Cisco IOS® MPLS
Virtual Private LAN Service
Business Overview

Enabling Innovative Services
Agenda

• Announcement
• Metro Ethernet
  Background
• Virtual Private LAN Service (VPLS)
  Relationship to Metro Ethernet
  Deployment Scenario
  Relationship to Other Cisco IOS Technologies
  Future Directions
• Summary
What’s New?

**Cisco IOS® MPLS Virtual Private LAN Service (VPLS)**
- Multipoint-to-multipoint support transparent operation (based on split horizon at MPLS PE)
- Multipoint-to-multipoint non transparent operation
- Circuit multiplexing
- Q-in-Q support
- MAC-Address learning forwarding & aging
- Jumbo frames support
- Rate limiting for SLA requirement (per-VLAN basis)
- Coexistence of point-to-point & multipoint-to-multipoint support in the same router

**Cisco® 7600 Series**
- Customer-facing interfaces (Customer Edge - Provider Edge)
  - WS-X6548-RJ-45
  - WS-X6516-GBIC
- Core-facing interfaces (Provider Edge – Provider Edge)
  - OSM-4OC12-POS-MM
  - OSM-4GE-WAN-GBIC
  - OSM-1OC48-POS

**Operational Support System (OSS)/Network Management System (NMS)**
- Enhanced MIB support
- Cisco IP Solution Center (ISC) 3.1 enhancements
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Metro Ethernet: Emerging Multiservice Access Opportunity
Metro Ethernet: Business Drivers*

**Service Provider**
- Revenue growth
  - New, differentiated services
  - Expanded enterprise penetration
- Cost efficiencies
  - Network convergence
  - Flexible bandwidth provisioning
  - Best value for increased bandwidth

**Enterprise**
- Business demands
  - Increased productivity
  - Peer-to-peer applications
- Service expectations
  - Scalable bandwidth (from 1Mbps to 1Gbps)
  - Customized services
  - Multipoint connectivity
  - Operational simplicity

Metro Ethernet: Revenue Opportunity

Worldwide Metro Ethernet Services Revenue 2002-2007*

Growing to Over $8 Billion in 3 Years

* Combines IDC US & Asia Reports, 2002 & 2003
Metro Ethernet: Cost Savings for Enterprise Customers

The Ethernet Advantage

- Connectionless, IP aware-operation
- Distributed intelligence
- Inexpensive, scalable bandwidth options
- L2 VPNs
  - Point-to-point
  - Multipoint
- L3 VPNs
- High speed transport enables innovative services and applications
  - Storage, IP video conferencing
- Value added services
  - IP Telephony
  - IP video conferencing
  - High speed, Business class Internet
  - Managed Security
  - Managed Storage
Metro Ethernet: Existing Architectures Based on L2 Switching

Strengths
- Multipoint topologies
- Supports transparency
- Relatively low CapEx
- High bandwidth

Weaknesses
- Limited scalability
- Number of customers
- Location of customers
- Limited service definitions
- L2 VPN only for now

Architectures:
- **Architecture A: GE Ring**
- **Architecture B: Hub & Spoke**
- **Architecture C: DWDM/CDWM**
- **Architecture D: SONET/SDH Ring**
VPLS Overview for Metro Ethernet

- Delivers Ethernet-based multipoint L2 VPN service
- Enhances L2 VPN scalability (geographic sites & no. of customers)
- Uses existing SP MPLS Core
- Supports operational speeds of 1 Gbps to 10 Gbps
- Is on track for IETF standardization: Draft Lasserre Kompella
- Uses familiar Ethernet user network interface
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  - Terminology & Service Definitions
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VPLS Terminology

CE  Customer Equipment
PE  Provider Edge
u-PE User-Facing Provider Edge (Provider Edge Customer-Located Equipment)
n-PE Network Provider Edge (Provider Edge Point of Presence)
UNI User Network Interface
Q-in-Q SP Ethernet encapsulation where a 2nd 802.1Q header is added for customer identification
CE-VLAN VLAN (tag) between CE and UNI
PE-VLAN VLAN (tag) within Service Provider Network
VEC Virtual Ethernet Circuit (Logical circuit between 2 UNIs. UNIs are based on Ethernet technology. Also referred to as EVC.)
VSI Virtual Switch Instance (Association of multiple VECs in a n-PE where forwarding decisions between associated VECs can occur based on Ethernet Switching mechanisms.)
VPLS Concepts: Point-to-Point Services

Point-to-Point Service Types
Ethernet Relay Service (ERS)
Ethernet Wire Service (EWS)

- Similar to Frame Relay for point-to-point services
- Circuit multiplexing allowed for ERS but not for EWS
- SP assigns VLAN value for ERS, but not for EWS
- Supported by original EoMPLS standard (Martini Draft)
VPLS Concepts: Multipoint-to-Multipoint Services

Multipoint Service Types
- Ethernet Multipoint Service (EMS)
- Ethernet Relay Multipoint Service (ERMS)

- End customer sees service as an Ethernet broadcast domain
- End customer has transparency to Ethernet protocol with EMS, but not with ERMS
- Circuit multiplexing allowed for EMS, but not for ERMS
- End customer can connect Layer 2 or Layer 3 Ethernet devices
## Metro Ethernet: Different L2 VPN Service Options

<table>
<thead>
<tr>
<th>Service Definition</th>
<th>Point-to-Point (PtP)</th>
<th>Multipoint (Mpt)</th>
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<tbody>
<tr>
<td>Multiplexed Services</td>
<td>Ethernet Relay Service</td>
<td>Ethernet Relay Multipoint Service</td>
</tr>
<tr>
<td>Transparent Services</td>
<td>Ethernet Wire Service</td>
<td>Ethernet Multipoint Service</td>
</tr>
</tbody>
</table>

VPLS supports these multipoint services.
Cisco VPLS Building Blocks

Layer 2 VPN
- Point-to-Point Layer 2 VPN
- Multipoint Layer 2 VPN
- Layer 3 VPN

Forwarding Mechanism
- Interface-Based/Sub-Interface
- Ethernet Switching (VFI)
- IP Routing

VPN Discovery
- DNS
- Centralized Directory Services
- Distributed BGP

Signaling
- Label Distribution Protocol

Tunnel Protocol
- MPLS
- IP

Hardware
- Cisco 7600
- Catalyst 6500

A Comprehensive Solution: Robust, Flexible, Scalable, Manageable
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VPLS: Typical Deployment Scenario

Benefits of VPLS:
Implements scalability and reliability of traditional Switched Ethernet networks
Simplifies provisioning for multipoint services for both SP and end user
Takes advantage of outstanding price/performance of GE and 10GE

VPLS is under evaluation in over 45 major service providers worldwide
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Policy-Based QoS for VPLS

- **New policy-based QoS application**
  - QoS policy (profile) pre-definition
  - QoS implemented as separate service
  - Constraint matrix-based implementation to validate end-to-end Implementation

- **QoS design**
  - QoS on access circuits
  - QoS definition for core based on smart template utility
  - QoS based on DiffServ architecture
  - QoS implemented using MQC and non-MQC

1) Packet Classification Based on Ingress Ethernet Packet CoS Value
2) Match CoS (.1P); set MPLS EXP. Rate-Limit/Police and Apply Drop Policy
3) Invoke QoS Policy Action Based on Edge Classification (Based on MPLS EXP), e.g., LLQ, CBWFQ, Drop Policy via WRED
Cisco IOS Management Available to VPLS

Cisco IOS® Software

Fault
Conf
Perf & Acc

CIC
ISC
EMSs

Customer OSS, NCON, ...
Concord, Infovista, Agilent, Digiquant, ...

SNMP
HTTP
Telnet

SNMP
XML
CLI

IOS Programmatic Interface

MIBs
Performance SAA
Accounting Netflow
LSP Ping Traceroute VCCV
Protocol Enhancements AutoTunnel AutoMEsh Security

MPLS Embedded Management

Infrastructure enhancements

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Unified MPLS Management

Integrated network management platform to manage:

- Metro Ethernet Services (switched as well as Ethernet transport over MPLS Core) services.
- MPLS BGP VPN services
- AToM (ATM/FR transport over MPLS) services
- Diffserv/IP/MPLS CoS treatment for MPLS services above
# VPLS:
One of Many Cisco IOS MPLS Service Types

<table>
<thead>
<tr>
<th>Layer 2</th>
<th>Point to Point</th>
<th>Multipoint</th>
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<tr>
<td>Layer 3</td>
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</table>

### Point to Point:
- PWES, including
- Ethernet over MPLS
- ATM/Frame Relay over MPLS
- HDLC & PPP over MPLS
- L2 VPN Interworking
- L2TPv3

### Multipoint:
- **VPLS**

### Layer 3:
- GRE
- IPSec

### Layer 3 VPN:
- MPLS L3 VPN

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ATM/Frame Relay
Ethernet
PPP
Cisco HDLC
IP

ATM/Frame Relay
Ethernet
PPP
Cisco HDLC
IP

MPLS

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Cisco 7600 Metro Ethernet Router for VPLS

- **Unique Multilayer Forwarding Architecture**
  - Layer 2 Ethernet switching
  - IPv4, IPv6
  - MPLS L3 VPN
  - EoMPLS, VPLS
  - PPPoEoV (MWAM)

- **Outstanding Price/Performance**
  - 30 – 200+ Mpps routing performance
  - Up to 720 Gbps bandwidth

- **Scalable & Diverse Physical Connectivity**
  - Leased-line interfaces from DS0 to OC-48/STM-16
  - High-density Ethernet from 10Mbps to 10Gbps
  - High density for T3/E3, OC-3/STM-1 and OC-12/STM-4

- **Outstanding Investment Protection**
  - Support for Cisco® 7500 port adapters
  - Support for Catalyst® 6000 LAN Modules

- **Versatile Range of Network Services**
  - Per-subscriber QoS, including ACL, LLQ TS, and Layer 4-7 CDN
  - Service blades: Firewall, IP Sec, NAM, SSL Term

*A comprehensive solution: Robust, flexible, scalable, manageable*
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VPLS Typical Deployment

A comprehensive solution: Robust, flexible, scalable, manageable
Integration of VPLS with Multiservice Access

A comprehensive solution: Robust, flexible, scalable, manageable
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- **Summary**
Cisco IOS® MPLS Virtual Private LAN Service (VPLS) with Cisco® 7600 enables flexibility in deploying and managing innovative services that increase productivity and operational efficiencies by connecting geographically dispersed sites as one giant LAN over high-speed Ethernet in a robust and scalable IP/MPLS network.
World-Class Customer Support

- **2000** technical support professionals
- **1600+** support engineers* (400 with CCIE® certification) on 24 hours
- **630+** depots and **10,000** field engineers in **120** countries*
- **85,000+** assisted cases/month
- **321,000** customer issues resolved/month
- **75%** TAC Web resolved: of **25%** assisted, **64%** were Web-initiated
- **98%** material availability
- **92%** orders submitted online, **55%** “no touch”
- **60%** change orders submitted online

* Internal & Outsource Partners
Cisco Leads in the MPLS Market

<table>
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<tr>
<th>Americas</th>
<th>EMEA</th>
<th>AsiaPac/Japan</th>
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<tbody>
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<td>Some 200 Customers (MPLS Core &amp; Layer2/3 Edge)</td>
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</table>
Cisco IOS MPLS

**Smarter**
The foundation for more services and more revenues

**Faster**
A flexible QoS framework to enable migration to a converged infrastructure

**Innovative Services**

**Lasting**
Extensibility to different transports with standards-based open architecture for investment protection