TE, particularly given the greater maturity of T-MPLS from a standards perspective - and has a lot to do with why Nortel is spending so much time and money on interoperability demos. And it seems to be having the desired effect.

RAD quoted projections of significant mobile data bandwidth growth, and suggested that following optimization of A-bis/A-ter backhaul links (removing silence) and cutting costs by aggregating E1/T1 ports onto STM-1/OC3 for the Base Station Controller (BSC) or Radio Network Controller (RNC), other key opportunities for cost savings included transitioning to packet-switched transport leveraging PWE3, and offloading data onto DSL access.

HSDPA offload is already seeing significant deployment in Europe this year. When it comes to synchronization, although GPS options are available, we think the majority of operators at this time will be more comfortable retaining TDM circuits to derive synchronization. Although there are only a handful of major PWE3 implementations at this time, PWE3's adaptability to dealing with the interfaces used by multiple radio technologies will eventually find strength in the market - particularly after standards-based IP clocking solutions have matured.

Transmode highlighted that the majority of IP traffic will still flow through fixed access, positioned cost effective, high speed, manageable multi-service transport is required for the second mile and noted the competitive challenges traditional operators face from new alternative providers like YouTube, Google, and Skype. Transmode concluded that service flexibility, geographic flexibility, and optical flexibility in a WDM based, L2 aware 2nd mile and metro core network - able to support triple play and wholesale GbE capacity - is what the market needs.

Service Operators

Belgacom discussed evolution to a converged infrastructure, the drivers of gaining application aware QoS and application-based SLAs, and how IPTV has caused a revolution in network design and helped fuel Ethernet demand.

BT discussed 21CN, ranging from its IP/MPLS core implementation, the physical and logical resilience measures in its network, and how it is addressing equivalence of input from other communications providers. BT indicated its 21CN Ethernet backhaul solution is based on the transport layer being independent from the traffic carried, and by simple transport layer recovery, QoS available in 4 classes, and OAM. BT indicated it will be deploying PBB-TE in

the 21CN Ethernet backhaul network, in the UK to also support non SMP products without consultation, and outside of the UK with no restrictions. BT is one of the first operators launching substantive bandwidth on demand services, and is planning deployment of PBB-TE outside the UK.

COLT highlighted the progression of Ethernet from the LAN to MAN and WAN, highlighted the migration from SDH, FR and ATM to Ethernet. COLT cited that 73% of its top 500 Enterprise customers are now buying Ethernet services, and detailed its COLT LANLink Point to Point and Hub and Spoke and COLT VPN services.

The migration from FR and ATM to Ethernet services is already well underway. The LANKLink Hub & Spoke services closely replicate the logical topology of many FR and ATM deployments in the installed base, but as a VLAN service has some scalability limitations. Point-to-point services have been an initial point of market entry for many operators - selling dedicated connectivity with deterministic performance and high security was the low hanging fruit of market opportunity for Ethernet. But the ratio of point-to-multipoint vs. point-to-point services will increase significantly over time, and the growing Enterprise comfort factor with Ethernet is enabling increasingly greater opportunity for VPN services.

eircom discussed the need for evolving SLAs from a focus on connectivity (availability, latency, and guaranteed bandwidth) to more encompassing, service centric SLAs that provide both network and IT quality guarantees, leverage Ethernet OAM standards, are based on implementation of QoS, and incorporate monitoring services. This operator indicated that strong performance reporting to back up SLAs can be a key source of differentiation in the market and a source of additional revenue. eircom also discussed the need for Ethernet demarcation devices for all access technologies - and cited end-to-end OAM similar to that of SDH/SONET and the completion of the E-NNI standard as crucial to increasing the competitiveness of Ethernet services.

eircom appealed for standardization of management and performance statistics from disparate equipment providers. SLAs have always been a bit of an insurance game for operators - but can be a key facilitator of customer assurance...particularly for operators looking to migrate customers of FR, ATM and TDM services to Ethernet services.

Level 3 discussed its significant experience in Ethernet services and use of Ethernet, and indicated that Ethernet is rapidly replacing SONET/SDH now. Level 3 conveyed that it has had a 4x increase in edge-facing 10 GE ports in its network over the past year, and indicated that its intra-node and backbone requirements would scale from 16 x 10GE today to as much as 150 x 10GE by 2010. Level 3 also stressed the importance of NNI development for Ethernet, and the need for faster failure detection.

Level 3's plea for 100GE LAG in future no doubt caught the attention of many of the vendors present, and its stress over current lack of an NNI is being felt by many operators at present. The NNI, at least, is a problem with a solution slated on the near-term horizon.

Mobilkom Austria discussed its "Idea of Y", consolidating access from 3 cell sites, multiplexing that traffic, and doubling the bandwidth for access for that multiplexed traffic - while using only one microwave hop. This solution has been helping them in rural areas where trenching for fiber is extremely costly and has less probability of quick payback. Mobilkom also discussed their deployment of an MPLS backbone based on two separate DWDM rings

Orange discussed the role of Ethernet in the mobile operator's network. Though it cited that IP transport in the UTRAN does not explicitly require Ethernet, Orange made a case for it - and concluded that PWE3 was going to be an absolutely essential part of unifying the transport requirements of multiple generations of radio technology...as ATM and TDM interfaces on R99 UMTS equipment and GSM base stations will remain in the network for years, and legacy base stations will not be upgraded to IP transport.

Orange Business Services cited its success in providing L3 VPN services for quite some time, and stated that one of the things it would like to see vendors do is provide stronger solutions to facilitate innovative delivery and billing of bandwidth on demand services.

Telecom Italia is one Tier 1 operator with fixed and mobile operations that has taken aggressive steps toward fixed/mobile convergence. TI discussed the evolution of MPLS from a technology orientation to an application orientation, and how PWE3 can help support the mix of protocols required to achieve fixed/mobile convergence. TI detailed how it has been replacing ATM/SDH with Ethernet /WDM in its new Optical Packet Metro network, providing UMTS backhauling with ATM over Ethernet transport by MPLS and Pseudowire - mapping ATM over NxE1 onto PLS/Ethernet with pseudowire using an access gateway, and collocating backbone gateways with the RNC.

Though TI did not mention it in the slides, when it comes to synchronization, they are continuing to leverage TDM clocking for now...which seems to be the predominant trend in the short-term for more established operators, particularly in EMEA and North America. Synchronization over L3 will come...but for most, not quite yet.

TeraGate described its TERAGATE INTELLIGENTETHERENT solution leveraging VPLS, its corporate network services, storage network services, and the TERAWEB customer portal and management tool for corporate WANs.

thus discussed its extensive U.K. network, which now has over 190 Ethernet enabled POPs, its City Ethernet and National Ethernet services, and how it has responded to customer bandwidth, geography, and access resilience requirements with a portfolio of Ethernet services delivered using EoFibre, EoDWDM, EoLL, and EoWireless. This operator also discussed upgrades to customer network management tools to include last mile status, alarm data, and QoS reporting.

Uecomm, the first Australian carrier to join the MEF in August, 2007, today offers a diverse range of data services including Ethernet VLAN at speeds of 1Mbps to 1Gbps, Ethernet Access services in particular Ethernet over Fibre, over E1, SHDSL and ADSL, managed data services, Voice over IP, IP Telephony, dark fibre and Uecomm Metrowave WDM, a point-to-point managed WDM service targeting SANs, business continuity and disaster back-up.

Yipes discussed any-to-any connectivity requirements, the security of L2 services, Capex/Opex advantages relative to L3 VPNs, and ease of site management as key drivers for VPLS services – citing growing need for support of latency sensitive applications, a migration path from hub and spoke to meshed topologies, and support for bandwidth on demand as key drivers for VPLS. At the same time, Yipes indicated a number of challenges for VPLS including scalability, multi-vendor interoperability, and SLA management across VPLS routes and across the NNI demarcation point. Included on Yipes' wish list as an operator was an auto-discovery standard for H-VPLS.

Other

The presentation by the **Sandwich Technology School**, in which Richard Wallis gave some insight into the way that the next generation will engage in collaborative communications in learning, and beyond into their work life, lent strong credibility to the need for significant scalability for 100G OTN and 100 GE being not too far distant.

The **Metro Ethernet Forum** discussed the applications drivers for Ethernet business services, citing the need for reduced latency, bandwidth on demand, and higher capacity services...and detailing the role that Ethernet can play in server and data center consolidation. Predicting a bright future for Ethernet as an enabler of IT applications and bandwidth, the MEF cited automated inter-carrier Ethernet connectivity as one of the challenges that must be overcome for that dream to be fully realized.