

Metro Area Ethernet

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Presentation Overview

- Metro Ethernet Summary
- Driving Factors
- Industry Groups
- Metro Ethernet Service Providers
- Technical Summary
- Implementation Examples
- City College Implementation
- Support Equipment

Metro Ethernet Summary

- Ethernet Used for Nearly All Local Area Networks
- Now Expanding to Metro Area and Wide Area Networks
- Metro is Very Similar to a Large Campus Network
- Low-Cost Equipment, Easy to Support
- Common Speeds are 1Gbps and 10Gbps
 - 10Gb Very Susceptible to Fiber Quality Variations
- Can Substitute for Expensive SONET Equipment
- Uses Fiber for >100m, Copper for <100m
 - Typically Fiber Ring with Copper Handoff
- Alternative Delivery Methods
 - WiFi/WiMAX, Free Space Optics (Lasers)

Metro Ethernet – Driving Factors

- Availability of 1Gb Ethernet – 1998
- Development of Gigabit Interface Converter (GBIC) – 1999
 - Originally Specified for Fiber Channel.
 - Now the de facto Standard for Gigabit Ethernet.
 - Currently Small Form Pluggable (SFP) Modules
- Lower Costs for Service Providers and Consumers
 - Due to Competitiveness of Ethernet Equipment Market
- Standardization of Data Format
 - LAN to MAN to LAN With No Interface Transitions

Metro Ethernet Industry Consortium

- Metro Ethernet Forum (MEF)
 - Mission: Accelerate Worldwide Adoption of Carrier-Class Ethernet Networks and Services
 - Developed Certification Programs for Equipment Makers and Service Providers
 - Currently Has Approximately 75 Members
- Related Organizations
 - Internet Engineering Task Force (IETF)
 - Institute of Electrical and Electronic Engineers (IEEE)



Accelerate Worldwide Adoption of Carrier-class Ethernet Networks and Services

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IN THE NEWS...

Carrier Ethernet Certification: The NGN Enabler

The Metro Ethernet Forum (MEF) 's mission is to accelerate worldwide adoption of carrier-class Ethernet networks and services through standardization and evangelization. The MEF Certification Program has been established to ensure global equipment and services compliance to the MEF standards for technical specifications and interoperability.



CP VIDEO

Metro Ethernet Forum Announce Winners of its Service Provider of the Year Awards

London, UK - December 7th, 2005 - COLT and FLAG Telecom Ltd are this year's winners of the Metro Ethernet Forum's (MEF's) prestigious "European Carrier Ethernet Service Provider of the Year" awards. The winners were announced at the Enterprise Networks Networking Dinner on 30th November, at the Renaissance Hotel, Heathrow.



More...

MEF Announces PCCW "Best in Business" and KVH "Outstanding Innovation" in its Asia Pacific Service Provider Awards

"Award Profile Boosted As MEF Membership Surges"

Beijing, China, October 28th, 2005: The winners of the Metro Ethernet Forum's prestigious "Asia Pacific Service Provider of the Year" awards were announced today - with Hong Kong's PCCW receiving the "Best in Business" award and the "Outstanding Innovation" award being received by KVH, Japan. The awards were presented by Nan Chen, President of the Metro Ethernet Forum (MEF) at a ceremony held at Ethernet World,

PORTALS

- End User
Service Provider

CARRIER ETHERNET NEWS



MEF Certified Equipment Vendors

- Actelis Networks
- Alcatel
- Atrica
- Cisco Systems
- Extreme Networks
- Fujitsu Network Communications
- Hatteras Networks
- Lucent Technologies
- Metrobility Optical Systems
- MRV, Nortel Networks
- Riverstone
- Siemens
- Tellabs
- T-pack
- World Wide Packets.

Metro Ethernet Service Providers

- AT&T/SBC: GigaMAN and OptiMAN Services
- BellSouth
- Comcast
- Met-Net Communications
- OnFiber Communications
- Qwest
- Time Warner Cable
- Verizon/MCI: Ethernet Private Line Service
- Yipes Communications
- Also Numerous Providers in Europe and Asia

Technical Summary

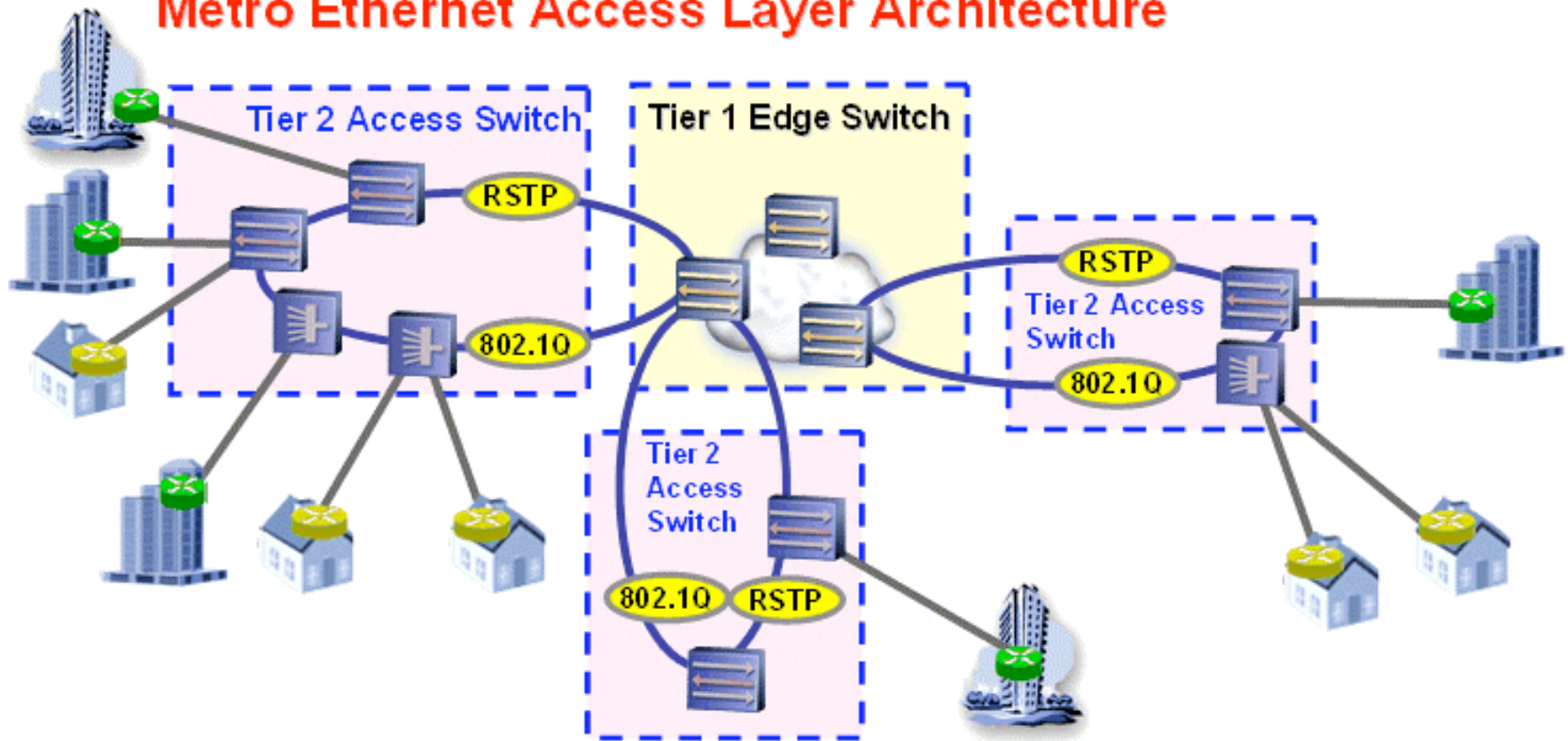
- “Carrier-Grade Ethernet” Goals
 - Maintain Same Standards as SONET/SDH Equipment:
 - Sub-50msec Recovery
 - 99.999% Availability
 - Allow for Automated Provisioning
- Gigabit Ethernet Standard – IEEE 802.3z
- 1000BASE-SX Short Wavelength (850 nm) – Up to 500m
- 1000BASE-LX Long Wavelength (1330nm) – Up to 10Km
- 1000BASE-ZX Long Wavelength (1550nm) – Up to 80Km

Technical Summary (Cont.)

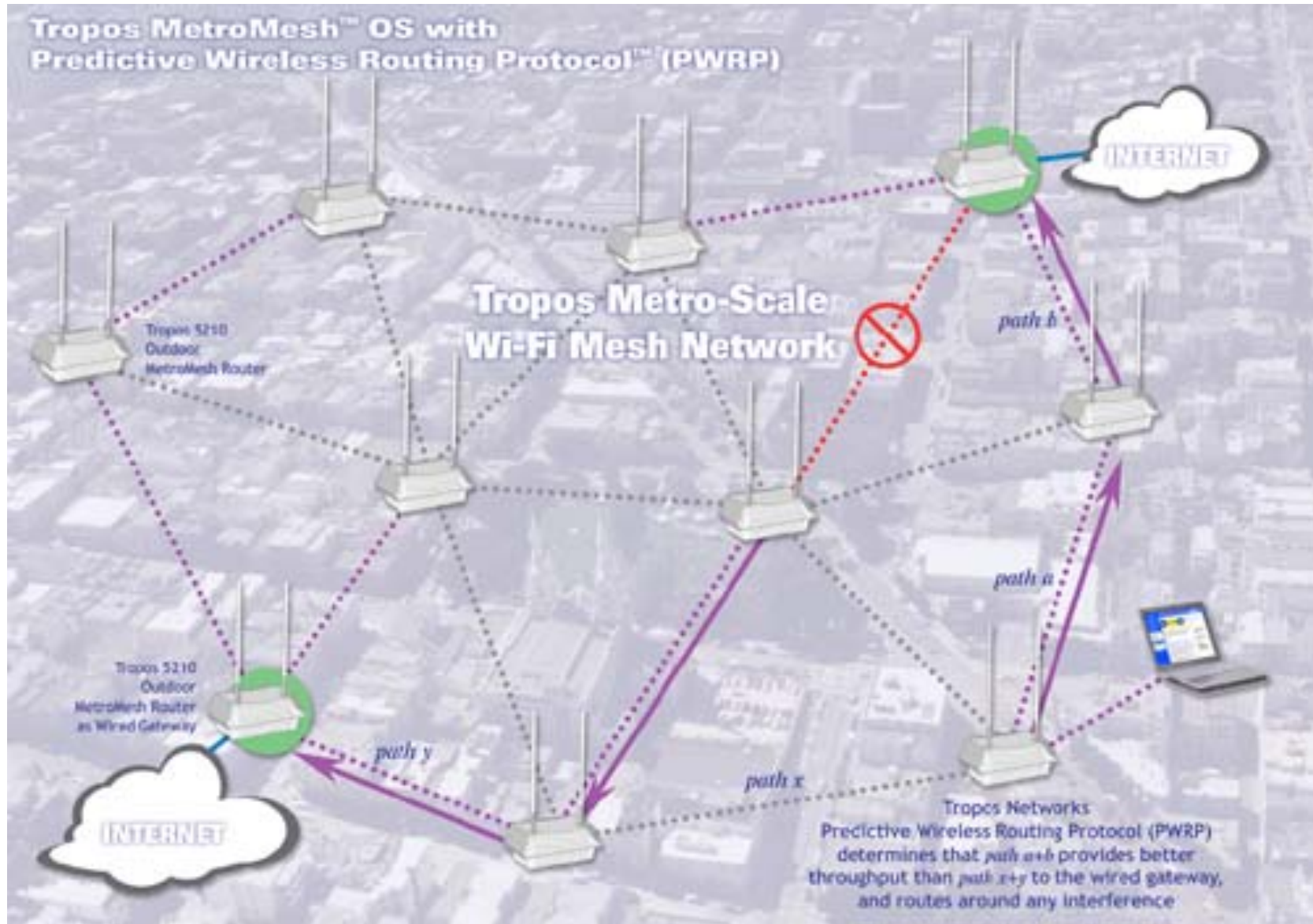
- Metro Ethernet Implementation Based on Virtual LAN Technology (VLAN)
- Traffic Segmented Using VLAN Tags (IEEE 802.1Q)
- Limitation of 4,096 VLANs per Ethernet Network
- Data Security Problematic With Ethernet CPE
- Quality of Service (QoS) Assigned on Per VLAN Basis
- Resilient Packet Ring (RPR) Used to Limit Congestion
- Redundancy Provided in Ring Architectures via Rapid Spanning Tree Protocol (RSTP)
 - Both Proprietary and Standardized (IEEE 802.1w)

Implementation Example – Service Provider

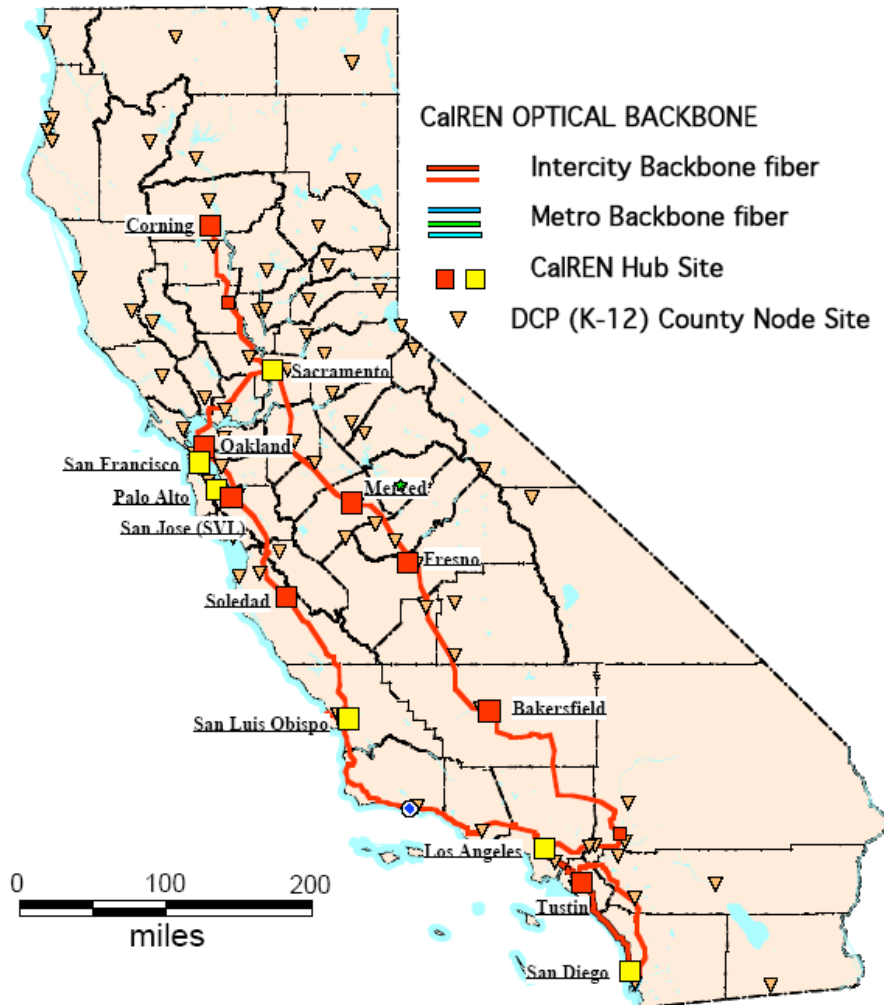
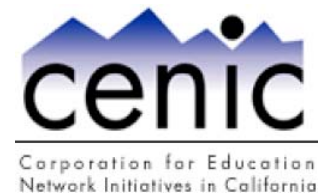
Metro Ethernet Access Layer Architecture



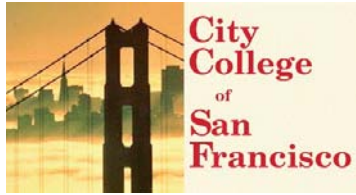
Implementation Example - Wi-Fi Mesh



Implementation Example Educational Network

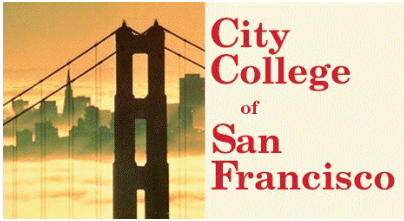


- Private fiber network
- 40 10Gbps Wavelengths
- Internet Access to All K-20 Schools
- Extend Fiber to Schools
- Buy telco access where needed
- Control access, reliability and security
- Support high performance applications
- Internet, Internet2, National LambdaRail...



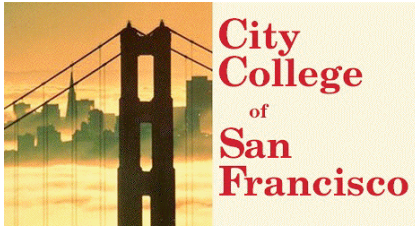
City College Metro Area Network Initiative

- Metro Area Network Goals:
 - Connect All Major Campuses With Fiber-Optic Infrastructure
 - Provide Scalability with Easily Maintained Components
 - Ensure Compatibility with Other Colleges and Universities
- Completed Feasibility Study in 2002
- Hired Optical Networking Consultant in 2003: Photisis Consulting
- Documented Existing San Francisco Commercial Fiber Plant
- Determined Municipal Partnership was a Preferred Solution
- Received Funding Approval from Board of Trustees (\$3.5M)
- Finalized Partnership Contract with City & County of San Francisco
 - Department of Telecommunications and Information Services (DTIS)
- Began Phase 1 Fiber Installation in August, 2004
- Completed Phase 1 in October, 2005
 - 8 Sites, 29.5 Mile Ring, 12 Strands



Metro Area Network Physical Fiber Path





Metro Ethernet Equipment Hewlett Packard*

**HP ProCurve Networking
Switch 5304xl**



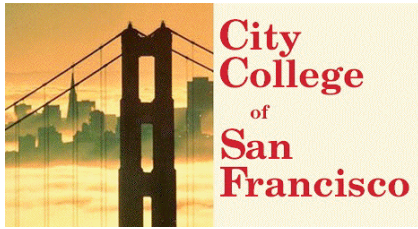
**HP ProCurve Switch xl
Mini-GBIC Module (J4878A)**



**HP ProCurve Gigabit-LX-LC
Mini-GBIC (J4859A)**



*Note: Not on MEF Certified Equipment List



Metro Network Additional Tasks

- Monitor Individual Port for Ring Continuity
 - Software Limitation Currently Prevents This
- Monitor Rapid Spanning Tree Port Status
 - Notify of Change in Forwarding/Blocking State
- Accurately Measure Re-Route Time
 - Current Estimate is 1-3 Seconds
- Determine Why Some Phone Calls Drop During Re-Route
- Utilize Fiber Infrastructure for New Services
 - SIP Trunking: Allows Reduction in PRI Circuits
 - Will Result in Ongoing Monthly Cost Savings

Support Equipment - Fiber Splicer



Support Equipment - OTDR



Support Equipment – Test Systems

