Cisco IOS® MPLS Management Technology Overview

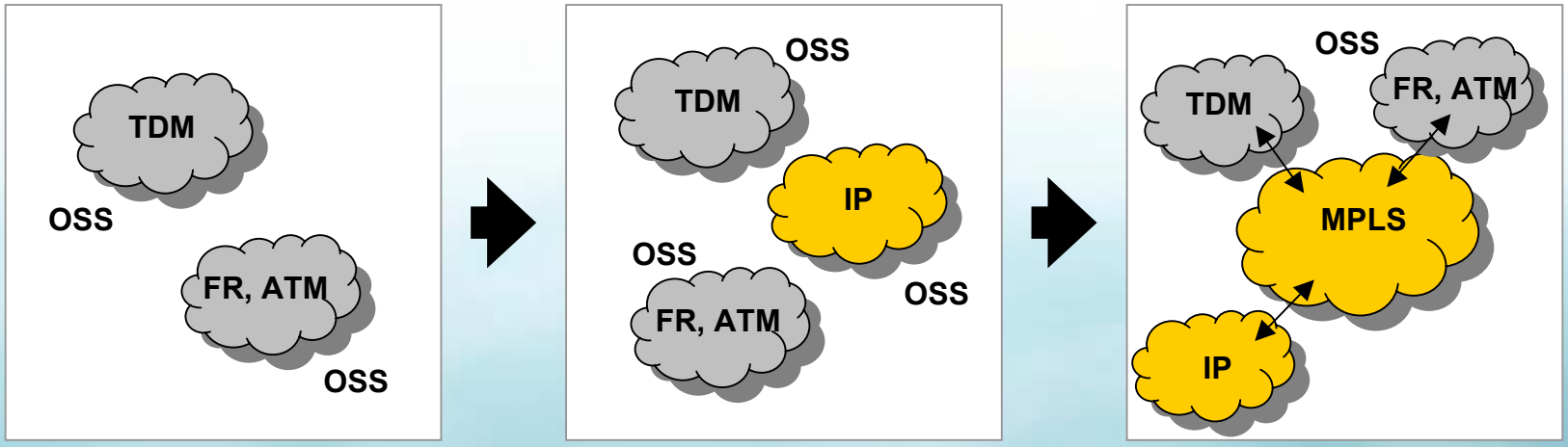
Enabling Innovative Services

February 2004

Agenda

- Introduction
  - Problems, challenges, requirements
- Technology Overview
- Summary

Service Provider Problems



- **Operational Efficiencies**

  Increase management automation and availability

- **New Services Provisioning**

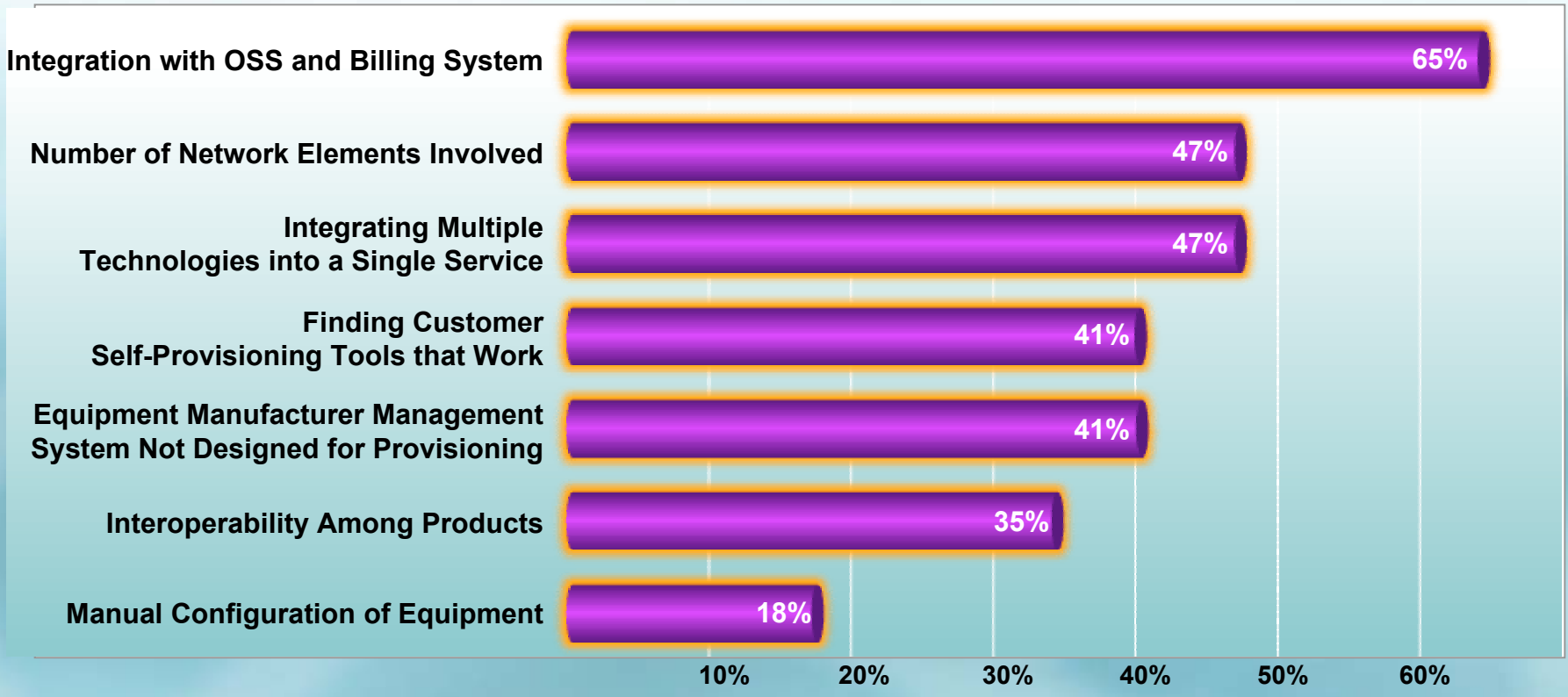
  Enable competitive differentiation and customer retention through profitable bundled services

- **Disparate Networks**

  Manage and consolidate traditional and emerging networks

MPLS Service Provisioning Challenge

Challenges in VPN Service Provisioning

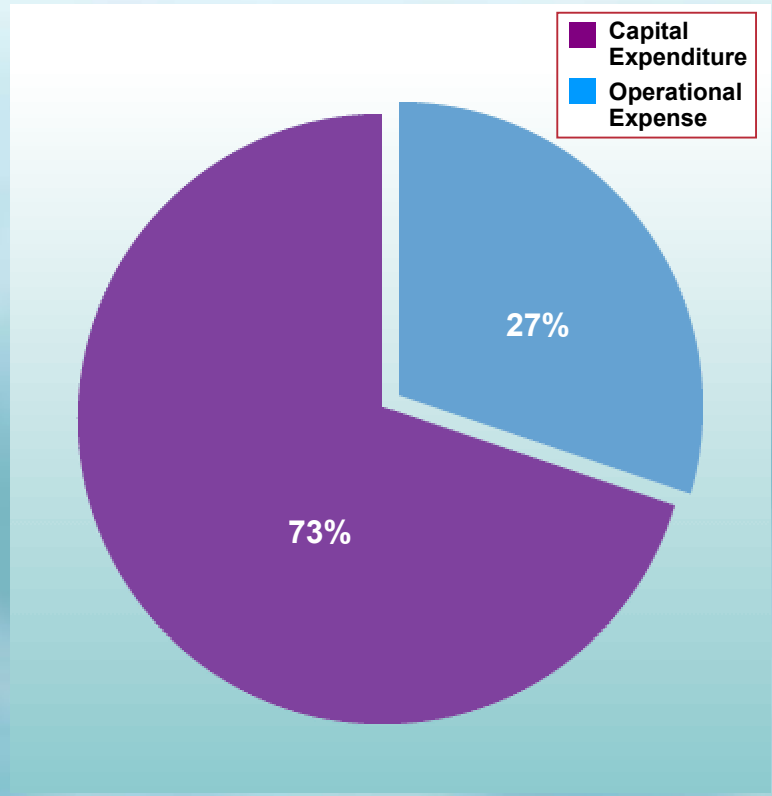


Source: Infonetics, 2003

Reducing OpEx with Network Management

- CapEx typically follows the economy
- OpEx is consistent

- Typical ratio of a Tier 1 carrier CapEx vs OpEx spending
- OpEx efficiencies have higher profitability and a higher ARPU



Source: Frost and Sullivan, 2002

Customer Requirements

- Provide systemic management solutions for achieving dramatic productivity gains through automation, intelligence, and simplification
- Enable competitive differentiation and customer retention through high-margin, bundled services
  - Provide automated embedded tools
  - Configuration
  - Error detection & recovery
  - Performance and accounting
- Perform data plane validation with respect to control plane
  - Data plane liveliness and troubleshooting
- Standards and open interfaces, APIs to management/OSS applications and third-party software vendors
- End-to-end circuit/service-level health/alarm correlation

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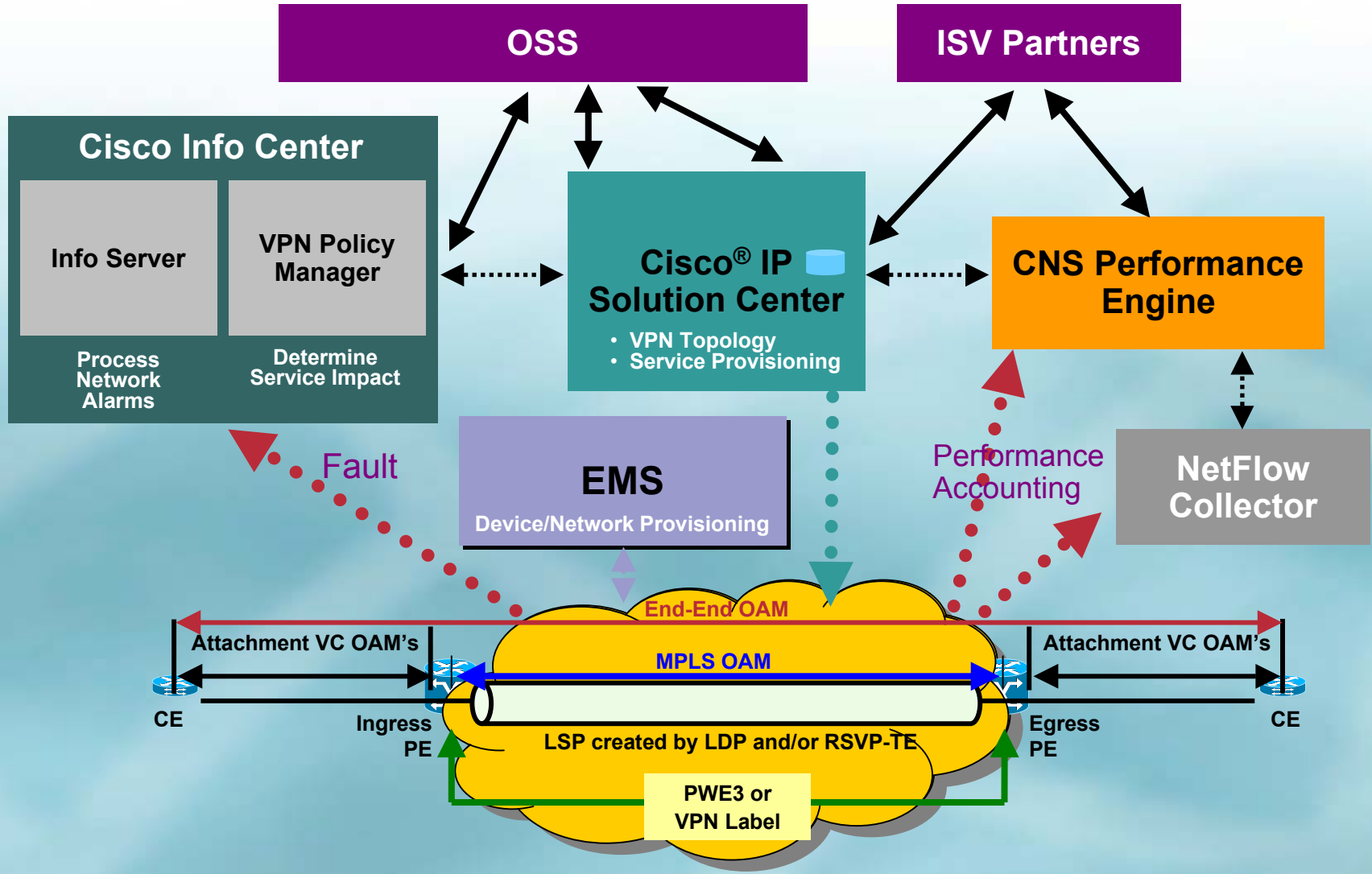
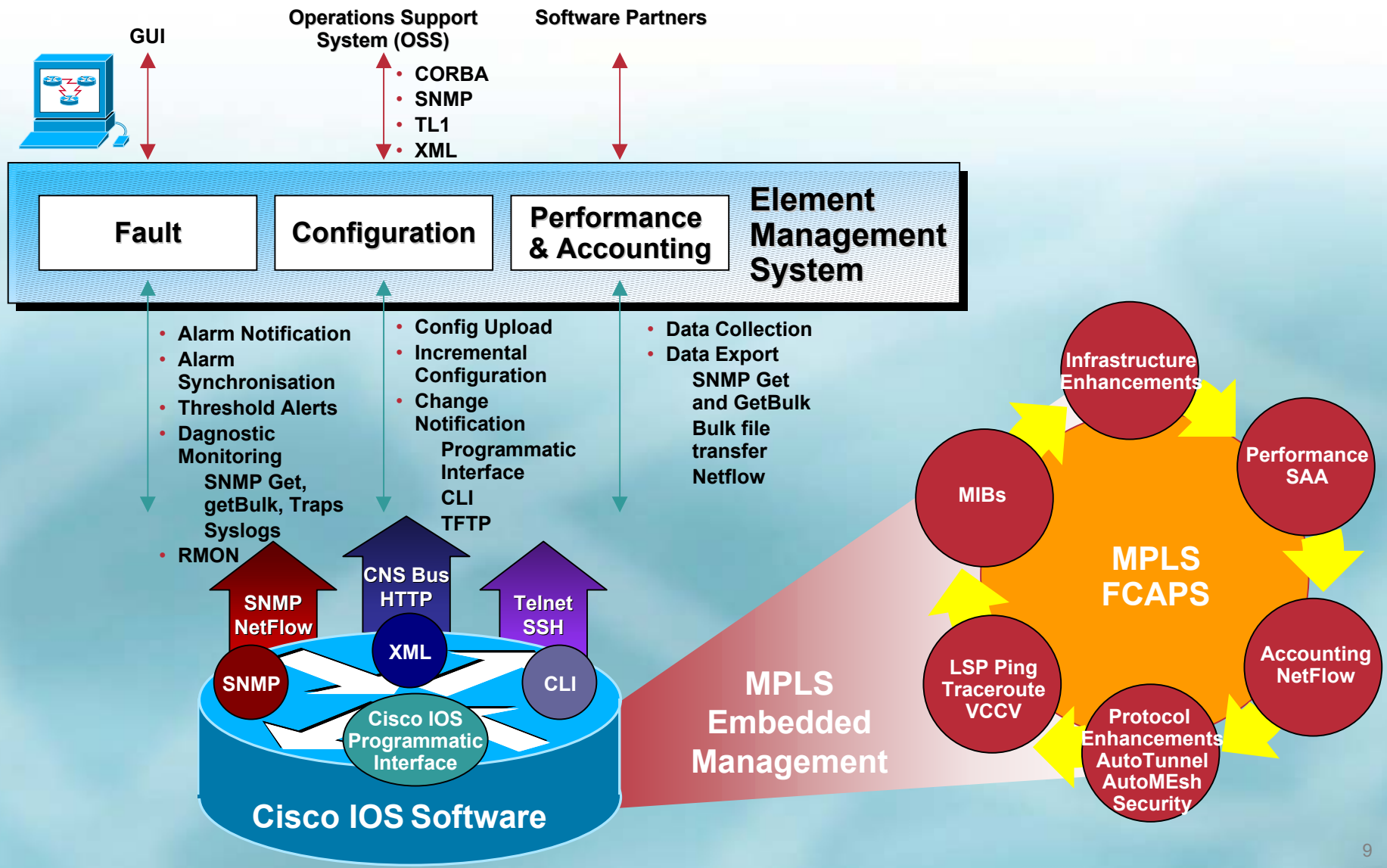
MPLS Management Life Cycle



MPLS Management Architecture

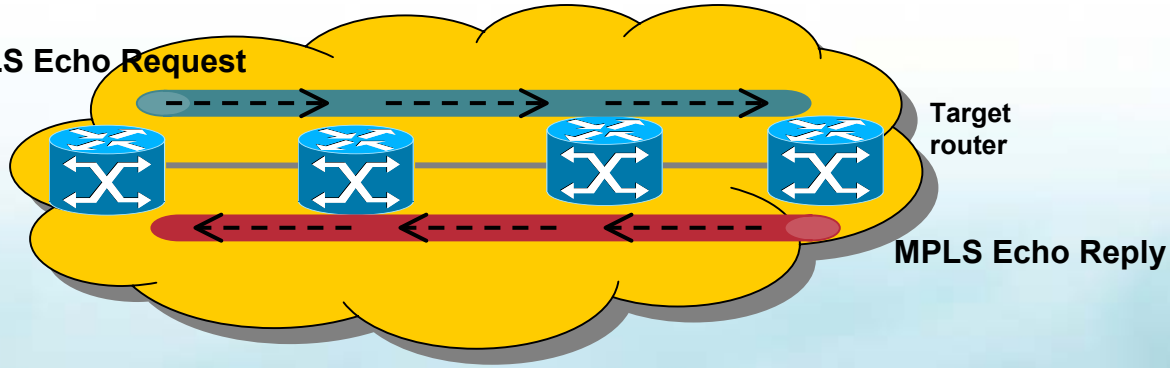


MPLS LSP Ping/Traceroute

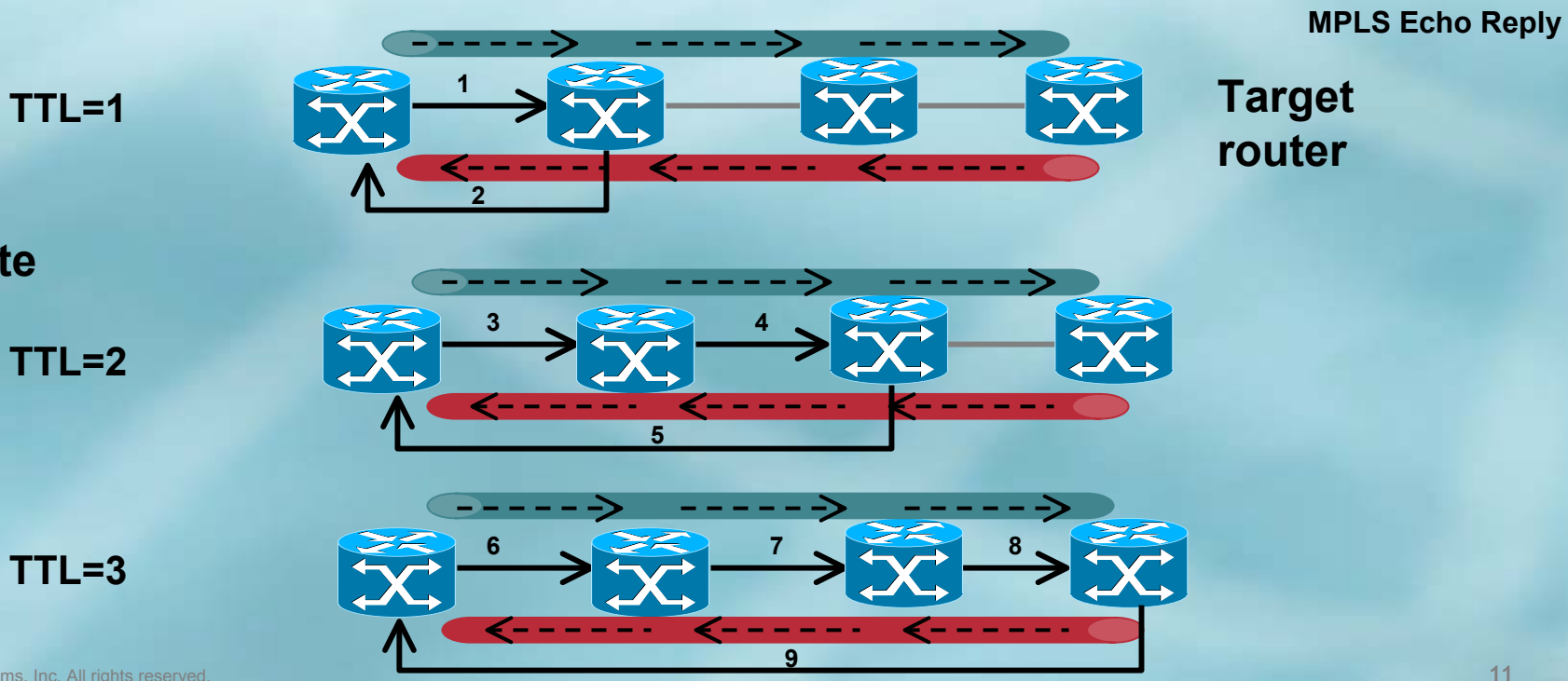
Requirement	• Detect MPLS traffic black holes or misrouting • Isolate MPLS faults • Verify data plane against the control plane • Detect MTU of MPLS LSP paths
Solution	• MPLS LSP Ping (ICMP) for connectivity checks • MPLS LSP Traceroute for hop-by-hop fault localization • MPLS LSP Traceroute for path tracing
Applications	• IPv4 LDP prefix • TE tunnel • MPLS PE, P connectivity for MPLS transport, MPLS VPN, MPLS TE applications
IETF Standards	• Draft-ietf-mpls-lsp-ping-xx.txt

LSP Ping/Traceroute Example

Ping



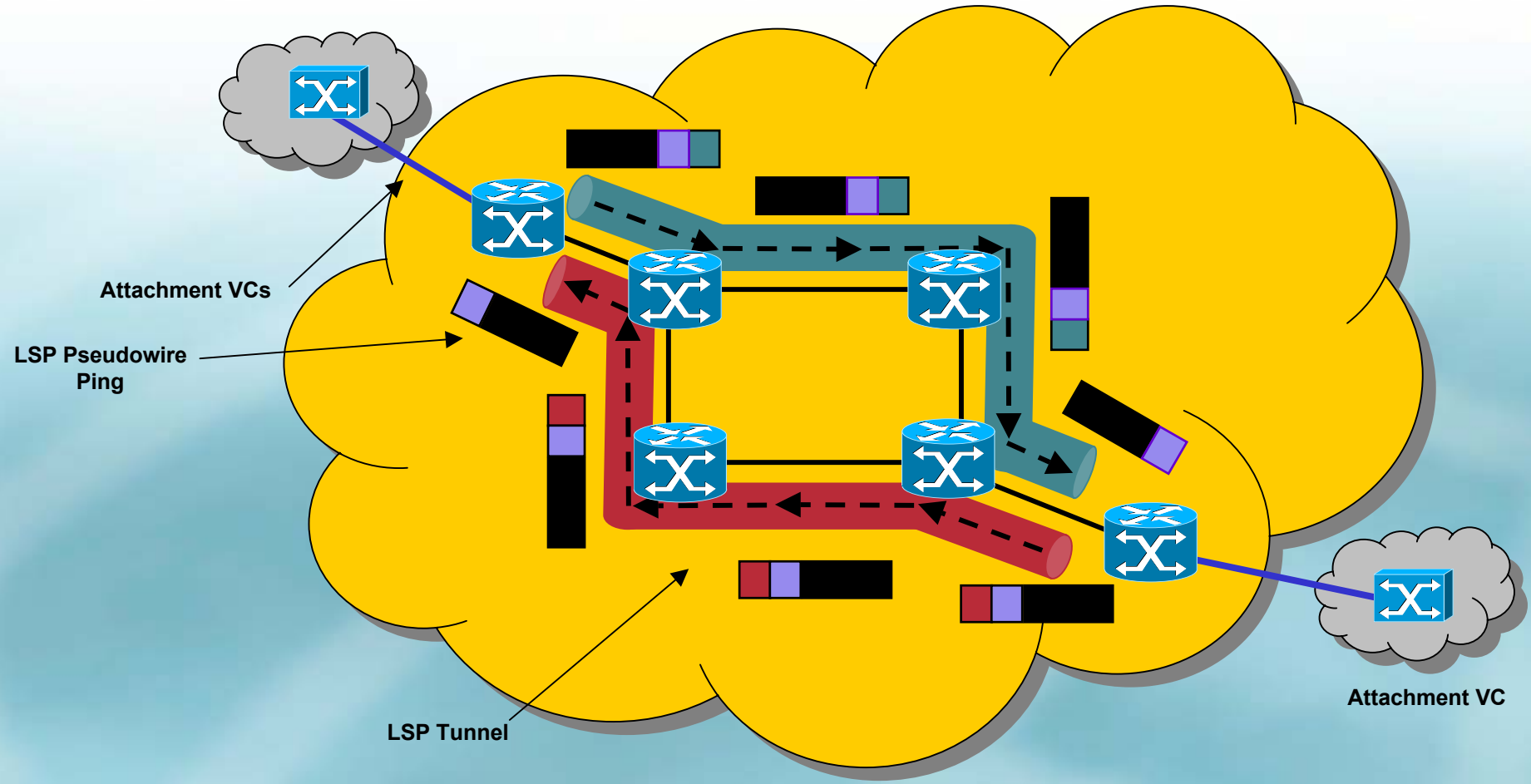
Traceroute



MPLS AToM Virtual Circuit Connection Verification (VCCV)

Requirement	• Ability to provide end-to-end fault detection and diagnostics for an emulated pseudowire service One tunnel can serve many pseudowires. MPLS LSP ping is sufficient to monitor the PSN tunnel (PE-PE connectivity), but not VCs inside of tunnel
Solution	• AToM VCCV allows sending control packets in band of an AToM pseudowire. Two components: Signaled component to communicate VCCV capabilities as part of VC label Switching component to cause the AToM VC payload to be treated as a control packet Type 1: uses Protocol ID of AToM Control word Type 2: use MPLS router alert label
Applications	• Layer 2 transport over MPLS FRoMPLS, ATMoMPLS, EoMPLS
IETF Standards	• Draft-ietf-pwe3-vccv-xx.txt

VCCV Example

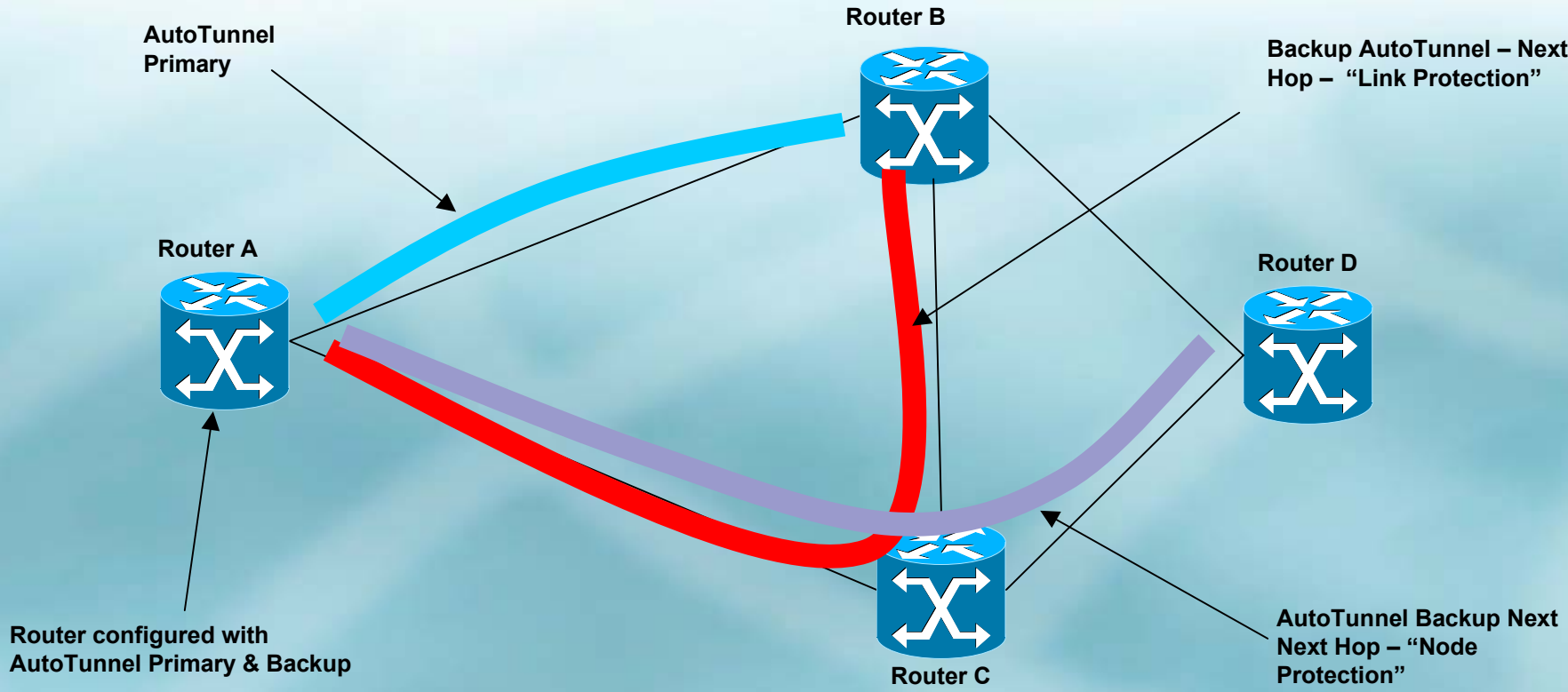


MPLS Traffic Engineering: AutoTunnel – Primary, Backup, & Mesh Groups

Requirement	• Ability to protect links and nodes with no requirement of "traffic engineering" • Need to ease configuration of "increased bandwidth inventory" MPLS TE designs such as full mesh
Solution	• Backup AutoTunnel—Enables a router to dynamically build backup tunnels • Primary one-hop AutoTunnel—Enables a router to dynamically create one-hop primary tunnels on all interfaces that have been enabled with MPLS TE tunnels • Mesh Group AutoTunnel – Enables automatic establishment of full- or partial-mesh of TE tunnels
Applications	• MPLS VPN with multiservice SLAs (voice, video, and data sites) • MPLS AToM-based Layer 2 services with "Bandwidth Assurances" • Enhanced SLA service offerings with low packet loss during failure condition – "Bandwidth Protection"
IETF Standards	• draft-ietf-mpls-rsvp-lsp-fastreroute-03.txt • draft-ietf-ospf-cap-01.txt • draft-vasseur-mpls-ospf-te-cap-xx.txt

MPLS Traffic Engineering AutoTunnel – Primary & Backup

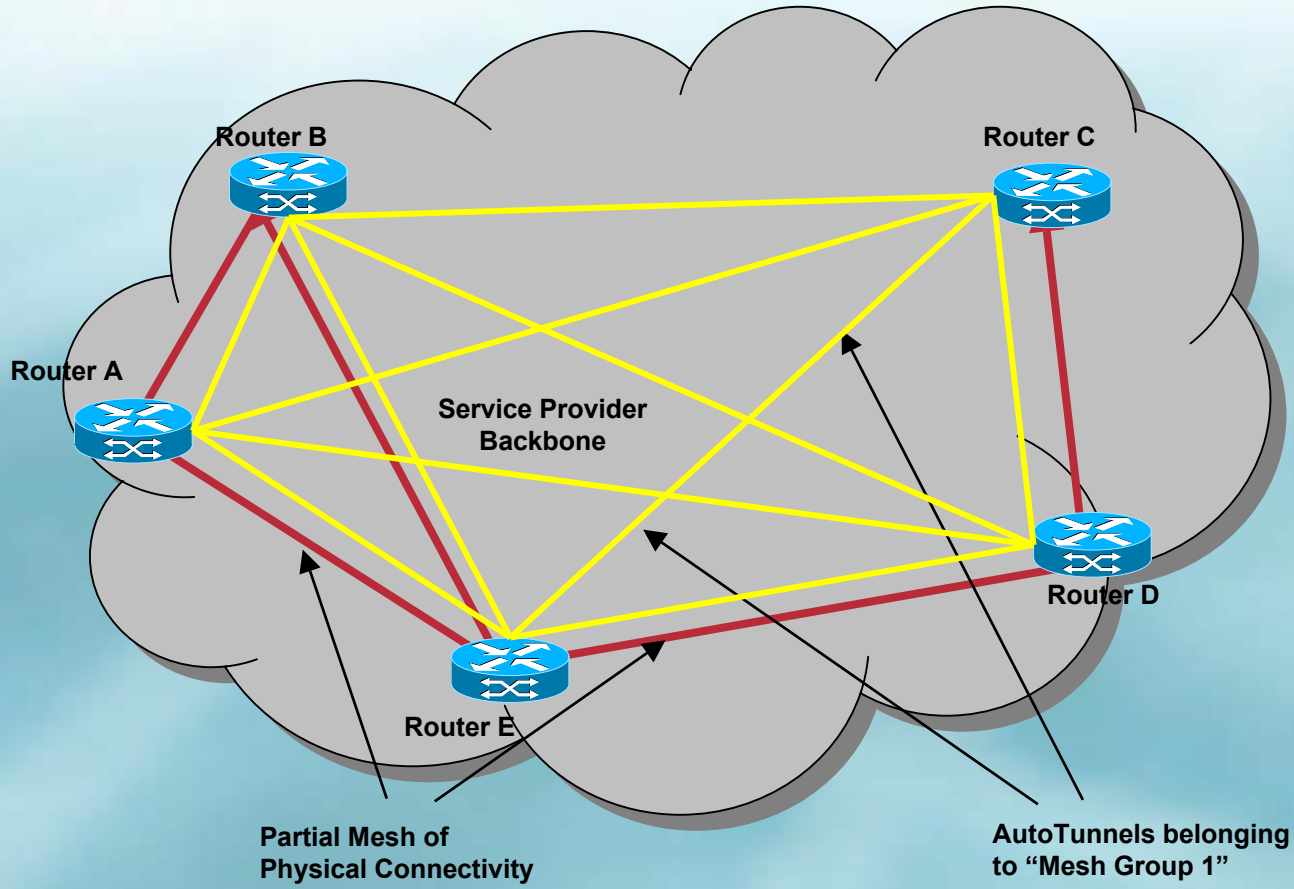
Router A establishes AutoTunnels to adjacent routers – "automates" configuration of Link & Node Protection



Manually configured Tunnels take precedence over AutoTunnels – provides "tweaking" capability for customers

MPLS Traffic Engineering AutoTunnel – Mesh Groups

Routers A, B, C, D, E – defined as members of “Mesh Group 1”
Capable of building multiple meshes for DiffServ aware Traffic Engineering
Automates configuration of full mesh of TE Tunnels resulting in operational efficiencies

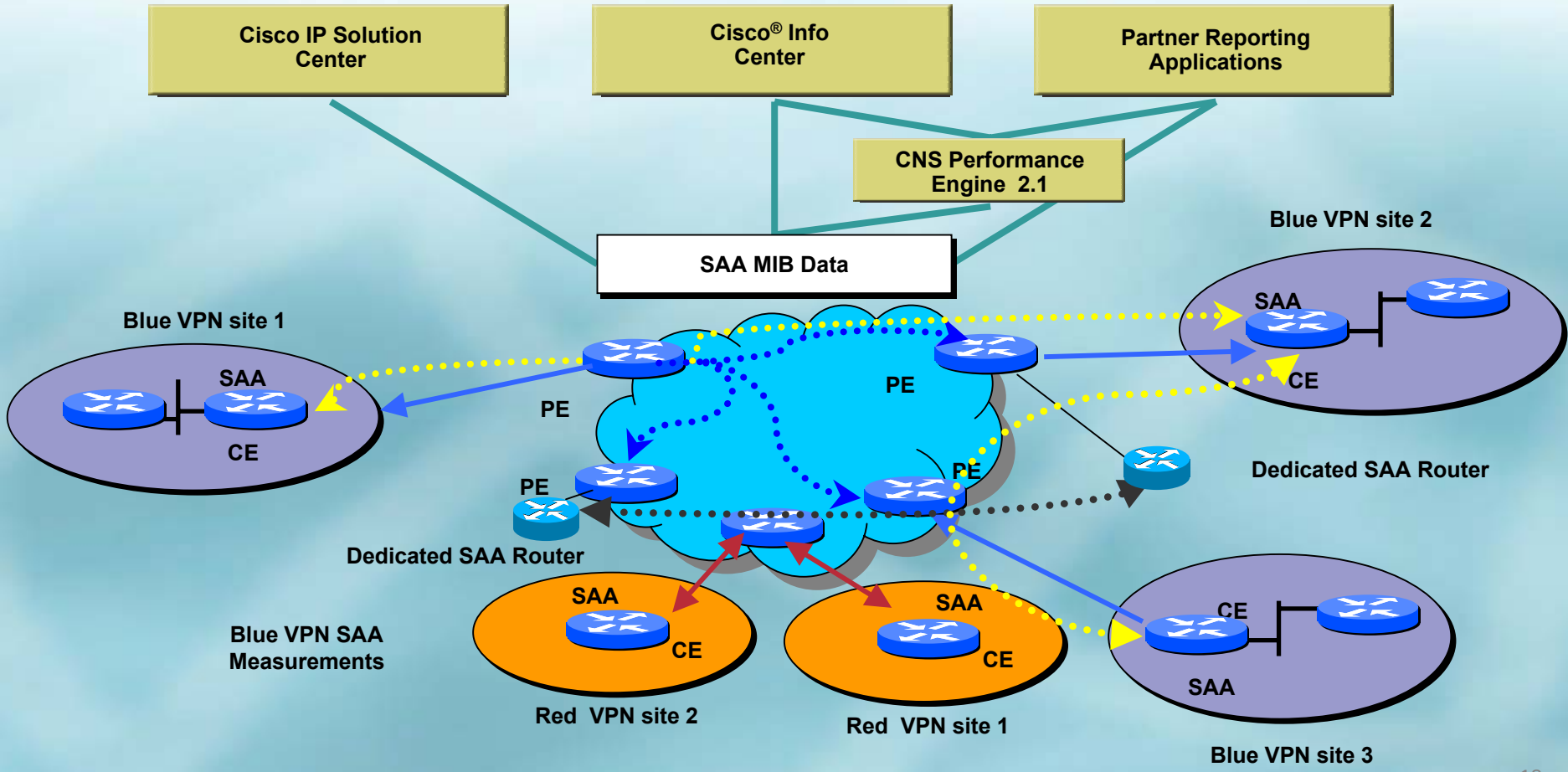


MPLS-Aware SAA

Requirement	• IP SLA monitoring for MPLS VPNs • Network performance monitoring per VPN • Hop-by-hop statistics for troubleshooting • Low-cost solution embedded in Cisco IOS® Software
Solution	• Active traffic generation within Cisco IOS using SAA • Jitter, packet loss, latency, connectivity • CPE to CPE, PE to CE, and PE to PE measurements • SAA PE, multi-vrf CE or dedicated SAA router
Applications	• MPLS, MPLS-VPN, MPLS-TE
IETF Standards	• RFC 1889 Jitter Compliant metrics

SAA VPN Measurements

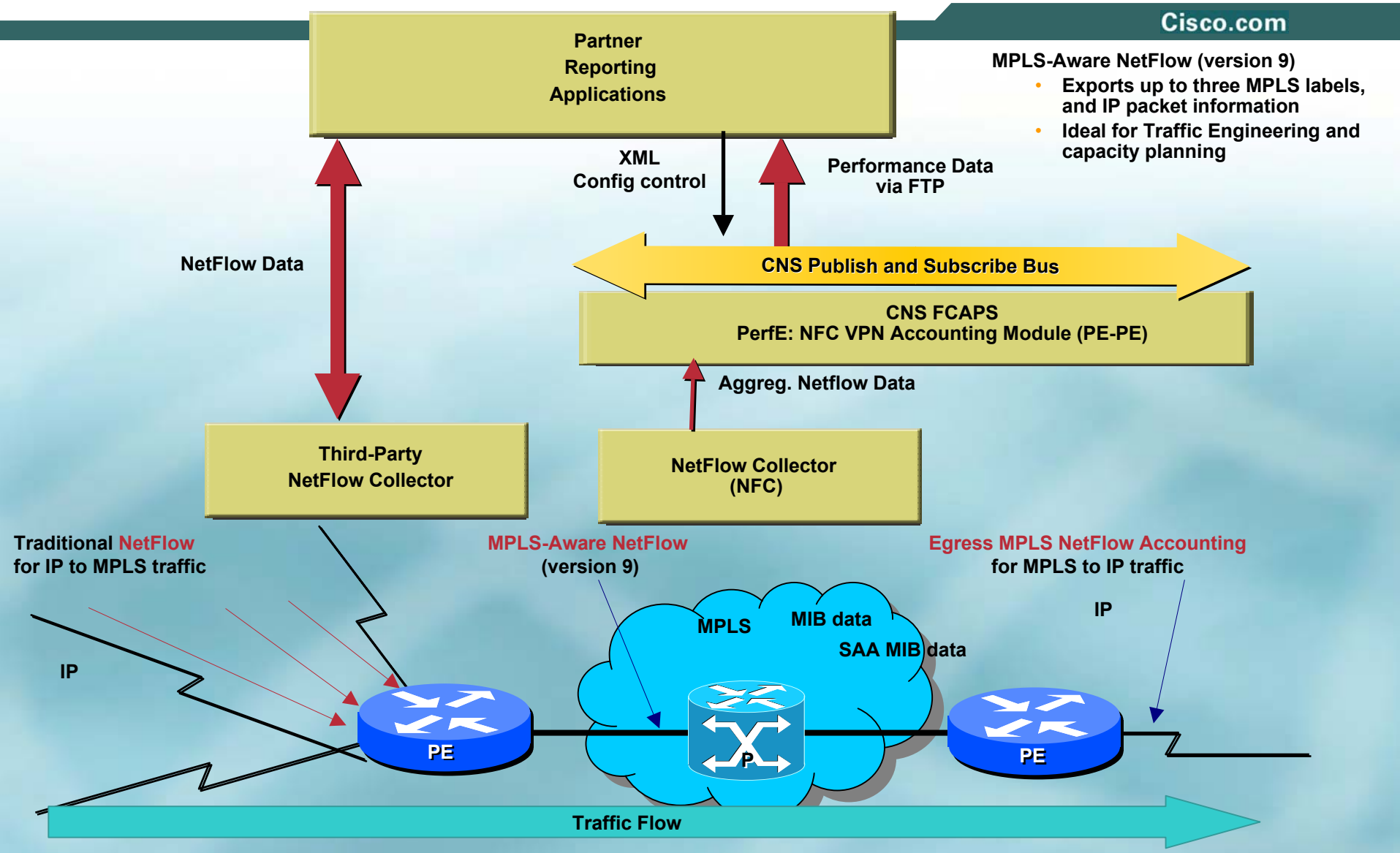
Per VPN Performance Monitoring
Packet loss, Latency, Jitter, Connectivity
- *PE to PE, CE to CE, PE to CE, PE to remote CE*



MPLS-Aware NetFlow

Requirement	• MPLS network capacity planning • PE to PE traffic matrix • Per-VPN MPLS accounting • IP flow analysis
Solution	• Cisco IOS MPLS-Aware NetFlow NetFlow version 9 Label export with destination prefix Per Label accounting aggregation • CNS NetFlow Collector 5.0 Support of EXP bits as a field to key flow reports on Using NFC 5.0 + add on PE-PE Traffic matrix module provides PE-PE traffic matrix aggregation
Applications	• MPLS, MPLS-VPN, MPLS-TE
IETF Standards	• IPFIX WG proposed standard

MPLS-Aware NetFlow

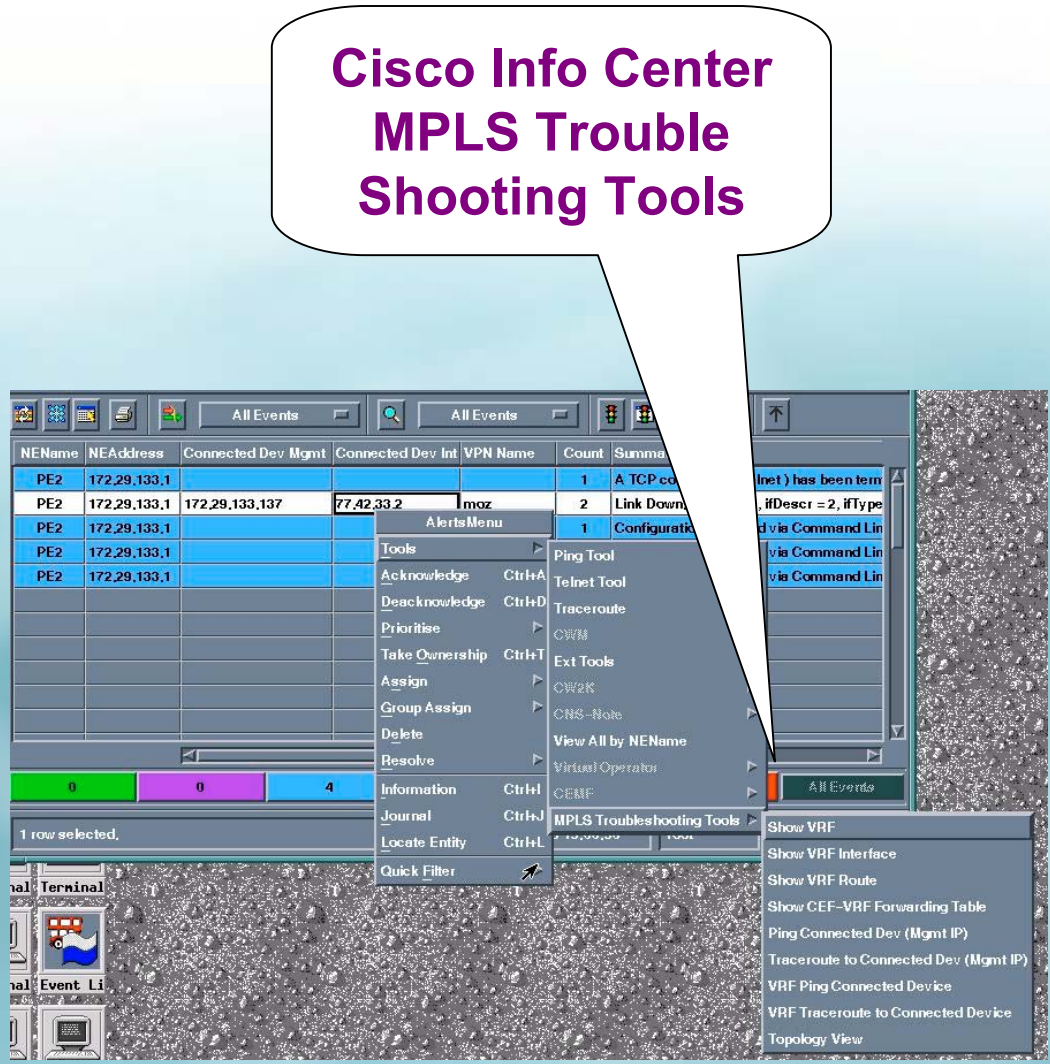


MPLS MIBs

Requirement	• Standards-based SNMP implementation • Integration with existing OSS and third-party vendors/software
Solution	• MIBs: LDP, LSR-MIB, TE-MIB, PPVPN-MPLS-VPN-MIB, PWE3-MPLS-MIB, MPLS-FRR-MIB
Applications	• MPLS, MPLS-VPN, MPLS-TE
IETF Standards	MPLS-LSR-STD MIB, MPLS-TE-STD MIB, MPLS-FTN-STD MIB, MPLS-LDP-STD MIB, MPLS-TC-STD MIB

Cisco Info Center: VPN Policy Manager 3.1

- Cisco Info Center VPN Policy Manager (Cisco Info Center and IP Solution Center integration) correlates network events to affected services
  - CIC VPN Policy Manager available today
- Cisco Info Center VPN Policy Manager 3.1 offers:
  - New Cisco Info Center VPN Policy Manager DSA developed
  - New Cisco Info Center VPN Policy Manager policies developed
  - Device/Interface/Sub-interface MPLS VPN subscriber correlation
  - MPLS troubleshooting tools



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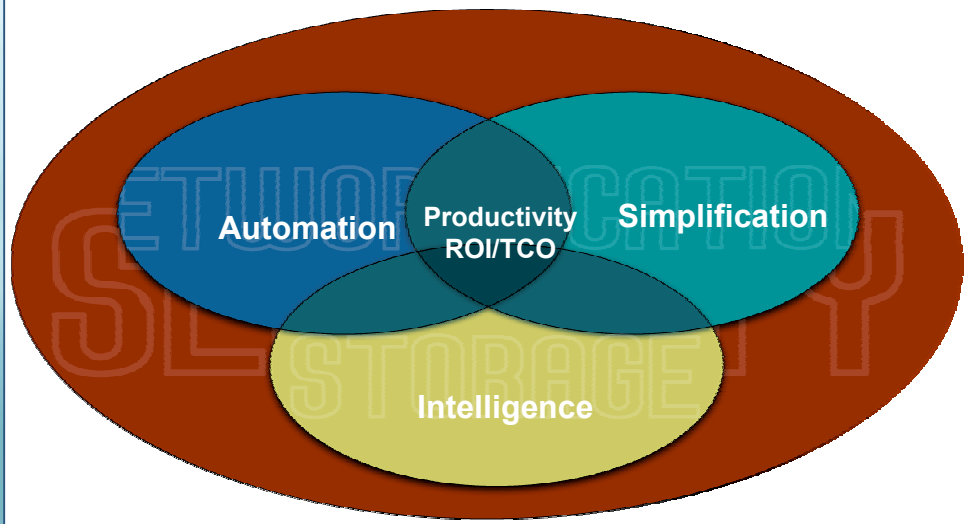
Summary

- Provide systemic, integrated, and innovative manageability solutions
- Standards-based open interfaces for easier and faster integration
- Complete end-to-end MPLS service and network management solutions



Cisco leads in the MPLS Market

Cisco.com

Americas	EMEA	AsiaPac/Japan

Over 200 Customers (MPLS Core & L2/L3 Edge)

Cisco IOS MPLS