

# **MPLS Standardization Status**

**Broadband Exchange, 14 Oct. 2003**

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Chairman and President, MPLS and  
Frame Relay Alliance



# Agenda

- > **Current ongoing Multi-Protocol Label Switching-related standardization in:**
  - > **Internet Engineering Task Force (IETF)**
    - > **MPLS Working Group**
    - > **Pseudo-Wire Edge-to-Edge (PWE3) Working Group**
    - > **Layer 2 Virtual Private Networks (L2VPN) Working Group**
    - > **Layer 3 Virtual Private Networks (L3VPN) Working Group**
    - > **Common Control and Measurement Plane (ccamp) WG**
  - > **MPLS and Frame Relay Alliance**
  - > **ITU-T Study Groups 11, 13 and 17**

# Internet Engineering Task Force

- > **Last meeting: Vienna Austria, July 13-18 2003**
- > **Standardizes IP and related protocols for the Internet**
- > **Originated MPLS standardization**
- > **SubIP temporary area is in the process of winding down**
  - > **L2vpn, L3vpn, pwe3 working groups moved to the Internet Area**
  - > **mpls and ccamp working groups still in SubIP, but the intention is that they complete their existing work and then shut down**

# MPLS RFCs in 2003

- > **MPLS-related RFCs to date in 2003:**
  - > **RFC 3443, Time To Live (TTL) Processing in MPLS Networks (Proposed Standard)**
  - > **RFC 3468, The MPLS Working Group decision on MPLS signaling protocols (Informational)**
  - > **RFC 3469, Framework for MPLS-based Recovery (I)**
  - > **RFC 3471, Generalized MPLS Signaling Functional Description (PS)**
  - > **RFC 3472, GMPLS Signaling Constraint-based Routed Label Distribution Protocol (CR-LDP) Extensions (PS)**
  - > **RFC 3473, GMPLS Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions (PS)**
  - > **RFC 3474, Documentation of IANA assignments for GMPLS RSVP-TE Usage and Extensions for Automatically Switched Optical Network (ASON) (I)**
  - > **RFC 3475, Documentation of IANA assignments for GMPLS CR-LDP Extensions for ASON (I)**
  - > **RFC 3476 Documentation of IANA Assignments for Label Distribution Protocol (LDP), RSVP, and (RSVP-TE Extensions for Optical UNI Signaling (I)**
  - > **RFC 3477, Signaling Unnumbered Links in RSVP-TE (PS)**
  - > **RFC 3478, Graceful Restart Mechanism for LDP (PS)**
  - > **RFC 3479, Fault Tolerance for LDP (PS)**
  - > **RFC 3480, Signaling Unnumbered Links in CR-LDP (PS)**
  - > **RFC 3496, Protocol Extension for Support of ATM Service Class-aware MPLS Traffic Engineering (I)**
  - > **RFC 3564, Requirements for Support of Differentiated Services-aware MPLS Traffic Engineering (I)**

# MPLS Working Group

- > **Original working group for MPLS standardization, since March 1997**
- > **25 RFCs published to date, more to follow**
- > **WG is gradually in the process of completing open items and trying to shut down, but new work items keep popping up – it's hard to stop people from innovating**
- > **Current major working items:**
  - > **MPLS SNMP MIBs recently (8/22/03) submitted for final review prior to approval for publication**
  - > **MPLS point-to-multipoint traffic engineering is near acceptance as a new work item**
  - > **Work items nearing completion:**
    - > **MPLS Fast Reroute**
    - > **MPLS encapsulated over IP or over GRE**
    - > **MPLS Operations, Administration, and Maintenance requirements**
    - > **MPLS Ping and Traceroute for LSP failure detection and debugging**

# Pseudo Wire Emulation Edge to Edge (pwe3) Working Group

- > Provide services that appear as "pseudo wires" across a packet switched networks, from network edge-to-edge
  - > Focusing on MPLS and L2TPv3 as the primary tunnel technologies
  - > In scope for PWE3:
    - > Encapsulation
    - > Pseudo wire edge to edge emulation (point-to-point)
    - > Edge to edge signaling and maintenance
  - > Not in scope:
    - > Multipoint VPNs
    - > Signaling in the underlying network (and underlying transport tunnels)

# pwe3 (continued)

- > Requirements and Architecture drafts just about ready for working group last call
- > Drafts for ATM, Ethernet, Frame Relay, PPP/HDLC and SONET encapsulations are (for the most part) stable
  - > All expected to reach WG last call by October
  - > Frame Relay draft may need updating following the September ITU-T SG17 meeting
  - > ATM draft may receive minor tweaks resulting from recent ITU-T SG13 meeting
- > Signaling draft (LDP extensions) is mostly stable, WG last call expected in October
  - > End-to-end status signaling is still being discussed
- > PW MIBs are dependent on the MPLS MIBs
- > PW fragmentation draft is done, WG last call also expected in October
- > Pseudo-wire virtual circuit connection verification (PW ping) is also under way
- > PWE3 in-packet multiprotocol identification (to allow multiple protocols to share the same PW) was proposed in Vienna, but was not agreed upon

## **pwe3 (continued)**

- > Low-rate TDM (DS0, T1/E1, T3/E3) has been the major area of contention**
- > Two major approaches have been fighting it out for about two years:**
  - > CESoPSN (Vainshtein, Axerra)**
    - > Very simple raw bit encapsulation, can even be implemented in SW if performance is not an issue**
  - > TDMoIP (Anavi, RAD)**
    - > Put TDM into AAL1 or AAL2, then carry that over MPLS, can implement using standard AAL1/2 SARs**
- > The two approaches have been approaching each other for encapsulating unstructured circuits; the authors agreed in Vienna to produce a single approach for unstructured TDM**
  - > The joint approach was published on Sept. 4 (draft-vain-stein-pwe3-satop-00.txt)**
- > No agreement on structured (channelized) TDM, these will be resubmitted as two individual drafts; both may be published as experimental RFCs in order to get operational experience**

# Provider Provisioned Virtual Private Networks (ppvpn) WG

- > Working group split in two
- > Was responsible for defining and specifying solutions for supporting Layer 2 and Layer 3 provider-provisioned virtual private networks
- > As of the Vienna meeting, split into two separate working groups to better progress the work:
  - > L2VPN
  - > L3VPN

# Layer 2 Virtual Private Networks (L2vpn) WG

- > **Responsible for defining and specifying solutions for supporting Layer 2 intra-area provider-provisioned virtual private networks**
- > **Standardizing:**
  - > **Virtual Private LAN Service (VPLS): L2 service that emulates a LAN, allowing standard Ethernet devices communicate with each other as if they were connected to a common LAN segment.**
  - > **Virtual Private Wire Service (VPWS): L2 service that provides L2 point-to-point connectivity (e.g. Frame Relay DLCI, ATM VPI/VCI, point-to-point Ethernet) across an IP and an MPLS-enabled IP network.**
  - > **IP-only L2 VPNs: L2 service allowing standard IP devices to communicate with each other as if they were connected to a common LAN segment or a point-to-point circuit.**

# L2vpn WG (continued)

- > Layer 2 VPN Requirements draft ready for WG last call
- > WG is working on drafts for:
  - > Layer 2 Framework
  - > VPLS using LDP signaling (aka lasserre-vkompella)
  - > VPLS using BGP signaling (aka kkompella)
  - > IPLS (IP is the only L3 protocol transported)
- > WG debated whether ARP Mediation is in or out of scope
  - > Allows IP over Ethernet to interwork at Layer 2 with IP over Frame Relay or IP over ATM
  - > Mediates between ARP on Ethernet and Inverse ARP on Frame Relay or ATM
  - > Discussion to be continued on the email list

# Layer 3 Virtual Private Networks (L3vpn) WG

- > Responsible for defining and specifying solutions for supporting Layer 3 provider-provisioned virtual private networks
- > Standardizing:
  - > RFC 2547 BGP/MPLS IP VPNs
  - > IP VPNs using Virtual Routers
  - > CE-based IP VPNs using IPSEC
- > VPNs may be intra-area, multi-area, and multi-provider

# L3vpn WG (continued)

- > Layer 3 VPN Framework draft is on its way to being published as an RFC
- > Layer 3 VPN Requirements draft is in its final stages
- > RFC 2547-bis draft is stable, will go for working group last call once requirements and framework documents are complete
- > MIBs are waiting on the MPLS WG MIBs
- > Other WG documents in progress:
  - > 2547 for IPv6
  - > PE-PE IPsec tunnels for 2547
  - > GRE and IP tunnels for 2547
  - > BGP for VPN autodiscovery
  - > OSPF as PE/CE interface protocol

# Common Control and Measurement Plane (ccamp) WG

- > Coordinates the work within the IETF defining a common control plane and a common measurement plane for ISP and SP core tunneling technologies**
- > Defines signaling and measurement protocols such that they support multiple physical path and tunnel technologies (e.g. O-O and O-E-O optical switches, ATM and Frame Relay switches, MPLS, GRE)**
- > Defines a set of protocol-independent network resource metrics and parameters for describing links and paths, and how they can be measured and distributed in routing protocols, such as OSPF-TE and ISIS-TE**
- > Published three Generalized MPLS RFCs to date**

# ccamp WG (continued)

- > **GMPLS extensions for RSVP-TE and CR-LDP published**
- > **GMPLS signaling for SONET/SDH networks on its way to publication**
- > **Requirements for ITU-T Automatic Switched Optical Networks (ASON) signaling is almost ready for WG last call**
- > **Ditto for GMPLS recovery draft**
- > **Other major documents in progress:**
  - > **GMPLS routing protocol extensions**
  - > **Link Management Protocol**
  - > **GMPLS MIBs waiting on the MPLS MIBs**
- > **In discussion as to whether to become working group drafts:**
  - > **Crankback**
  - > **Optical recovery requirements**

# IETF Summary

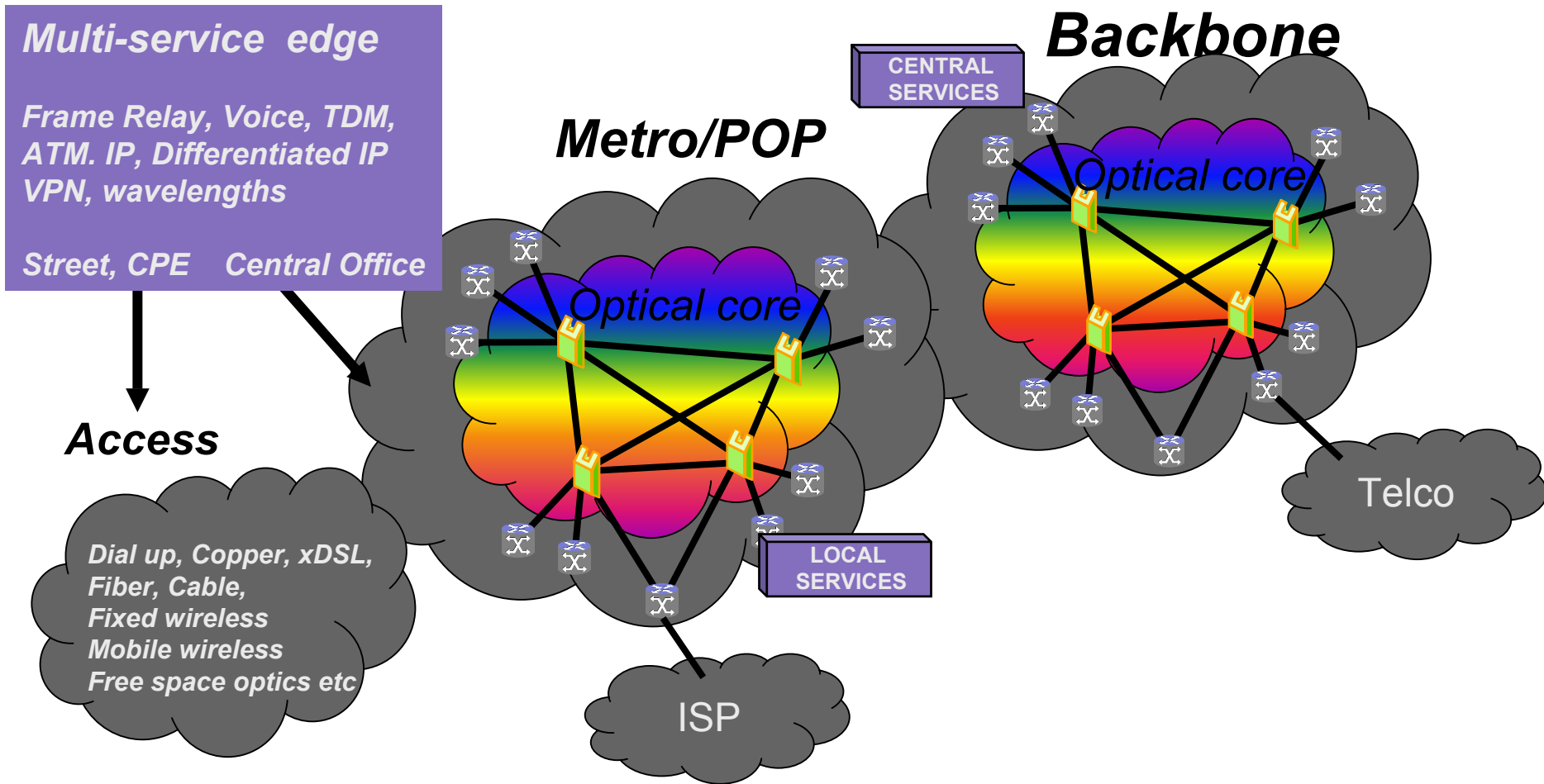
- > **MPLS WG still “winding down” with plenty still to complete**
- > **PWE3 encapsulation battles just about over**
  - > **Structured low-rate TDM is the last argument**
- > **L2VPN is whittling down the huge number of VPLS proposals**
  - > **For the most part, the market has already chosen: lasserre-vkompella and kkompella**
- > **The market has DEFINITELY chosen for L3VPNs: 2547-bis**
- > **Implementations, as always, are preceding standardization, especially in these working groups**
- > **Still lots to do!**
- > **Next meeting: Minneapolis, Nov. 9-14 2003**

# The MPLS and FR Alliance

- > An industry-wide association of networking and telecommunication companies focused on advancing the deployment of multi-vendor multi-service label switching networks and associated applications.
- > Formed by merging the MPLS and Frame Relay Forums in April 2003



# The Converged Network Vision



# MPLS/FR Alliance Information and Membership

- > **Founded April 2003 by merging the MPLS Forum and Frame Relay Forum**
- > **Combined vision of FR access to MPLS in the core**
- > **60 members as of July 2003**
- > **Three primary committees**
  - > **Marketing Awareness and Education (MAE) Committee**
  - > **Technical Committee**
    - > **Applications and Deployment Working Group**
    - > **Frame Relay Working Group**
  - > **Interoperability Committee**
- > **Most recent meeting: Northern Virginia, July 2003 (co-located with ATM and BCD Forums)**
- > **Next meeting: London, October 2003 (also co-located with ATM and BCD Forums)**

# Alliance Leadership Positions

- > **Board members**
  - > **Bernard da Costa, Bell Canada, Board Member**
  - > **Joe Kimball, Sprint, Board Member**
  - > **Gary Leonard, Riverstone Networks, VP of Marketing**
  - > **Andrew Malis, Tellabs, Chairman and President**
  - > **Doug O’Leary, Verizon, Treasurer**
  - > **Ananda Sen Gupta, Agilent Technologies, Vice Chairman, International Development**
  - > **David Sinicrope, Ericsson, Secretary**
  - > **Rick Wilder, Masergy Communications, VP of Technology**
  - > **Tom Walsh, Lucent Technologies, Vice Chairman**
  - > **Ex officio: David Drury, Accipiter Systems, President Emeritus**

# Alliance Leadership Positions

- > **Technical Committee**
  - > Rao Cherukuri, Cisco Systems, Co-Chair
  - > Dr. John Yu, Hammerhead Systems, Co-Chair and Frame Relay Working Group Chair
  - > Jarrod Siket, Marconi, Vice-Chair
  - > David Sinicrope, Ericsson, Applications and Deployment Working Group Chair
  - > Nikhil Shah, Lucent Technologies, A&D WG Vice Chair
- > **Marketing Committee**
  - > Gary Leonard, Riverstone Networks, Co-Chair
  - > Roger Ruby, Quick Eagle Networks, Co-Chair
  - > Sunil Khandekar, TiMetra Networks (soon to be Alcatel), Vice Chair
  - > Kimberly Booth, Laurel Networks, Press Relations Working Group Chair
  - > David Christophe, Lucent Technologies, Education Working Group Chair
- > **Interoperability Committee**
  - > Ananda Sen Gupta, Agilent Technologies, Chair
  - > Mark Dyga, Laurel Networks, Vice Chair

# Published Frame Relay Forum Implementation Agreements

- > FRF.1.2, PVC User-to-Network Interface (UNI) Implementation Agreement, July 2000
- > FRF.2.2, Frame Relay Network-to-Network Interface (NNI) Implementation Agreement, March 2002
- > FRF.3.2, Frame Relay Multiprotocol Encapsulation Implementation Agreement, April 2000
- > FRF.4.1, SVC User-to-Network Interface (UNI) Implementation Agreement, January 2000
- > FRF.6.1, Frame Relay Service Customer Network Management Implementation Agreement, September 2002
- > FRF.5, Frame Relay/ATM PVC Network Interworking Implementation, December 1994
- > FRF.7, Frame Relay PVC Multicast Service and Protocol Description, October 1994
- > FRF.8.1, Frame Relay / ATM PVC Service Interworking Implementation Agreement, February 2000
- > FRF.9, Data Compression Over Frame Relay Implementation Agreement, January 1996
- > FRF.10.1, Frame Relay Network-to-Network SVC Implementation Agreement, September 1996
- > FRF.11.1, Voice over Frame Relay Implementation Agreement, March 1999
- > FRF.12, Frame Relay Fragmentation Implementation Agreement, December 1997
- > FRF.13, Service Level Definitions Implementation Agreement, August 1998
- > FRF.14, Physical Layer Interface Implementation Agreement, December 1998
- > FRF.15, End-to-End Multilink Frame Relay Implementation Agreement, August 1999
- > FRF.16.1, Multilink Frame Relay UNI/NNI Implementation Agreement, May 2002
- > FRF.17, Frame Relay Privacy Implementation Agreement, January 2000
- > FRF.18, Network-to-Network FR/ATM SVC Service Interworking Implementation Agreement, April 2000
- > FRF.19, Frame Relay Operations, Administration and Maintenance Implementation Agreement, March 2001
- > FRF.20, Frame Relay IP Header Compression Implementation Agreement, June 2001

# Published MPLS Forum Implementation Agreements

- > **MPLS Forum 1.0: Voice over MPLS – Bearer Transport, July 2001**
- > **MPLS Forum 2.0.1: MPLS PVC User to Network Interface, May 2003**
- > **MPLS Forum 3.0: LDP Conformance Test Plan, December 2002**
- > **MPLS/FR Alliance 4.0: TDM Transport over MPLS using AAL1, June 2003**

# Market Awareness & Education

## > Tutorials

- > MPLS Introduction                      full day
- > MPLS Virtual Private Networks              ½ day and full day
- > Traffic Engineering                      ½ day
- > GMPLS                                      ½ day
- > VoMPLS                                      ½ day
- > ½ day tutorial debuted in February 2003
  - > Legacy Service Migration to MPLS (FR, ATM, Ethernet, Sonet/SDH)
- > New ½ day tutorial under development
  - > Layer 2 VPNs and Virtual Private LAN Services
- > Conferences and exhibitions
  - > Almost every MPLS conference globally has had an Alliance speaker
- > Website and Newsletter
  - > In January 2003, new website and newsletter were launched

# Interoperability Committee

## > Conformance Test Plans

- > LDP - Completed, now published as MPLS Forum 3.0
- > RSVP-TE – Completed straw ballot, approved by TC for BoD review prior to Final Ballot

## > Interoperability Test Plans

- > LDP – To be sent to Straw Ballot at Virginia meeting
- > RSVP-TE - To be sent to Straw Ballot at Virginia meeting
- > BGP/MPLS VPNs - to be sent to Straw Ball at Virginia meeting
- > L2oMPLS (Martini/PWE3) - modifications to reflect recent changes and detailed test cases
- > Virtual Private LAN Service (VPLS), Fast Reroute (FRR) – work continuing on test plans

# Technical Committee

- > **MPLS multi-service core**
  - > **Enables service providers a migration path to MPLS**
    - > **Tunnel legacy services over MPLS**
    - > **Network and Service Interworking**
  - > **Builds upon and conforms to IETF PWE3 and PPVPN and ITU-T SG 13 work**
    - > **Fills in “missing pieces” and/or provides source material**
- > **MPLS service edge**
  - > **MPLS UNI**
  - > **MPLS/PNNI signaling interworking**
  - > **Interworking between FR, ATM, and Ethernet over MPLS networks**
  - > **FR/MPLS network interworking (joint work with ITU-T Study Group 17)**

# Technical Committee Work Items

| <ul style="list-style-type: none"> <li>•<b>Technical Committee Work Item &amp;Description</b></li> </ul>                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>•<b>Target Straw Ballot Complete</b></li> </ul> | <ul style="list-style-type: none"> <li>•<b>Target Final Ballot Complete</b></li> </ul> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>•<b>I.366.2 Voice Trunking Format over MPLS</b></li> <li>•Using MPLS to carry packetized ITU I.366.2 Voice formatted traffic. Similar to the way AAL2 is transported by ATM.</li> </ul>                                                            | <ul style="list-style-type: none"> <li>•Jan 2003</li> </ul>                            | <ul style="list-style-type: none"> <li>•Aug 2003</li> </ul>                            |
| <ul style="list-style-type: none"> <li>•<b>FR/MPLS Network Interworking</b></li> <li>•frame relay to frame relay service offered using MPLS as a backbone transport. Both 1:1 as well as Port mode.</li> </ul>                                                                            | <ul style="list-style-type: none"> <li>•Oct 2003</li> </ul>                            | <ul style="list-style-type: none"> <li>•Jan 2004</li> </ul>                            |
| <ul style="list-style-type: none"> <li>•<b>LSP Connection Service Definition</b></li> <li>•Definition of native MPLS LSP transport service.</li> </ul>                                                                                                                                    | <ul style="list-style-type: none"> <li>•Aug 2003</li> </ul>                            | <ul style="list-style-type: none"> <li>•Jan 2004</li> </ul>                            |
| <ul style="list-style-type: none"> <li>•<b>PNNI/MPLS Interworking</b></li> <li>•This allows signaling service interworking between ATM and MPLS networks, by translating between ATM PNNI signaling as defined by the ATM Forum and MPLS LDP signaling as defined by the IETF.</li> </ul> | <ul style="list-style-type: none"> <li>•Aug 2003</li> </ul>                            | <ul style="list-style-type: none"> <li>•Jan 2004</li> </ul>                            |

# Technical Committee Work Items

|                                                                                                                                                                                                                                          |                                                              |                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• <b>UNI QoS Proxy Admission Control Service Definition</b></li> <li>• Definition of a service provided on the MPLS UNI that allows a CE to request resources of the provider network.</li> </ul> | <ul style="list-style-type: none"> <li>• Oct 2003</li> </ul> | <ul style="list-style-type: none"> <li>• Jan 2004</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>UNI QoS Proxy Admission Control Protocol</b></li> <li>• UNI protocol modifications to support the UNI QoS Proxy Admission Control Service Definition</li> </ul>                              | <ul style="list-style-type: none"> <li>• Oct 2003</li> </ul> | <ul style="list-style-type: none"> <li>• Apr 2004</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>ATM/FR/Ethernet Service Interworking</b></li> <li>• Transport of ATM, Frame Relay and/or Ethernet over MPLS without requiring the same service on both ends of the connection.</li> </ul>    | <ul style="list-style-type: none"> <li>• Oct 2003</li> </ul> | <ul style="list-style-type: none"> <li>• Apr 2004</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>SONET over MPLS</b></li> <li>• Implementation specification for transport of SONET/SDH over MPLS</li> </ul>                                                                                  | <ul style="list-style-type: none"> <li>• Jan 2004</li> </ul> | <ul style="list-style-type: none"> <li>• Jul 2004</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>HDLC over MPLS</b></li> <li>• Implementation specification for transport of HDLC over MPLS</li> </ul>                                                                                        | <ul style="list-style-type: none"> <li>• Jan 2004</li> </ul> | <ul style="list-style-type: none"> <li>• Jul 2004</li> </ul> |

# Relationships w/Other Bodies

## > IETF

- > Alliance work based on IETF RFCs and/or ITU-T Recommendations
- > Only do work that does not fit in IETF charter, such as MPLS test plans, PNNI interworking, VoMPLS, etc.
- > Strong common participation between IETF and Alliance

## > ITU-T

- > Achieved A4 and A5 liaison status with ITU-T
- > Communicating with Study Groups 11, 13, 15, and 17 regarding such topics as MPLS OAM, MPLS/PNNI signaling interworking, VoMPLS carriage and signaling

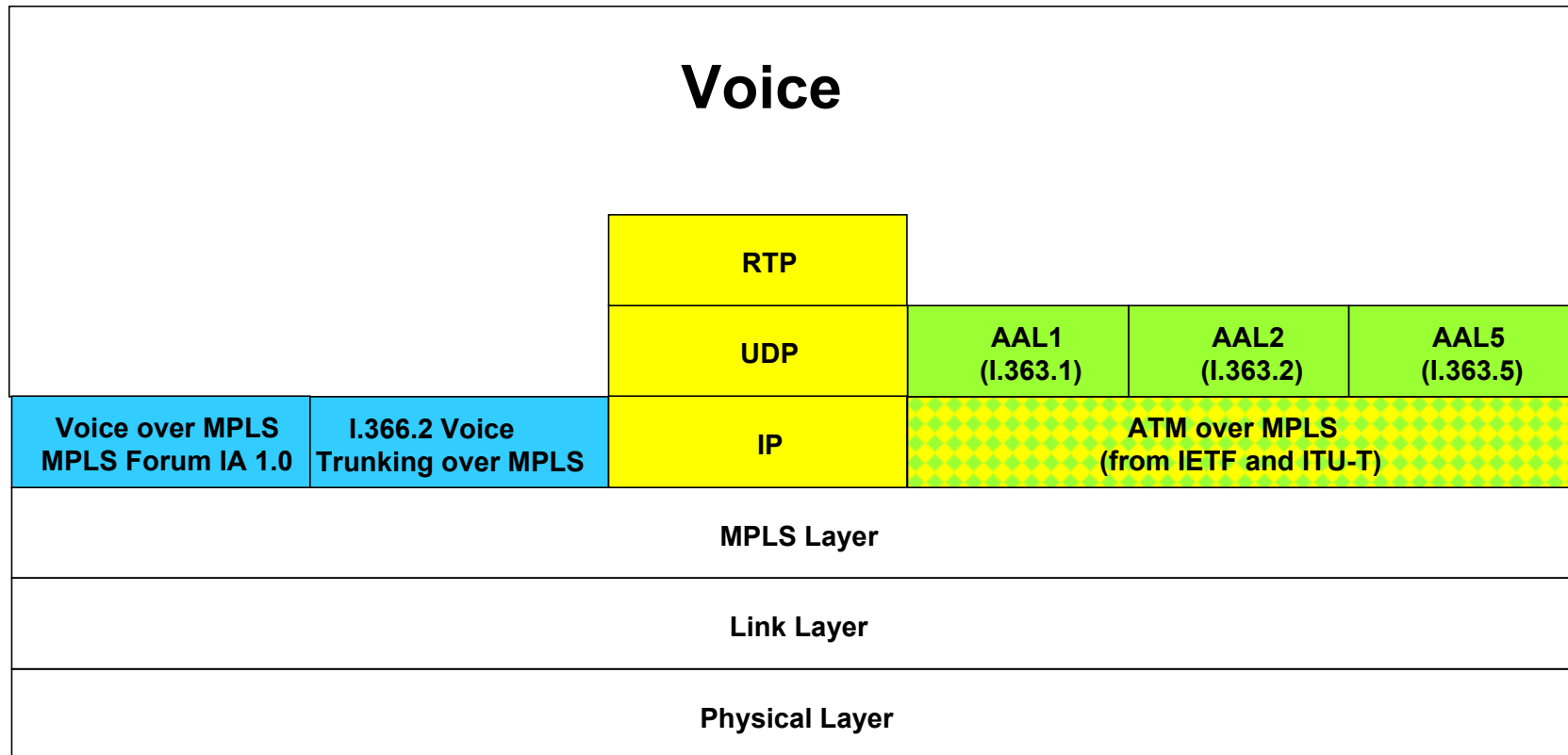
## > ATM Forum

- > In October 2001, began a program of joint conference calls
- > Held co-located meetings in January and July 2003, more co-located meetings planned

## > Metro Ethernet Forum

- > Jointly announced a formal liaison relationship, working in concert on FR/ATM/Ethernet interworking

# Voice Services over MPLS (ITU-T Y.1261)



Legend:

Alliance

IETF

ITU-T

# Comparing MPLS/PNNI Signaling Interworking Approaches

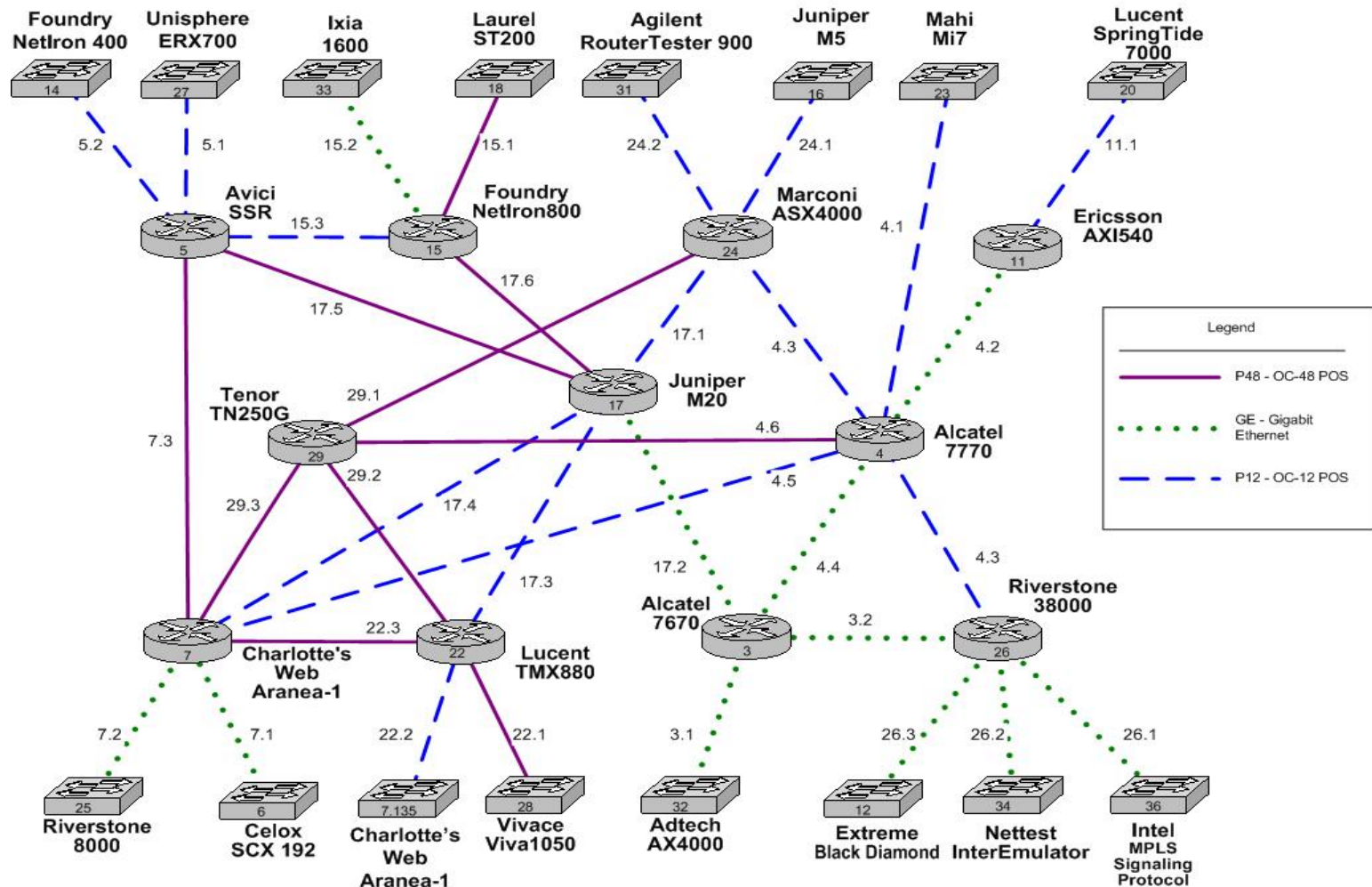
- > **ATM Forum**
  - > **First to get started and first to complete (currently in final ballot)**
  - > **Simple in concept: MPLS LSPs become PNNI virtual trunks**
  - > **LSPs (virtual trunks) dedicated to ATM PNNI VCs and signaling only – cannot multiplex multiple VC types (or even IP) over MPLS LSPs used for PNNI-based ATM VCs**
  - > **MPLS network failures cause all calls on the virtual trunk to be cleared**
    - > **Failure protection requires additional functionality expected in the next revision of the specification**
  - > **Adds extensions to PNNI signaling to distribute MPLS VC labels – turns PNNI into an MPLS label distribution protocol (does not conform to IETF PWE3 signaling)**
- > **MPLS and Frame Relay Alliance**
  - > **Started later, and completing later (currently in straw ballot stage)**
  - > **Builds on and conforms to IETF PWE3/Martini ATM over MPLS encapsulation and signaling**
    - > **Uses LDP for VC label distribution**
    - > **Multiplex IP, ATM, and other applications through the same MPLS traffic tunnels**
  - > **Resilient over MPLS network failures – can switch ATM VCs and signaling to a backup LSP without clearing calls**

# Public Interoperability Events

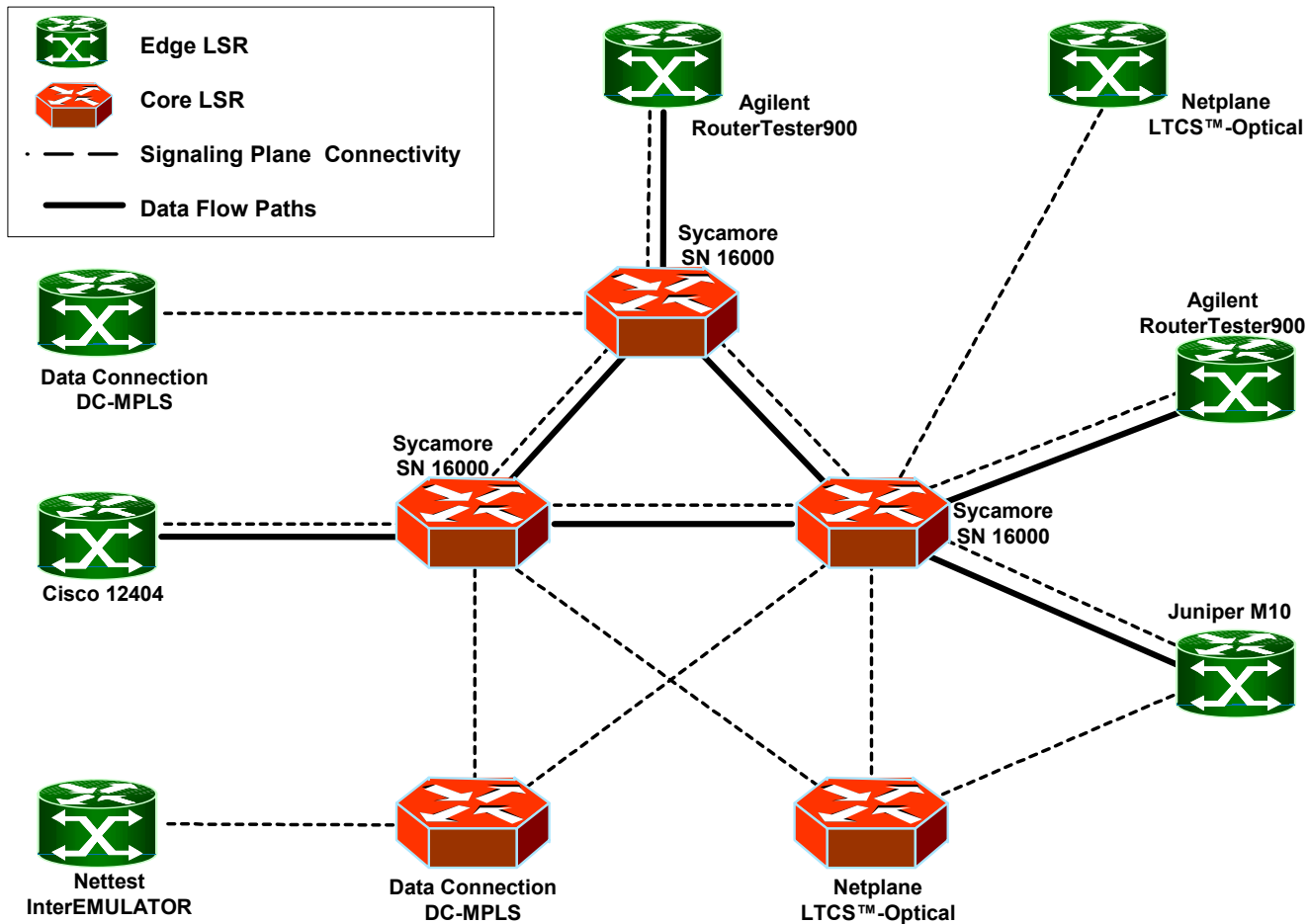
- > **SUPERCOMM (Atlanta), June 2002**
  - > **MPLS traffic engineering, Layer 2 and 3 Virtual Private Networks (VPNs)**
- > **Next Generation Networks (Boston), October 2002**
  - > **Generalized MPLS (GMPLS)**
- > **MPLS World Congress (Paris), February 2003**
  - > **BGP/VPN Scalability, MPLS Fast Reroute (FRR)**
- > **SUPERCOMM (Atlanta), June 2003**
  - > **Frame Relay, ATM, Ethernet/VLAN over MPLS, Virtual Private LAN Services (VPLS), MPLS Fast Reroute (FRR)**

# SUPERCOMM SUPERDemo 2002: MPLS TE, Layer 2 and 3 VPNs

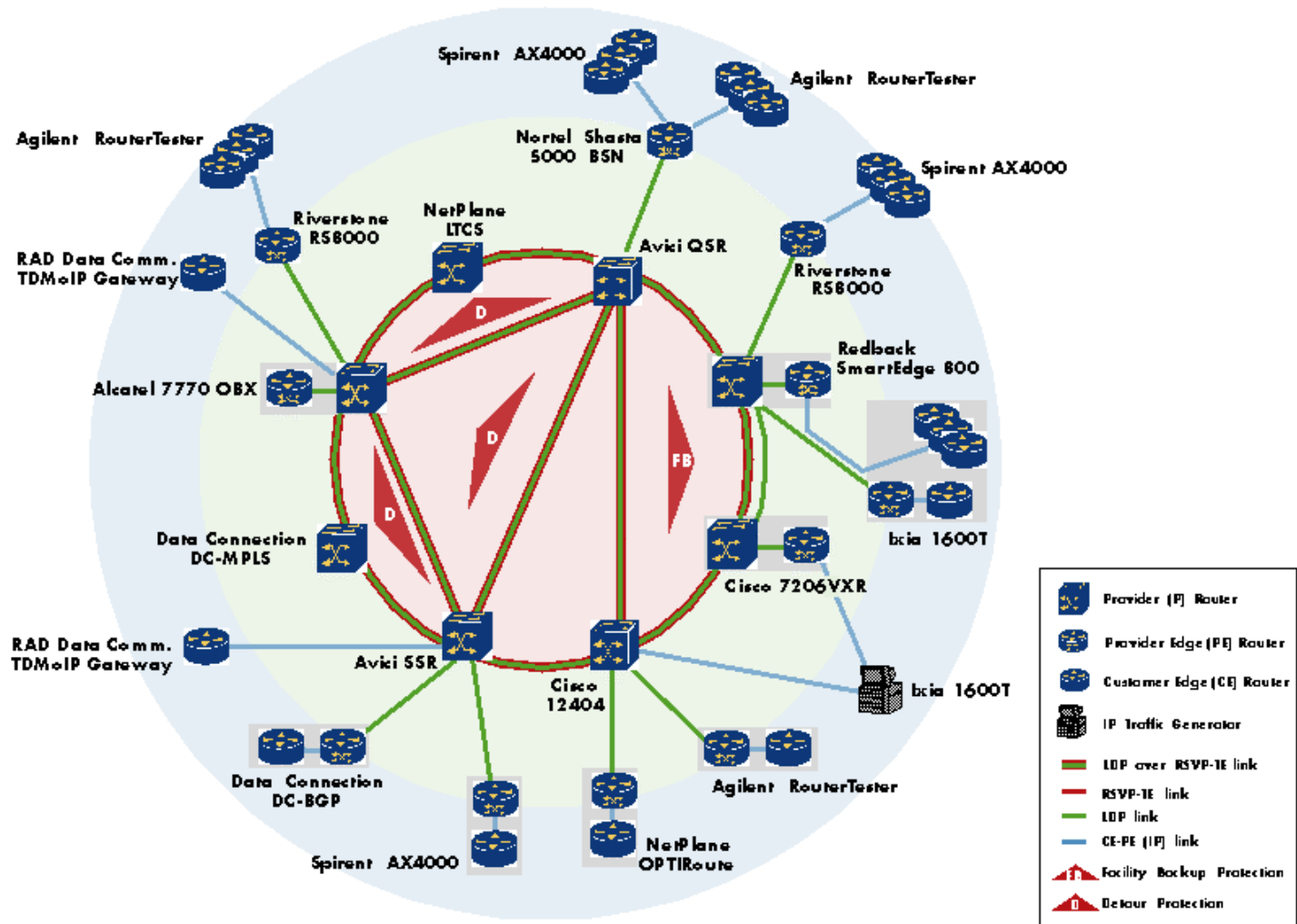
MPLS Forum SUPERDemo  
Network Topology



# Next Generation Networks 2002: GMPLS Interoperability



# MPLS World Congress 2003: Fast Reroute Protection, L3 VPN Scalability



# **SUPERCOMM SUPERDemo 2003**

- > Focus on demonstrating multivendor interoperability in the following areas:**
  - > Frame Relay over MPLS**
  - > ATM over MPLS**
  - > Ethernet/VLAN over MPLS**
  - > Virtual Private LAN Services (VPLS)**
  - > MPLS Fast Reroute (FRR)**
- > New interoperable, scalable services while offering service guarantees**

# 18 Participating Products

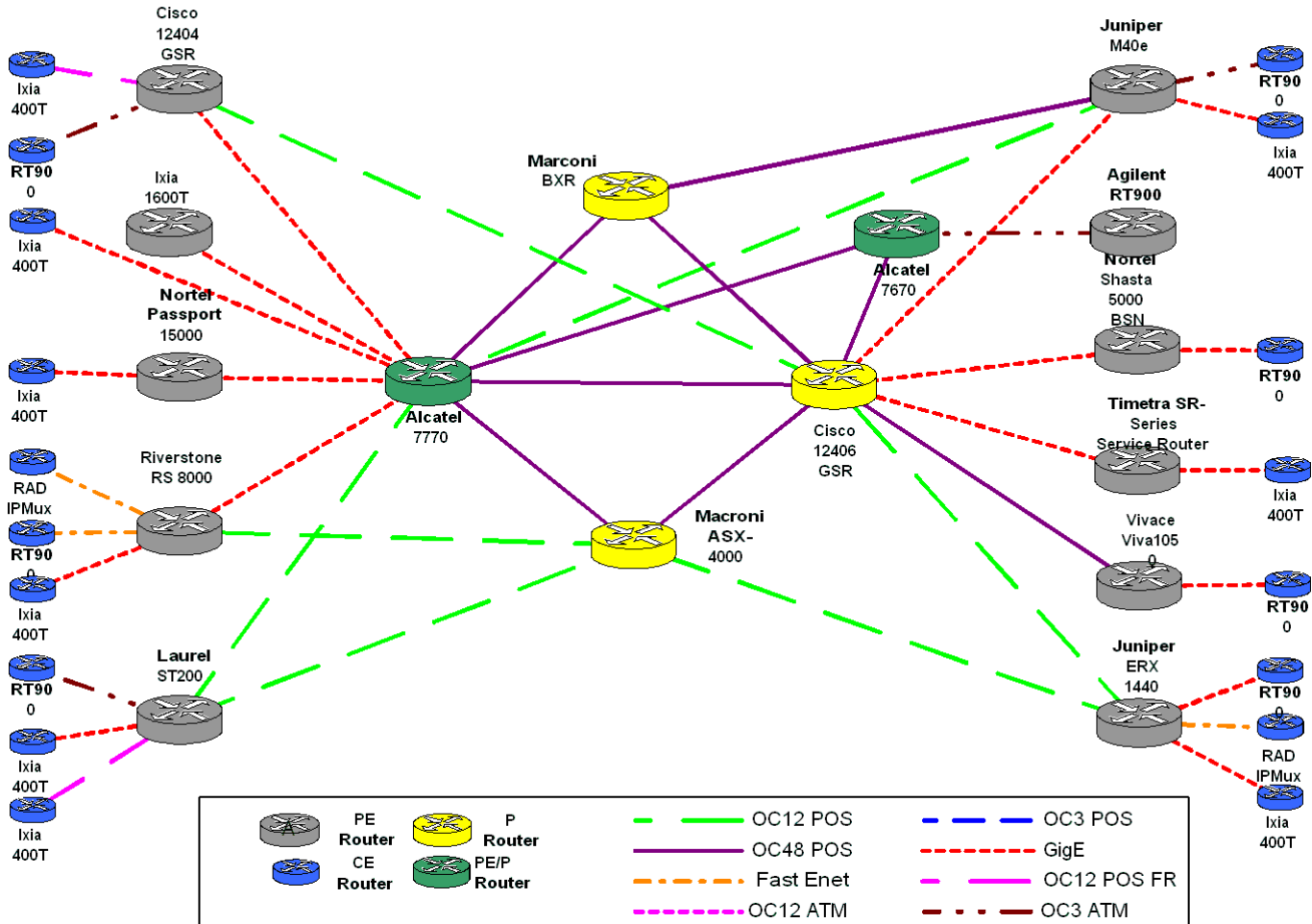
- > Alcatel 7670 Routing Switch Platform (RSP)
- > Alcatel 7770 Optical Broadband Exchange (OBX)
- > Agilent RT900
- > Cisco GSR 12404
- > Cisco GSR 12406
- > Ixia 400T and 1600T
- > Juniper M40e
- > Juniper ERX 1440
- > Laurel ST200
- > Marconi BXR-48000
- > Marconi ASX-4000
- > Nortel Passport 15000
- > Nortel Shasta 5000 Broadband Service Node (BSN)
- > RAD IPmux
- > Riverstone RS 8000
- > TiMetra SR-Series Service Router
- > Vivace Viva1050

# Test Scenarios

- > **Fast Reroute was tested in the Core**
- > **Three MPLS service scenarios tested in isolation and then implemented across a core MPLS network:**
  - > **Layer 2 point to point Transport services:**
    - > **ATM (Cell and AAL5 modes)**
    - > **Frame Relay (Transport mode)**
    - > **Ethernet (Port and VLAN modes)**
  - > **Virtual Private LAN service (VPLS)**
  - > **BGP/MPLS VPN service**

# SUPERCOMM 2003 Topology

## SuperDemo Test Network Topology



# The SUPERDemo in Action



# The Results

- > **Multi-vendor interoperability, scalability, and resilience successfully demonstrated**
- > **A few protocol issues were identified – read the white paper:**  
[http://www.mplsforum.org/tech/superdemo\\_2003.pdf](http://www.mplsforum.org/tech/superdemo_2003.pdf)
- > **Alliance plans to continue its interoperability events – popular with member companies**

# ITU-T Update

- > **ITU-T MPLS standardization concentrated in Study Groups 11, 13, and 17**
- > **Most recent SG meetings:**
  - > **SG 11: 11 - 22 November 2002**
  - > **SG 13 : 21 July - 1 August 2003**
  - > **SG 17: 20 - 29 November 2002**

# Study Group 11 Ongoing Work

## > Draft TRQ.aom

- > ATM over MPLS Signaling Requirements

## > Draft Q.aom

- > DSS2 Signaling for ATM Services over MPLS Networks
- > Another MPLS label distribution protocol

## > Draft TRQ.amsir

- > ATM/MPLS Signaling Requirements for Protocol Interworking
- > Focus on interworking with MPLS control protocols (RSVP-TE, CR-LDP)

## > Draft TRQ.NBoMPLS

- > Narrowband Bearer Services over MPLS Signaling Requirements baseline

# Study Group 11 Ongoing Work

- > **Draft TRQ on RSVP-TE**
  - > Requirements to adopt RSVP-TE as ITU-T protocol
- > **Draft TRQ on Signaling Requirements for IP Quality of Service**
  - > **QoS signaling requirements are expressed in terms of attributes related to user-network Signaling**
    - > network QoS Class (from Y.1541/Table 1)
    - > network capacity levels (from Y.1221)

# SG13 Draft Recommendations completed in July meeting

| •ITU-T Rec.<br>No.                  | •Status  | •Title                                                                  |
|-------------------------------------|----------|-------------------------------------------------------------------------|
| •Y.1412<br>(formerly<br>Y.atmplsF)  | •New     | •ATM-MPLS network interworking – Frame mode user plane interworking     |
| •Y.1712<br>(formerly<br>Y.17iw)     | •New     | •OAM functionality for ATM-MPLS interworking                            |
| •Y.1711                             | •Revised | •Operation and maintenance mechanism for MPLS networks                  |
| •Y.1720                             | •Revised | •Protection switching for MPLS networks                                 |
| •Y.1312<br>(formerly<br>Y.11vpnsdr) | •New     | •Layer 1 Virtual Private Network Generic requirements and architectures |
| •Y.1281<br>(formerly<br>Y.MIPoMPLS) | •New     | •Mobile IP over MPLS                                                    |

# Study Group 13 Ongoing Work

- > **Y.vsmpls (Voice Services over MPLS Network Interworking)**
  - > **Voice over IP over MPLS**
  - > **Voice over MPLS using AAL2 SSCS**
  - > **Voice over MPLS (MPLS Forum 1.0)**
- > **MPLS Interworking**
  - > **Y.tdmpls**
    - > **TDM-MPLS Network Interworking- User Plane Interworking**
  - > **Intention to develop draft on FR over MPLS**
    - > **Possible conflict with SG 17 Draft X.84**
    - > **What needs to happen is one document with two numbers**
    - > **Has become a turf battle**

# Study Group 13 Ongoing Work

## > IP QoS

### > Draft Y.1541

- > Network performance objectives for IP-based services
- > Defines (suggested) QoS classes

### > Draft Y.1221

- > Traffic control and congestion control in IP based networks
  - > Identifies Traffic parameters and descriptors
  - > IP Transfer Capabilities

### > Draft Y.qosar

- > An Architectural Framework for Support of Quality of Service (QoS) in Packet Networks

# Study Group 17 Ongoing Work

- > **Draft Recommendation X.84**
  - > **Support of Frame Relay services over MPLS Core networks**
  - > **Based on input from**
    - > **MPLS and Frame Relay Alliance**
    - > **IETF PWE3 draft for FR over MPLS**
    - > **IETF PWE3 fragmentation draft**
  - > **IETF FR over MPLS draft and X.84 have the same editor – being kept in sync with each other**
  - > **See earlier comments about a possible conflict with SG 13**

# Conclusion

- > **MPLS has already been proven to be a success (over 200 service provider deployments)**
  - > **In wide use for traffic engineering**
  - > **New applications (VPNs, QoS, multimedia) are undergoing development and deployment**
- > **IETF, MPLS and Frame Relay Alliance, and ITU-T are all continuing their standardization and specification activities**
  - > **MPLS has proven to be a fertile base for new innovations**
- > **Interoperability and conformance testing continue to be crucial as new applications are standardized**

# Standards Online

## > Free documents:

- > IETF RFCs can be found at <http://www.ietf.org/rfc/>
- > IETF Internet Drafts can be found at <http://www.ietf.org/internet-drafts/>
- > MPLS Forum Interoperability Agreements can be found at <http://www.mplsforum.org/>

## > Documents requiring payment:

- > ITU-T recommendations can be found at <http://www.itu.int>  
(three free downloads per year per email address)

**Thank you!**

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