

SUPERDEMO 2003

INTEROPERABLE METRO ETHERNET SERVICES

Metro Ethernet ... At Your Service!

A METRO ETHERNET FORUM WHITE PAPER

June 2003

On Demonstration

at SuperComm 2003 in Atlanta, GA

Hall C, booth 10115

Tuesday June 3rd to Thursday June 5th

What is SuperDemo 2003?

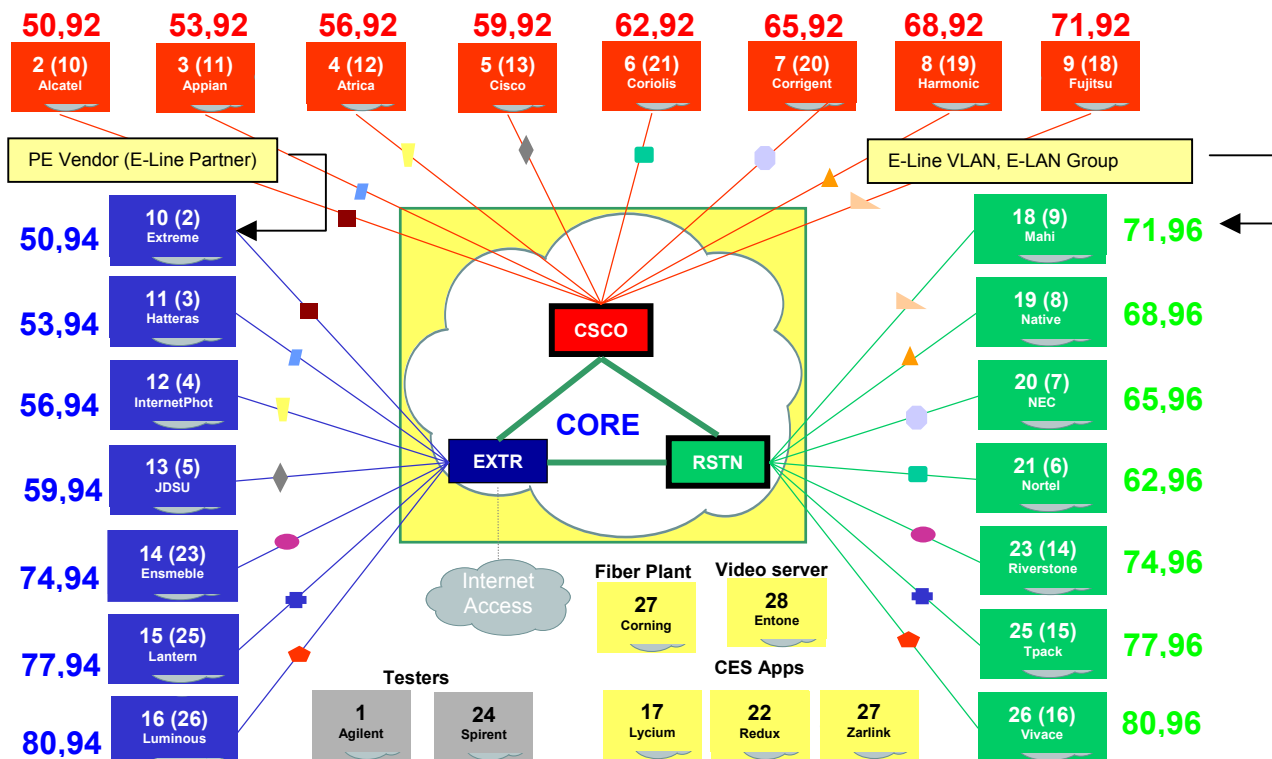
Sponsored by the Metro Ethernet Forum (MEF), SuperDemo 2003 is the largest, and also the most comprehensive services interoperability demonstration of Metro Ethernet Services to date. Equipment from no fewer than 28 member companies of the MEF was used to build an end-to-end metro Ethernet network to fully support the Ethernet E-Line and E-LAN services defined by the MEF.

The MEF's SuperDemo 2003 network provides fully meshed high-speed connectivity through a 10GigE Ethernet core interconnecting 22 Ethernet aggregation and as many Ethernet access switches to a variety of hosts running applications ranging from webcam enabled instant messaging to IP telephony and video streaming over Ethernet point-to-point and point-to-multipoint services.

The unprecedented scale and technical success of SuperDemo 2003 provides tangible proof to service providers that:

1. Metro Ethernet services can successfully extend packet delivery from the LAN to the provider networks' access, aggregation and core layers;
2. Metro E-Line and E-LAN services defined by the MEF are carrier-grade service options that provide seamless end-to-end connectivity to hosts running both point-to-point and multipoint-to-multipoint applications;
3. Metro Ethernet products from multiple vendors can interoperate at all layers of the provider network.

The SuperDemo 2003 Infrastructure



The Participants

The MEF's SuperDemo 2003 network is built around a fully meshed 802.1Q Ethernet switched 10GigE core. The twenty-two vendors supplying aggregation devices are Alcatel, Appian Communications, Atrica, Cisco Systems, Coriolis Networks, Corrigent Systems, Ensemble, Extreme Networks, Fujitsu, Harmonics, Hatteras Networks, Internet Photonics, JDS Uniphase, Lantern Communications, Luminous Networks, Mahi Networks, Native, NEC, Nortel Networks, Riverstone Networks, Tpack, Vivace.

Three vendors, Lycium Networks, Redux Communications and Zarlink supplied Circuit Emulation Services and Agilent and Spirent Communications testers for the network. Corning Optical Fiber supplied all of the optical fiber and fiber patch panel while Entone supplied a video server. Robert Mandeville, President of Iometrix, was named facilitator of SuperComm 2003 and co-ordinated both the 5 day hot staging of the demo at facilities provided by Extreme Networks in Santa Clara, CA as well as the SuperComm event itself.

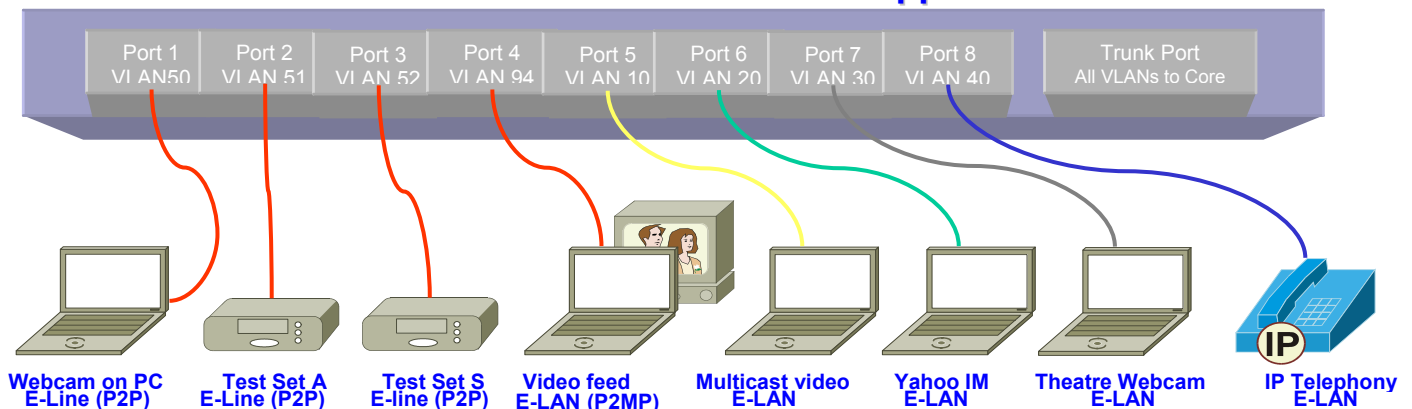
The Interoperability Program

In order to demonstrate the interoperability of Ethernet services participants establish:

1. Three mandatory point-to-point E-Line services support webcam-enabled Netmeeting sessions as well as two test sets. Each service is configured between two partnering vendors. They are eleven such pairs on the network.
2. One mandatory E-LAN service supports an MPEG video stream broadcast to each one of three groups seven or eight vendors.
3. Vendors also have the option of establishing global E-LAN services to support four applications: global video streaming, Yahoo Instant Messaging, theatre webcam and IP telephony.
4. In addition the Circuit Emulation Services vendors establish end-to-end connections through the core to demonstrate their ability to transport various types of TDM traffic over Ethernet.
5. Additional services and applications, described in the participant contributions section below, are established on a voluntary basis and can be viewed at SUPERCOMM 2003.
6. Service Level Agreements (SLAs) specifying Committed Information Rate (CIR) and Peak Information Rate (PIR) bandwidth profiles for each application, are applied to the E-Line and E-LAN services.

The Metro Ethernet Forum is demonstrating the fully interoperable SuperDemo 2003 network supporting this complete set of mandatory, optional and additional E-Line and E-LAN services and applications at SuperComm 2003 in Atlanta, GA from June 3rd to 5th. The 28 participating members of the MEF welcome the opportunity to show service providers and end users the state of the art in Metro Ethernet services.

The End-to-End Service Applications



Participant Contributions

Agilent

The Agilent testing participation was realized via the RouterTester 900 product line. This particular demo configuration comprised a chassis containing two high-port-density 10/100 Ethernet cards and the RouterTester 900 application running on a laptop PC. Other RouterTester 900 interfaces (GbE and 10GbE) were also made available during the setup and debug process.

The test vendor participation had two prime objectives:

- 1) Assist and debug the Metro Ethernet switch vendors through traffic generation and capture tools
- 2) Verify SLA parameters on the demo network as follows:
 - a) Provide background traffic to load the E-line services to facilitate the demonstration of the MEF-defined bandwidth shaping/policing profiles implemented on vendor devices
 - b) Validate that service privacy between different 'customers' across an E-Line service is maintained
 - c) Confirm service integrity such that no traffic is lost during normal service conditions
 - d) Measure loss, latency and jitter performance

Alcatel

Alcatel's new generation OmniSwitches are powerful, intelligent multi-layer switches that provide the industry benchmark for network performance and availability. OmniSwitches deliver carrier class features and functionality to provide high availability, intelligent switching and routing services, MPLS, and multi-layer security — all at wire speed.

The OmniSwitch portfolio is comprised of several platforms optimized for specific capacities and form factors including OmniSwitch 8800, 7800, 7700, 6648 and 6624. The OmniSwitch 7700 (CE) and 7800 (PE) are participating in the MEF Interoperability showcase. Connectivity between the PE and CE is achieved with 802.1q and multimode GigE link and the PE is connected to a Cisco core switch via an 802.1q and single mode GigE link. Several point-to-point or multi-point sessions support applications across separate customer VLANs, with the applied QoS, to other vendor CEs.

A unique feature of the OmniSwitch family is smart continuous switching (SCS), which provides continuous operation in the event of a failure. With SCS, all source learning, spanning tree functions and established routes are distributed throughout the network interface modules instead of a central engine. In the event of a management/fabric module failure, the system automatically switches over to hot standby with no loss of connections or fabric capacity. In addition, Alcatel's OmniSwitch series is capable of creating new connections during this failover — an industry first.

Appian Communications

Appian Communications has provided a two node Ethernet-over-SONET aggregation network that is grooming E-Line and E-LAN services through the Ethernet switching core to multi-vendor service endpoints elsewhere in the network.

The Appian Optical Services Activation Platform (OSAP) 4800 and OSAP 1600 platforms are interconnected through a protected SONET ring that is also running Appian's resilient packet ring implementation.

The OSAP 1600 provides a number of Fast Ethernet connections to video conferencing, streaming video, IP telephony and Internet Access equipment as it demonstrates end-to-end E-Line and E-LAN services. The OSAP 4800 is also on the SONET ring and provides a Gigabit Ethernet connection into the network core.

The OSAP 4800 and 1600 platforms are based on a hybrid packet/TDM architecture that supports native TDM and next generation Ethernet services that are scalable, efficient and resilient. The solution optimizes a carrier's existing investments as it aggregates and grooms services to a standard SONET/SDH and/or IP services network. The OSAPs standards-based service interworking also enables Ethernet access to established frame relay, ATM and IP service networks.

Atrica

Atrica Inc., a leader in the metro Ethernet vision, technology and market, designs and manufactures Optical Ethernet Systems that enable service providers to deliver profitable Ethernet-based services and transport worldwide. As a founding member of the MEF, Atrica fully supports MEF's activities and today demonstrates its commitment by providing the E-Line and E-LAN services defined by the MEF.

Atrica's demonstration will feature end-to-end SLAs for E-Line and E-LAN services, sub-50 millisecond network resiliency, TDM over Ethernet through Circuit Emulation Services (CES), and ASPEN, a point-n-click provisioning and OAM network management. In addition, the demonstration will feature Customer Network Management (CNM) that enables end-customers to monitor and manage their own services on demand.

We work with MetNet Communications, a new Ethernet service provider, to demonstrate bandwidth on demand. Atrica's family of products on display includes the A-2100, A-8000 and ASPEN.

Cisco Systems

Cisco Systems is the only complete Metro Ethernet vendor. At the MEF demo Cisco offers the MEF E-Line and E-LAN services. Cisco's Metro Ethernet solution involves *Ethernet First Mile (EFM) Transport* at Layer 1, *Ethernet* at Layer2, *Service Delivery* at Layer 2/3+ and end-to-end *Management and Provisioning*. At the Metro Ethernet Forum demo, Cisco leads the way in supporting multiple Transport architectures including SONET, CWDM, Wireless and EFM.

Cisco also adds to the demo by providing a Switch/Router in the demo's core, numerous edge switches/routers attaching to global applications as well as IP telephones and call managers functioning at booth at the demo.

The devices in this network include the OSR 7600 switch/router, Catalyst 6500 switch/router, Catalyst 4500 switch/router, Catalyst 3550 switch/router, ONS 15454 a Multi-service SONET/Ethernet/DWDM/RPR NE, the ONT 1031 a Hardened Ethernet-Optical CPE repeater, a CWDM-

Mux, the Aironet 360 wireless access point and Cisco 7960 IP telephones. Although, at the MEF's request, the core of the network is 802.1Q Ethernet switched, Cisco offers a full variety of service delivery protocols including MPLS-VPN, VPLS, Anything over MPLS via Martini tunnels (AToM), VLAN tag stacking, Ethernet to Frame/Relay and ATM L2 interworking and L1 transport. Only Cisco allows the customer this degree of flexibility at every layer of the network, because Cisco realizes networks are not one size fits all and that all protocols do not scale and perform equally.

Coriolis Networks

Coriolis Networks is demonstrating the versatility of using an SONET/SDH OC-48/STM-16 ring-based aggregation network with the OptiFlow™ family of next-generation multiservice provisioning platforms (MSPP) to support the interoperability of MEF E-Line and E-LAN services. In the MEF Superdemo, the two OptiFlow 1015 service units, typically placed in an MTU environment, support tiered and fixed-rate Ethernet L2 over SONET/SDH services by aggregating all the pt-pt and pt-multipoint VLANs from the Riverstone ES 500 CE switch via a gigabit Ethernet connection. Ethernet services are transported across an OC-48 metro access ring to an OptiFlow 3000 hub node that simulates a carrier POP site. A gigabit Ethernet port connects the aggregation network to the Cisco Ethernet switch in the MEF core. All the MEF Ethernet-based applications (IP telephony, web cam, video feed, theatre cam, IM) are configured with specific CIR and PIR bandwidth profiles that are provisioned and maintained across the OptiFlow aggregation network and across the entire MEF demonstration network. Additional bandwidth, VLANs, or circuits can be easily configured using the Coriolis OptiView EMS. The E-Line and E-LAN applications can be combined with additional Ethernet VLANs configured with 802.1p or CoS to support SAN over Ethernet transport applications. In addition to supporting the MEF Ethernet services demonstration, this OptiFlow aggregation network supports native DS-n and OC-n private line TDM services.

Corning Optical Fiber

Corning Optical Fiber and Corning Cable Systems provide industry-leading infrastructure for optical networks worldwide. Corning offers tip-to-tip solutions, encompassing hardware, connectorization, and cables. The Metro Ethernet Forum interoperability demonstration runs over a Corning SMF-28* optical fiber backbone, with connectivity and cable management provided by Corning Cable Systems' LANscape* Solutions hardware. Through industry leading optical fiber specifications and innovative hardware solutions, Corning allows limitless flexibility and unsurpassed capability in optical networks both large and small.

Corrigent Systems

Corrigent Systems leads a new class of metro-optical transport products with its CM-100, a packet-ADM that fuses together SONET/SDH technologies such as Virtual Concatenation, GFP, and LCAS, with packet technologies such as RPR, Ethernet and MPLS to evolve today's SONET/SDH-based transport infrastructure to the next generation packet-based transport network, in both a standards-based and interoperable manner. As part of the MEF Superdemo,

Corrigent is demonstrating its packet ADM based network architecture, used to deliver interoperable E-Line and E-LAN services end-to-end.

Ensemble

Ensemble's Fiberless system enables metro-Ethernet service providers to extend their service footprint to off-net buildings quickly and cost effectively. Connecting the Fiberless 16200 hub station's Gigabit Ethernet interface to the network, Ethernet services (VoIP, streaming video, Internet access, VPN) are carried via microwave to buildings within a 2-5 mile radius of the fiber MAN. The point-to-multipoint architecture enables bandwidth sharing over the air link, minimizing equipment and spectrum requirements, while maintaining quality of service demanded by business grade applications.

In this demonstration the Fiberless hub station is configured with both point-to-multipoint and point-to-point links. Connected to the core MAN via gigabit Ethernet, the hub station directs various applications' VLANs over air links operating in the 31 GHz LMDS band. The system supports various licensed frequencies between 10 and 45 GHz. In this demonstration VLANs carrying real-time sensitive traffic are provisioned with minimum guaranteed rates to ensure QoS. Each Fiberless 320 terminal multiplexer, supports up to twelve 10/100BT ports and can be configured for transparent VLAN, port-based tagging, or pre-tagged frames. In addition to Ethernet services, the Fiberless system supports legacy TDM services by providing a 4-port T1 card for the Fiberless 320 and DS-3 ports on the hub station.

Entone

(Non-MEF member participant)

Entone's StreamLiner carrier grade video server provides advanced streaming functions and unparalleled performance using industry standard hardware and Entone's optimized streaming software. The model 2250 featured at SUPERCOMM features dual Gigabit Ethernet interfaces, up to 880MB of integrated content storage and the capacity to stream more than 500 streams of MPEG video in a compact, 2U enclosure. The StreamLiner natively support 802.1q VLANs (up to 64) and is able to stream both point-to-point and IP multicast data via VLAN. StreamLiner exemplifies the next generation of "distributable" videos server with enable service operators to cache video content strategically with their networks to provide the optimal balance of cost, operational efficiency and interactivity to customers.

Extreme Networks

The Extreme Networks MEF SuperDEMO demonstration will consist of an Extreme Black Diamond Core Ethernet Switching Platform with 2 10GbE Ethernet cards being used to create the SuperDEMO core Metro Ethernet Network along with Riverstone and Cisco. The physical connections to the Extreme Provider Edge (PE) aggregation network to the core uses 2-8 port gig modules with LX gbics combined with a single SMF and a 48 port 10/100 module. The uplinks from the PE aggregation network will be configured with Rapid Spanning Tree Protocol (.1d) for resiliency and fast failover. There are a total of 48 (simulated) Provider VLANs coming into the Extreme core switch, and being switched across the core. We also provided wired and wireless Internet access for the E-Line service that will be used to provide connectivity for Instant Messenger clients in each vendor's booth. The Extreme PE aggregation network consisted of 1 summit1i and 1 summit 5 as connecting to a Customer Edge (CE) switch. The CE switch is an Extreme Alpine 3804 Service Provisioning Ethernet Switching Platform configured with a 4 port MTRJ blade (MMF), 2 - 32 port 10/100 modules and 1-4 port gbic blade. The CE switch will provide point to point connectivity to Alcatel for the demonstration of the E-Line service with a digi camera being used to demonstrate connectivity end to end. The CE switch will also connect the Extreme attached stations to

the E-LAN service running among multiple vendors in a multi-point configuration

Fujitsu

Fujitsu is showcasing three products in the MEF SUPERDemo at SUPERCOMM 2003 and each product provides a unique, value-added set of features that together result in a complete Ethernet solution.

The GeoStream® A500 Ethernet PON series enables service providers to build extremely cost-effective FTTx access network solutions.

The FLASHWAVE® 5500 Ethernet Switch series provides Layer 2 transport through the WAN for scalable Transparent LAN services across a single IP/MPLS infrastructure.

The carrier-class GeoStream R900 Multiservice Edge Router series supports a wide variety of Layer 2 and Layer 3 services, including VPLS, Broadband RAS and VoIP, to allow carriers to enter new markets and easily expand service offerings.

For the demo, the GeoStream A550 EPON system is the Customer Edge (CE) device where it attaches the appropriate VLAN tag to incoming signals and aggregates traffic into a single Gigabit Ethernet connection. The FLASHWAVE 5540 Ethernet switch is the Provider Edge (PE) device to provide aggregation and policing on a VLAN basis. VPLS is demonstrated using the GeoStream R920 router platform to show how E-Line and E-LAN can be carried on a routed network. The resulting network demonstrates a QoS-aware Ethernet transport system across a managed IP network.

Harmonic

Harmonic is demonstrating CURBswitch™, the *only* environmentally hardened and fully-managed Gigabit Ethernet switch in the MEF Interoperability Superdemo. The CURBswitch is industry's first optical Layer 2 switch that can be installed in the outside plant, allowing a single fiber pair to deliver high-speed data, voice and video to multiple customers. Each CURBswitch contains one upstream card with two 1-Gigabit ports and up to six hot-swappable 4-port Fast Ethernet downstream plug-in cards.

Because it can be deployed virtually anywhere-on strands or poles, in a street cabinet or even underground-it enables operators to overcome right-of-way and other time-to-market constraints that have limited the introduction of high-speed Ethernet-based services. CURBswitch makes Ethernet deployments much easier and more cost-effective with significant savings in fiber, real-estate and air-conditioning.

The CURBswitch is managed and monitored using Harmonic's LightView™ Element Management System, an intuitive graphical tool. LightView supports multiple, simultaneous remote clients, user management and access control, and a centralized SQL database.

In addition, Harmonic is showing the NIU9001 managed media converter, a cost-effective device for converting between single-mode fiber and Cat-5. This addressable media converter, which demarcates the provider edge and CPE, supports SNMP, telnet, a serial console and browser-based management.

Hatteras Networks

Hatteras Networks, is the only company in the MEF's Services Interoperability Demonstration showcasing E-Line and E-LAN service options over last-mile copper and fiber. Hatteras Networks is demonstrating a solution that enables telecommunications carriers to create new revenue opportunities while reducing operational and capital costs with high-performance Ethernet services. Hatteras Networks' Access Class Ethernet™ solution provides a robust suite of enhanced Ethernet data services for business subscribers that can be used by carriers to generate new business from existing customers, win new customers, and even win back lost T1 customers with more desirable product offering rather than just dropping their prices.

Hatteras Networks' platform enables carriers to seamlessly extend highly profitable Ethernet Transparent LAN services to customers that are served with copper and/or fiber. The Ethernet architecture enables carriers to leverage the simplicity and manageability of Ethernet to reduce the ongoing operational costs of delivering carrier-grade data services to business customers. With Hatteras Networks equipment, carriers can layer multiple services across a single physical connection, delivering carrier-grade service level agreements on a per-service and per-port basis. These layered services can be used to create additional revenue opportunities without additional capital costs. The Hatteras platform operates in central offices, controlled environmental vaults, and remote terminals, allowing carriers to deliver Ethernet to all business buildings on their copper and fiber infrastructure.

Internet Photonics

Internet Photonics is showing the LightStack GSLAM and LightStack MXA in the MEF Superdemo as optical transport options for E-LINE and E-LAN services. The LightStack GSLAM is a scalable, purpose-built multiservice platform that integrates ADM functionality, transport aggregation, and cross-connect functions for services based on both CWDM and DWDM. The LightStack MXA is a CWDM-based multi-services optical access platform that provides a managed demarcation point between the service provider or cable operator's network and the customer. Besides aggregation and add drop functionality, the LightStack MXA adds enhanced performance monitoring, fault detection and localization, single-ended remote management, local/remote loop-back control, and <50 microsecond protection switching.

Together, these solutions allow network operators to deliver a whole host of services such as wholesale bandwidth services, managed private Ethernet services for retail/enterprise customers, or on-demand services. Internet Photonics products employ two unique features to deliver these services with the highest reliability and lowest network impact and cost. These two features are SONET Wraparound(tm) and Virtual Wire(tm). SONET Wraparound allows operators to open additional capacity on their existing fiber infrastructure that is running legacy services over SONET/SDH. This approach creates essentially free additional bandwidth for new Ethernet service deployment. Virtual Wire is a patented technology, which allows for the simple, but contention free bit multiplexing of Ethernet or storage data onto one or more wavelengths of light. The end result is transit delay (latency) of only three micro seconds and zero delay variation (jitter) - for up to 100% line utilization. For network operators, this means any application can be transmitted with the highest service quality automatically.

JDS Uniphase

The JDS Uniphase Supercomm demo is illustrating the fiber access options for E-Line and E-LAN services interconnecting the CE and PE devices.

Three different access options are shown demonstrating CWDM and DWDM in protected and unprotected configurations over a single fiber using 1310nm and 1550nm wavelengths. Long reach optics are used over a simulated fiber loop with 30dBm link budget. The CWDM option uses WaveReady 2000 and 3500 modules in CPE and CO configurations. The DWDM option uses WaveReady 3500 modules interconnected by simulated fiber loops

The CE device is connected via 1000Base SX interfaces to the WaveReady 2000/GBX-1280 carrying E-line services and to the WS413 DWDM transponder carrying E-LAN services. In the CO the WaveReady 3500 provides the connectivity to the PE via an 1000Base SX or 1550nm optics for both services. Optical protection switches which mount into the WaveReady 3500 or 3100 are used to switch in the event of a fiber break in under 10 milliseconds.

Lantern Communications

Lantern Communications, a Sunnyvale, CA based Metro Ethernet vendor, demonstrated a 10Gb Ethernet Resilient Packet Ring using the MPS-FX series product. MEF E-LINE and E-LAN services were demonstrated over RPR (the product was running a pre-standard version of IEEE 802.17 as the transport). Lantern successfully participated in all optional and mandatory service demonstrations.

Lantern demonstrated both a PE and a CE device in one chassis - one node in the RPR ring provided 16 10/100 Ethernet ports conforming to pre-standard version of the MEF UNI 1.0. Another node in the ring provided 1GB Ethernet PE ports as an uplink to the Ethernet Core. All Ethernet flows were transported over 10GBE RPR.

Services were successfully demonstrated with strict policing to the traffic parameters specified. Multiport Virtual Bridges were set up to transport the E-LAN traffic and two-port Virtual Bridges were set up to transport the E-LINE traffic.

Luminous Networks

Luminous Networks is a leader in providing the industry's first carrier-class multi-service pack transport platform for toll-quality, voice, data, video and wavelength services. Luminous will be exhibiting a three-node RPR ring comprised of the Luminous PacketWave C-Series carrier class platform.

The PacketWave C-Series provides full support for circuit TDM services, while delivering a range of new differentiated packet data services. The C-Series will be delivering [IP Phone](#) and [Internet access \(Yahoo! Instant Messenger\)](#) services over [the same VLAN](#). The demo will show [interoperability](#) with products from [Agilent and Spirent](#). The C-Series will also deliver [streaming video](#) and [Web cam video](#) services.

Luminous will be showcasing ELINE ([Agilent, Spirent and Web Cam](#)) and ELAN services (Yahoo Instant Messenger, [steaming video and IP Phone](#)). [Vivace Networks](#), Luminous' partner in the demo, [is connected to Riverstone Networks in the Core](#). Luminous is connected to [Extreme Networks in the Core](#).

Lycium Networks

Circuit Emulation technology provides carriers and customers alike the opportunity to turn Metro Ethernet Network into a multi-service network, providing E-Line and E-LAN services together with circuit delivery.

Lycium Networks is a leader in the emerging market of circuit emulation over packet (CEP). The company is pioneering System-on-Chip solutions for the seamless convergence of legacy services with existing and next-generation packet networks. Using Lycium CEP technology, T1 and T3 delivery as well as T1 to OC-N aggregation and OC-N Add-Drop-Multiplexing applications can be deployed across the MEN.

Lycium Networks demonstrated a SONET OC-3 Add-Drop-Multiplexing application at the MEF SuperDemo Atlanta. Lycium Tropic-1000 multi-service Ethernet Switches are used for the demonstration. Three Tropic-1000 boxes are connected to the MEN core switches in 1 G-Ethernet Links. The first Tropic is connected to Riverstone's switch, the second to Cisco's switch and the third to Extreme's switch.

A SONET Tester is connected to the third Tropic switch through an OC-3 link running STS-3 signal. A loopback is attached to the OC-3 interfaces of the second and third Tropic switches.

The third Tropic switch extracts the first STS-1 signal and sends it across the MEN to the first Tropic. The second STS-1 signal is sent to the second Tropic. The incoming STS-1 signals received across the MEN are sent by the first and second Tropics back to the third. The SONET tester verifies the correct operation of the SONET OC-3 ADM application.

The three Tropic-1000 boxes are not synchronized to a common reference clock, demonstrating adaptive clock recovery techniques crucial for the deployment of circuit emulation over asynchronous MEN.

Mahi Networks

Mahi Networks is participating in the MEF-sponsored Superdemo to showcase the Metro Ethernet Transport (MET™) application capabilities of the Mi7 Metro Core Aggregation System in a multi-vendor networking environment.

The Mi7 delivers the capabilities of a highly scalable digital STS cross-connect, interoperable multi-vendor SONET ring aggregation, and MEF-compliant Ethernet service delivery combined with an intelligent G-MPLS based control plane. Service level agreements (SLAs) are enforced as they transit the Mi7's Gigabit Ethernet and SONET (OC-3 to OC-192) interfaces.

The MET application suite enables the deployment of low-cost, user-transparent Ethernet services on existing SONET and evolving metropolitan infrastructures. The Mi7 is available today for deployment in service provider networks.

Native Networks

At the MEF Hot-stage Native Networks demonstrated a single-vendor Metro Ethernet aggregation network, including L2PE functionality. This was Transporting & aggregating Ethernet traffic using Native Networks *MPLS* Packet Ring using an Ethernet-over-MPLS-over-SDH/SONET approach. The aggregation Network consisted of three (3) EMX3500 nodes in a ring configuration running at 2.5 Gb/s (STM16/OC48), a GbE Uplink to the core network and a HP Procurve switch acting as the CE device. The Network was then set-up to provide both MEF Compliant E-LINE and E-LAN Metro Ethernet services across the core network to other vendors.

The CE access device collects application traffic (Video Client, web cam etc.) and connects to the EMX ring aggregation node over a FE interface, which applies the appropriate VLAN tag. This port uses a forced bandwidth policy (or bandwidth profile) for each VLAN according to MEF service definitions. Traffic is then transported and aggregated over the Ring (simulating a Metro Ring), using the QoS/SLA policy, and at the exit node it is aggregated onto a GbE interface and presented to the core network with each traffic flow again being delineated by a VLAN tag. Conversely VLAN tagged traffic from the Core network is delivered to the destination CE port using a bandwidth profile and the VLAN tagged on exit from the CE device.

NEC

NEC's demonstration is centered around the BlueFire CX2510 Optical Ethernet Distribution System, a solution suitable for both ISP and enterprise applications. The BlueFire CX2510 is an Ethernet switch with 24 single-strand fiber 100 Mbps ports for supporting end users. The 100 Mbps fiber strands terminate at the user premises into a BlueFire CX2100 Media Converter, a device much like a cable modem that converts the optical signals into copper for distribution across the end user's LAN. Each 100 Mbps connection transmits full duplex through the single strand. With a reach of up to 15 kilometers, the CX2510 system offers an ideal way for organizations and enterprises to provide end users at campus or metro branch offices a "local" LAN appearance without requiring routers or other WAN transport devices. With two Gigabit Ethernet GBIC slots, the CX2510 system is connected to the core through NEC's BlueFire 740 Ethernet Switch which is non-blocking with a 48 Gbps fabric (full duplex, bi-directional = 96 Gbps).

CX2510 Optical Ethernet Distribution System Overview

- Campus/Metro LAN Extension
- Fiber To The X (FTTX—Home, Business, etc.)
- ISP or Enterprise Applications
- Integrated Data, Voice & Video
- Link Aggregation
- 24 100 Mbps Fiber Ports
- Up to 15 Kilometer Range
- 2 GBIC Slots for Up-Link
- Multiple VLAN Support
- QoS for Convergence

Nortel Networks

Nortel Networks is once again leading the way in showcasing a full compliment of both Ethernet Line and LAN services at Supercomm. Inter-working with 27 other vendors, Nortel Networks is showcasing live carrier grade Metro Ethernet services on its proven platform of Passport 8600 routing switch and the OPTera Metro 1000 Ethernet Service Modules. Demonstrating both point-to-point and any-to-any services, Nortel Networks provides a proven and profitable solution for delivering converged voice, video and data applications such as Internet Access, broadband video or VPNs.

Defining a new class of Optical Ethernet edge device, the OPTera Metro 1000 series serves as the customer demarcation point and entry ramp onto the service provider's network. As such, the OPTera Metro 1000 series offers the industry's first reliable Ethernet user-to-network (UNI) interface, delivering cost-effective, secure and scalable separation of customer traffic.

When the OPTera Metro 1000 is combined with other Nortel Networks' products such as Passport 8600 Ethernet Switch, OPTera Metro 8000 Services Switch, OPTera Metro 3500 Multiservice Platform, or OPTera Metro 5200 Platform, service providers can offer profitable Line and LAN services over Fiber, RPR and DWDM and reduce their total costs.

Redux Communications

Redux Communications RS-160 single-chip solution is being used to demonstrate transparent tunneling of E1 traffic over an E-Line.

The RS-160 is embedded in a prototyping platform which comprises two 100BaseT Ethernet interfaces and a single E1 interface. The E1 interface is connected to a standard small enterprise telephony switch (PBX). One of the Ethernet interfaces is connected to the E-Line (a Cisco aggregation switch). The second Ethernet interface supports a data connection to a subscriber network, and in the demo is connected to a webcam/PC.

Two of the RS-160 prototyping platforms are connected to one another via the E-Line. In turn, the two E1 telephony switches are connected over the E-Line using the RS-160 prototyping platforms to tunnel the E1 through the E-Line. The webcam traffic is multiplexed together with the tunneled E1 traffic over the E-Line to demonstrate use of the E-Line for both TDM and data services simultaneously.

The Redux RS-160 part of the MEF SuperDemo demonstrates the ease, cost effectiveness and immediacy of connecting existing E1/T1 legacy equipment, such as enterprise telephony switches, via existing Metro Ethernet Networks.

Riverstone Networks

Riverstone Networks is demonstrating Metro Ethernet Services, E-Line and E-LAN, from a number of our edge devices and highlighting our 10Gb Ethernet switch in the core. The following equipment is showcased:

The XGS 9016 is a true 10GbE core switch, capable of scaling up to 1.6 Tbps of aggregate switching capacity. The XGS 9016 is providing a highly scalable and stable 10GbE core for all demonstrated edge services.

The RS 8600 is a feature-rich Provider Edge device with advanced Ethernet service-creation features such as VPLS, VLAN stacking, QoS, rate limiting, rate shaping, DoS protection, and multicast video. All of these features are available over various media including Ethernet, ATM, POS, and Channelized TDM interfaces. The RS 8600 is demonstrating E-LAN and E-Line services with fine-grained CIR and PIR and with a full set of Ethernet protocols.

The RS 3000 is a flexible Customer Edge device providing customer access to E-Line and E-LAN services and supporting multiple interfaces like ATM, POS, and Channelized TDM. The RS 3000 incorporates smart edge features like rate shaping, VPLS, VLAN stacking, and DoS protection.

The ES 500 is a cost-effective Ethernet CPE capable of supporting E-Line and E-LAN services over Ethernet.

Spirent Communications

Spirent Communications test systems will be playing a pivotal role in the demonstration. Specifically, to support of this important MEF initiative, Spirent has created a new product SmartBits "SmartMetro(tm)" product to verify, functionality, interoperability, performance and scalability of the new E-LINE (point to point) and E-LAN (multi-point to multi-point) services being defined by the Metro Ethernet Forum.

The tests include correct operation of the network in multi-vendor multi user environments, handling complex VLAN configurations, multi-rate per flow provisioning, committed and peak information tests across interface complying to the MEF UNI 1.0 draft standard. Interface support from 10Mbps to 10Gbps is provided, with testing across a of metro network topologies. The system works with other SmartBits applications to test Routing, VoIP and Web applications running across these new services.

In the demo, Spirent' SmartBits test systems are being used to generate and analyze traffic by connecting to each of the participants equipment and traversing the demo network and back to the originating system for final analysis. The new SmartBits SmarMetro products is designed to accelerate time to market and deployment of these new metro services.

Tpack

Tpack provides E-LAN and E-Line services as an integrated solution. The Tpack subnet is an SDH / SONET ring that consists of four boxes. These boxes have been configured to support 4 E-LAN and 3 E-Line services for 7 applications. Each MEF application has a unique bw profile defining the available PIR and CIR.

Each service is set up as a private virtual switch. To tap into a service, just plug into the port that belongs to the right virtual switch. Each application also has a different bandwidth profile to exemplify individual customer SLA's.

The core connection translates the VLAN tagged (VLAN ID = 10) Ethernet packets coming from the GE backbone to MPLS labeled frames (and visa versa), which are GFP encapsulated, and transmitted over the virtual concatenated group via SDH / SONET.

Tpack maps between MEF VLAN tagged packets into MPLS tunnels to statistically multiplexing Ethernet in TDM systems.

Virtual concatenation and LCAS are set up in an arbitrary group of 60 VC-12's virtual concatenated channels on each STM-1 link. This provides a payload bandwidth of 120Mbps for the data applications.

Virtual Ethernet switches in the Tpack switch are physically located in the same chip. The advanced Tpack Ethernet switch device can be configured into 1024 virtual switches with up to 16 ports per switch and unique QoS profiles for each customer.

The E-LINE services allocate different bandwidths and are configured from the Tpack subnet via the backbone to another vendor– in our case to Lantern equipment.

With Lantern, the E-Line service supports a Webcam at both ends displaying the video. The bandwidth allocation is 2Mbps PIR and 2Mbps CIR.

The tester application generates and receives Ethernet packets, which are passed over the backbone to the Tpack subnet. In this case PIR and CIR are set to 10Mbps.

All these applications illustrate how Tpack delivers Ethernet virtual circuits and virtual Ethernet switching per customer (E-line and E-LAN services) with existing SDH / SONET networks utilizing installed bandwidth to its full capacity.

Vivace Networks

Vivace Networks is Redefining the Multi-Service Edge by providing the industry's first carrier-grade platform capable of aggregating both E-LINE and E-LAN services over multiple transport types. Innovative architectures combining Ethernet Inter-Working with legacy WAN protocols are now achievable from a single platform.

The unique capabilities of the Viva Multi-Service IP switch family allows carriers to utilize cost-effective, intelligent transport concepts such as Ethernet over SONET/SDH, MPLS, VPLS, ATM, Frame Relay, 10/100, Gigabit and 10 Gigabit interfaces. Combined with revolutionary, deterministic "ATM-type" QOS for Ethernet, VLAN scaling and a variety of Inter-Working capabilities, the VISTA chipset resident on Vivace's Viva platforms allow services such as E-LINE and E-LAN to be offered simultaneously. These capabilities ensure that service providers can take advantage of Ethernet's cost advantages while retaining deployed infrastructure for WAN transport purposes where necessary as Ethernet becomes the Carrier Transport of choice.

Vivace's Viva platforms offer fully redundant hardware and software capabilities enabling service providers to offer QOS and SLA guarantees formerly only available via more expensive technologies such as ATM. This "CBR Ethernet" service enables real-time applications to be delivered over the medium of choice while retaining the desired characteristics of guaranteed delivery and predictable transport.

In short, Vivace offers the ability to combine multiple packet networks, re-focus design and deployment efforts to offer new services while continuing to Leverage, Extend, and Evolve their legacy data networks.

Zarlink

For the SuperComm SuperDemo, Zarlink is demonstrating a T-Line (TDM-line) service across a standard E-Line (Ethernet point-to-point) service over Metro Ethernet. The demonstration is achieved using the Circuit Emulation Services over Packet (CESoP) Packet Processor evaluation board. This evaluation board serves as a reference design as well as an evaluation platform for the Packet Processors. The CESoP Packet Processor is a single chip solution offering CES over Ethernet of 32 T1/E1 lines or 2 T3/E3 lines, therefore providing the inter-working function between the TDM circuit-switched network and the Ethernet packet-switched network. On the evaluation board, the TDM interface is connected to either a handset via a PCM CODEC, or an E1 tester through an LIU. The Ethernet interface port is connected to Metro Ethernet via off-the-shelf PHYs. At SuperComm, two boards are linked to Cisco and Riverstone PE equipment, respectively. Bit error free operation has been achieved between the two boards. PRBS is sent from the E1 tester, through the Packet Processor into the core of the network. The data is received from the core, passing through the second Packet Processor and back to the original E1 tester for BERT verification. Alternatively, a phone connection can be established between a handset on the first board and a handset on the second board.

Zarlink is also demonstrating a solution to TDM synchronization across an Ethernet network. This is a very challenging part of CESoP. The Packet Processor has integrated PLL, 32 DCOs and additional hardware to support clock recovery. With one board operating as the clock master and the other board operating as the slave, the lock achieved between them will be shown on a digital oscilloscope.

Main features of the Packet Processor include:

- Single chip CES solution for 32 T1/E1 lines or 2 T3/E2 lines
- Support of multiple protocols such as VLAN, IP, UDP, RTP, L2TP, MPLS, PW (Pseudo-Wire) etc.
- A sophisticated scheme, supported by both hardware and software, to deal with clock recovery from the packet network. The recovered clock is able to meet T1/E1 timing specifications
- Packetize T1/E1 or T3/E3 data directly into Ethernet frames, with high bandwidth efficiency
- On chip SRAM for buffering up to 128ms PDV