Cisco IOS Software Release 12.2(33)SXH Introduction

August, 2007

Agenda

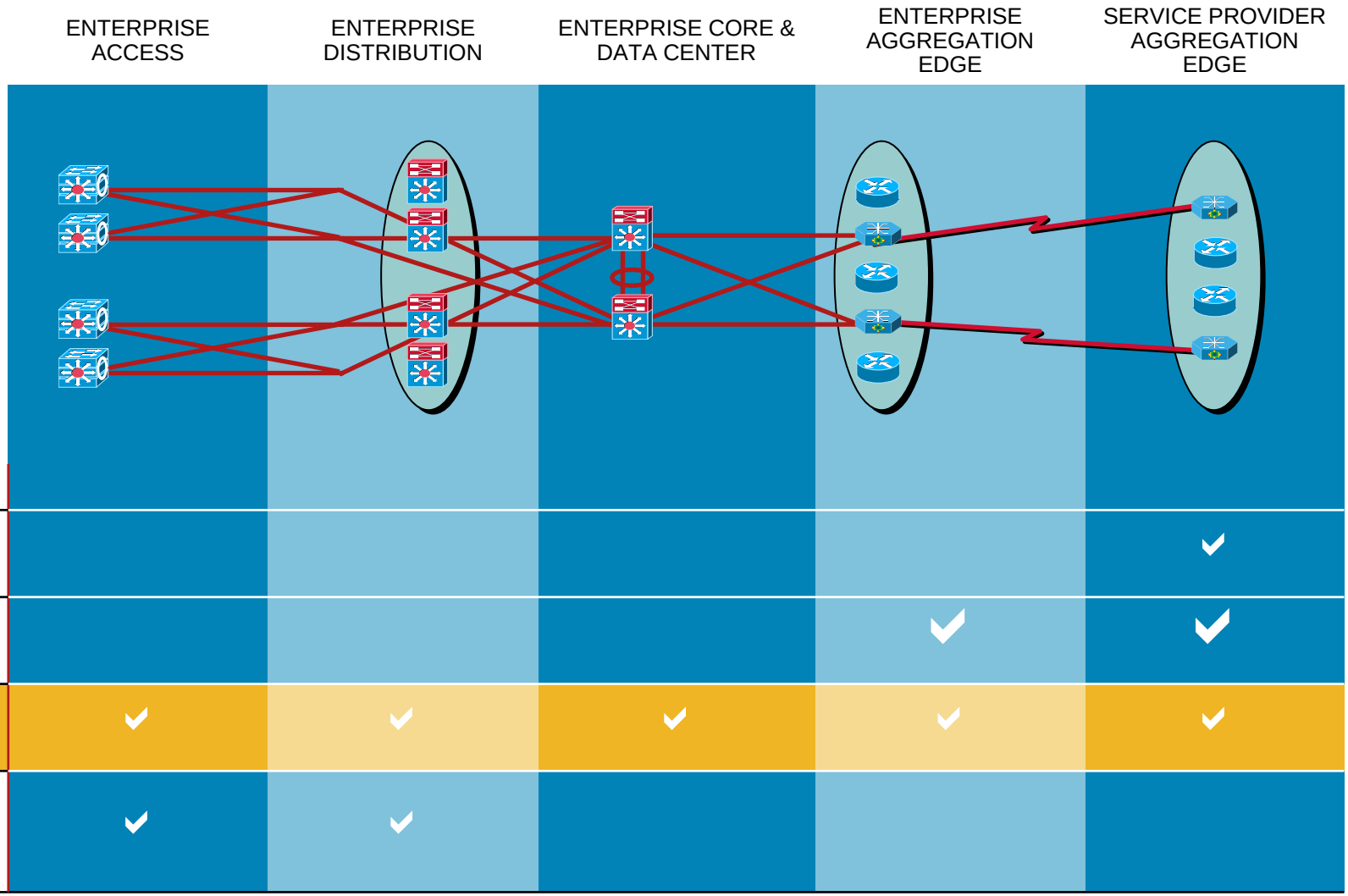
- Introducing Cisco IOS® Software Release 12.2SX
- Release 12.2(33)SXH Highlights
- Release 12.2(33)SXH Availability and Migration
- Summary

Cisco IOS Software Release 12.2SX

Delivering industry-leading advancements for innovative secure, converged services, from the wiring closet to the core to the data center to the WAN edge

- **Provides leading-edge new features, software modularity, high availability, and hardware support for the Cisco Catalyst 6500 Series Switch**
- **Delivers features that support scalable, end-to-end LAN and WAN solutions for Enterprises, as well as Service Provider deployments such as Metro Ethernet**
- **Integrates Cisco IOS Software innovations spanning multiple technology areas, including Security, High Availability, QoS, MPLS and VPNs, IP Addressing and Services, IPv6, IP Routing & Multicast, and Embedded Management**
- **Leverages Release 12.2S family infrastructure innovation and technology leadership**

Release 12.2SX
Key Member of the Release 12.2S Family



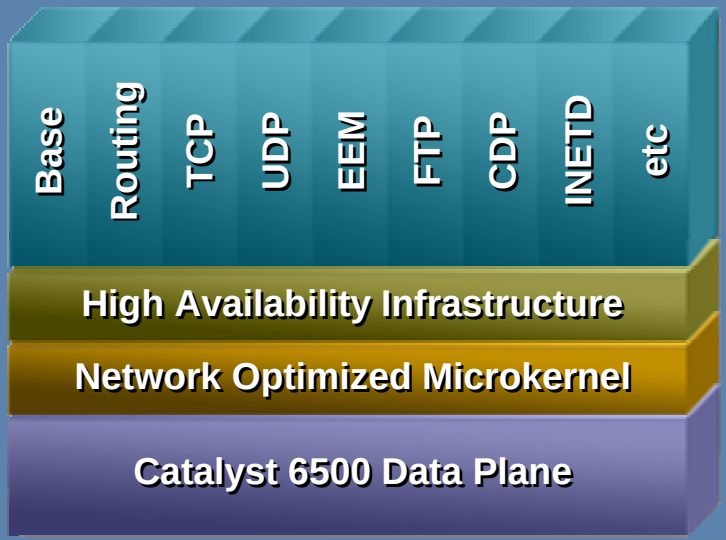
Release 12.2SB Broadband & Leased-Line Aggregation, MPLS PE					✓
Release 12.2SR High-end Metro Ethernet, MPLS PE				✓	✓
Release 12.2SX **High-end Ethernet LAN switching, Metro Ethernet**	✓	✓	✓	✓	✓
Release 12.2SE & 12.2SG Mid-range and low-end Ethernet LAN switching	✓	✓			

Release 12.2SX: Catalyst 6500 Cisco IOS Software Modularity

Innovations and Benefits

INNOVATION

Cisco IOS Software Modularity



- Memory protection
- Fault containment
- Stateful process restarts
- Subsystem ISSU

BENEFITS

Catalyst 6500 Series with Cisco IOS Software Modularity

- Minimize Unplanned Downtime
- Simplify Software Changes
- Automated Policy Control

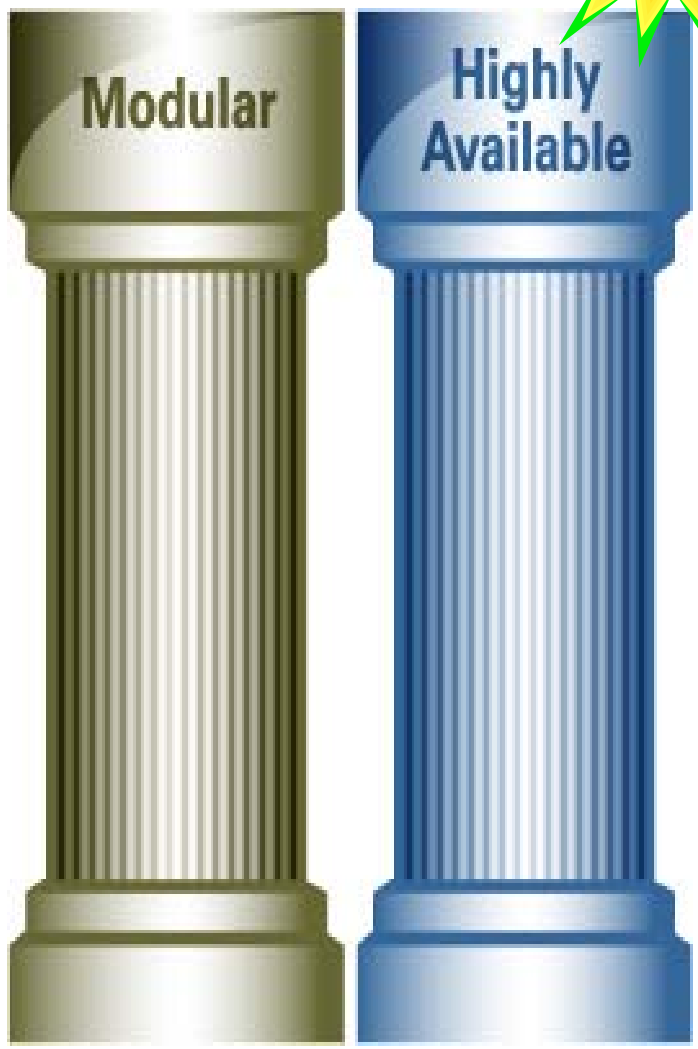
New in Release 12.2(33)SXH Modularized IPv6 and MPLS Support

Q: What does IPv6 and MPLS modularization mean?

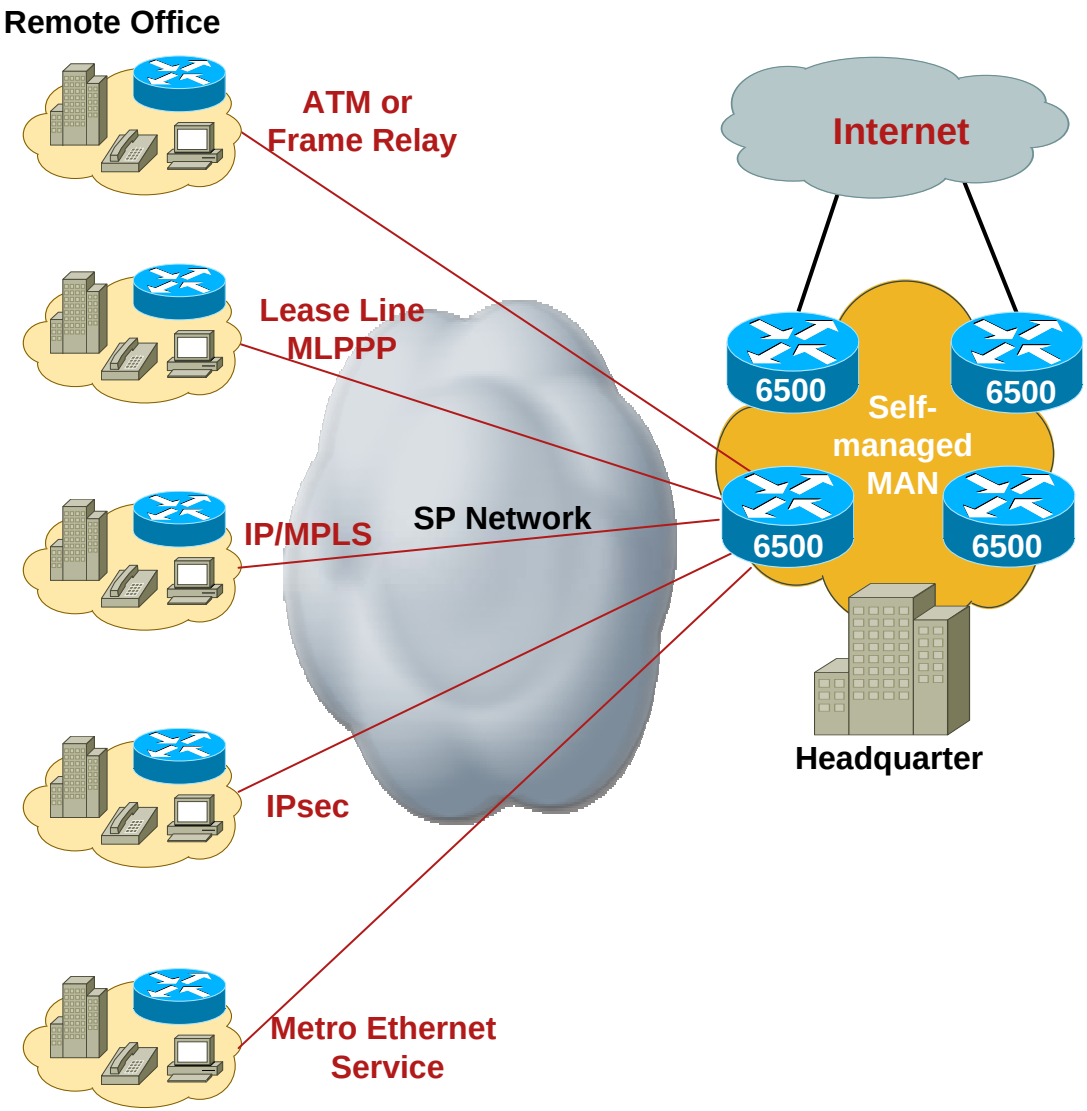
- **Modularization in SXH moves certain IPv6 routing and L3 VPN control plane software components to the iprouting process**
  - **IPv6 routing protocols (RIPng, OSPFv3, etc.)**
  - **L3 VPN control plane components (BGP MPLS/VRF related code)**
- **Remaining components continue to reside in ios-base process**
  - **IPv6 neighbor discovery, IPv6 multicast, etc.**
  - **MPLS TE, FRR, AToM, etc.**

Q: Can I still use other non-modularized IPv6 and MPLS features in SXH?

- **Yes – Other IPv6 and MPLS features supported on Catalyst 6500 have been enhanced so they are "co-existent"**



Catalyst 6500 Release 12.2SX Enterprise WAN – Positioning



Traditional WAN Aggregation

- High Port Density, High Performance
- WAN Interfaces from DS0 to OC48
- Sophisticated QoS support: LLQ, cRTP, LFI, MLPPP,FRF.16

IPsec Aggregation

- Support up to 16000 tunnels per chassis
- Stateful failover support for IPsec tunnels, DMVPN support in HW
- QoS over static IPsec Tunnel support in HW

Virtualization in the Enterprise

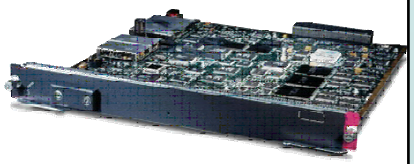
- Complete layer-2 and layer-3 MPLS VPN Solution
- Up to 1000 VRF support
- Alternative IP-based virtualization solutions

Distribution or core network

- Full support for self-managed MAN with features like QinQ and VPLS
- High Performance with services enabled: ACL, QoS and Security
- HW-assisted Security solution: FWSM,sIPSec SSC/SPA

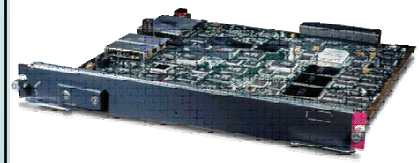
Catalyst 6500 Release 12.2SX Services Modules Portfolio

Firewall



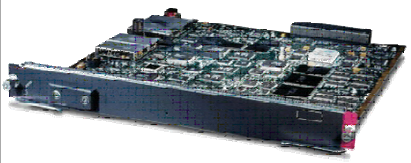
- 5.5 Gbps Throughput
- Routed or Transparent
- Active/Active
- Multicast
- 250 Context/Module
- Application Firewall
- IPv6 Phase 1

Wireless LAN



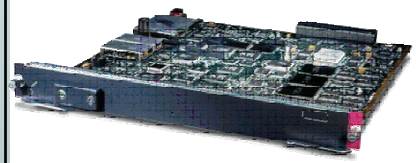
- Converge wireless and wired infrastructure
- Scalability to 3600 AP's per cluster; 1500 AP's per chassis; and 300 AP's per module
- Layer 3, N+1 redundancy

ACE



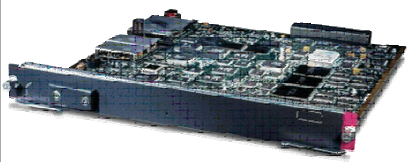
- SLB
- SSL Offload, TCP Offload
- Virtualization & RBAC
- Application Acceleration
- Application Security
- 16 Gig

Intrusion Detection



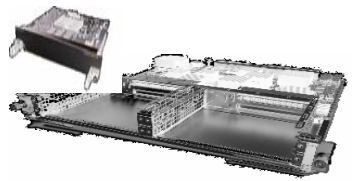
- Simultaneously monitor multiple VLANs
- Unlimited VLAN support
- Transparent via passive promiscuous operation

Network Analysis



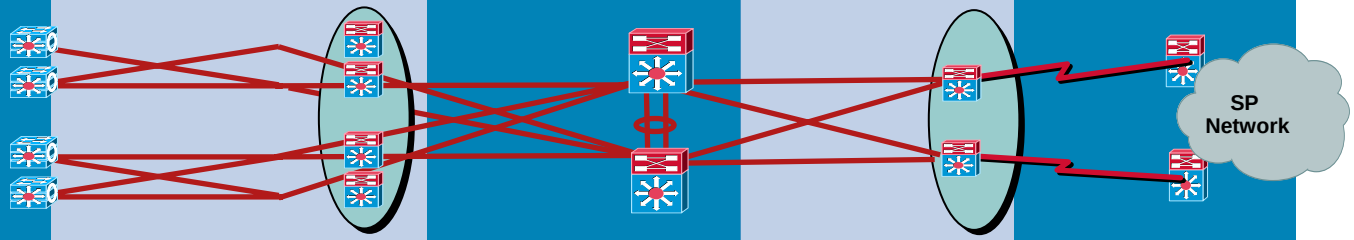
- L2-7 protocol visibility, analysis and decode
- Real-Time and historical statistics
- Capture & Reports export
- MPLS tag monitoring

IPsec VPN SPA



- 2.5 Gbps Throughput
- Feature parity with VPNSM
- AES (128, 192, 256-bit key sizes)
- Jumbo Frame support

Introducing Release 12.2(33)SXH for the Cisco Catalyst 6500 Series Switches – Key Features



	ENTERPRISE ACCESS	ENTERPRISE DISTRIBUTION	ENTERPRISE CORE & DATA CENTER	ENTERPRISE AGGREGATION EDGE	CARRIER ETHERNET
Switching Platform Leadership	▪ Cisco IOS Software Modularity	▪ VSS capable DFC3C ▪ Software Modularity ▪ Wide array of 1G, 10G interfaces	▪ Routing enhancements ▪ VSS capable DFC3C ▪ Software Modularity ▪ Wide array of 1G and 10G interfaces	▪ High Performance WAN Interfaces (DS0 to OC48)	▪ Flexible Interface Types
Unified Network Services	▪ Wide Array of PoE, 10/100/1000 modules ▪ MAC move notification	▪ NAC ▪ IPv6 Multicast Enhancements ▪ L2VPN enhancement	▪ Wireless Services Module (WiSM) ▪ IPv6 Multicast Enhancements	▪ MPLS Enhancements ▪ Inter-AS Support, ▪ Extranet Multicast VPN	▪ ME 6524 with software modularity ▪ L2, L3 and MPLS integration into single platform
Non-stop Communication	▪ Flexlinks ▪ LACP 1-1 redundancy	▪ Hot Standby Fabric sync ▪ HSRP and GLBP SSO ▪ Enhanced Object tracking	▪ Hot Standby Fabric ▪ Enhanced Object tracking ▪ BFD	▪ Graceful Restart, ▪ Session Protection, ▪ Hot Standby Fabric sync	▪ Graceful Restart, ▪ MPLS FRR link and Node protection ▪ Multiplexed UNI
Operational Manageability	▪ Smart-Ports ▪ IP Phone Power Limiting	▪ IP SLA ▪ EEM ▪ Distributed ERSPAN	▪ IP SLA ▪ Smart Call-Home ▪ EEM	▪ IP SLA ▪ Smart Call-Home	▪ E-OAM (802.1ag & 802.3ah ▪ MPLS MIB
Virtualization	▪ VRF Lite	▪ VRF Lite	▪ VRF aware Syslog	▪ MPLS and MPLS TE Enhancements ▪Scalable EoMPLS	▪ Traffic segregation features – private hosts
Application Intelligence Fluency	▪ AutoQoS	▪ Per interface NDE ▪ NetFlow Top Talkers ▪ Multicast NDE	▪ NetFlow Top Talkers ▪ Per interface NDE	▪ Sophisticated QOS support with LLQ, cRTP, LFI, MLPPP	▪Sophisticated QoS support for optimized Triple Play services
Integrated Security	▪ Identity-Based networking services	▪ Policy-Based ACLs ▪ IGMP Filtering ▪ Multicast Router Guard	▪ Policy-Based ACLs ▪ IGMP Filtering ▪ Multicast Router Guard	▪ 16K IPsec tunnels ▪ DMVPN support in HW	▪ Address spoofing prevention ▪ Hardware accelerated security features

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Release 12.2(33)SXH Highlights
New Hardware Support

Release 12.2(33)SXH is designed for Enterprise campus and Service Provider edge Catalyst 6500 deployments that require world-class IP and MPLS, high availability, WAN/LAN services, embedded management, and software modularity.

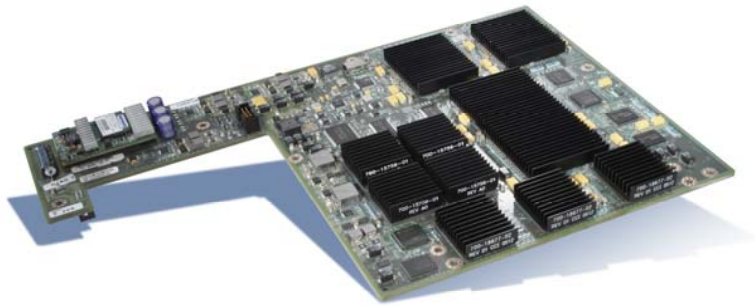
- **Powerful New Hardware Support**
  - **Distributed Forwarding Card, IP 16-way ECMP, SPAN Enhancements, Cisco IOS Software Modularity for SIP-200, SIP-400, and Enhanced FlexWAN SPAs**
- **MPLS LDP Enhancements**
  - **MPLS LDP Session Management, Label Signaling and Assignment, Graceful Restart, Session Protection, MPLS High Availability**
- **MPLS Traffic Engineering Enhancements**
  - **AutoTunnel Primary/Backup, AutoTunnel Mesh Groups, Class-Based Tunnel Selection, Fast Re-Route Link/Node/Bandwidth Protection, Inter-AS TE, Inter-AS TE Fast Re-route, Inter-AS TE Authentication and Policy Control, MPLS TE LSP Attributes, MPLS TE Verbatim Support, Shared Risk Link Groups**
- **L2 VPN Enhancements**
  - **AToM Tunnel Selection, AToM Pseudowire Provisioning, Ethernet over MPLS, Frame Relay over MPLS, L2 Local Switching, Multiplexed UNI**
- **MPLS Management Enhancements**
  - **MPLS LDP MIB , MPLS VPN MIB, Support for MPLS TE FRR MIB, MPLS OAM support, MPLS HA support for MPLS MIBs**
- **Quality of Service (QoS) Enhancements**
  - **Cisco IOS AutoQoS**
- **IP Services Enhancements**
  - **HSRP/GLBP Stateful SwitchOver (SSO), EOT for FHRP, HSRP/GLBP MD5 Authentication**
- **Routing and Multicast Enhancements**
  - **OER, BGP: Dynamic Neighbors, Multicast VPN Inter-AS Support, Extranet Multicast VPN, IPv6 Multicast Enhancements, IPv6 MLD Access Group Filtering for (S,G), IPv4 Extended ACL Support for IGMP to support SSM, Auto-RP Enhancement, Multicast SNMP MIB, MSDP Compliance with IETF RFC 3618, Multicast HA: Triggered PIM Join(s), Multicast Router Guard, Enhanced IPv6 Multicast Shared Tree Performance in Hardware, IGMP Filtering and Snooping Access Control**
- **Embedded Management Enhancements**
  - **NetFlow Top Talkers, CISCO-NETFLOW-MIB, IPv4 Multicast NDE Using NetFlow V9, NetFlow for IPv6, Per-Interface NetFlow, LLDP-MED, IOS Configuration Rollback/Replace, Embedded Syslog Manager, Netconf Support over SSH2, TCL Scripting, SNMP Periodic Data Collection and Transfer, Cisco IOS IP SLAs, IEEE 802.3ah – Link OAM, IEEE 802.1ag Connectivity Fault Management (CFM), Smart Call Home, SPAN enhancements**
- **Integrated Security Enhancements**
  - **IBNS (802.1x) Enhancements, Policy-Based ACLs (PBACL), AutoSecure, Private Host, IP Source Guard**

Distributed Forwarding Card 3C/3CXL

Hardware

Key highlights:

- **Supports System Virtualization via VSS 1440**
- **Supports all the functions that DFC3B and DFC3BXL support**
- **Deployed in CEF720 line cards such as WS-X6704-10GE, WS-X6724-SFP, WS-X6748-SFP, and WS-X6748-GE-TX**



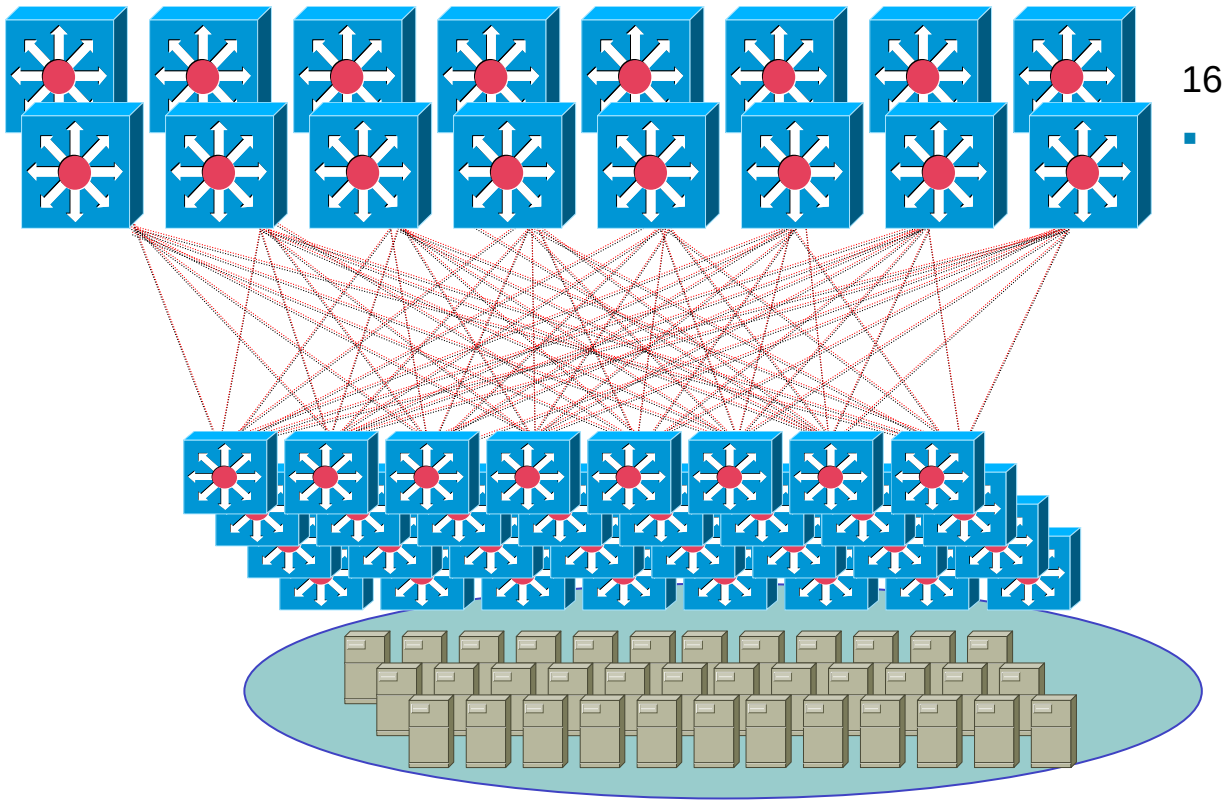
Feature	Cisco Distributed Forwarding Card (DFC3C)	Cisco Distributed Forwarding Card (DFC3CXL)
VSS	Yes	Yes
MAC Entries	96,000	96,000
Memory	512M	1G
IP Routes	256,000 entries	1,000,000 entries
NetFlow Entries	128,000 entries	256,000 entries

16-Way Equal-Cost Multipath Load Sharing

- Enables new higher-density High Performance Computing (HPC) Data Center designs
  - Earlier designs scale-limited due to 8-way load-sharing limit prior to Release 12.2(33)SXH
  - Content-provider customers pushing for ever-denser deployments to interconnect clustered applications (ie: “search”)
  - Key is managing oversubscription levels
- All PFC3 versions provide hardware support for 16-way Equal-Cost Multipath (ECMP) load sharing
- Configured with “maximum-paths” under routing process, or via static routes

Cluster Configuration with 16-Way ECMP and 6704-10GE

Hardware



16 Core 6509s

- 32 10GE ports, 1 to each Access

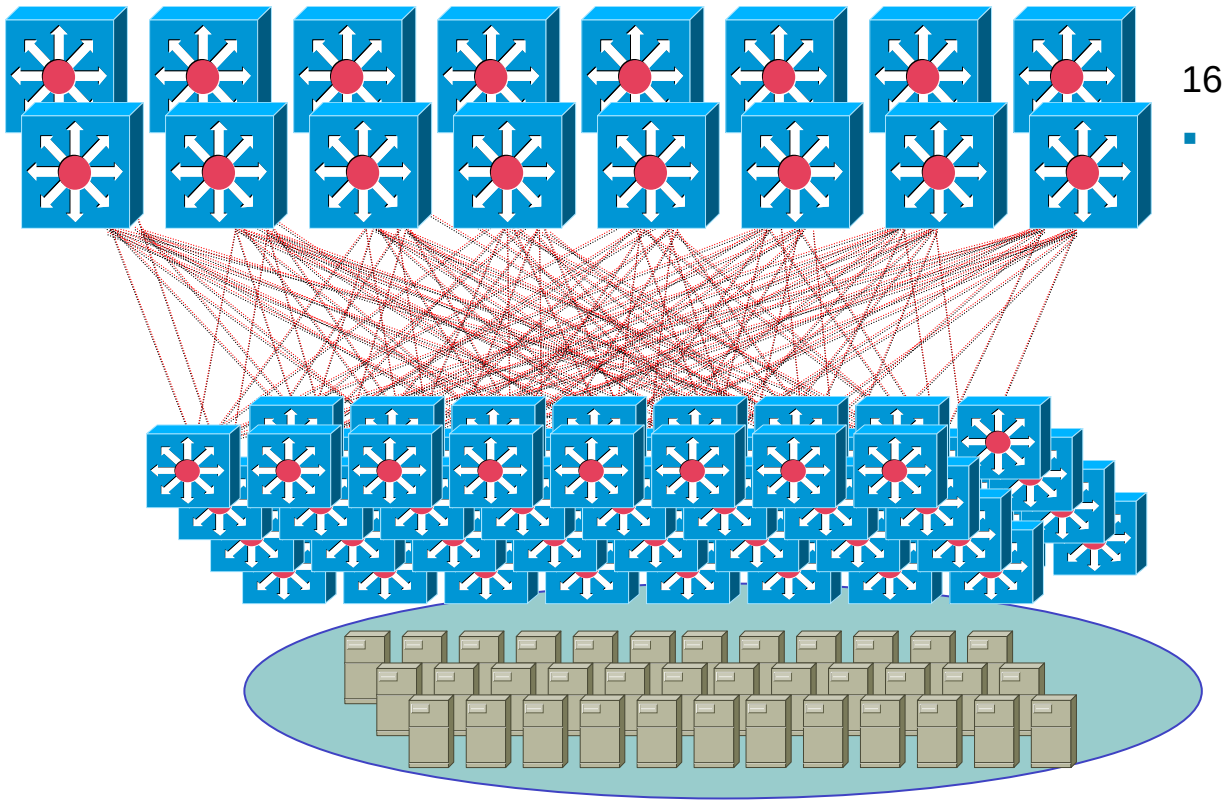
32 Access 6513s

- 16 10GE links each using 4 dual channel slots (using 4 ports/slot)
- 1 48port GE Blade using dual channel slot (using 40 ports/slot)
- 7 24port GE Blades using single channel slots (using 20 ports/slot)
- 180 ports per chassis

- All slots using DFC3-enabled 6704, 6748, 6724 modules
- 180G from servers, 160G toward core = 1.125 : 1 oversubscription
- 160G core-facing bandwidth, 180 servers = 888 Mbps per server
- 32 Access 6513s * 180 ports each = 5,760 GE-attached servers

Cluster Configuration with 16-Way ECMP and 6708-10GE

Hardware



16 Core 6509s:

- 64 10GE ports, 1 to each Access

64 Access 6513s:

- 16 10GE links each using 2 dual channel slots (using 8 ports/slot)
- 3 48port GE Blade using dual channel slot (using 40 ports/slot)
- 7 24port GE Blades using single channel slots (using 20 ports/slot)
- 260 ports per chassis

- All slots using DFC3-enabled 6708, 6748, 6724 modules
- 260G from servers, 80G toward core = 3.25 : 1 oversubscription
- 80G core-facing bandwidth, 260 servers = 308 Mbps per server
- 64 Access 6513s * 260 ports each = 16,640 servers attached with GE

Cisco IOS Software Modularity Support for Catalyst 6500 SIP-200 and SIP-400 SPAs

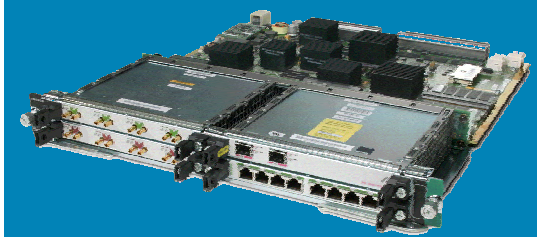
Hardware

SIP-200

1.1 Mpps
622 Mbps with Services

7500 Feature Parity
4 SPA Bays

Dual CPU-based



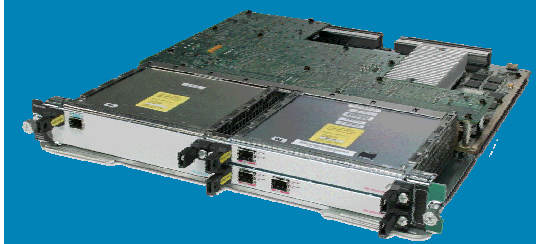
cRTP
LFI—ATM, FR, MLPPP
Classification, Marking
CBWFQ/LLQ
WRED
Hierarchical TS

T1/E1, T3/E3, OC-3, CT3

SIP-400

6 Mpps
4 Gbps with Services

32,000 full duplex queues
4 SPA Bays
Dual Network Processors



3-Level Hierarchical Shaping
Dual-rate, 3-Color Policing
CBWFQ + LLQ with WRED

AToM Functionality (Ethernet, ATM (AAL5 and Cell Relay, FR)

GE, OC-3/OC-12, POS & ATM

New SPA Support
- 1xOC48 POS
- 4xFE
- 8xFE
- 1xChSTM1/OC3

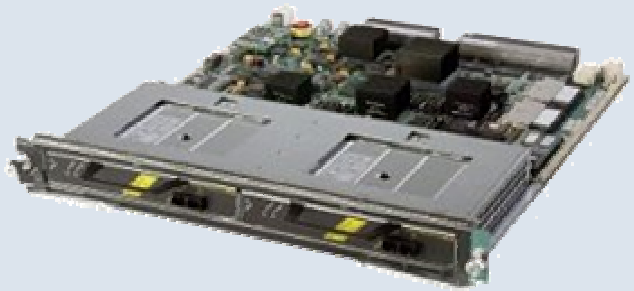
For complete SIP/SPA support, visit the link below

Cisco IOS Software Modularity Support for Catalyst 6500 Enhanced FlexWAN

Hardware

Enhanced FlexWAN Module

- Cisco 7500 to Catalyst 6500 Migration
- Provides investment protection for 7200/7500 PAs
- Low-speed WAN connectivity
- Rapid feature development: New services with microcode or software upgrade



Enhanced FlexWAN Module Features

- Versatile Interface Processor (VIP) Feature Parity and Enhancement: Buffering in Eos, new feature for metro-solution like MPB, same port local switching, etc.
- Link efficiency features supported such as cRTP, LFI, FRF.12, and FRF.16
- OIR support for Enhanced FlexWAN Module

Investment Protection

Common 7xxx Port Adapters (PAs)

Cisco 7500 to 6500 Migration

VIP Feature Parity

Performance

625 Kpps

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MPLS LDP Enhancements

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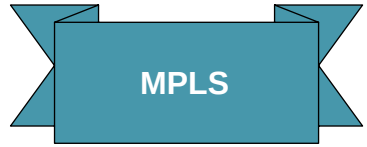
MPLS Label Distribution Protocol (LDP)

- Standards-based MPLS LDP signaling based on RFC 3036
- Allocation and distribution of MPLS label information between Label Switched Routers (LSRs)
- Two distribution modes supported
  - Downstream Unsolicited (DU)
  - Downstream On Demand (DoD)
- Independent and Ordered mode support
- LDP Hello adjacencies and sessions
  - Link Hellos
  - Targeted Hellos

MPLS LDP - New Features in Release 12.2(33)SXH



- **MPLS LDP Session Management, Label Signaling and Assignment**

  MPLS LDP support for Static Labels and VRF-aware Static Labels

  Static bindings between MPLS labels and IPv4 prefixes to support MPLS hop-by-hop forwarding through neighbor router nodes that don't support LDP label distribution

- **MPLS LDP High Availability**

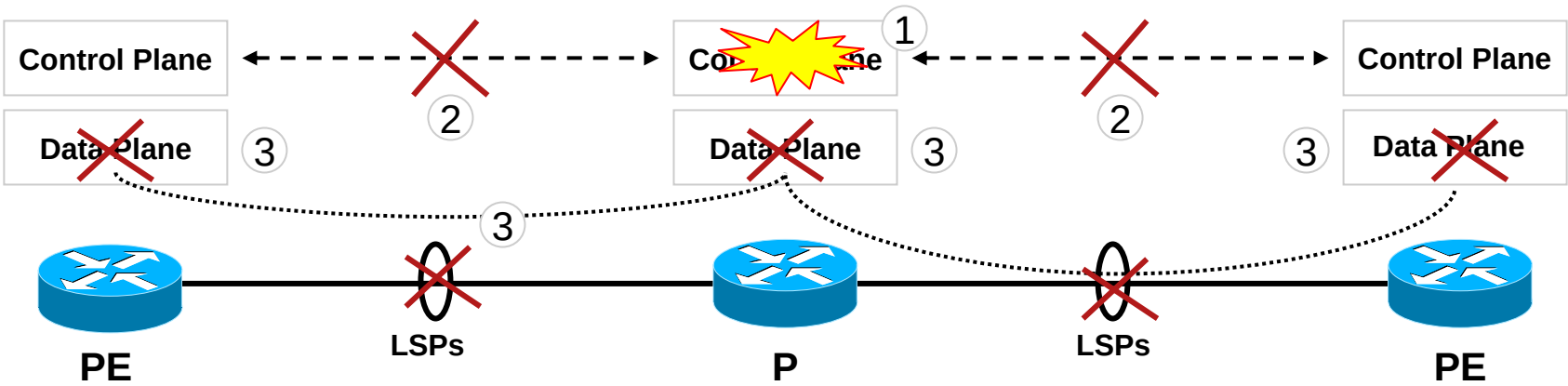
  MPLS LDP – Graceful Restart (GR) Support

  MPLS LDP – Session Protection

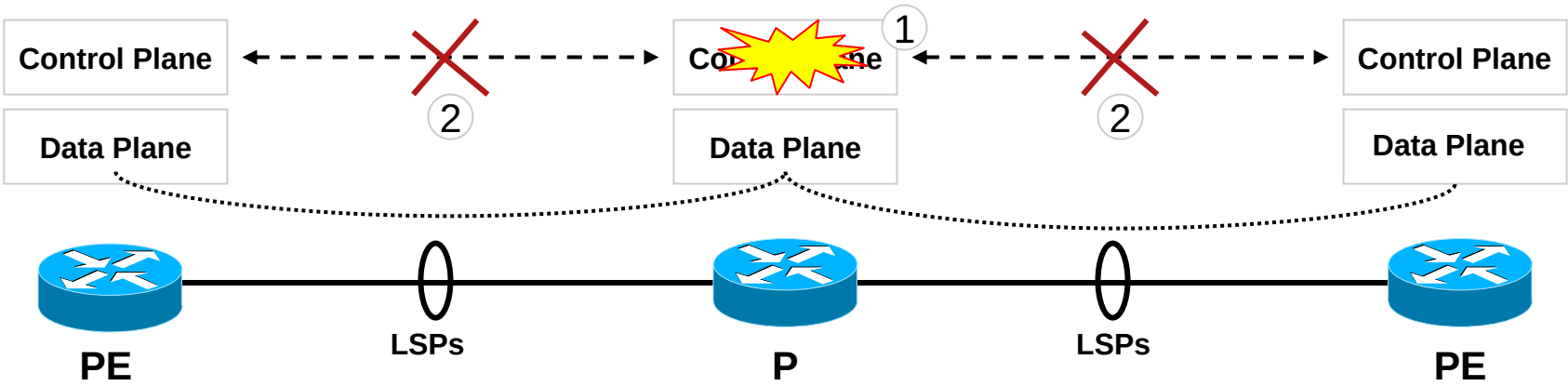
  MPLS LDP – HA (SSO and NSF) Support

MPLS Graceful Restart + NSF/SSO

No MPLS HA Support

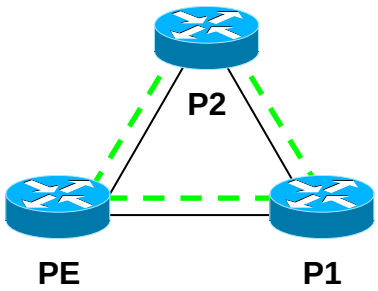


MPLS HA Support: NSF/SSO + Graceful Restart

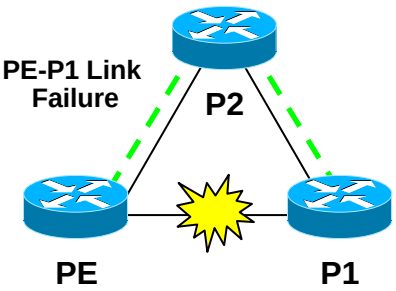


MPLS LDP Session Protection

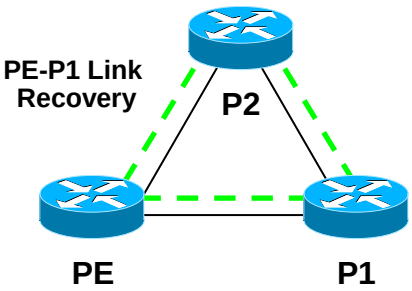
No LDP Session Protection Support



LDP session with link Hellos

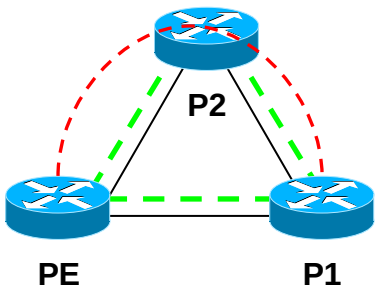


1. PE-P1 LDP session goes down
2. LDP reprograms MPLS forwarding (via P2)

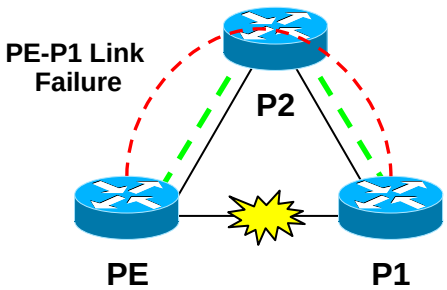


1. LDP discovery across PE-P1 link
2. Setup of LDP session across PE-P1 link
3. Exchange of label bindings
4. Reprogramming of MPLS forwarding by LDP

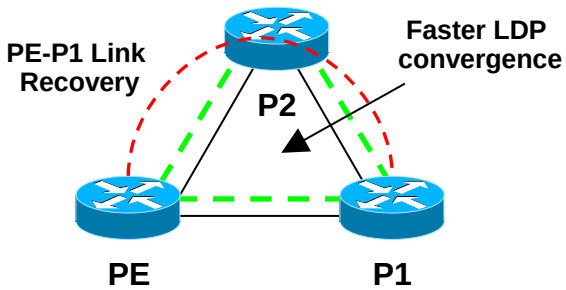
LDP with Session Protection Enabled



LDP session with link Hellos
LDP session with targeted Hellos



1. Targeted hellos continue to be exchanged between PE and P1.
2. LDP session remains up supported by targeted hellos.
3. LDP reprograms MPLS forwarding (via P2)



1. LDP hello's resume on PE-P1 link
2. Reprogramming of MPLS forwarding by LDP

Customer Benefits

- **Increased MPLS LDP resiliency**

  MPLS High Availability support enables MPLS LDP to continue to stay operational during a Route Processor (RP) switch-over event

  Faster LDP convergence after link failure event via LDP session protection

- **MPLS LDP support for static MPLS forwarding configuration**

  Enables configuration of static bindings between MPLS labels and IPv4 prefixes to support MPLS hop-by-hop forwarding through neighbor router nodes that don’t support LDP label distribution

Release 12.2(33)SXH Highlights
MPLS Traffic Engineering Enhancements

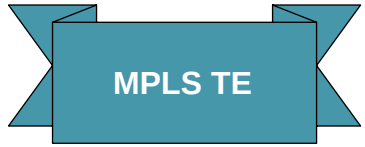
12.2(33)SXH is designed for Enterprise campus and Service Provider edge Catalyst 6500 deployments that require world-class IP and MPLS, high availability, WAN/LAN services, embedded management, and software modularity.

- **Powerful New Hardware Support**
  - Distributed Forwarding Card, IP 16-way ECMP, SPAN Enhancements, IOS Software Modularity for SIP-200, SIP-400, and Enhanced FlexWAN SPAs
- **MPLS LDP Enhancements**
  - MPLS LDP Session Management, Label Signaling and Assignment, Graceful Restart, Session Protection, MPLS High Availability
- **MPLS Traffic Engineering Enhancements**
  - AutoTunnel Primary/Backup, AutoTunnel Mesh Groups, Class-Based Tunnel Selection, Fast Re-Route Link/Node/Bandwidth Protection, Inter-AS TE, Inter-AS TE Fast Re-route, Inter-AS TE Authentication and Policy Control, MPLS TE LSP Attributes, MPLS TE Verbatim Support, Shared Risk Link Groups
- **L2 VPN Enhancements**
  - AToM Tunnel Selection, AToM Pseudowire Provisioning, Ethernet over MPLS, Frame Relay over MPLS, L2 Local Switching, Multiplexed UNI
- **MPLS Management Enhancements**
  - MPLS LDP MIB , MPLS VPN MIB, Support for MPLS TE FRR MIB, MPLS OAM support, MPLS HA support for MPLS MIBs
- **Quality of Service (QoS) Enhancements**
  - Cisco IOS AutoQoS
- **IP Services Enhancements**
  - HSRP/GLBP Stateful SwitchOver (SSO), EOT for FHRP, HSRP/GLBP MD5 Authentication
- **Routing and Multicast Enhancements**
  - OER, BGP: Dynamic Neighbors, Multicast VPN Inter-AS Support, Extranet Multicast VPN, IPv6 Multicast Enhancements, IPv6 MLD Access Group Filtering for (S,G), IPv4 Extended ACL Support for IGMP to support SSM, Auto-RP Enhancement, Multicast SNMP MIB, MSDP Compliance with IETF RFC 3618, Multicast HA: Triggered PIM Join(s), Multicast Router Guard, Enhanced IPv6 Multicast Shared Tree Performance in Hardware, IGMP Filtering and Snooping Access Control
- **Embedded Management Enhancements**
  - NetFlow Top Talkers, CISCO-NETFLOW-MIB, IPv4 Multicast NDE Using NetFlow V9, NetFlow for IPv6, Per-Interface NetFlow, LLDP-MED, IOS Configuration Rollback/Replace, Embedded Syslog Manager, Netconf Support over SSH2, TCL Scripting, SNMP Periodic Data Collection and Transfer, Cisco IOS IP SLAs, IEEE 802.3ah – Link OAM, IEEE 802.1ag Connectivity Fault Management (CFM), Smart Call Home, SPAN enhancements
- **Integrated Security Enhancements**
  - IBNS (802.1x) Enhancements, Policy-Based ACLs (PBACL), AutoSecure, Private Host, IP Source Guard

MPLS Traffic Engineering (TE)

- **Standards-based signaling for improved QoS in an MPLS TE Network**
  - **Differential Services ware Traffic Engineering**
  - **Maximum allocation model for Bandwidth Constraint**
  - **Russian Dolls Model Bandwidth Constraint**
- **Release 12.2(33)SXH delivers a number of key MPLS TE features for improved convergence, including**
  - **MPLS- TE Fast Tunnel Down Support**
  - **MPLS- TE Node Protection Desired**
  - **MPLS- TE Fast Re-Route over ATM**
  - **MPLS- TE Loose Hop**
- **Many additional new MPLS TE features in Release 12.2(33)SXH (covered in this section)**

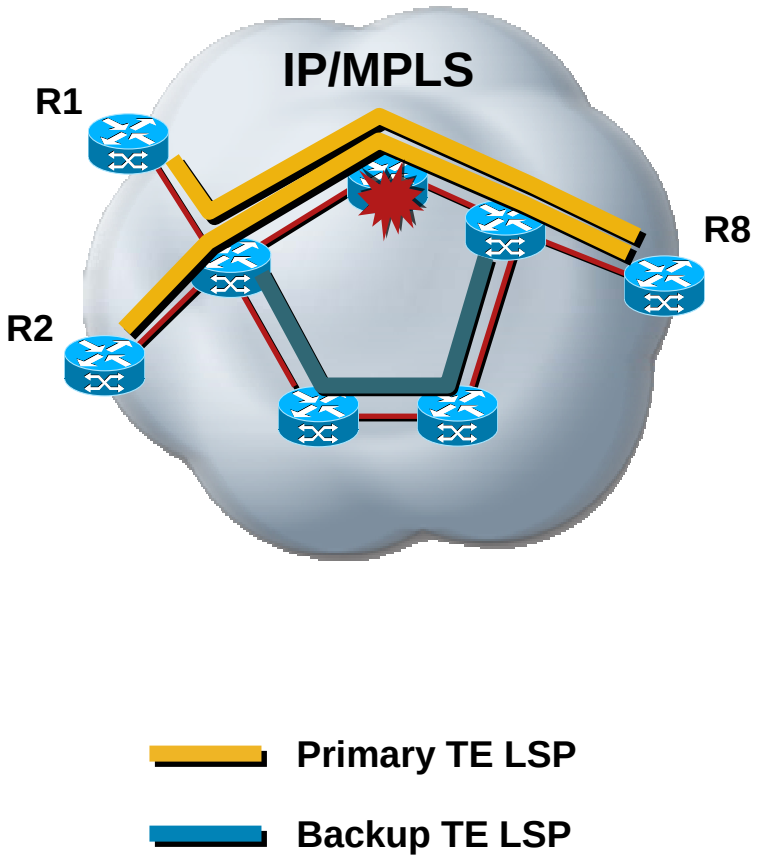
MPLS TE Improved Convergence Features – Customer Benefits



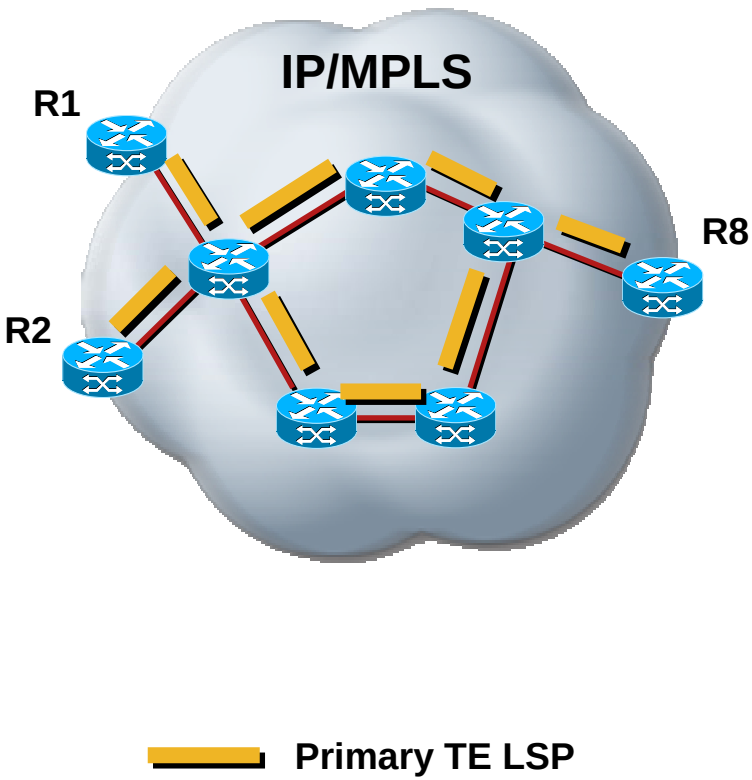
- **Increased MPLS TE resiliency**
  1. **MPLS Fast Tunnel Down Support: Enables the interface to immediately start a switch over as soon as the label Switch protocol detects that a link on a Label-Switched Path (LSP) has gone down.**
  2. **MPLS- TE Node Protection Desired: Protects Label Switch Paths in an MPLS TE enabled network to reroute the LSPs and their traffic around the failed node to the next-next hop.**
  3. **MPLS- TE Fast Re-Route (FRR) over ATM: Introduces FRR functionality for ATM interfaces**
  4. **MPLS- TE Loose Hop: Allows MPLS-TE Label Switch Paths to transverse Multiple Autonomous systems boundaries**

AutoTunnel: Primary Tunnels What's the Problem?

- FRR can protect TE Traffic
- No protection mechanism for IP or LDP traffic
- How to leverage FRR for all traffic?
- What if protection desired without traffic engineering?



AutoTunnel: Primary Tunnels What's the Solution?



Forward all traffic through a one-hop protected primary TE tunnel

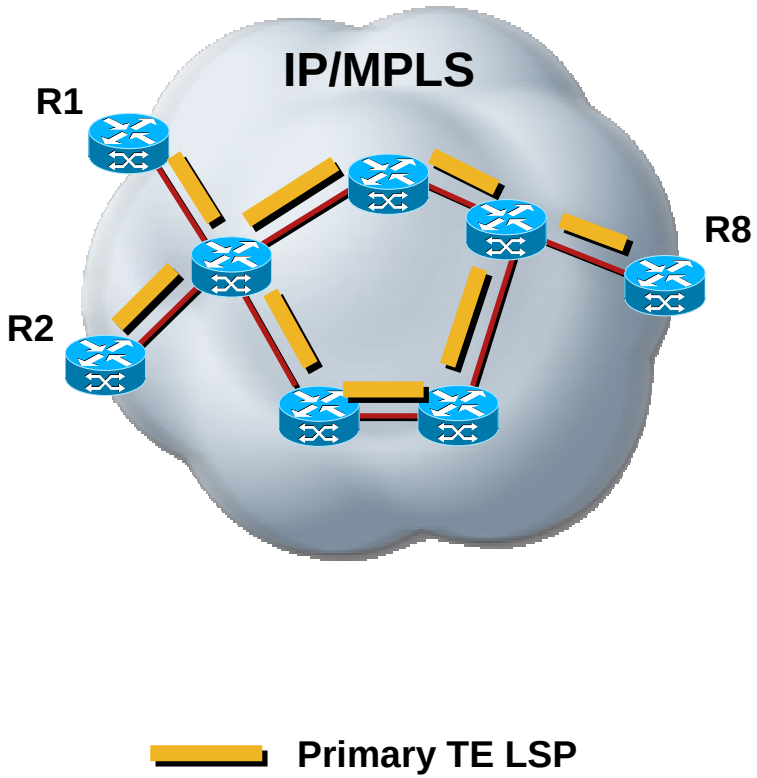
- Create protected one-hop tunnels on all TE links

Priority	7/7
Bandwidth	0
Affinity	0x0/0xFFFF
Auto-BW	OFF
Auto-Route	ON
Fast-Reroute	ON
Forwarding-Adj	OFF
Load-Sharing	OFF

- Tunnel interfaces not shown on router configuration
- Configure desired backup tunnels (manually or automatically)

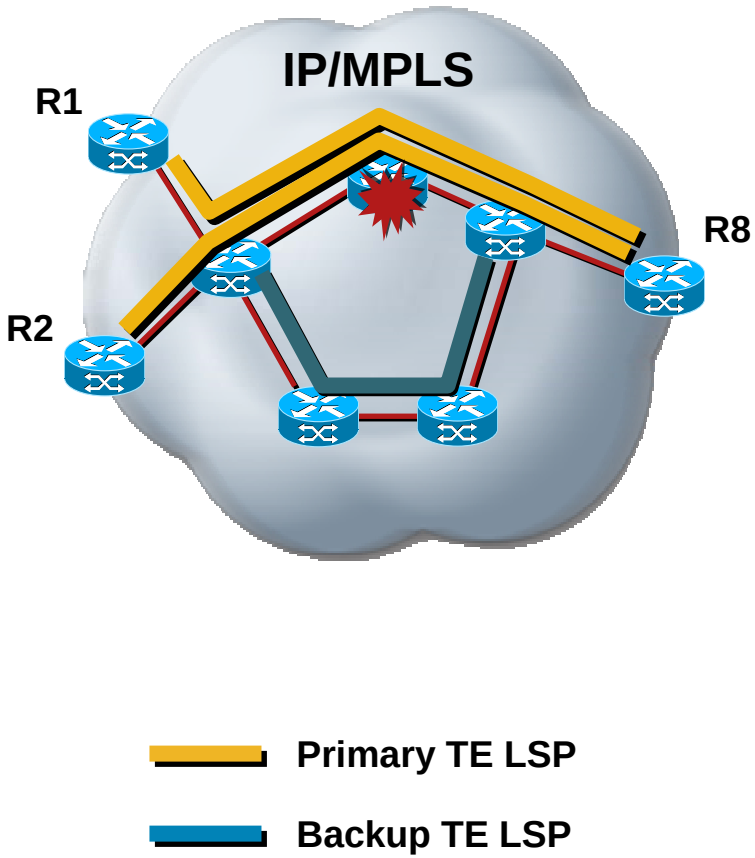
AutoTunnel: Primary Tunnels Why One-Hop Tunnels?

- CSPF and SPF yield same results (absence of tunnel constrains)
- Auto-route forwards all traffic through one-hop tunnel
- Traffic logically mapped to tunnel but no label imposed (imp-null)
- traffic is forwarded as if no tunnel was in place

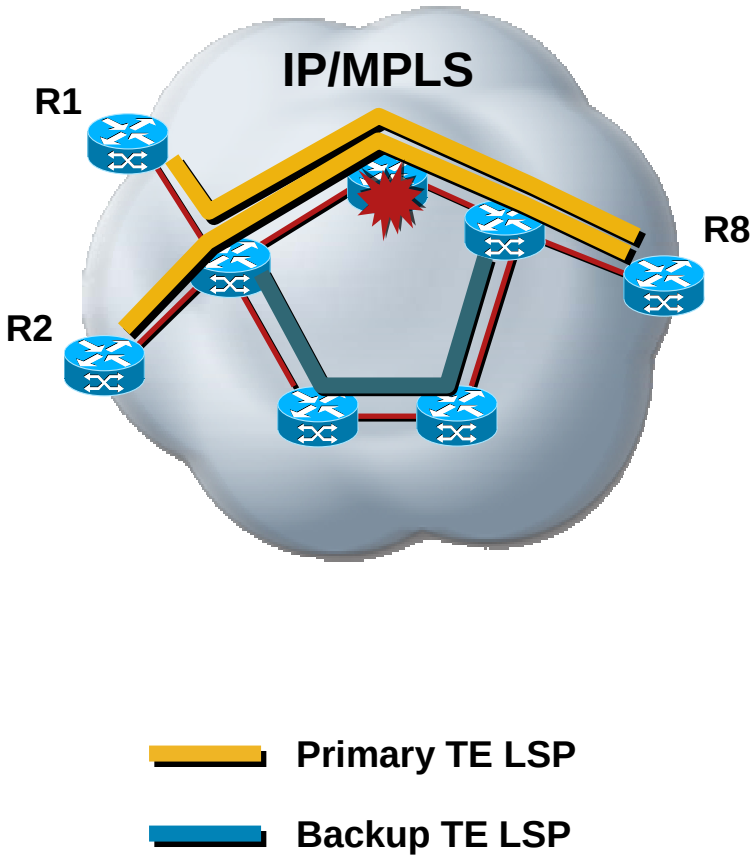


AutoTunnel: Backup Tunnels What's the Problem?

- MPLS FRR requires backup tunnels to be preconfigured
- Automation of backup tunnels is desirable



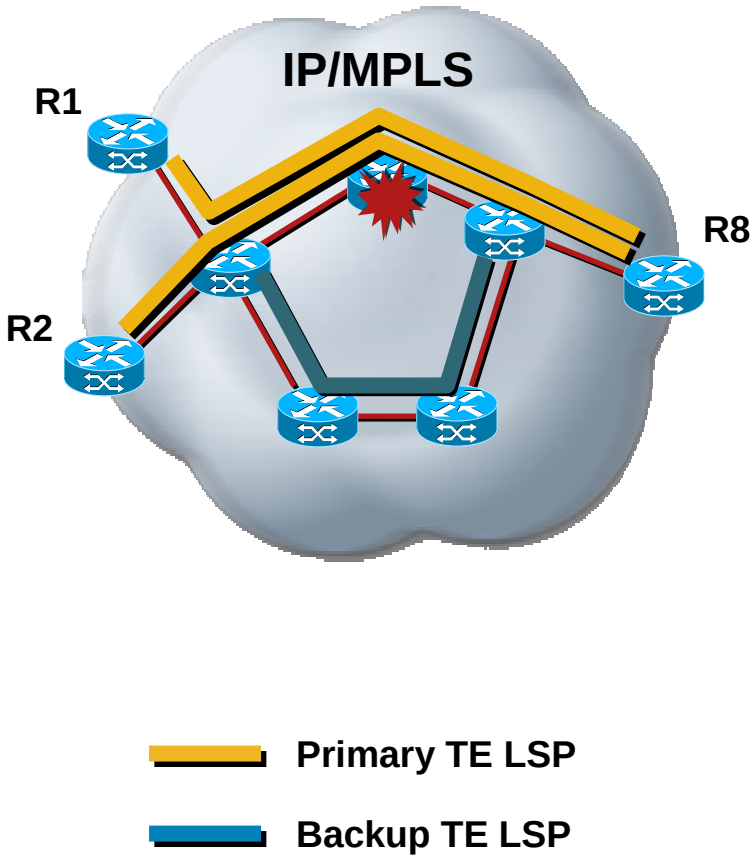
AutoTunnel: Backup Tunnels What's the Solution?



Create backup tunnels automatically as needed

- Detect if a primary tunnel requires protection and is not protected
- Verify that a backup tunnel doesn't already exist
- Compute a backup path to NHOP and NHOP excluding the protected facility
- Optionally, consider shared risk link groups during backup path computation
- Signal the backup tunnels

AutoTunnel: Backup Tunnels What's the Solution? (cont.)



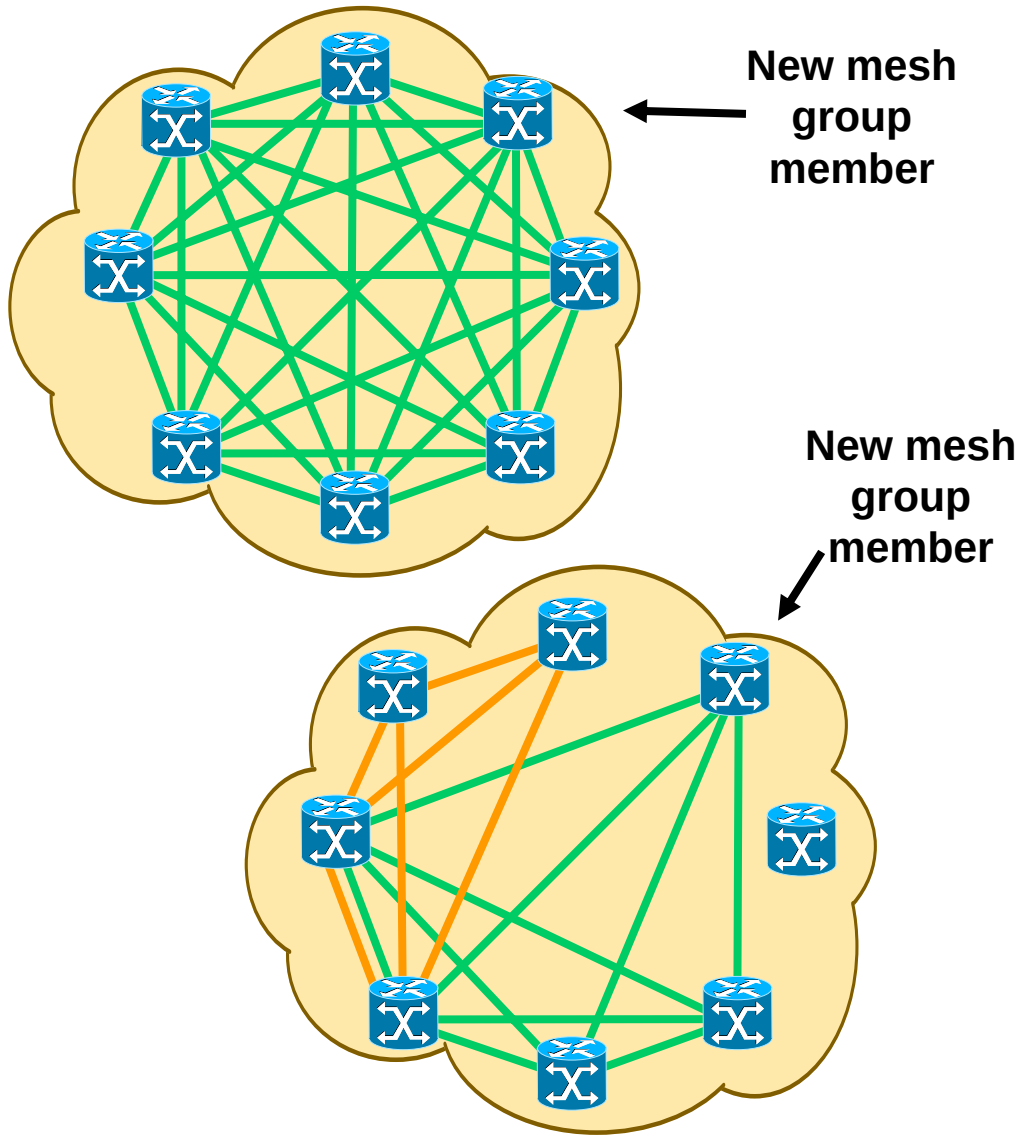
- Backup tunnels are preconfigured

Priority	7/7
Bandwidth	0
Affinity	0x0/0xFFFF
Auto-BW	OFF
Auto-Route	OFF
Fast-Reroute	OFF
Forwarding-Adj	OFF
Load-Sharing	OFF

- Backup tunnel interfaces and paths not shown on router configuration

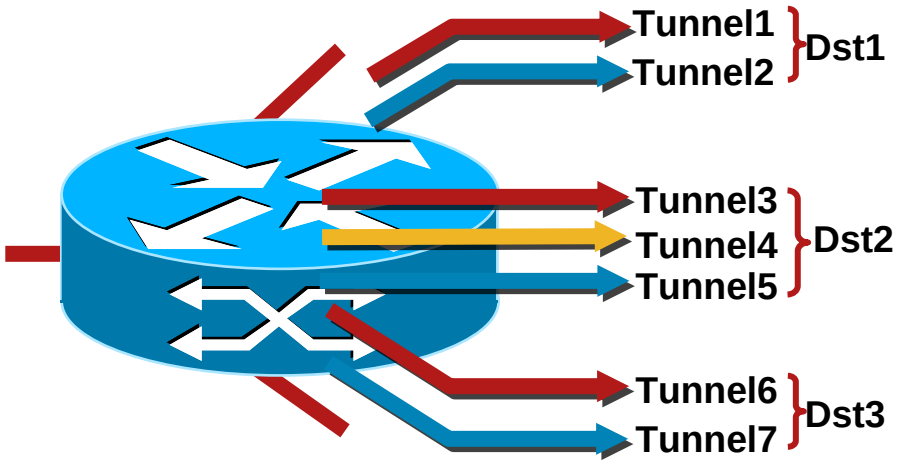
AutoTunnel: Mesh Groups

- Reduces configuration work for TE meshes
- Easier integration of new nodes
- Mesh group: LSRs to fully mesh automatically
- LSR may identify mesh group members by matching TE Router ID against ACL
- Mesh group members would share same tunnel attributes
- Mesh group advertisement would require IGP extensions



Class-Based Tunnel Selection CBTS

MPLS TE



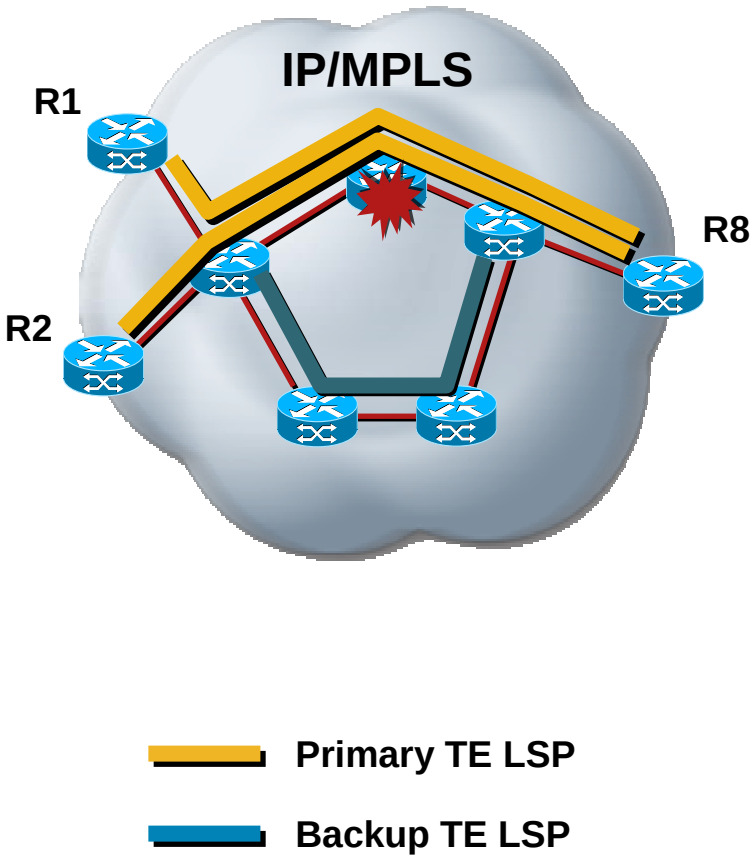
FIB

Dst1, exp 5	Tunnel1
Dst1, *	Tunnel2
Dst2, exp 5	Tunnel3
Dst2, exp 2	Tunnel4
Dst2, *	Tunnel5
Dst3, exp 5	Tunnel6
Dst3, *	Tunnel7

***Wildcard EXP Value**

- EXP-based selection between multiple tunnels to same destination
- Local mechanism at head-end
- Tunnels configured with EXP values to carry
- Tunnels may be configured as default
- No IGP extensions
- Supports VRF traffic, IP-to-MPLS and MPLS-to-MPLS switching
- Simplifies use of DS-TE tunnels

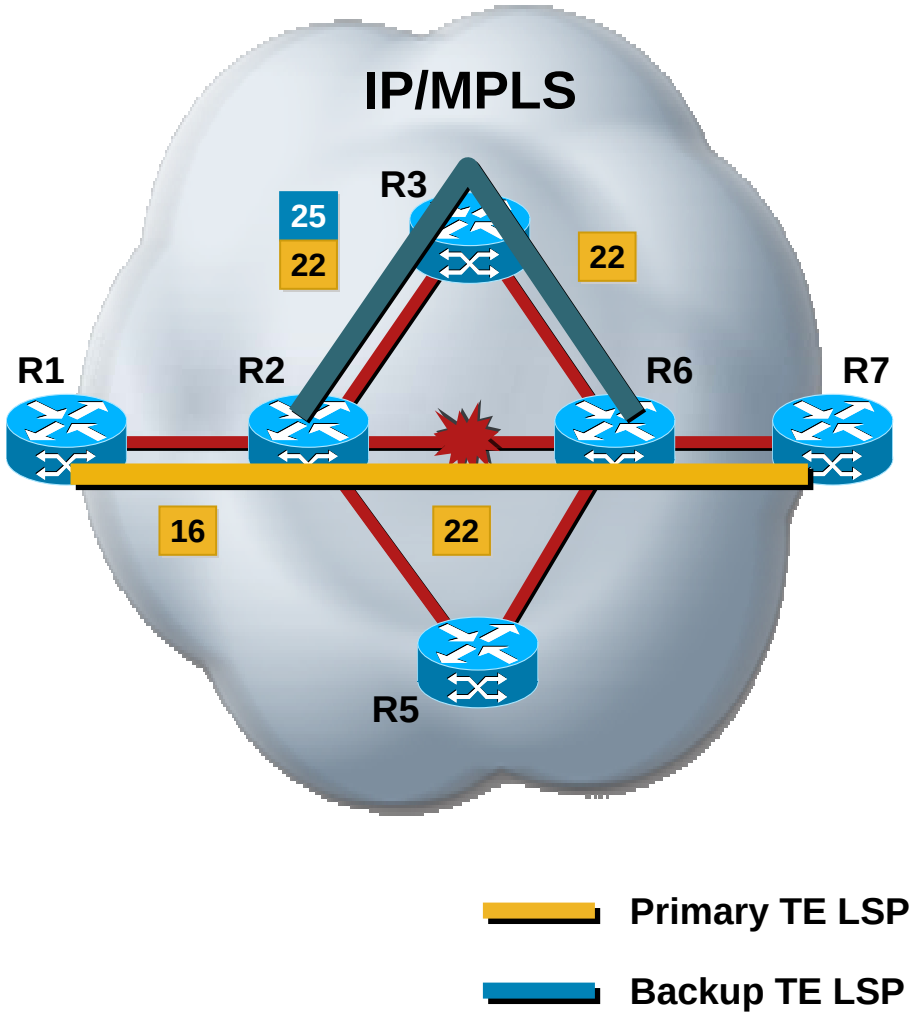
MPLS TE Fast Re-Route (FRR)



- Subsecond recovery against node/link failures
- Scalable 1:N protection
- Greater protection granularity
- Cost-effective alternative to optical protection
- Bandwidth protection

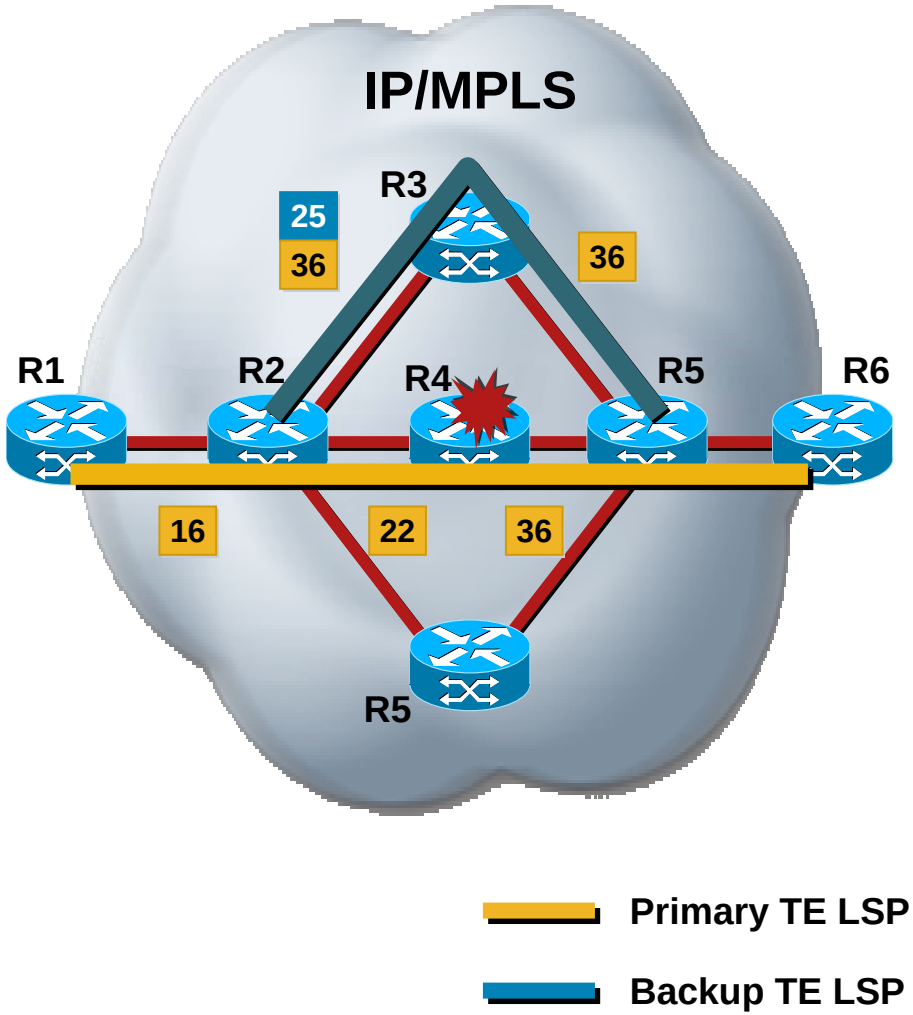
FRR Link Protection Operation

- Requires Next-Hop (NHOP) backup tunnel
- Point of Local Repair (PLR) swaps label and pushes backup label
- Backup terminates on Merge Point (MP) where traffic rejoins primary
- Restoration time expected under ~50 ms



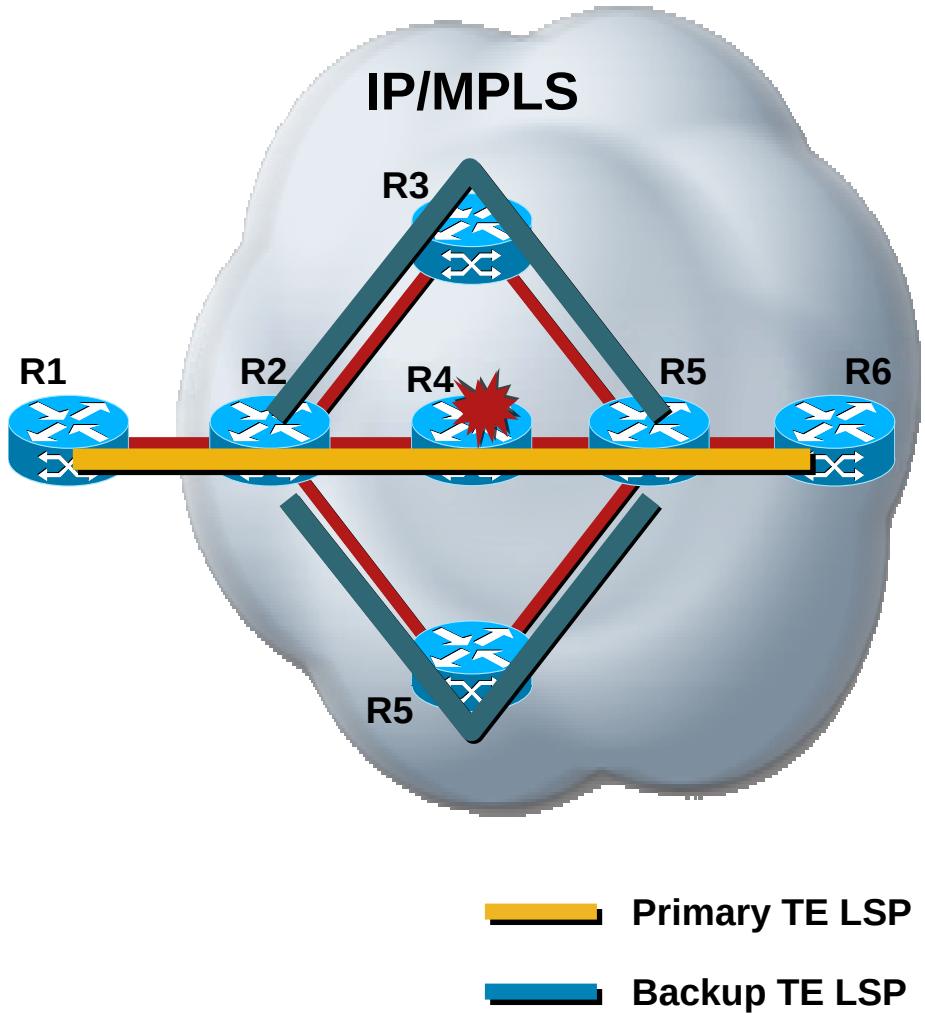
FRR Node Protection Operation

- Requires Next-Next-Hop (NNHOP) backup tunnel
- Point of Local Repair (PLR) swaps next-hop label and pushes backup label
- Backup terminates on Merge Point (MP) where traffic rejoins primary
- Restoration time depends on failure detection time

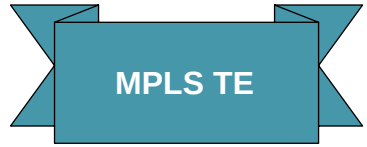


FRR Bandwidth Protection Operation

- Backup tunnel with associated bandwidth capacity
- Backup tunnel may or may not actually signal bandwidth
- PLR will decide best backup to protect primary (nhop/nnhop, class-type, node-protection flag)

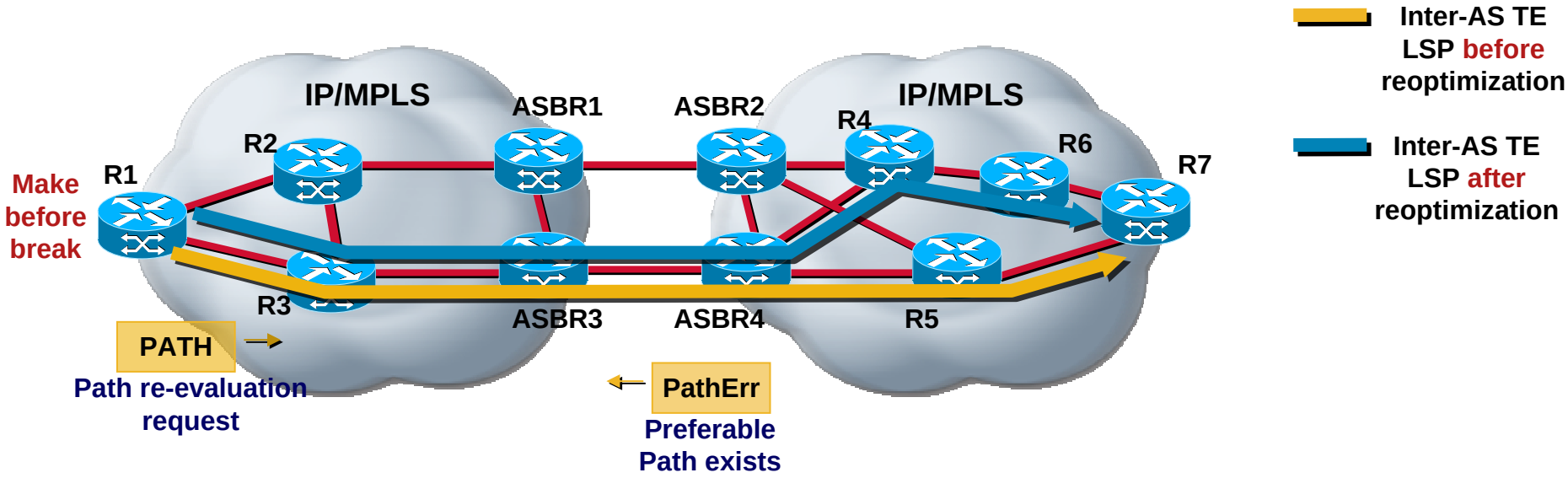


Inter-AS Traffic Engineering (TE) Introduction



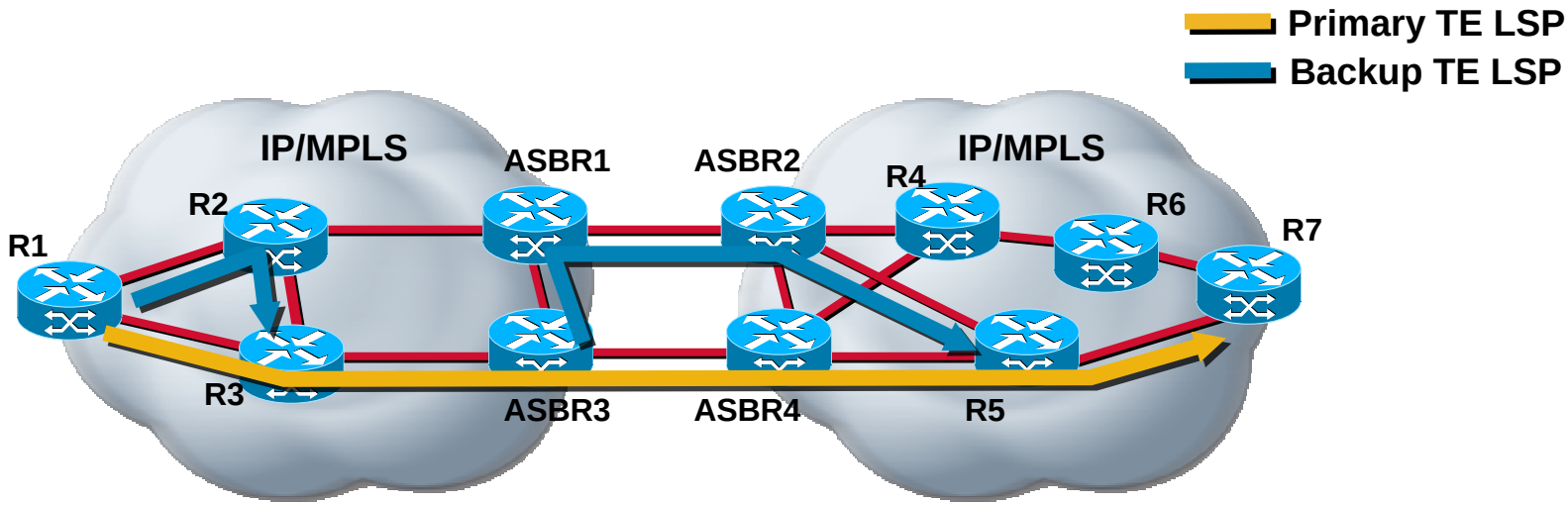
- Domain defined as an IGP area or autonomous system
- Head end lacks complete network topology to perform path computation in both cases
- Current solution requires per-domain path computation using ERO loose-hop expansion

Inter-AS TE: TE LSP Reoptimization



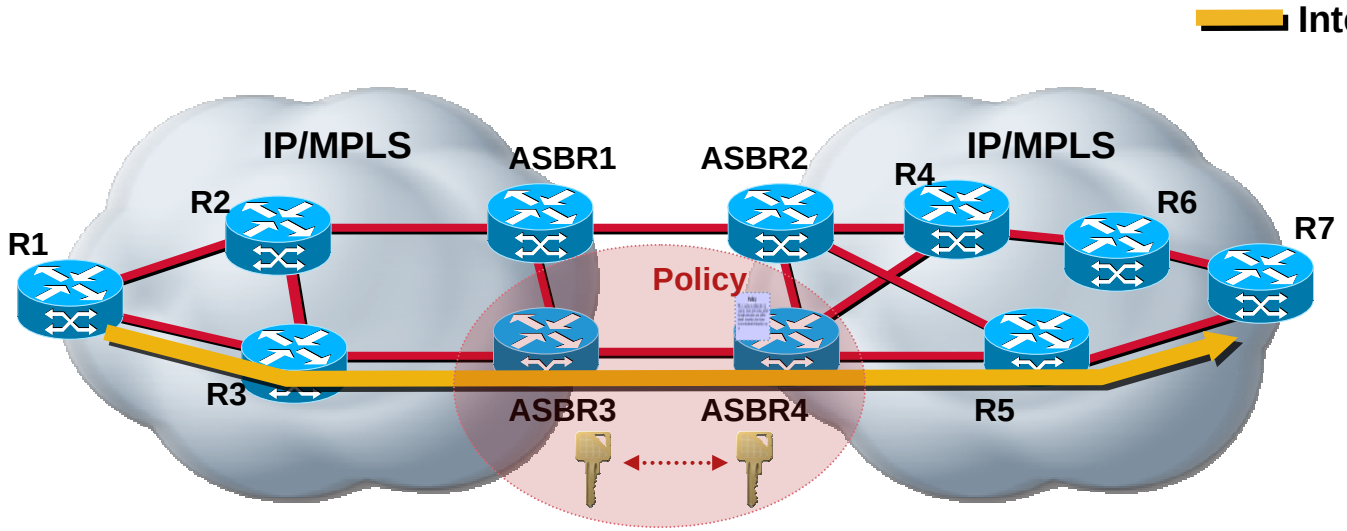
- Reoptimization can be timer/event/admin triggered
- Head end sets ‘path re-evaluation request’ flag (SESSION_ATTRIBUTE)
- Head end receives PathErr message notification from boundary router if a preferable path exists
- Make-before-break TE LSP setup can be initiated after PathErr notification

Inter-AS TE: Fast Re-route



- Same configuration as single domain scenario
- Support for node-id sub-object required to implement ABR/ASBR node protection
- Node-id helps Point of Local Repair (PLR) detect a Merge Point (MP)

Inter-AS TE: Authentication and Policy Control



- Authentication and policy control desirable for Inter-AS deployments
- ASBR may perform RSVP authentication (MD5/SHA-1)
- ASBR may enforce a local policy for Inter-AS TE LSPs (ie: limit bandwidth, message types, protection, etc.)

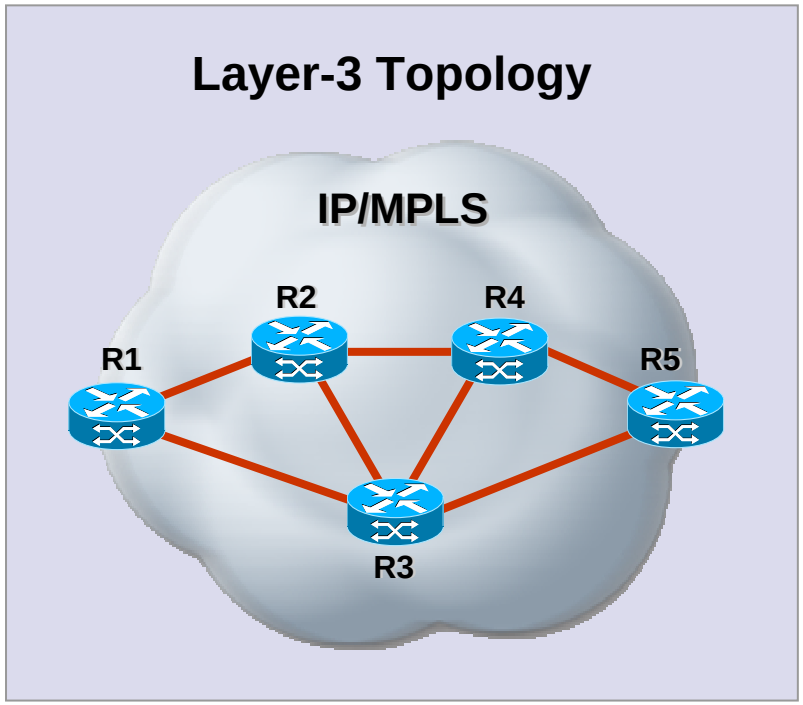
MPLS TE LSP Attributes

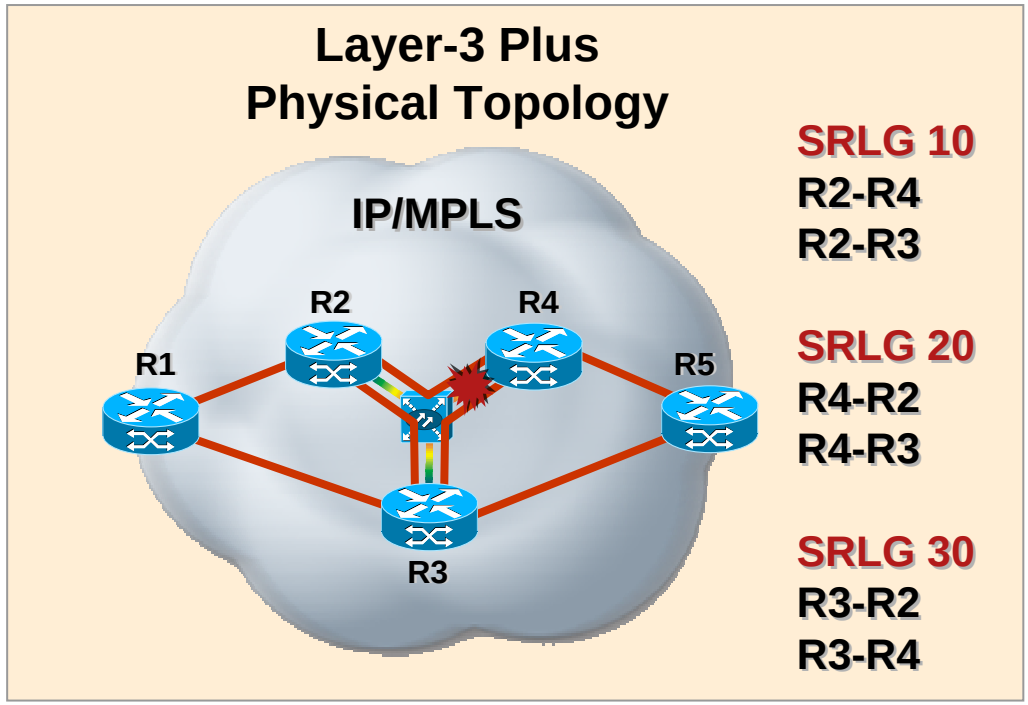
- Flexible configuration of attributes
- A tunnel can have multiple attribute profiles
- Enables attribute override
- Enables named attribute lists (affinity, auto-bw, bandwidth, lockdown, priority, protection, record route)
- List can be associated with path options
- A tunnel can have very different attributes depending on the path options used
- Path option attributes take precedence over tunnel attributes
- Path option syntax extended with bandwidth option for quick bandwidth override configuration

MPLS TE Verbatim Support

- Enables TE with no or limited IGP TE network support
- Useful for off-line TE not using IGP TE extensions
- Explicit path not checked against TE topology database by head-end
- Loose object expansion by midpoint falls back to IGP topology database if necessary

Shared Risk Link Group (SRLG)





- Some links may share same physical resource (ie: fiber, conduit)
- AutoTunnel Backup can force or prefer exclusion of SRLG to guarantee diversely routed backup tunnels
- IS-IS and OSPF flood SRLG membership as an additional link attribute

Release 12.2(33)SXH Highlights
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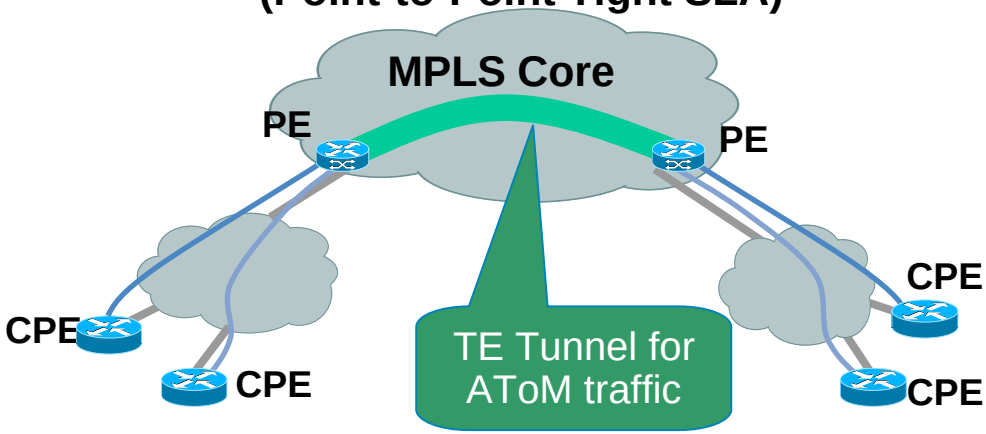
Any Transport over MPLS (AToM)
AToM Tunnel Selection

MPLS / L2VPN

- Allows network providers to protect and guarantee better SLAs for subscriber Pseudowire traffic by combining MPLS AToM and Traffic Engineering functionality
- Tunnels with special characteristics can be predefined for Pseudowires

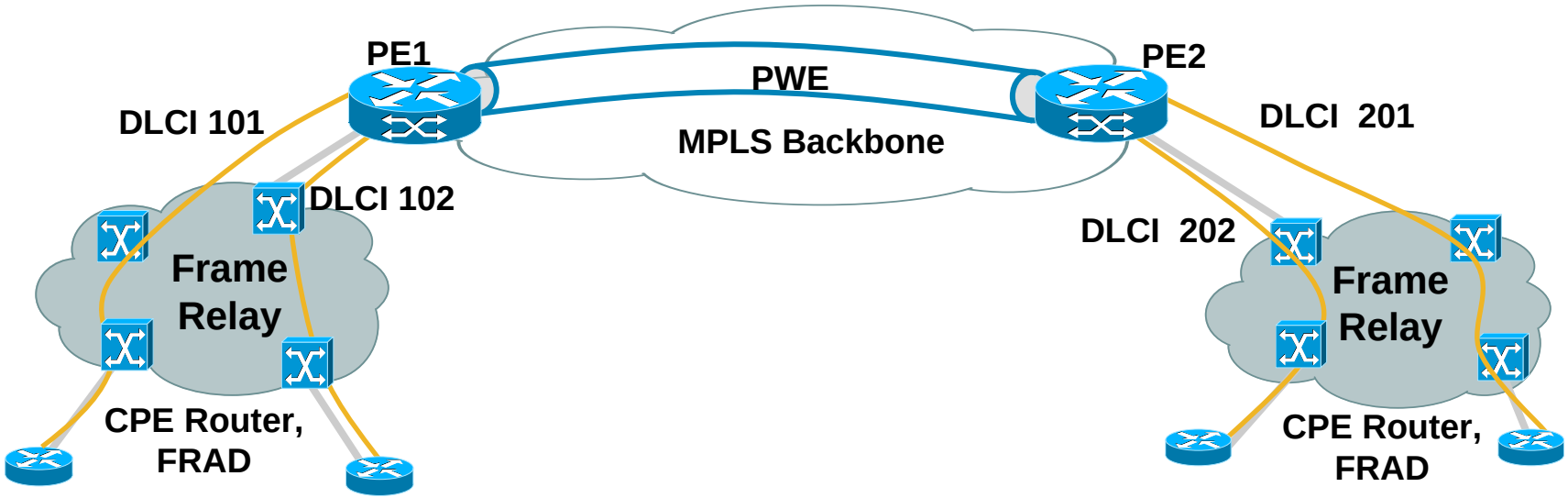
L2 Service Transported over a TE Tunnel
(Point-to-Point Tight SLA)



- Enables path selection traffic uses instead of pre-selected default path (based on MPLS TE tunnel, destination IP address, or DNS name)
- VCs option to use the default path if the preferred path is unreachable
- Tunnel is defined as preferred path in pseudowire class
- Fallback can be disabled if TE tunnel is unreachable

AToM: Static Pseudowire Provisioning

- Offers network providers various options for AToM service provisioning
- Eliminates the dependency on directed LDP session to create a pseudowire

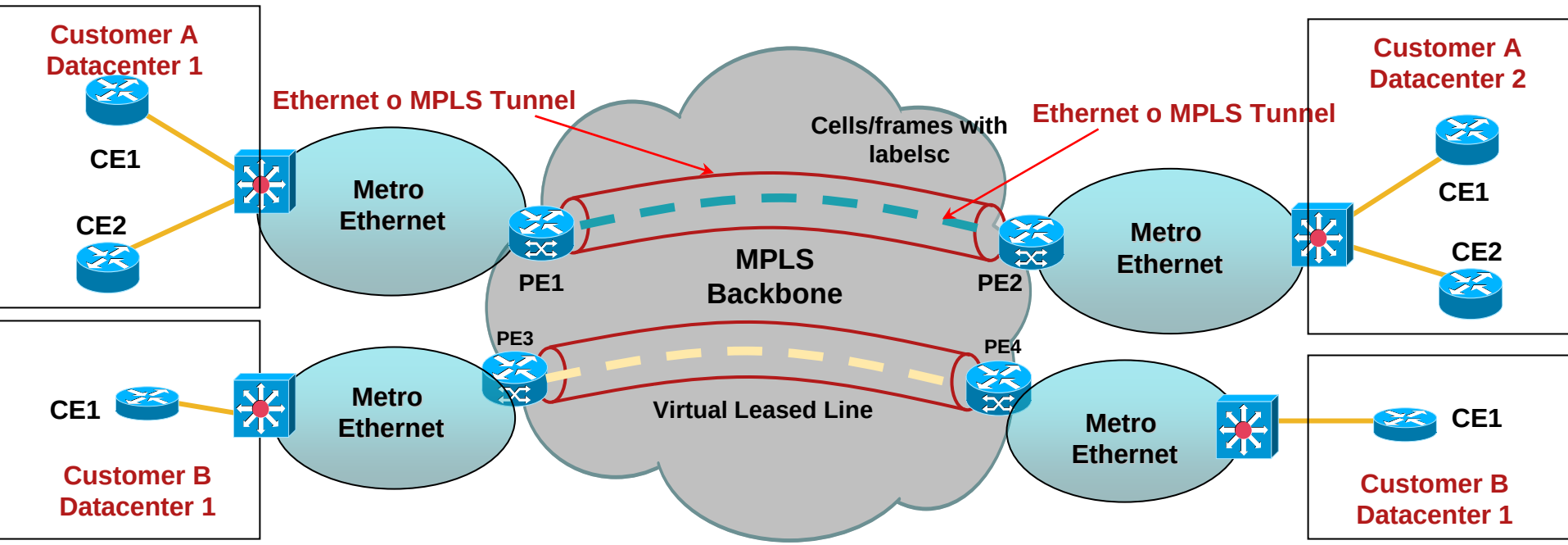


- AToM pseudowires setup using directed Label Distribution Protocol (dLDP)
- Parameters such as remote Pseudowire label, inclusion of control word, and interface parameters (example: MTU) exchanged via LDP label advertisement

AToM: Ethernet over MPLS (EoMPLS)

MPLS / L2VPN

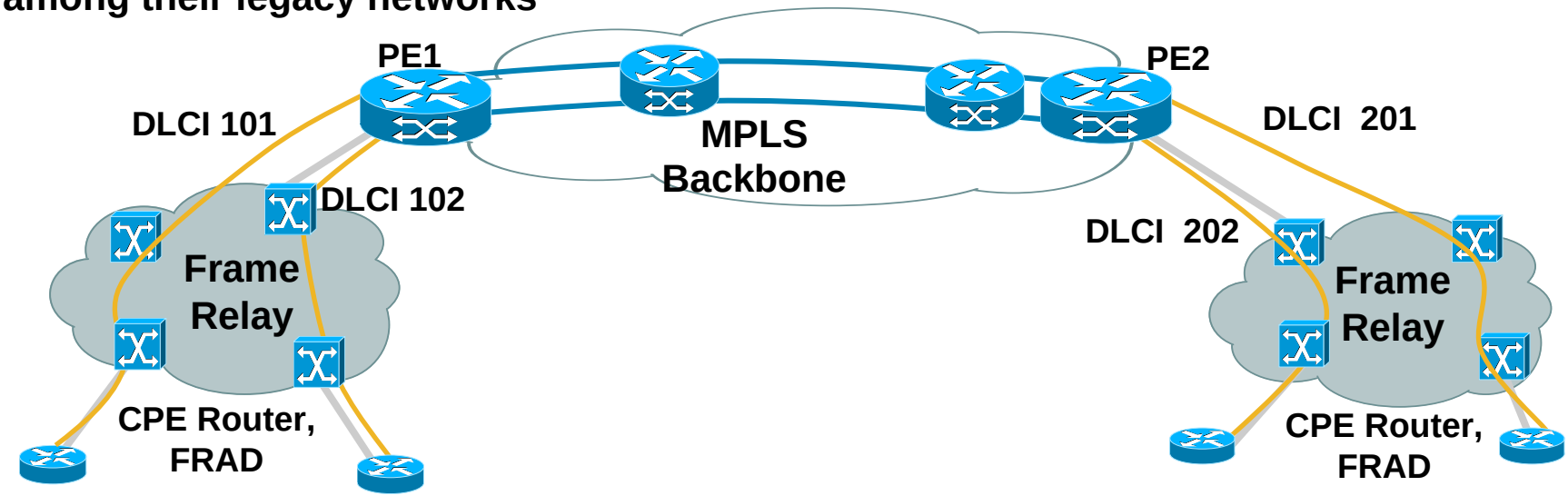
- Allows network providers to extend services to Metro Networks
- Extends reachability among subscriber LAN islands by providing transport over MPLS core
- Supports EoMPLS Port and VLAN modes



AToM: Frame Relay over MPLS (FRoMPLS)

MPLS / L2VPN

- Allows network providers to maintain their existing customer base with legacy technology and increase service portfolio w/o changing their infrastructure
- Flexible WAN connectivity solution for Enterprise customers needing WAN connectivity among their legacy networks



- Ingress PE encapsulates Frame Relay Protocol Data Units (PDUs) in MPLS packets and forwards them to egress PE:

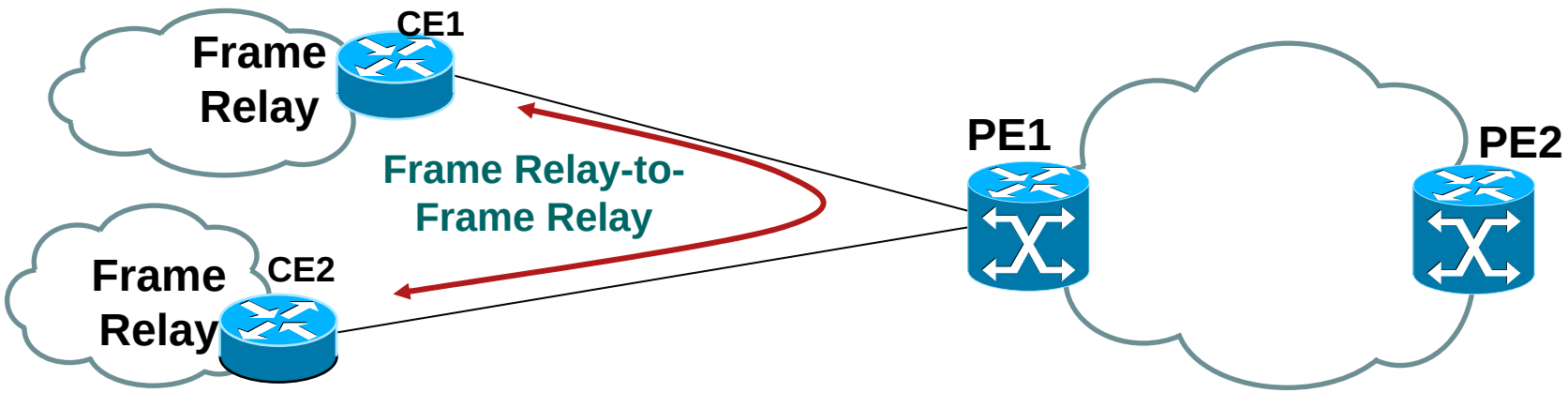
  DLCI-to-DLCI Connections: PE routers manipulate the packet by removing headers, adding labels, and copying control word elements from the header to the PDU.

  Port-to-Port Connections: HDLC mode used to transport the FR encapsulated packets. In HDLC mode, the HDLC flags and FCS bits are removed. The contents of the packet are including the flag bits are not changed.

L2 Local Switching – Same Port Switching for Frame Relay

MPLS / L2VPN

- This feature is designed to meet requirements of Incumbent Local Exchange Carriers (ILECs) who use an Inter Exchange Carrier (IXC) to carry traffic between two local exchange carriers. Telecom regulations require the ILECs to pay the IXCs to carry traffic. At times, it's possible for different ILECs connections to terminate in the same LATA, which may also be on the same router.
- In another case, two logical interfaces could reside on the same channelized physical interface. Network providers with such a configuration need to support incoming and outgoing traffic across these logical interfaces.



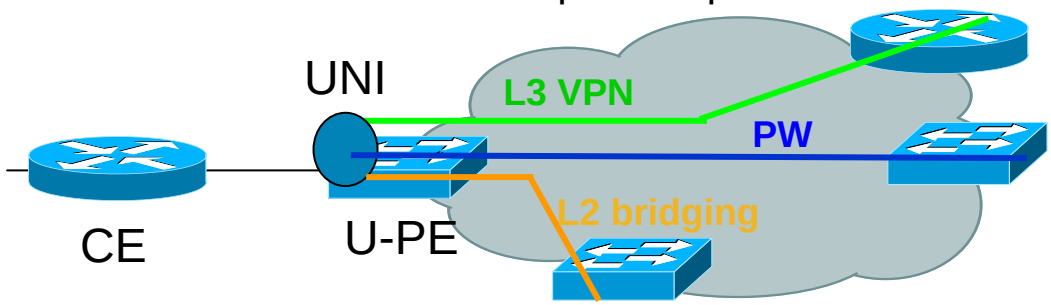
- As shown above, a Frame Relay PVC from CE1 is connected directly to a Frame Relay PVC from CE2 on PE1. PE1 could also be switching additional Frame Relay PVCs across an MLPS or IP core to PE2.

Multiplexed UNI

- Support for L2 bridging, PW and L3VPN on the same UNI interface
- By allowing to configure sub-interface on L2 switchport interfaces
- Support for L2 switching AND EoMPLS xconnect on the same UNI interface
- L2 trunk interface with layer 3 sub-interfaces
- Port-Channel can be multiplexed UNI

```
interface Port-channel100
   switchport
   switchport trunk encapsulation dot1q
   switchport trunk allowed VLAN 100-200
   switchport mode trunk
   no ip address

interface Port-channel100.1
   encapsulation dot1Q 3100
   xconnect 10.0.0.30 100 encapsulation mpls
```



Internet Access (L3 VPN)

Inter-branch Connectivity (EoMPLS)

VLAN Bridging

Release 12.2(33)SXH Highlights
MPLS Management Enhancements

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- **MPLS Traffic Engineering Enhancements**
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MPLS Management

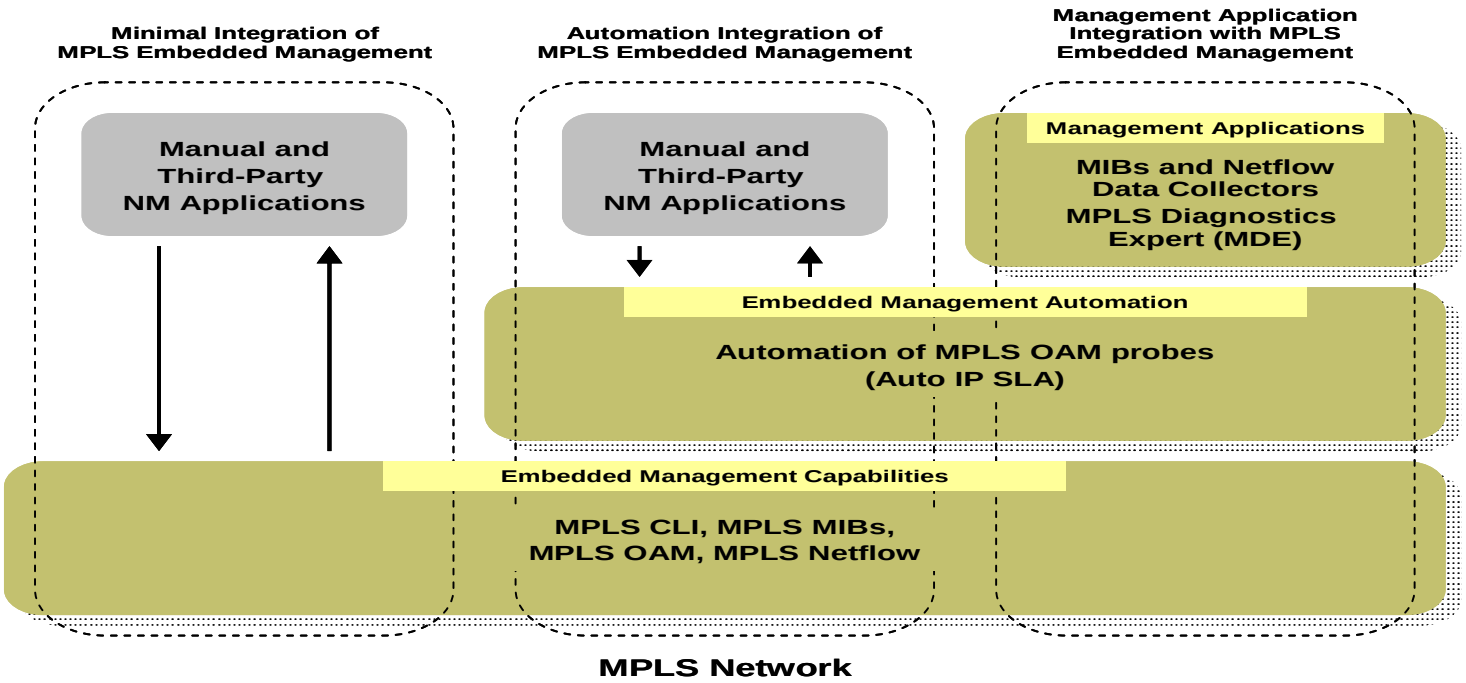
- MPLS embedded management capabilities integrated into IOS
- IETF standards based + Cisco-specific value adds
- MPLS embedded management feature areas
  - MPLS SNMP MIBs (RFC-based + Cisco extensions)
  - MPLS OAM (RFC-based + Cisco-specific automation)
  - MPLS-aware NetFlow
- Detailed MPLS resource monitoring via SNMP MPLS MIBs
- MPLS connectivity troubleshooting via extensive MPLS OAM feature capabilities

MPLS Management Enhancements in Release 12.2(33)SXH

- **MPLS LDP MIB enhancements**
  - Based on draft-ietf-mpls-ldp-08.txt
  - Trap enhancements; inclusion of ifIndex in LDP session Up/Down Traps
  - VRF support; MPLS LDP MIB in VRF-context
- **MPLS VPN MIB enhancements**
  - Based on draft-ietf-ppvpn-mpls-vpn-mib-05.txt
  - New VpnThreshCleared notification; indicates that number of routes in a VRF has fallen below the configured max-route threshold
- **Support for MPLS TE FRR MIB**
  - Based on draft-ietf-mpls-fastreroute-mib-01.txt
- **MPLS OAM support**
  - MPLS LSP Ping and Trace for MPLS core (draft-ietf-mpls-lsp-ping-03.txt)
  - MPLS LSP Ping for L2VPN (via VCCV, based on draft-ietf-mpls-lsp-ping-03.txt)
- **MPLS HA support for MPLS MIBs**
  - MPLS NSF/SSO support for MPLS LDP MIB and VPN MIB

MPLS Management Enhancements Benefits

MPLS Management



- **Enables enhanced MPLS resource monitoring**

  MPLS MIB modules provide standard SNMP access to a wide variety of MPLS-specific resources, including MPLS label forwarding and LDP session information

- **Increases operational efficiency**

  MPLS OAM tools, such as LSP Ping and LSP Trace, enable fast detection and isolation of complex MPLS connectivity problems, which improves trouble resolution time

- **Provides a comprehensive solution for addressing MPLS network and service availability**

  Cisco's MPLS embedded management capabilities can be integrated with Cisco's Auto IP SLA and are supported by Cisco's MPLS Diagnostics Expert (MDE)

Release 12.2(33)SXH Highlights
Quality of Service (QoS) Enhancements

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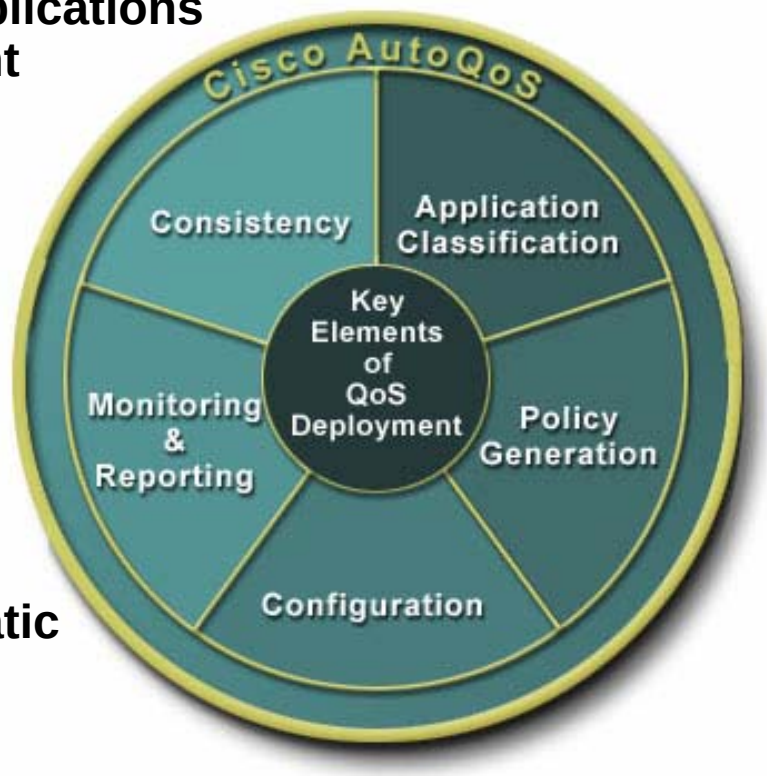
Cisco IOS AutoQoS, Automating the Key Elements of QoS Deployment

Quality of Service

1. **Application classification**
   - **Example: automatically discovering applications and providing appropriate QoS treatment**
2. **Policy generation**
   - **Example: auto-generation of initial and ongoing QoS policies**
3. **Configuration**
   - **Example: providing high level business knobs, and multi-device / domain automation for QoS**
4. **Monitoring and reporting**
   - **Example: generating intelligent, automatic alerts and summary reports**
5. **Consistency**
   - **Example: enabling automatic, seamless interoperability among all QoS features and parameters across a network topology – LAN, MAN, and WAN**



Cisco AutoQoS – Enterprise Framework DiffServ Functions Automated

Quality of Service

- **Automation and simplification of the existing user interface to expedite deployment of QoS features for voice, video, and data**
- **Fine-tuning of Cisco AutoQoS generated parameters by user, if desired**

DiffServ Function	Cisco IOS QoS Features	Behavior
Classification	Network Based Application Recognition (NBAR), IP Precedence DiffServ Code Point (DSCP), Port	Classification of voice, video, and data traffic based on packet attributes – up to 10 classes of service
Marking	Class-Based Marking	Set Layer 2 and Layer 3 attributes to bucketize packets into a class
Congestion Management	Percentage-based Low Latency Queuing (LLQ), Class-Based Weighted Fair Queuing (CBWFQ) Weighted Round Robin (WRR)	Provides expedited forwarding treatment for voice, assured forwarding treatment for video and Enterprise Resource Planning (ERP) data, and best effort treatment for default traffic
Shaping	Class-based Shaping or Frame Relay Traffic Shaping (FRTS)	Shape to Committed Information Rate (CIR) to prevent burst & smooth traffic from configured rate
Congestion Avoidance	Weighted Random Early Detection (WRED)	Intelligent packet drop decisions to prevent tail drops across multiple Transmission Control Protocol (TCP) sessions
Link Efficiency Mechanism	Header compression, link fragmentation and interleaving	Reduce VoIP bandwidth requirement & jitter experience by voice packets

Automation with Cisco AutoQoS Benefits

- **Makes QoS configuration for voice, video, and data traffic a simple two steps process**
  - **Cheaper QoS deployments – up to 2/3rds reduction in cost**
  - **Faster QoS deployments – up to 2/3rds reduction in deployment time**
- **Automatically discovers statistics for all applications and protocols using NBAR / DSCP**
- **Automatically provisions up to ten classes of service**
- **Intelligent policy generation**
  - **Based on underlying network environment and site specific network traffic profile**
  - **Automatically enables link-specific QoS settings, if required**
- **Enables customers to retain complete control over QoS configuration**
  - **Auto-generated QoS parameters and configuration can be user-modified**

Release 12.2(33)SXH Highlights
IP Services Enhancements

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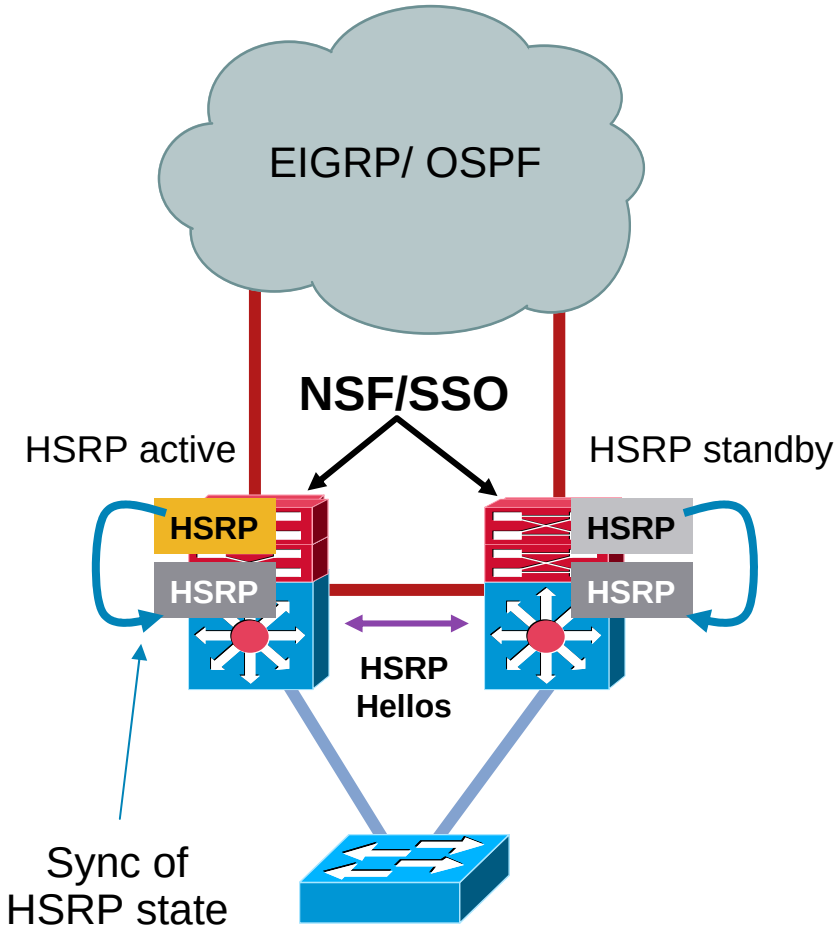
Stateful Switchover (SSO) for First Hop Redundancy Protocols (HSRP/GLBP)

IP Services

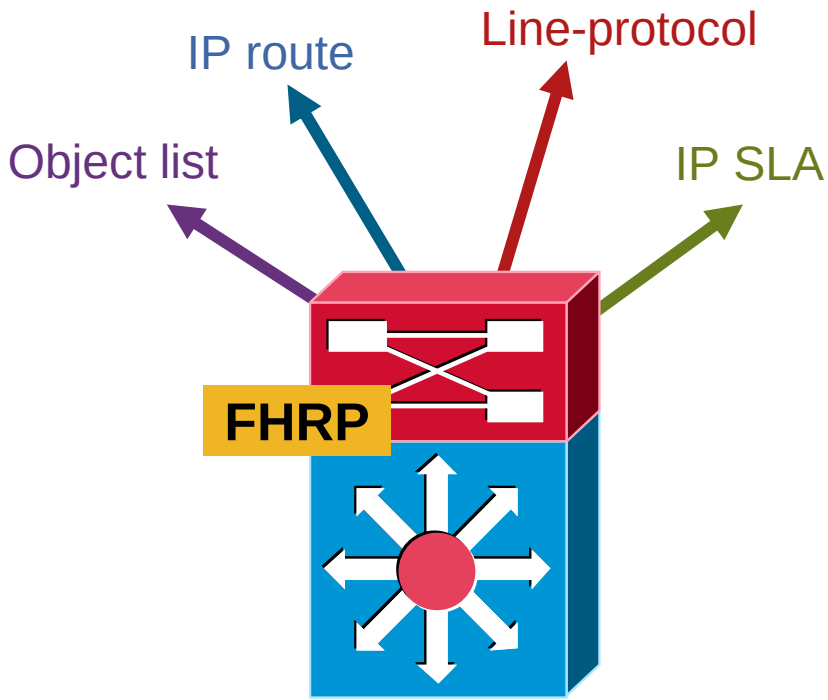
- **Use case — Ultra-redundant deployments where both in-box and network redundancy desired**
- **Before Release 12.2(33)SXH, HSRP and GLBP are not SSO-aware**
  - **System relinquishes Active/AVG role on SSO switchover**
- **Release 12.2(33)SXH delivers SSO awareness to HSRP/GLBP**
  - **Active/AVG/AVF roles retained after failover, standby systems unaware of failover event**



Enhanced Object Tracking for First Hop Redundancy Protocols

IP Services

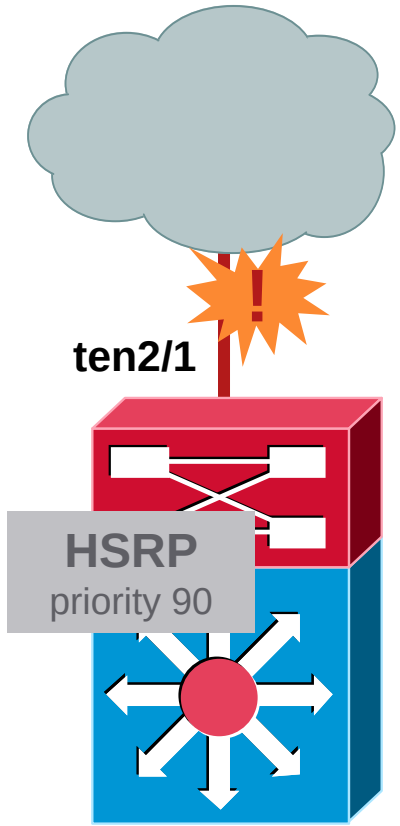
- Enables simple to sophisticated FHRP tracking configurations
- Enhanced Object Tracking (EOT) provides flexible method for manipulating First Hop Redundancy Protocols (FHRP) interface priority and/or weighting
  - Works with HSRP, GLBP, VRRP
- Capable of tracking state of:
  - Interface IP routing capability or line-protocol
  - IP route reachability or metric threshold
  - Boolean or threshold-based list of multiple tracking objects
  - IP SLA event state



Example: HSRP Interface Tracking

- Simple HSRP interface tracking object

```
interface Vlan10
 ip address 10.10.1.2 255.255.255.0
 standby 10 ip 10.10.10.1
 standby 10 priority 110
 standby 10 preempt
 standby 10 track 10 decrement 20
!
track 10 interface TenGigabitEthernet2/1 line-protocol
```



Other Enhanced Object Tracking Capabilities in Release 12.2(33)SXH

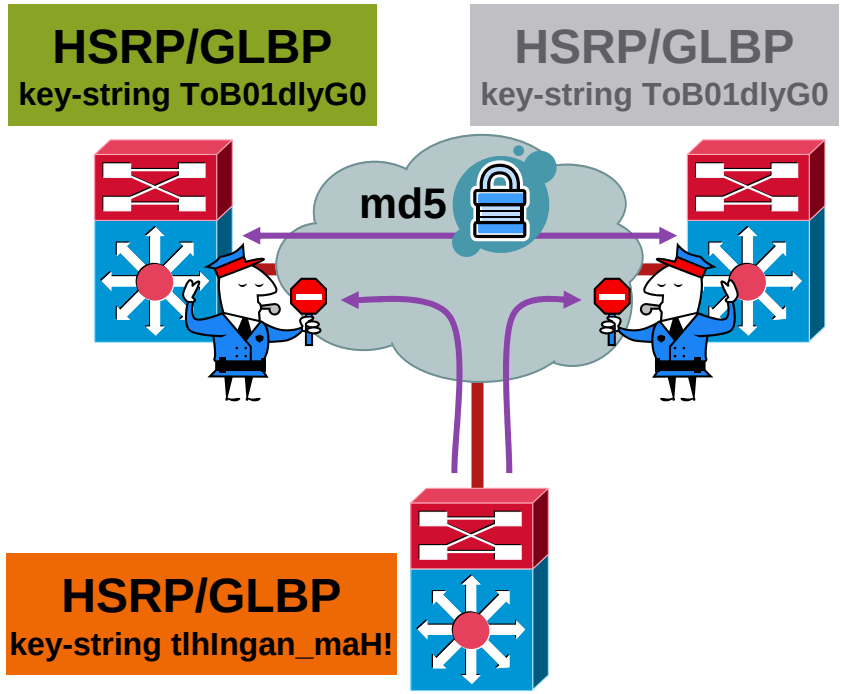
IP Services

- Object-tracking lists
  - Tracking object containing other objects
  - “Up” or “down” state of object list dependent on state of child objects
  - Simple example: track object is Up only if two independent IP routes are both in routing table
- Object tracking for IP SLA entries
  - Tracking state based on IP SLA monitoring entry state
  - Simple example: IP SLA udpEcho entry tests remote host reachability, track object is Up if reachable, Down if unreachable

HSRP/GLBP Message Digest 5 (MD5) Authentication

IP Services

- Use case — Any HSRP/GLBP deployment where security and anti-spoofing are a consideration
- Configure directly using MD5 key-string or indirectly via MD5 key-chain



Release 12.2(33)SXH Highlights
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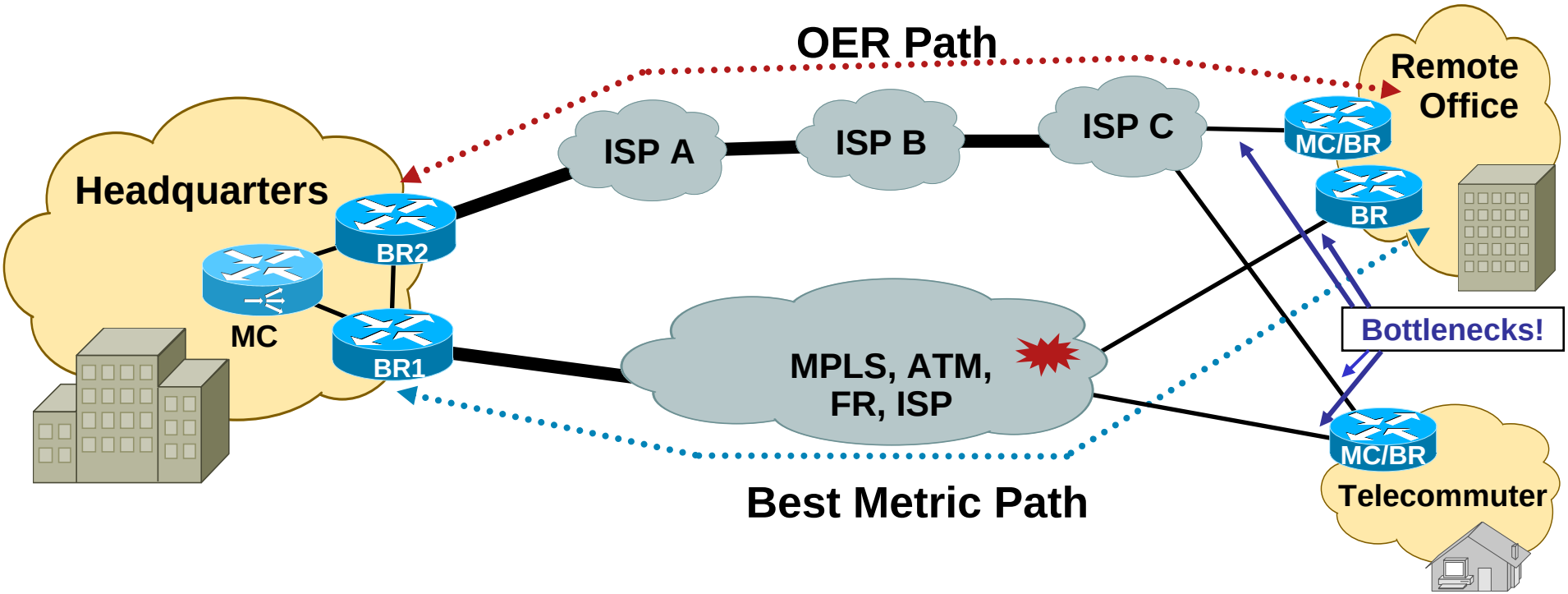
Performance Routing (PfR)
Optimized Edge Routing (OER)

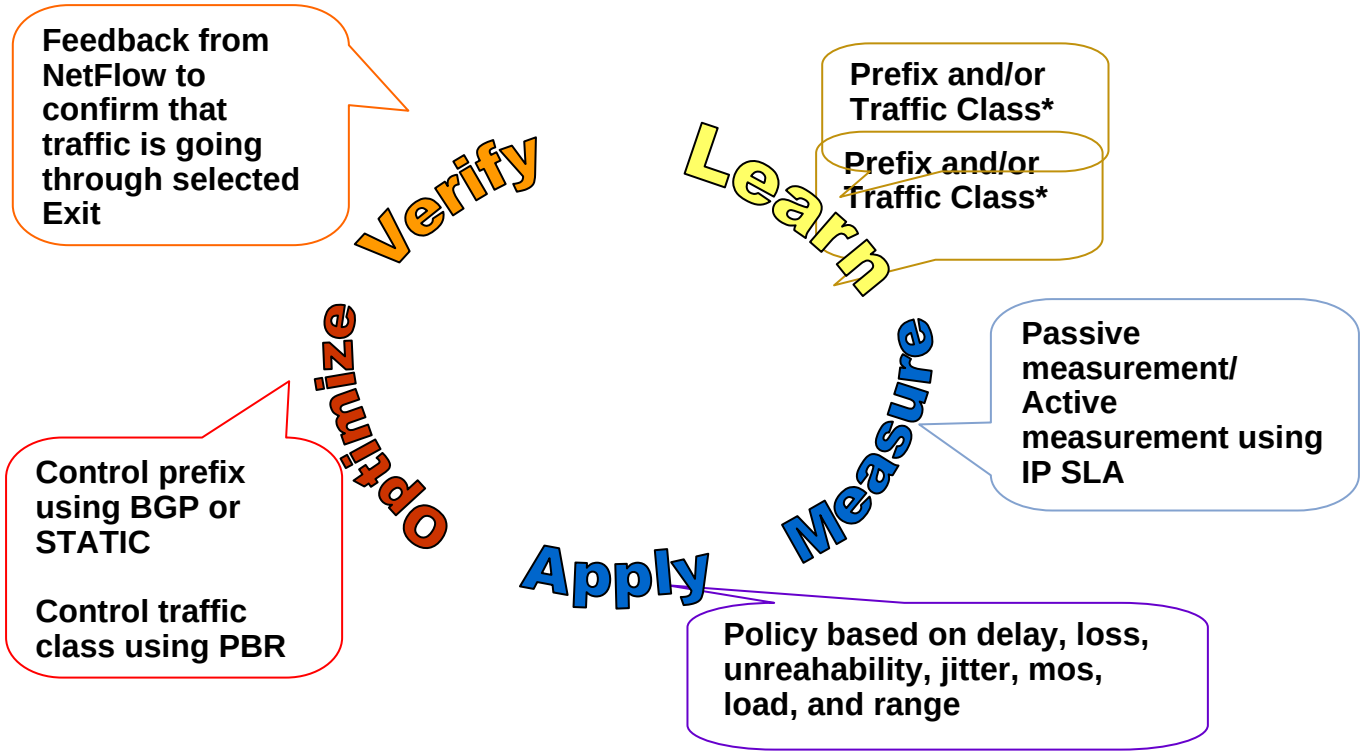
IP Routing and Multicast

- **Reduces Operational Costs - Optimal use of low cost WAN links**
- **Better User Experience - Optimal Path based on application type**
- **Flexible Criterion for Path Selection - Uses Reachailability, Delay, Jitter, MOS, Throughput, Load**



Performance Routing (PfR) OER Mechanism

IP Routing and Multicast



- Monitors network performance constantly and selects optimal paths for applications
- Allows user to configure policies

  Application specific, cost, and other policies
- Validates the operation of optimal paths

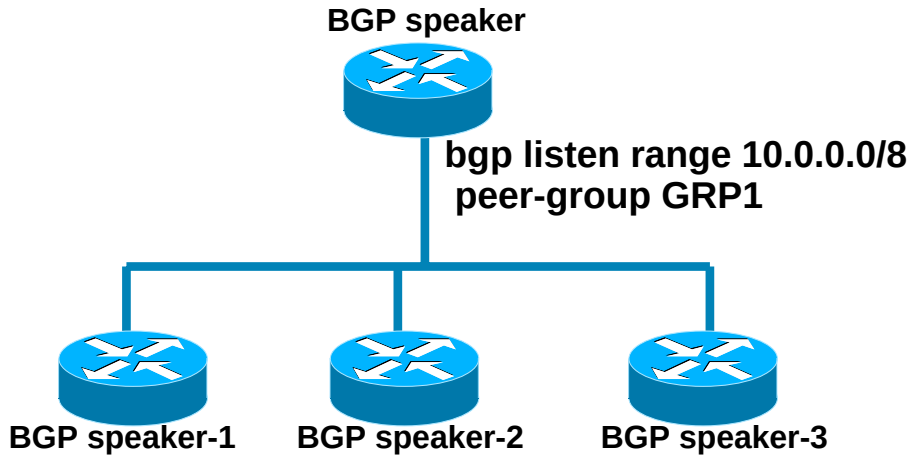
BGP: Dynamic Neighbors

Benefits

- **Simplified Configuration**
  - –Allows BGP connections from many speakers
- **Flexible Configuration**
  - – Configurable option to limit number of neighbors
  - – Peer group template allows dynamic neighbor configuration
  - – Peer group members can belong to different Autonomous Systems

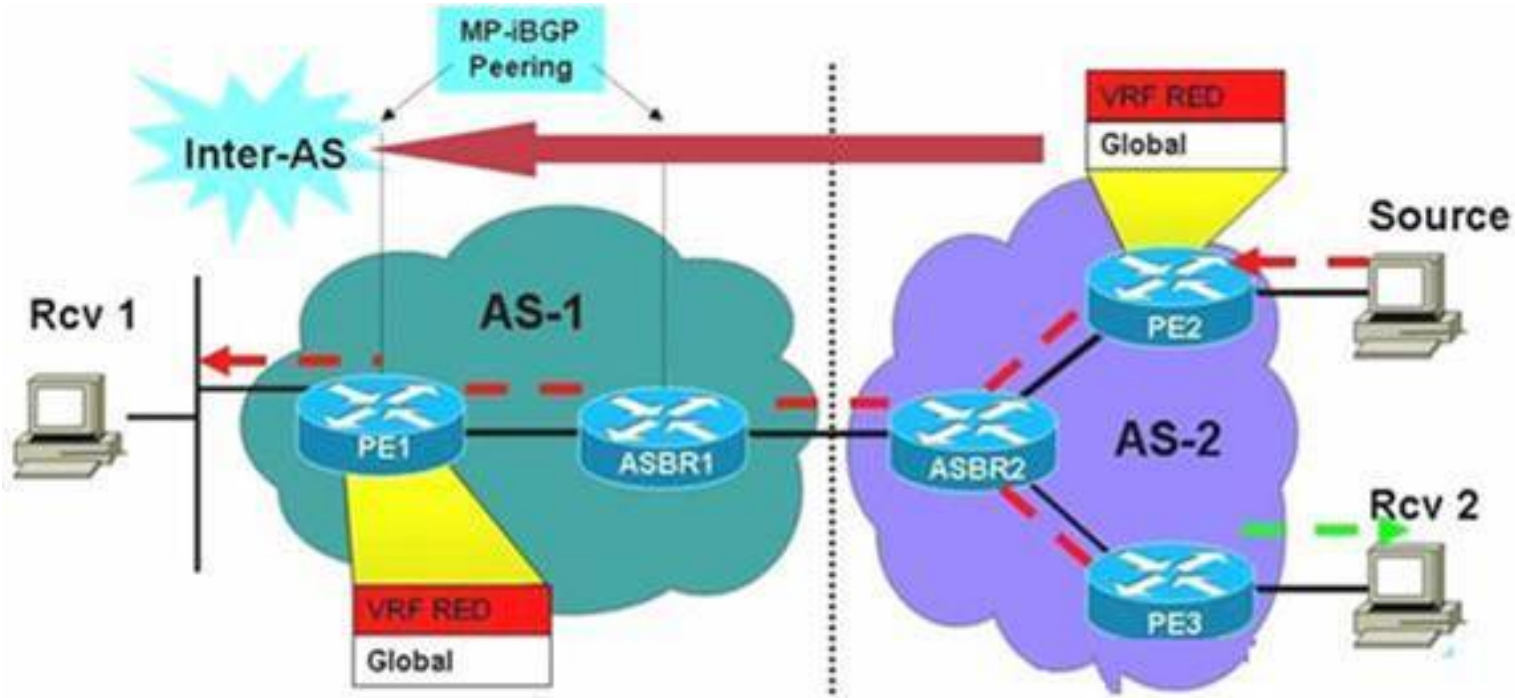
Deployment Scenarios

- **Hub and Spoke Networks**
  - – Configure Dynamic Neighbors only once at hub
  - – Add spokes as needed
  - – Only spokes need BGP configuration
- **Data Centers**
  - – Configure Dynamic Neighbor at Router
  - – Add BGP speakers (Servers) as needed

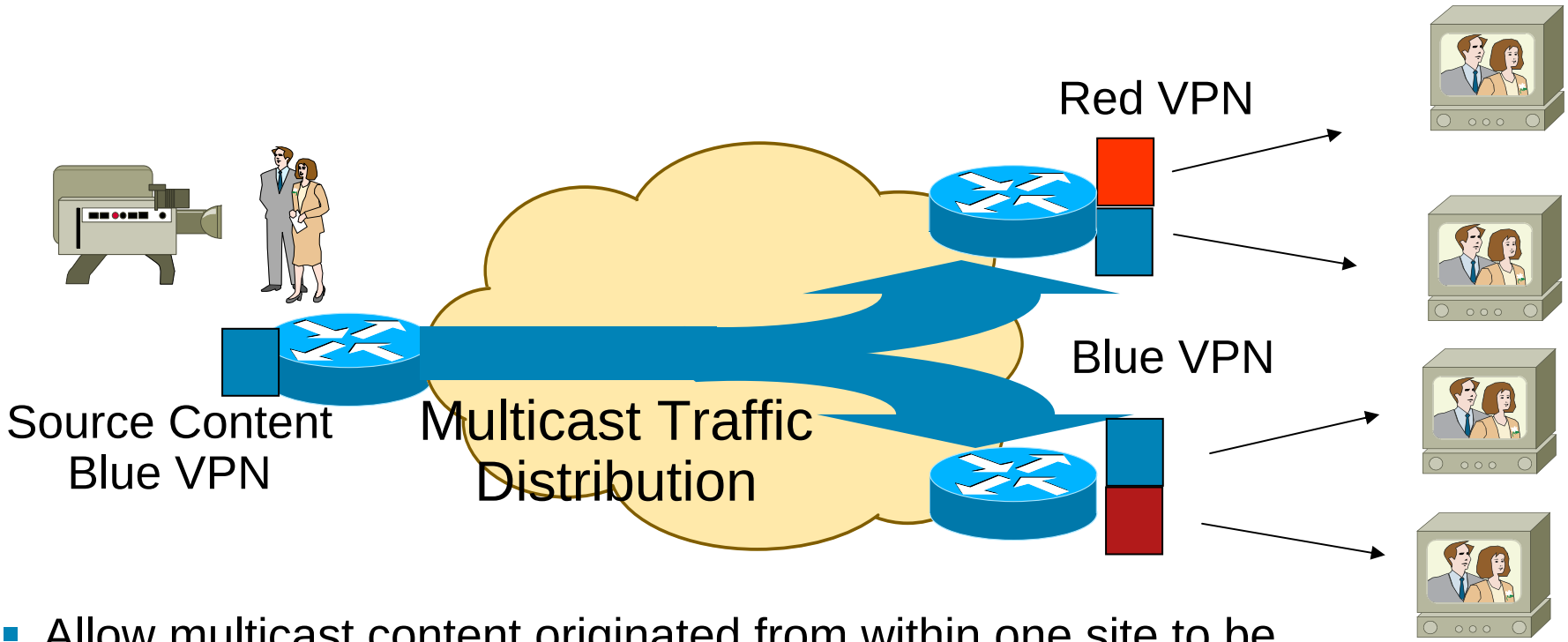


Multicast VPN (mVPN) Inter-AS Support

- Multicast VPN enhances Layer 3 MPLS VPN services by delivering multicast across the MPLS network
- The Inter-AS support enhances today's mVPN by seamlessly carrying multicast traffic across multiple BGP AS's
- The 3 IETF specified Inter-AS connection options are supported



Extranet Multicast VPN (MVPN)



- Allow multicast content originated from within one site to be distributed to other sites in different MPLS VPN's
- Require no new protocols
- Supports VRF Group select, allowing selection of the reverse path forwarding (RPF) check in a specific VRF

IPv6 Multicast Enhancements

- Cisco continues its leadership in hardware based IPv6 Multicast forwarding and protocols
  - Cisco has supported PIM Sparse Mode and Source Specific Multicast (SSM) for the building of multicast tree's from source to receivers
  - Cisco has host support for IPv6 Multicast Listener Discovery (MLD v1 and v2) protocol
- Cisco has enhanced its support for IPv6 with eight new features including
  - New security enhancements
  - Reduced leave latency for hosts (fast IPTV channel change)
  - Rendezvous Points (RP) improvements and more
  - Static Multicast routes (Mroutes)

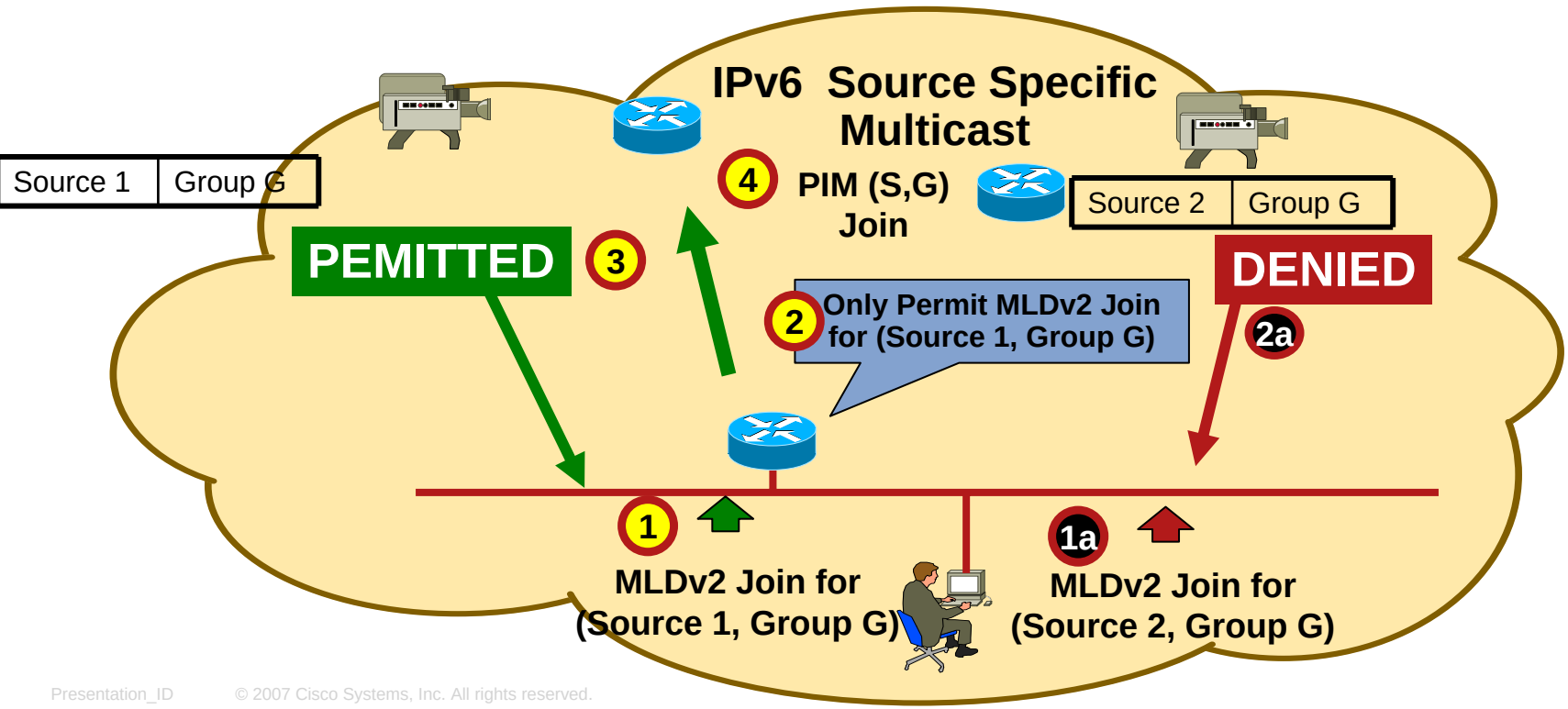
Release 12.2SX IPv6 Multicast Feature Breadth

Description	Features
PIM Support	PIM Sparse Mode
	PIM Source Specific Multicast
	IPv6 SSM mapping for MLDv1
Receiver Protocols	MLD v1, v2
Security Features	*MLD Access Group Filtering
	*PIM Accept register
RP Support	*Embedded RP support
	*IPv6 BSR
	*RPF Flooding of BSR Packets
	IPv6 embedded RP using one register tunnel
Other	*Explicit Tracking of Receivers (Fast Leave)
	*Static Mroutes
	*Route-able address hello option
	Scooping Support
	Distributed multicast forwarding
	IPv6-in-v4 Tunneling

*** New features in Release 12.2(33)SXH are in red**

IPv6 MLD Access Group Filtering for (S,G)

- Multicast Listener Protocol (MLD) is used by hosts to receive and join multicast streams
- MLD Access Group Filtering allows enhanced security for Source Specific Multicast (SSM) protocol based networks
  - Specifically the router can filter MLD join requests based on (S,G) pairs protecting or filtering how receivers join streams
  - For Example in the diagram below, group G is allowed to receive source 1 but not source 2

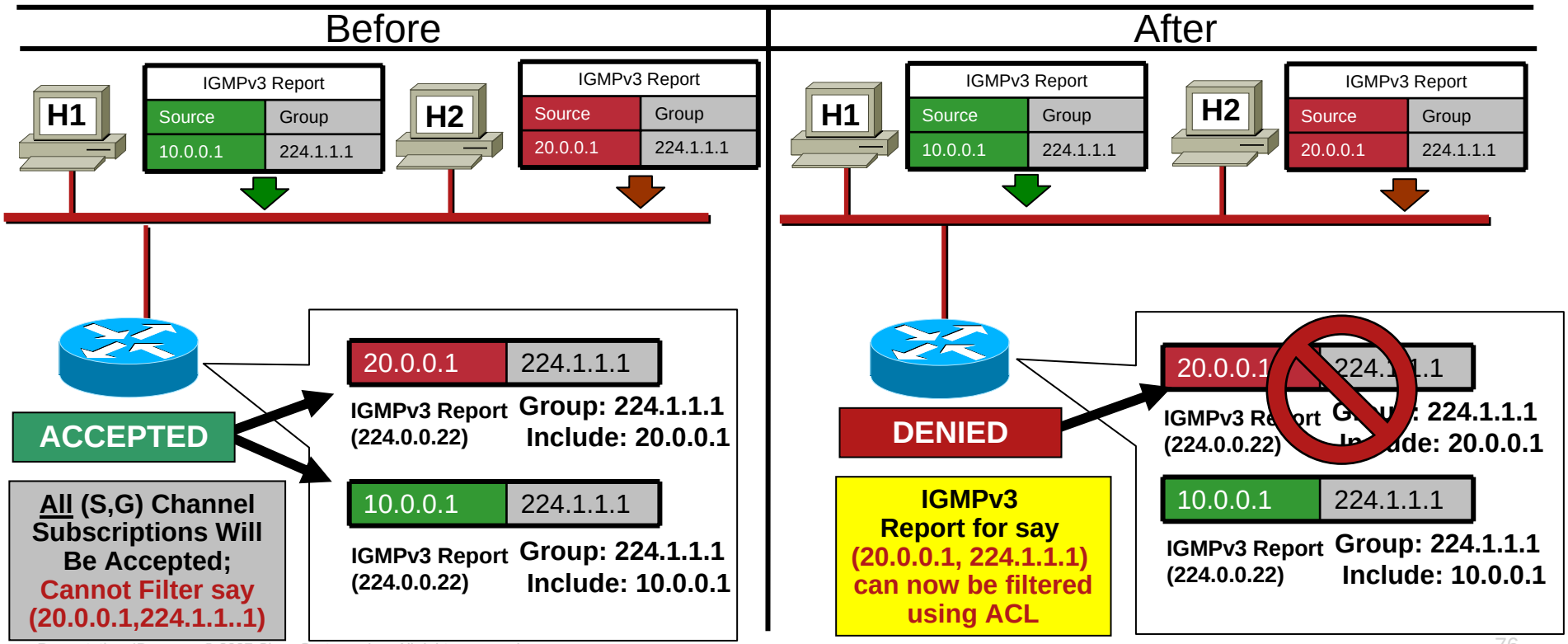


IPv4 Extended Access-lists (ACL) Support for IGMP to support SSM

IP Routing and Multicast

- IGMP is used by hosts to receive and join multicast streams
- IGMP extended ACL allows enhances security for a Source Specific Multicast (SSM) protocol based network

The router can filter IGMP reports based on a source(s) or Source and Group (S,G) pairs protecting or filtering how receivers join streams



Auto-RP Enhancement, No Dense Mode *Fallback* After RP Info Loss

IP Routing and Multicast

- Rendezvous Point (RP's) are used by sources to announce their existence and by receivers of multicast packets to learn about new sources
- Cisco provides the Auto-RP protocols to announce RP information to multicast enabled devices in the network
- Historically if a multicast enabled device could not find an RP then Multicast Dense Mode was used to assure the delivery of multicast streams. This behavior is called "Dense Mode Fallback"
- A new enhancement allows the user to enable or disable fallback to dense mode functionality

No Dense Mode flooding with all state remaining in Sparse Mode

- IOS Global Command

  no ip pim dm-fallback

New Multicast SNMP MIBS: IETF Standard Multicast Route MIB and mVPN MIB

- **IPMROUTE-STD-MIB is an IETF standard MIB**
  - **Contains information about multicast routes (Mroutes) such as traffic counters and routing flags**
- **The Multicast VPN MIB (Cisco-MVPN-MIB) is a Cisco proprietary MIB to enhance Multicast VPN (mVPN) manageability**
  - **Based on draft-svaidya-mcast-vpn-mib to be re-submitted as L3VPN WG draft**

MVPN MIB Capabilities
Determine the number of multicast VRF's and the number of multicast enabled interfaces
Determine the multicast distribution tree groups joined and addresses allocated
Information on multicast distribution tree tunnels being utilized
Changes in creation and deletion of multicast VRF's on the PE device

Multicast Source Distribution Protocol Compliance with IETF RFC 3618

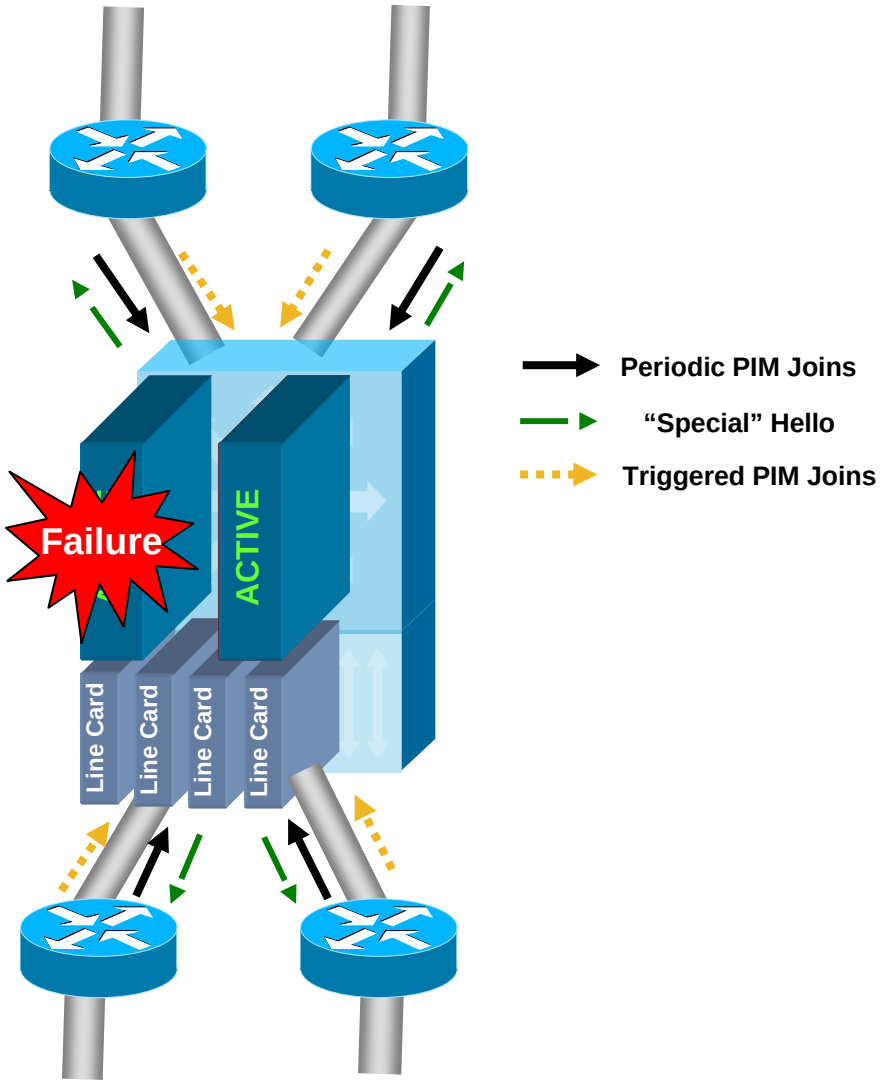
- Multicast Source Distribution Protocol (MSDP) is a protocol used to distribute multicast source information between multicast domains or between Rendezvous Points (RP's)
- The MSDP Compliance with IETF RFC 3618

  Border Gateway Protocol (BGP) route reflectors without running MSDP

  Interior Gateway Protocol (IGP) for the Reverse Path Forwarding (RPF) check, allowing peering without BGP or Multi-protocol BGP (MBGP).

  Peering between routers in non-directly connected autonomous systems. This capability helps in confederation configurations and for redundancy.

Multicast HA : Triggered PIM Joins



Triggered PIM Joins
Active Route Processor Fails

Active Route Processor receives periodic PIM hello's in steady-state

Active Route Processor fails

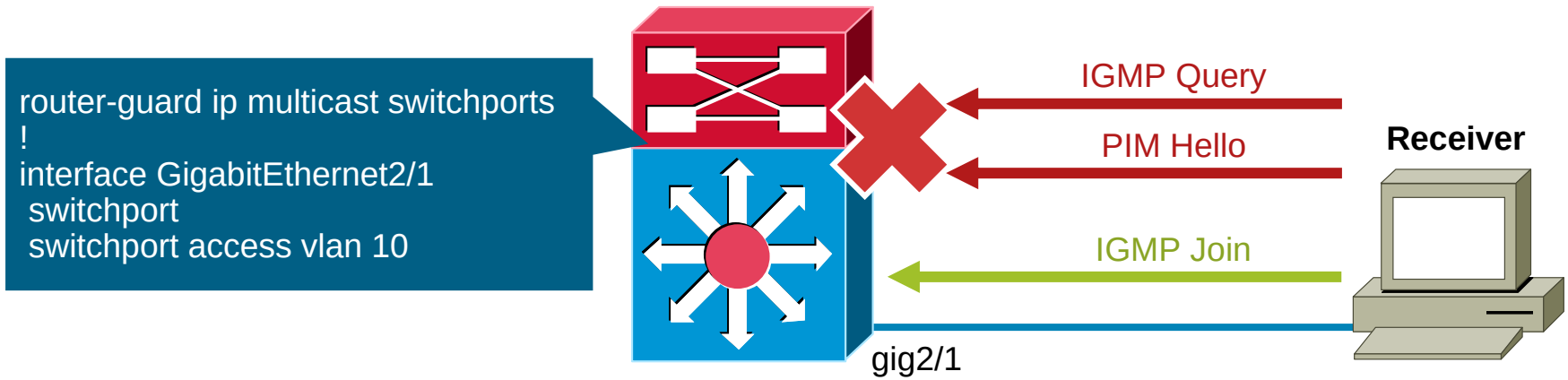
Standby Route Processor takes over

Interfaces send PIM hello

Neighbor receives PIM hello

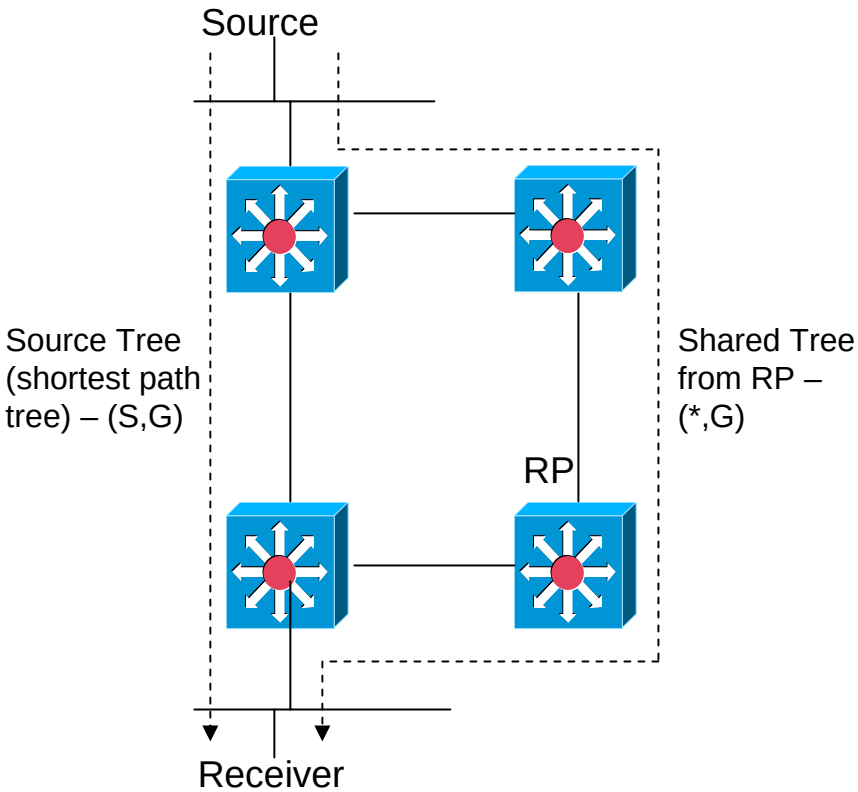
Triggers adjacent PIM neighbors to resend PIM Joins refreshing state of distribution tree(s) preventing them from timing out

Multicast Router Guard



- **Prevents unauthorized devices from becoming multicast router and disrupting multicast traffic flow**
- **Multicast Router Guard makes all switchports multicast "host ports"**
  - **Port cannot become router port**
  - **All multicast router-control packets discarded**
- **Packets discarded if received on a router-guard port:**
  - **IGMP query messages**
  - **IGMP PIM messages (PIMv1)**
  - **IPv4 PIMv2 messages**
  - **DVMRP messages**
  - **RGMP messages**
  - **CGMP messages**

Enhanced IPv6 Multicast Shared Tree Performance in Hardware



- **Existing implementation prior to Release 12.2(33)SXH:**
  - **Default SPT threshold set to zero**
  - **SPT threshold configured larger than zero, will result in:**
    1. **Limited software (*,G) entries can be created.**
    2. **Poor IPv6 Multicast forwarding performance.**
- **Feature implementation in Release 12.2(33)SXH:**
  - **With SPT threshold configured larger than zero (or infinity to always use shared tree):**
    1. **(*,G) entries created in hardware.**
    2. **Higher IPv6 Multicast forwarding performance since packets are hardware switched.**

IGMP Filtering

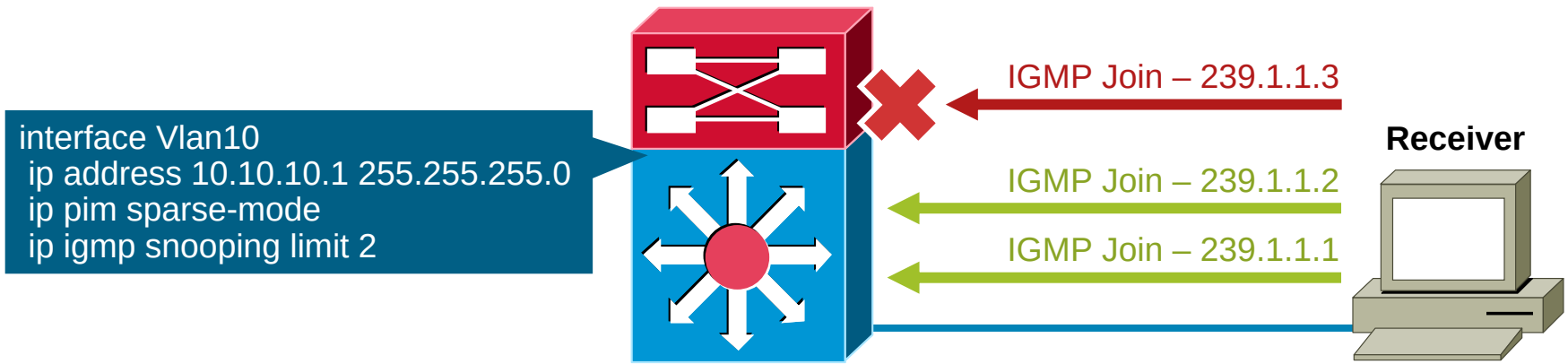
- Use case — Multicast deployments requiring administrative control of stream delivery
- IGMP filtering comprises suite of configuration options that control multicast join behavior at snooping level
  - IGMP Group/Channel Access Control
  - Number of IGMP Groups/Channels Limit
  - IGMP Protocol Minimum-Version

IGMP Snooping Access Control

- Granular control of which multicast streams allowed on switchport or VLAN
- Limit users to specific group membership or channel membership

Several configuration options:

- Per-SVI — Provides default filter for all access switchports in VLAN
  - For L2 only VLAN, SVI must exist but can be shut
- Per-L2-switchport — Overrides any default SVI filter
  - On trunk, applies to all VLANs on trunk, overriding SVI filters
- Per-VLAN on L2 trunk port — Overrides any configured switchport filter for that VLAN



Release 12.2(33)SXH Highlights
Embedded Management Enhancements

12.2(33)SXH is designed for Enterprise campus and Service Provider edge Catalyst 6500 deployments that require world-class IP and MPLS, high availability, WAN/LAN services, embedded management, and software modularity.

- **Powerful New Hardware Support**
  - Distributed Forwarding Card, IP 16-way ECMP, SPAN Enhancements, IOS Software Modularity for SIP-200, SIP-400, and Enhanced FlexWAN SPAs
- **MPLS LDP Enhancements**
  - MPLS LDP Session Management, Label Signaling and Assignment, Graceful Restart, Session Protection, MPLS High Availability
- **MPLS Traffic Engineering Enhancements**
  - AutoTunnel Primary/Backup, AutoTunnel Mesh Groups, Class-Based Tunnel Selection, Fast Re-Route Link/Node/Bandwidth Protection, Inter-AS TE, Inter-AS TE Fast Re-route, Inter-AS TE Authentication and Policy Control, MPLS TE LSP Attributes, MPLS TE Verbatim Support, Shared Risk Link Groups
- **L2 VPN Enhancements**
  - AToM Tunnel Selection, AToM Pseudowire Provisioning, Ethernet over MPLS, Frame Relay over MPLS, L2 Local Switching, Multiplexed UNI
- **MPLS Management Enhancements**
  - MPLS LDP MIB , MPLS VPN MIB, Support for MPLS TE FRR MIB, MPLS OAM support, MPLS HA support for MPLS MIBs
- **Quality of Service (QoS) Enhancements**
  - Cisco IOS AutoQoS
- **IP Services Enhancements**
  - HSRP/GLBP Stateful SwitchOver (SSO), EOT for FHRP, HSRP/GLBP MD5 Authentication
- **Routing and Multicast Enhancements**
  - OER, BGP: Dynamic Neighbors, Multicast VPN Inter-AS Support, Extranet Multicast VPN, IPv6 Multicast Enhancements, IPv6 MLD Access Group Filtering for (S,G), IPv4 Extended ACL Support for IGMP to support SSM, Auto-RP Enhancement, Multicast SNMP MIB, MSDP Compliance with IETF RFC 3618, Multicast HA: Triggered PIM Join(s), Multicast Router Guard, Enhanced IPv6 Multicast Shared Tree Performance in Hardware, IGMP Filtering and Snooping Access Control
- **Embedded Management Enhancements**
  - NetFlow Top Talkers, CISCO-NETFLOW-MIB, IPv4 Multicast NDE Using NetFlow V9, NetFlow for IPv6, Per-Interface NetFlow, LLDP-MED, IOS Configuration Rollback/Replace, Embedded Syslog Manager, Netconf Support over SSH2, TCL Scripting, SNMP Periodic Data Collection and Transfer, Cisco IOS IP SLAs, IEEE 802.3ah – Link OAM, IEEE 802.1ag Connectivity Fault Management (CFM), Smart Call Home, SPAN enhancements
- **Integrated Security Enhancements**
  - IBNS (802.1x) Enhancements, Policy-Based ACLs (PBACL), AutoSecure, Private Host, IP Source Guard

Embedded Management Value Proposition

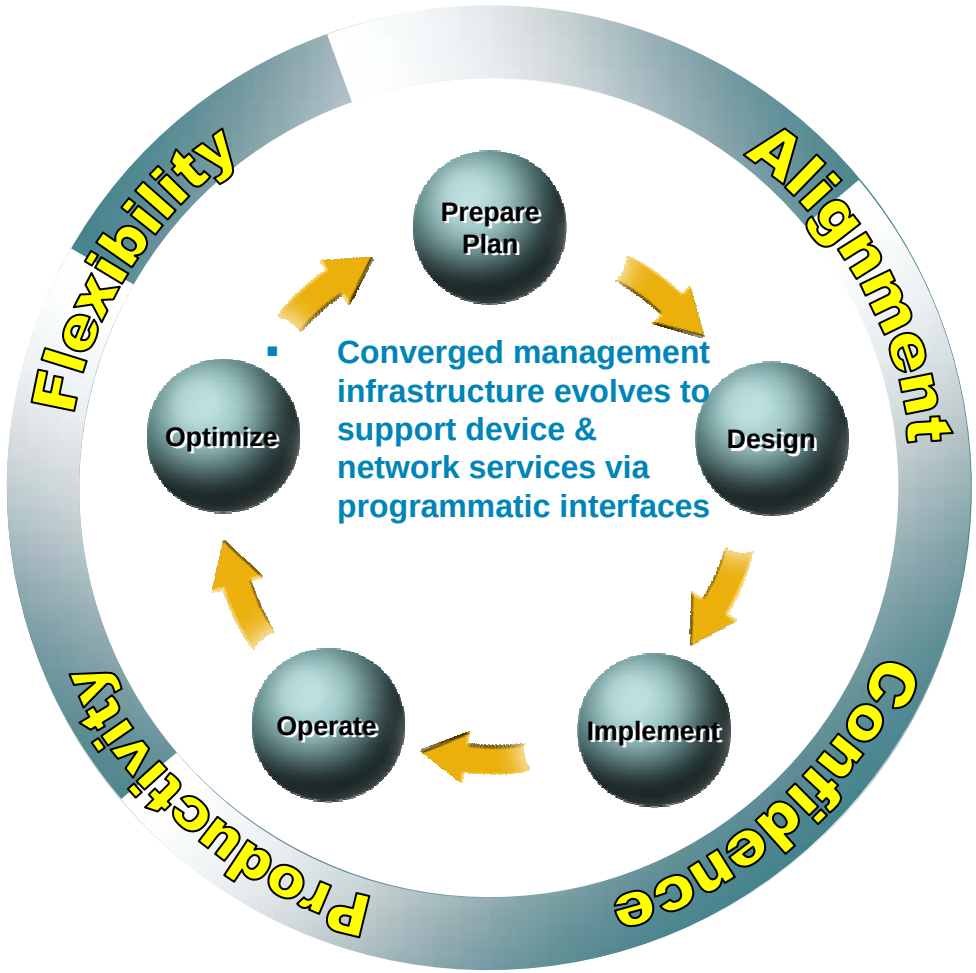
Embedded Management

Customer Objectives

- Faster operations integration, Reduced OpEx
- Reduce complexity – improve technology transitions and service rollouts, & hence customer satisfaction & competitiveness
- Streamline operations and lower OpEx
- Manage towards compliance - reduce risks from change and planning

Cisco Differentiation

- Embedded pro-active event handling and active/passive measurements to enable high performance network analysis, reduce OpEx through proactive maintenance & support SLAs
- Accelerate scalable service rollouts through automation and simplified management and reduce add/move/change errors through configuration robustness
- Reduced cost, complexity in developing management applications



NetFlow Top Talkers

Embedded Management

- The flows that are generating the heaviest traffic in the cache are known as the "top talkers"
- Allows flows to be sorted by either of the following criteria
  - By the total number of packets in each top talker
- Match criteria for the top talkers, works like a filter
- The top talkers can be retrieved via the CISCO-NETFLOW-MIB (cnfTopFlowsTable)
- A new separate cache
  - Similar output of the show ip cache flow or show ip cache verbose flow command
  - Generated on the fly
  - Frozen for the “cache-timeout” value
- **NetFlow Top Talkers is also supported in Release 12.4(15)T and higher**

CISCO-NETFLOW-MIB

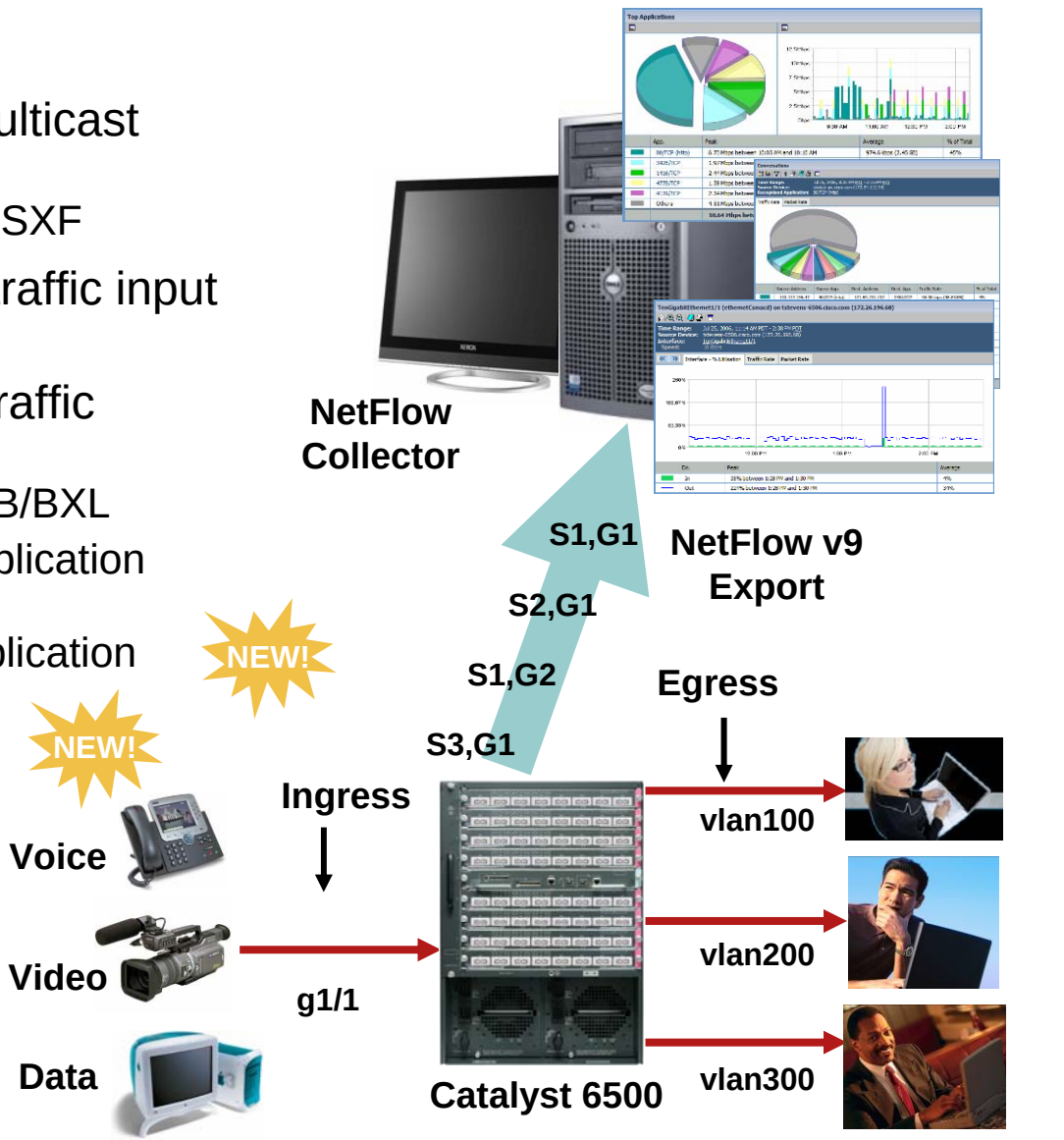
Embedded Management

- Managed objects to configure the following NetFlow information
  - Flow cache, interface, export, peer-as versus origin-as
  - Exception: no sampled NetFlow configuration
- Managed objects to monitor the following NetFlow information
  - Packet size distribution, number of bytes exported per second, number of flows/UDP datagrams exported, number of template active, export statistics, protocol statistics, etc.
- Monitor the top flows
- The CISCO-NETFLOW-MIB.my is not:
  - A replacement for the traditional method of exporting a flow cache
- Note that CISCO-SWITCH-ENGINE-MIB, on the Cisco Catalyst, allows to query the multilayer switching flow records
- Don’t forget the threshold mechanism with the RMON event/alarm or the EVENT-MIB
- CISCO-NETFLOW-MIB is also supported in Release 12.4(15)T and higher

IPv4 Multicast NetFlow Data Export (NDE) Using NetFlow v9

Embedded Management

- Support for ingress and egress multicast statistics
  - Supported since Release 12.2(18)SXF
- Ingress NetFlow tracks multicast traffic input on an interface
- Egress NetFlow tracks multicast traffic replicated (output) on an interface
  - Egress accounting requires PFC3B/BXL
  - Egress accounting with ingress replication mode
  - Egress accounting with egress replication mode
- Support of RPF-Fail Accounting



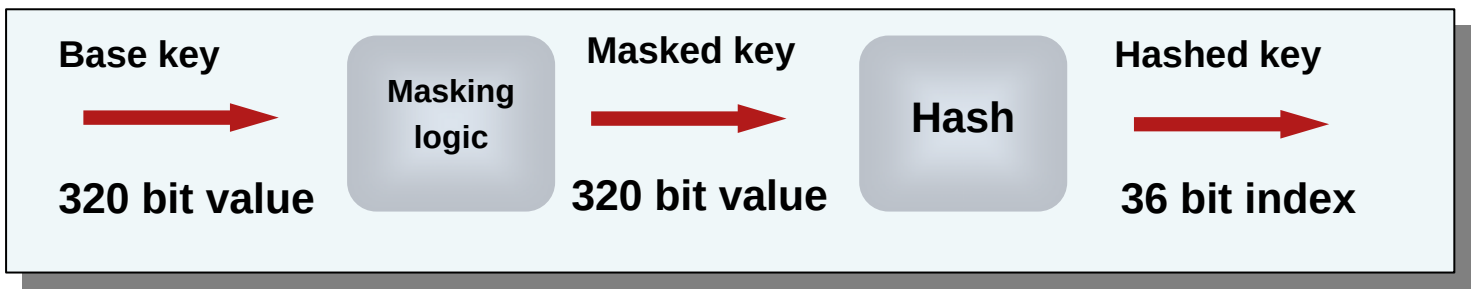
NetFlow for IPv6

Embedded Management

- Based on NetFlow version 9
- For both ingress and egress IPv6 traffic
- Full Flow support (no sampling supported)
- IPv6 Flow records export over IPv4 only

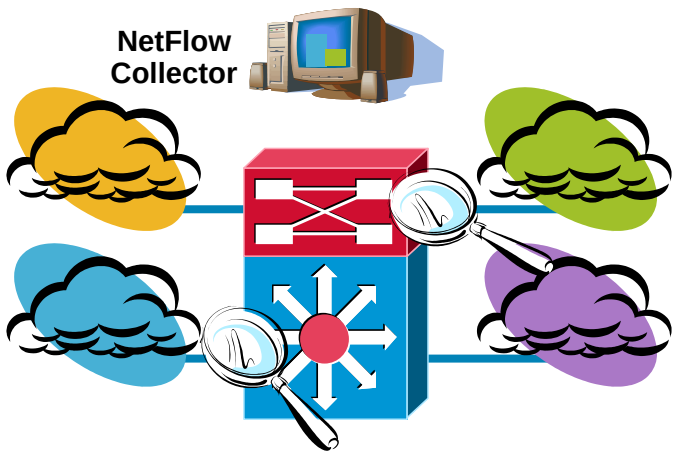
Larger “hashed keys” provide more efficient TCAM utilization as TCAM is 36 bit wide

SUP720 3BXL – IPv6



Per-Interface NetFlow

- Prior to SXH, hardware IPv4 NetFlow creation is global
  - When mls flow ip configured, NetFlow entries created for ALL flows on ALL interfaces
  - When mls nde sender enabled, NetFlow entries exported for ALL flows on ALL interfaces
- With per-interface NetFlow, user explicitly chooses interfaces that will create and export NetFlow entries
  - Only interfaces with ip flow ingress will create NetFlow entries
- Can decrease hardware NetFlow table utilization and reduce CPU load



Link Layer Discovery Protocol Media Endpoint Discover

- IEEE standard for IP phone device discovery
- Provides interoperability with 3rd party IP phones by discovering and negotiating power
- Concurrent CDP and Link Layer Discovery Protocol-Media Endpoint Discover (LLDP-MED) support planned
- Enables negotiation of L2/L3 policies, VLAN, and Location
- No LLDP MIB support yet

LLDP-MED Required Type-Length-Values (TLV)

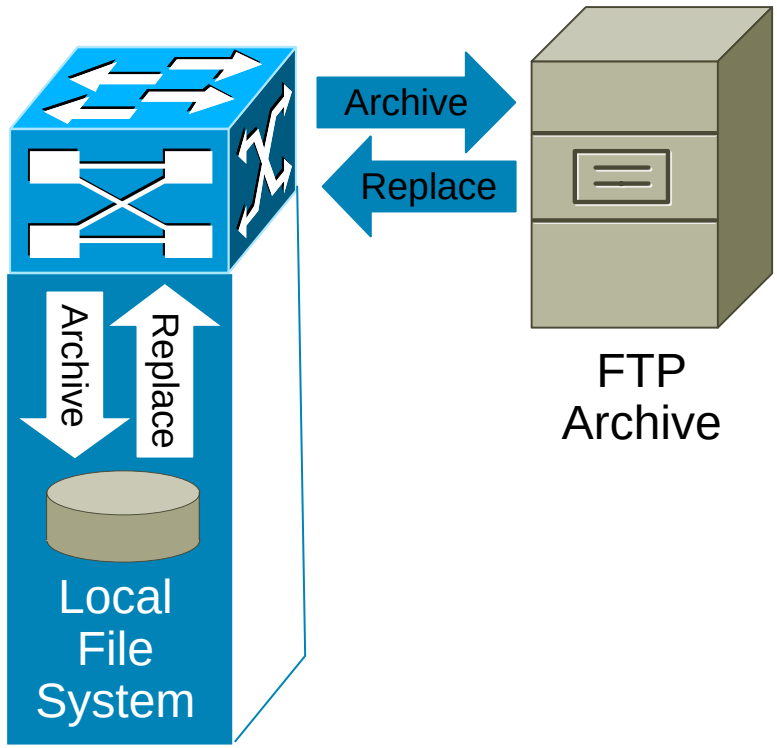
Embedded Management

TLV	Status	Description
Chassis ID	**Mandatory**	**Chassis identification**
Port ID	**Mandatory**	**Port identification**
Time to Live	**Mandatory**	**TLV Time to Live**
System Capabilities	**Mandatory for IP phones**	**Identifies device type**
MAC/PHY configuration/status	**Mandatory**	**Identifies duplex and speed**
Extended Power via MDI	**Mandatory for PoE devices**	**Power negotiation**
Network Policy	**Must support this to provide CDP equivalent VLAN negotiation**	**VLAN negotiation**

Cisco IOS Configuration Rollback/Replace

Embedded Management

- Provides rapid and accurate configuration rollback for IOS configuration changes
- Replace the running configuration with any archived IOS config without rebooting
- Only delta changes are applied allowing very rapid configuration applications
- Combined with automatic Configuration Archive, IOS Config Rollback/Replace allows automated configuration management and control
- Improves accuracy by allowing restoration to a well-know state without need for manual reconfiguration



IOS Configuration Rollback/Replace Benefits

Embedded Management

Traditional Undo

- Find the old configuration
- Manually compare differences in configuration
- Type in differences between the old configuration and the currently running configuration
- Fix mistakes and typos

IOS Config Rollback/Replace Benefits

- Single command rollback/replace
- Accurate
- Fast
- Saves reboots
- Save manual reconfiguration

Embedded Syslog Manager (ESM)

Embedded Management

- Customizable framework integrated in Cisco IOS Software for correlating, augmenting, filtering, and routing syslog messages
- Allows complete control over system message logging at the source
- Provides a programmatic interface to allow you to write custom filters
- Allows user to configure post-processing of syslog messages with selected ESM filters

ESM Benefits

Embedded Management

- Fully customizable processing of system logging messages, with support for multiple, interfacing syslog collectors
- Ability to configure unique severity levels for syslog messages instead of using the system-defined severity levels
- Ability to route specific messages or message types, based on type of facility or type of severity, to different syslog collectors
- Capability for notifications using TCP to external servers, such as TCP-based syslog collectors or Simple Mail Transfer Protocol (SMTP) servers
- Ability to limit and manage syslog "message storms" by correlating device-level events

Netconf support over SSH2

- The NETCONF over SSHv2 feature enables performing network configurations via Cisco Command-Line Interface (CLI) over an encrypted transport
- NETCONF uses Extensible Markup Language (XML)-based data encoding for the configuration data and protocol messages
- The NETCONF Network Manager, which is the NETCONF client, must use Secure Shell Version 2 (SSHv2) as the network transport to the NETCONF server; multiple NETCONF clients can connect to the NETCONF server
- Benefits

  The network configuration protocol (NETCONF) defines a simple mechanism through which a network device can be managed, configuration data information can be retrieved, and new configuration data can be uploaded and manipulated

Embedded Management

Cisco IOS TCL Scripting

- TCL first introduced in IOS in 1994
- Open source code with IOS customizations
- Many IOS components use TCL scripts – EEM, IVR
- Used for rapid prototyping, scripted applications and testing; can be created and modified dynamically
- SNMP MIB access using TCL

TCL Scripting Benefits

Embedded Management

- Powerful method of custom-processing the events or states within a router, and taking a variety of actions based on them
- Easy to Learn: industry standard language
- All Cisco IOS Software CLI commands may be referenced by Tcl scripts, in both EXEC and CONFIG mode API to verify the signatures if customers customize the scripts
- Tcl scripts can be used to create customized commands, grouping multiple IOS commands, processing and customizing output, even creating auto-refreshing commands for real-time refresh at the CLI level

SNMP: Periodic Data Collection & Transfer A New Efficient MIB Collection Agent

Embedded Management

- Scalable
  - Collect only what is needed, with a configurable list of OIDs
  - Separate collection schedule and export schedule, no periodic polling is required
  - No SNMP processing overhead
  - Can afford to collect more frequently
- Reliable
  - Data can be kept in the device for a period of time, depending on device storage
  - Even if the device goes down, stored data can be retrieved
  - Data is exported in FTP with user configurable URL
  - Hot and standby export URL to further ensure data availability

Embedded Management

Cisco IP SLAs

- Developed and patented at Cisco® Systems in 1998
- IP SLAs has VoIP, MPLS, Metro-Ethernet and TCP/IP network capabilities
- Provides network performance and availability monitoring, change impact planning, QoS verification, and more
- Release 12.2(33)SXH provides a major upgrade to IP SLAs for the 6500 Series Platforms
- Supported in both Cisco IOS and IOS-XR Software Platforms
- For More Information : http://www.cisco.com/go/ipsla

The IP SLAs Advantage

Embedded Management

Platform Coverage

- Supported on nearly all Cisco IOS and IOS-XR platforms

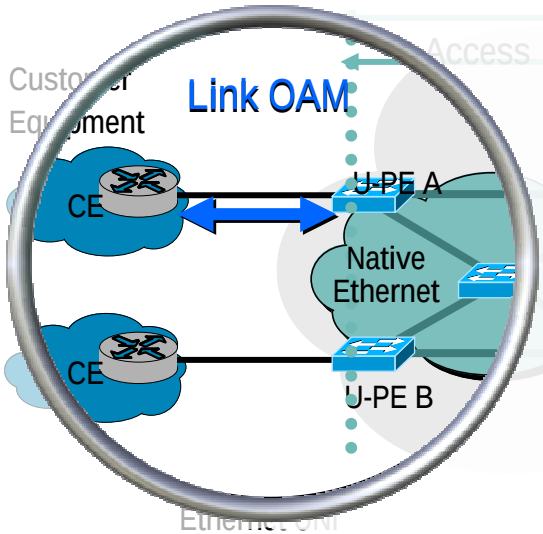
Embedded Performance Tool

- Network and Network Performance technologies in one

IP SLAs Benefits

- Verify and Monitor VoIP, MPLS, Metro-Ethernet and TCP/IP
- Real-time alerts directly from the source device in the network
- Diverse network management solution support
- Fully distributed – test between any two points in the network
- Allows pinpoint accuracy in determining and isolating incidents

IEEE 802.3ah – Link OAM



- Maintain consistency of an Ethernet *transport* connection (per link, or “physical” OAM)
- Address key operational issues when deploying Ethernet across geographically disparate locations
- Operates on a single point-to-point link between 2 devices
- Slow protocol using packets called OAMPDUs which are never forwarded
- Standardized as part of IEEE 802.3ah (Ethernet in the first mile)

IEEE 802.1ag: Connectivity Fault Management (CFM)

Embedded Management

- Connectivity Fault Management is Per Service OAM ("per VLAN OAM")

  Standard efforts: IEEE 802.1ag and ITU SG13/Q3

- Fault Management Functions

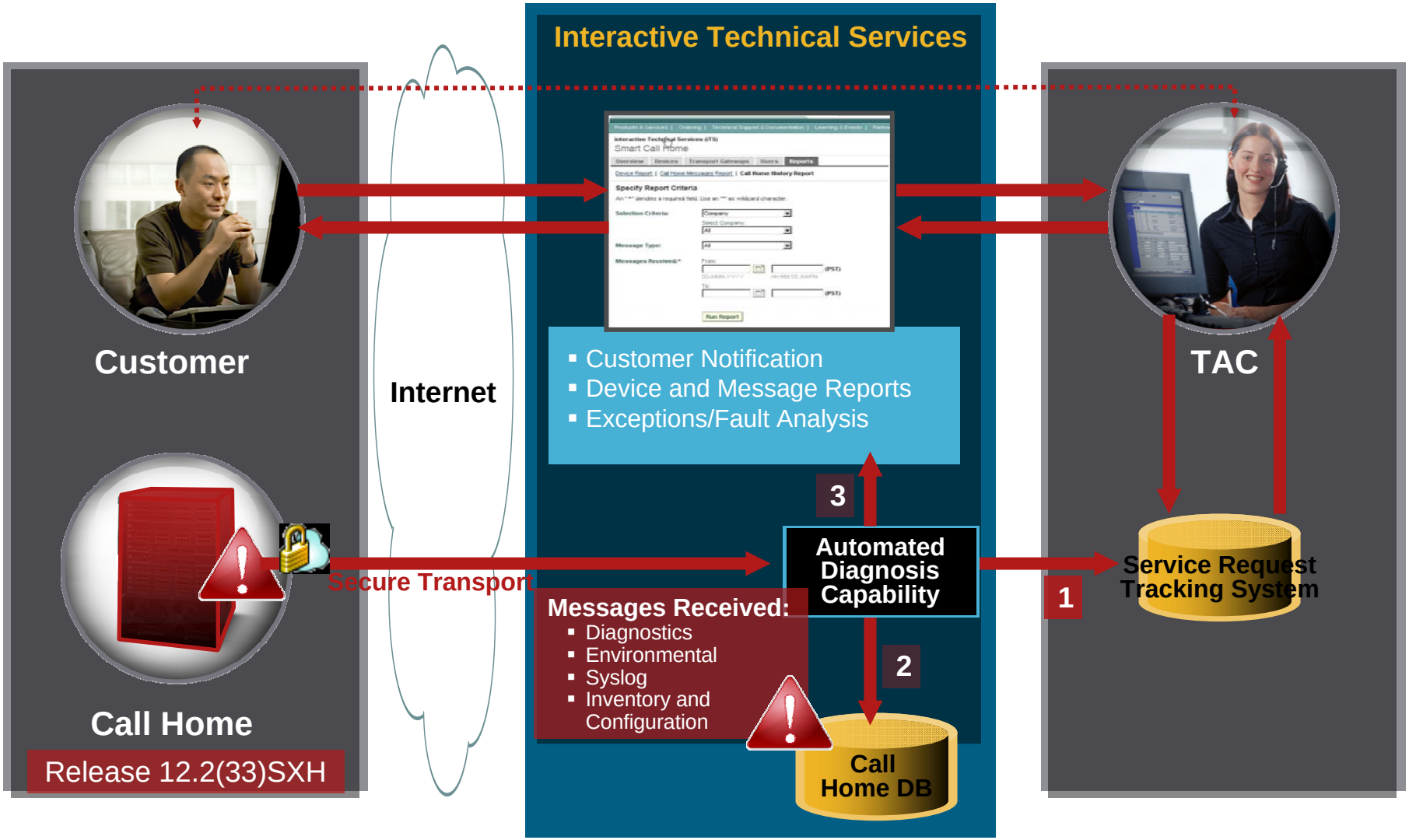
  Fault Detection: Continuity Check (CC)
  Fault Verification: Loopback (LP)
  Fault Isolation: Path Trace and Loopback
  Fault Notification: Alarm Indication Signal (AIS)

Note:

- **CFM Fault detection should NOT be used for fast failover**
  - **Not built to have CC messages sent every 20ms**
- **CFM serves as a backup for when failover mechanisms fail**
  - **Use RSTP, Etherchannel, Flexlink, FRR, SONET APS, etc for rapid convergence**

Embedded Management

What is Smart Call Home?



Enables Cisco Catalyst 6500 Switches to send diagnostic information directly to Cisco TAC, significantly reduces the time to solve minor hardware problems and RMA cycle

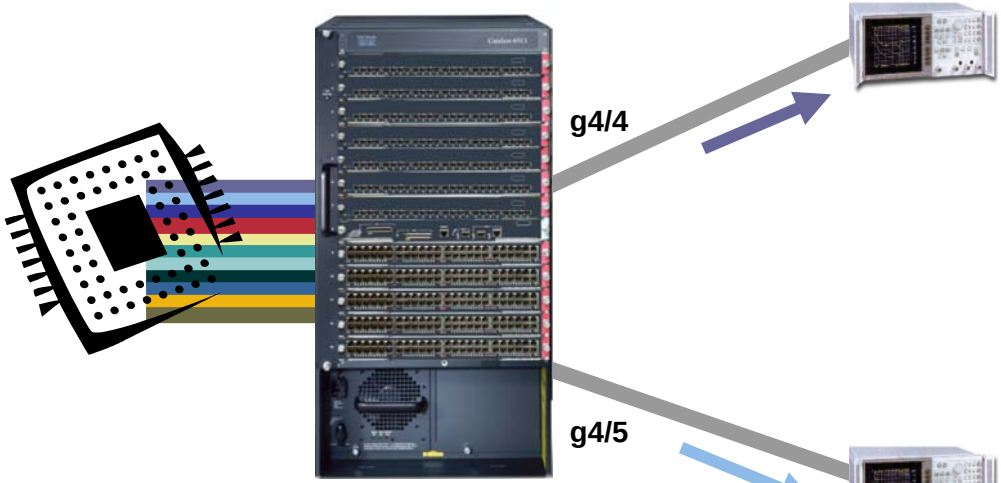
Switched Port Analyzer (SPAN) Enhancements

SPAN enhancements in Release 12.2(33)SXH

- Total of 16 SPAN sessions, with 14 Tx-only SPAN sessions & 2 existing Tx/Rx/Both sessions
- Ability to accept ingress traffic on SPAN destination port
- Allow Etherchannels as SPAN destination port to allow more scalable IDS and network analysis solutions
- Option to enable MAC learning on SPAN destination port
- Configurable per-destination interface
- SPAN extended to provide ability to capture CPU-bound and CPU-generated traffic
- Distributed egress Tx SPAN which helps overcome the existing centralized Tx SPAN issues including limited centralized replication bandwidth and Increased fabric-channel bandwidth consumption

Inband SPAN with VLAN Filter and Virtual SPAN

Embedded Management




```
interface GigabitEthernet4/4
 switchport
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 10
 switchport mode trunk
 switchport nonegotiate
 spanning-tree portfast trunk
```

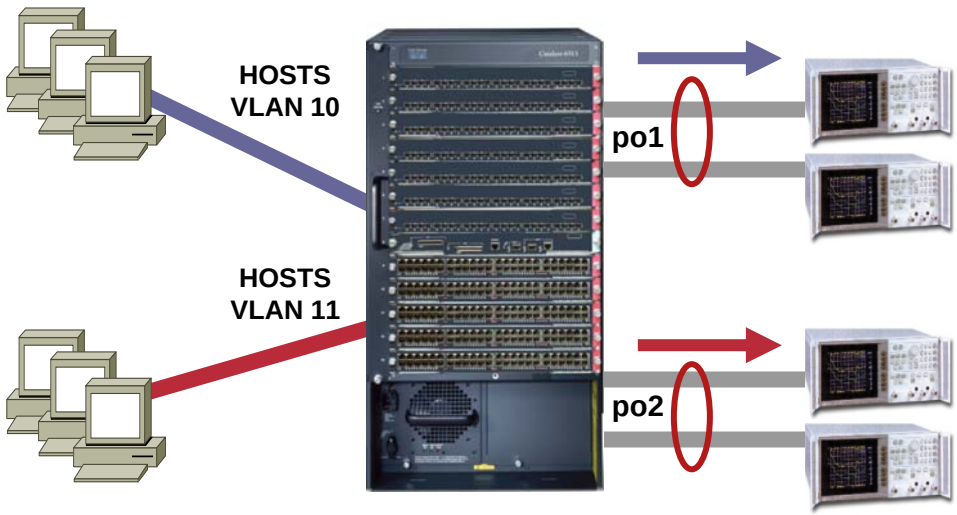
```
interface GigabitEthernet4/5
 switchport
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 20
 switchport mode trunk
 switchport nonegotiate
 spanning-tree portfast trunk
```

```
monitor session 10 type local-tx
 filter vlan 10 , 20
 source cpu rp tx
 destination interface Gi4/4 - 5
```

- **Internal VLANs are supported in VLAN allowed list on SPAN destination ports**
  - **VLAN filter in SPAN session not supported with internal VLANs (ie: routed interfaces)**

EtherChannel as SPAN Destination with Virtual SPAN - Example

Embedded Management




```
interface Port-channel1
 switchport
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 10
 switchport mode trunk
 switchport nonegotiate
```

```
interface Port-channel2
 switchport
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 11
 switchport mode trunk
 switchport nonegotiate
```

```
monitor session 16 type local
 source vlan 10 - 11
 destination interface Po1 , Po2
```

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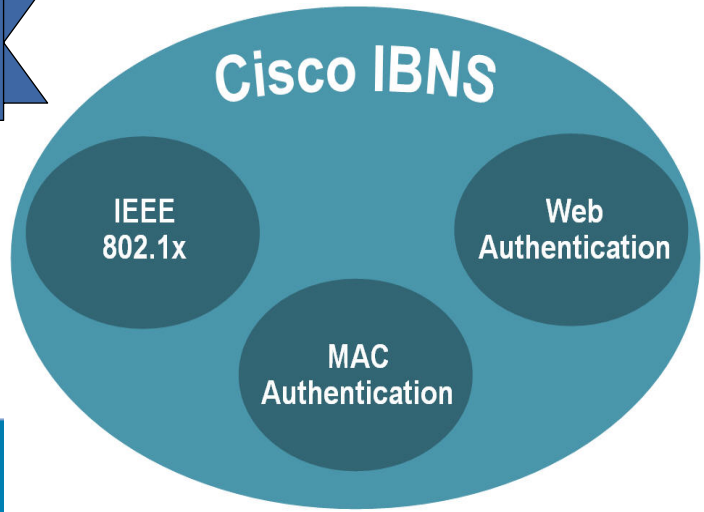
  - OER, BGP: Dynamic Neighbors, Multicast VPN Inter-AS Support, Extranet Multicast VPN, IPv6 Multicast Enhancements, IPv6 MLD Access Group Filtering for (S,G), IPv4 Extended ACL Support for IGMP to support SSM, Auto-RP Enhancement, Multicast SNMP MIB, MSDP Compliance with IETF RFC 3618, Multicast HA: Triggered PIM Join(s), Multicast Router Guard, Enhanced IPv6 Multicast Shared Tree Performance in Hardware, IGMP Filtering and Snooping Access Control
- **Embedded Management Enhancements**
  - NetFlow Top Talkers, CISCO-NETFLOW-MIB, IPv4 Multicast NDE Using NetFlow V9, NetFlow for IPv6, Per-Interface NetFlow, LLDP-MED, IOS Configuration Rollback/Replace, Embedded Syslog Manager, Netconf Support over SSH2, TCL Scripting, SNMP Periodic Data Collection and Transfer, Cisco IOS IP SLAs, IEEE 802.3ah – Link OAM, IEEE 802.1ag Connectivity Fault Management (CFM), Smart Call Home, SPAN enhancements
- **Integrated Security Enhancements**
  - IBNS (802.1x) Enhancements, Policy-Based ACLs (PBACL), AutoSecure, Private Host, IP Source Guard

Integrated Security

Identity-Based Network Services (IBNS)



IEEE 802.1x

- Standard for link layer authentication and access control
- Components: supplicant (client), authenticator (switch), and AAA server
- Uses on EAP protocol to transport authentication information

MAC Auth Bypass (MAB)

- Authenticate using the client's MAC address
- For devices that don't support 802.1x (no supplicant), such as printers

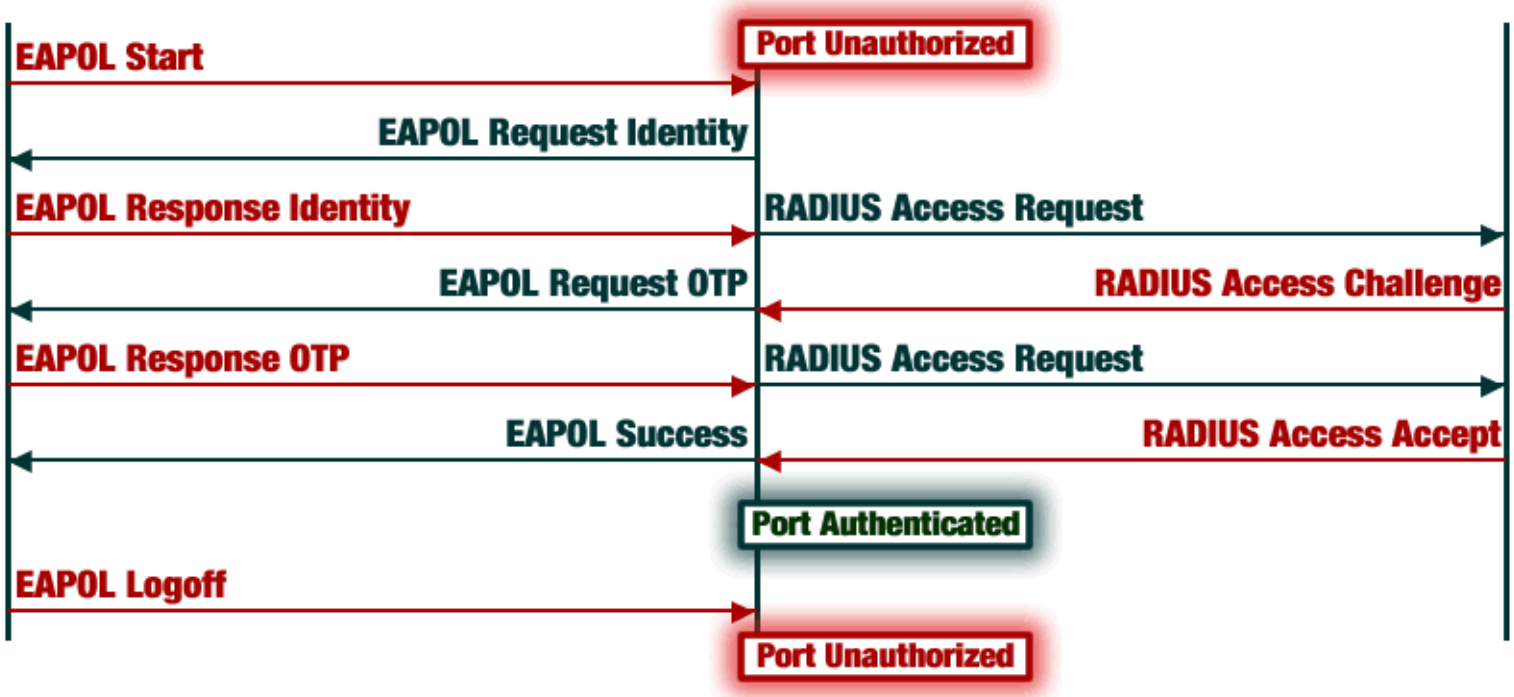
Web Authentication

- For clients that don't support 802.1x (no supplicant), but are capable for interactive HTTP authentication

Integrated Security

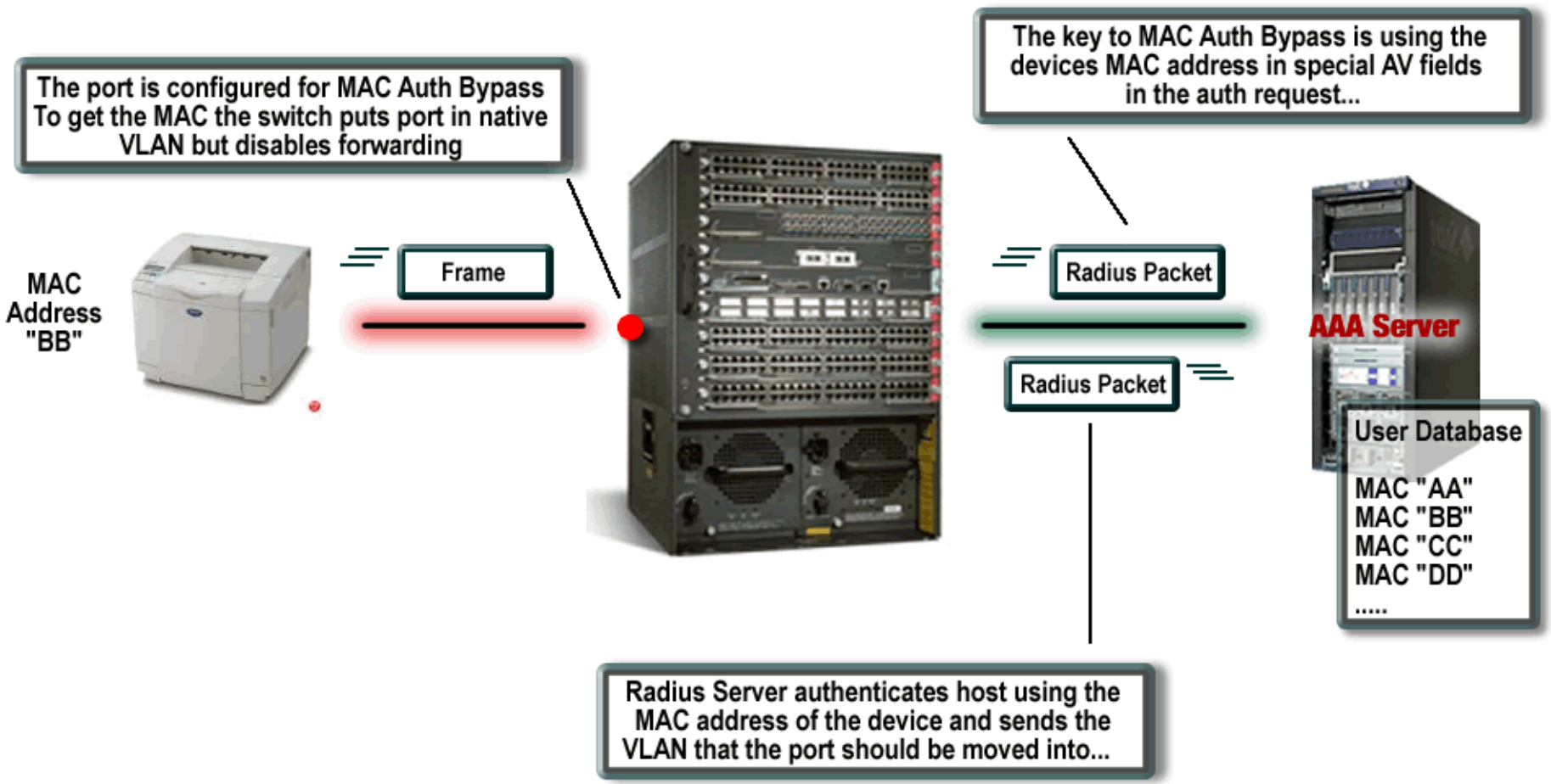
How 802.1x Authentication Works

IEEE 802.1x provides a means to identify and authenticate valid users prior to granting the access to the network...



MAC Authentication Bypass

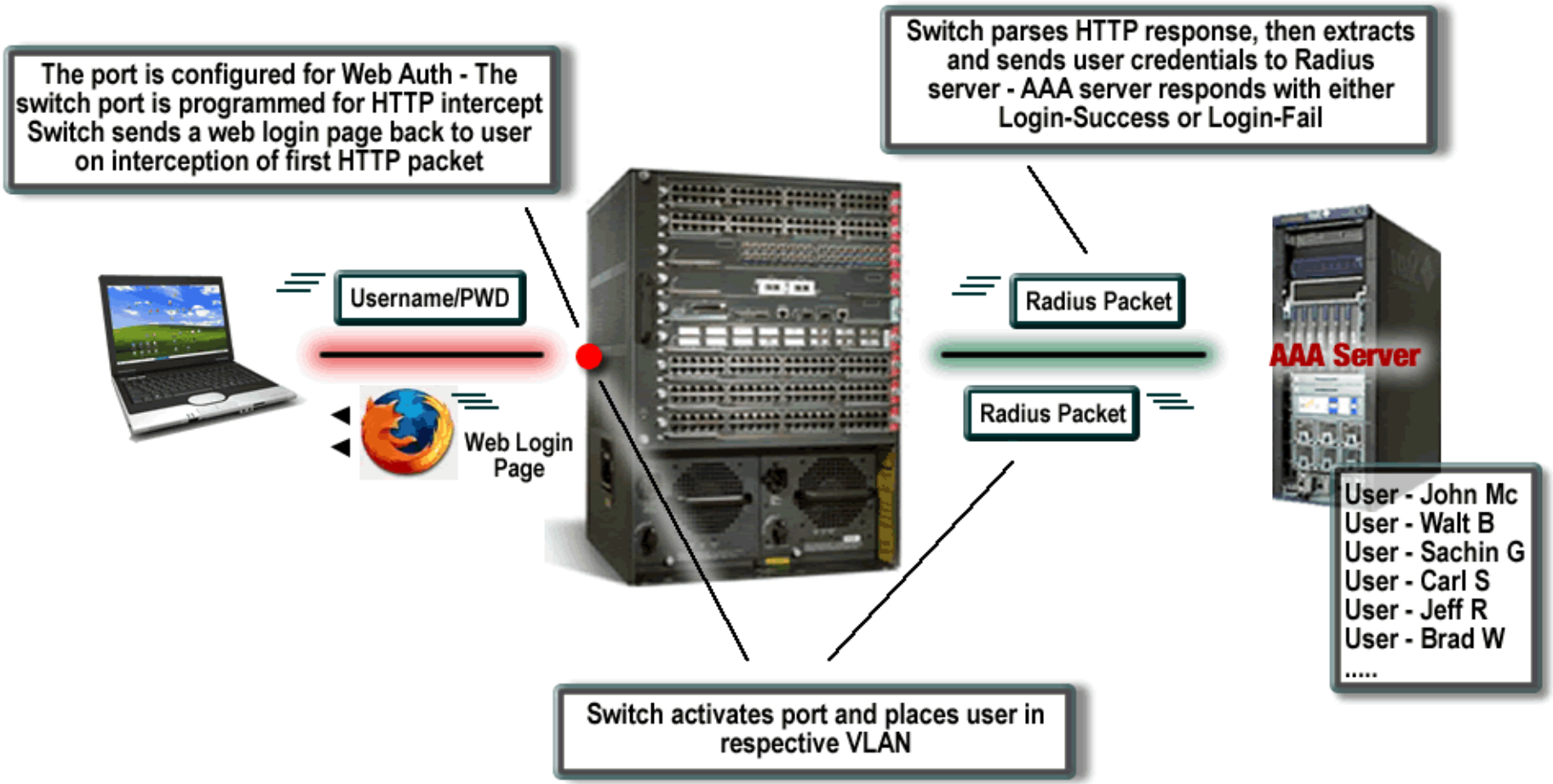
Question: What happens if want to control non-802.1x clients accessing my network?
Answer: MAC-Auth Bypass can be used to control which non-802.1x clients can connect into the network...



Integrated Security

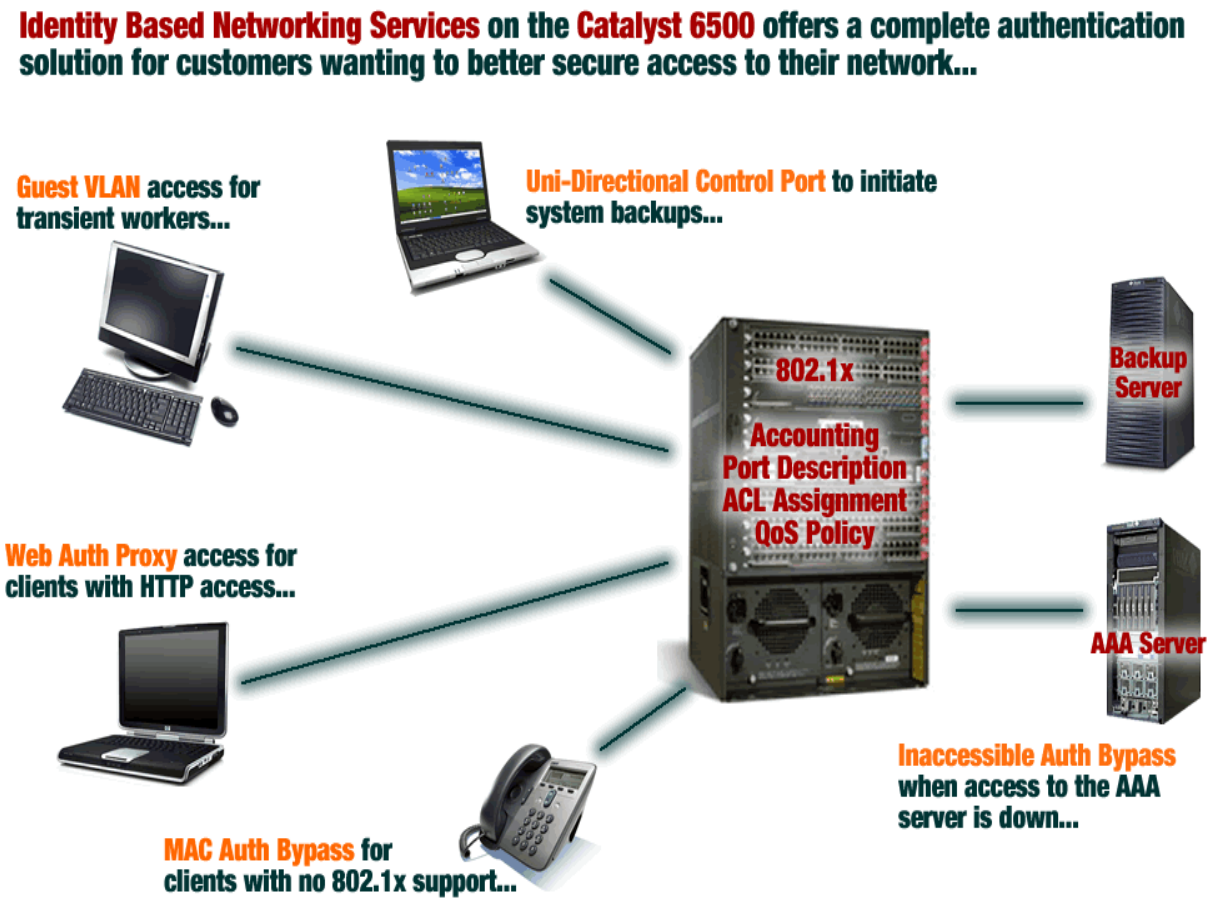
Web Authentication Proxy

Question: What about users who have OS's that dont support 802.1x?
Answer: Web-Auth Bypass can be used to allow users to use a Web Page to sign in, thus allowing any user with a Web browser to be authenticated prior to accessing the network.



IBNS Enhancements For Practical Deployment

Integrated Security

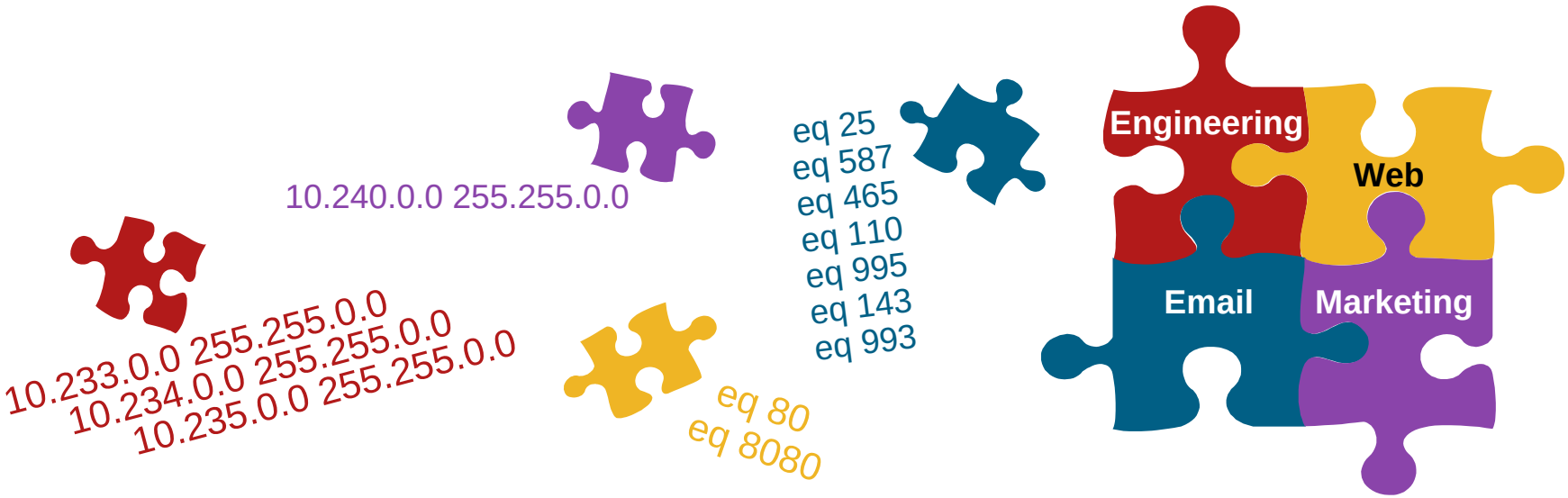


IBNS Enhancements In Release 12.2(33)SXH

- 802.1x with VLAN assignment
- 802.1X with Guest VLAN
- 802.1X with Auth Fail VLAN
- 802.1x with Wake-on-LAN
- 802.1x with Voice VLAN
- 802.1x with port security
- 802.1X with PVLAN
- 802.1X with DHCP Snooping
- 802.1X with HA
- 802.1x and Accounting
- 802.1x with Radius-supplied timeout
- 802.1x with Inaccessible Authentication Bypass
- Web Auth
- Web Auth with downloadable ACLs
- MAC authentication Bypass

Policy-Based ACLs (PBACL)

- Eases security-policy management by introducing level of abstraction in security policies
- Allows use of group names in ACEs instead of IP addresses and protocol ports
- Each ACE represents a rule applicable to classes of users and/or applications



PBACL Details

- IPv4 RACL policies only in SXH
  - Identify IP addresses or network ranges
  - Identify L4 ports or port ranges
- No difference in terms of ACL hardware resource usage
  - Main goal of PBACL is making ACL management easier!
- Enables simple ACL reconfiguration
  - Changes to object-group automatically updated in applied ACLs

AutoSecure - One Touch Automated Switch Lockdown

Integrated Security

Disables Non-Essential Services

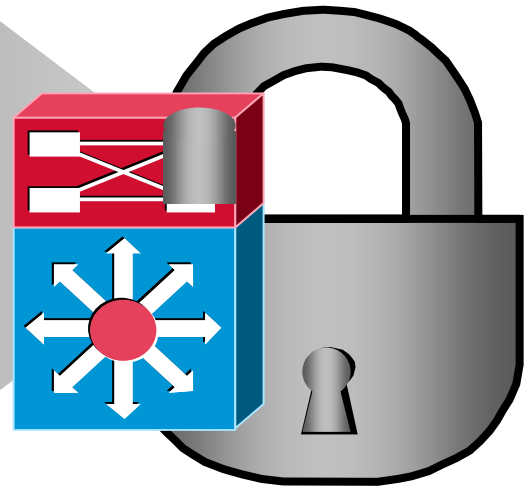
- Eliminates DoS attacks based on fake requests
- Disables mechanisms that could be used to exploit security holes

Enforces Secure Access

- Enforces enhanced security in accessing device
- Enhanced security logs
- Prevents attackers from knowing packets have been dropped

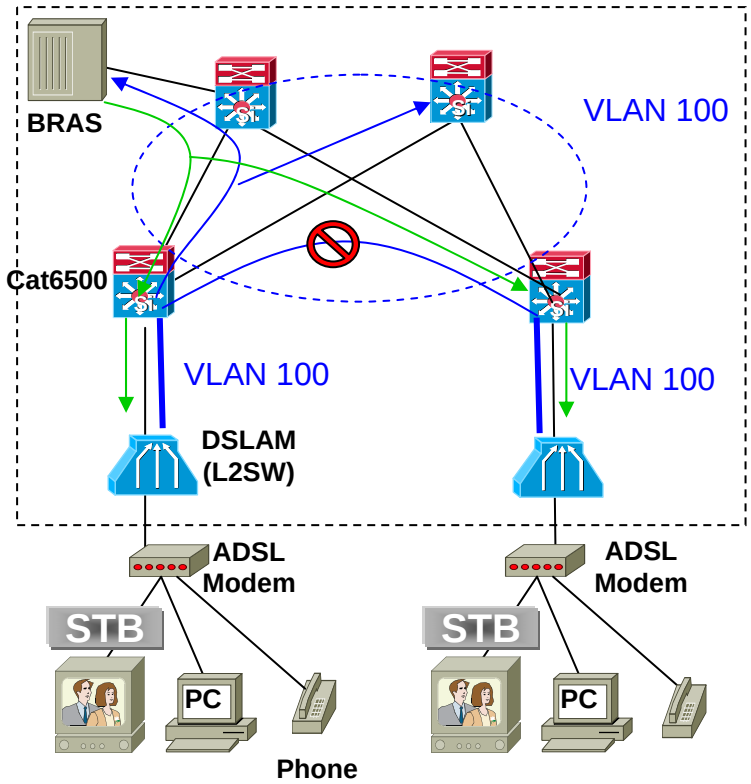
Secures Control Plane

- Enables RP rate-limiters to protect control plane



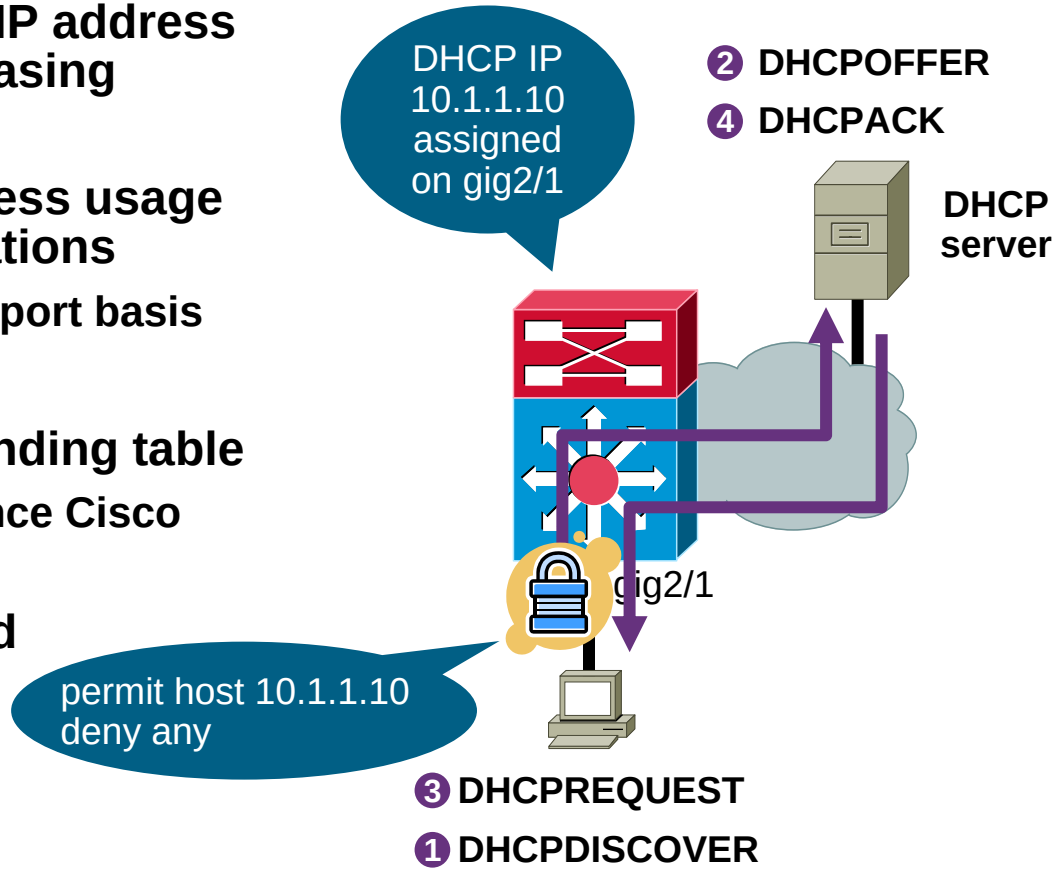
Private Host

- Equivalent of Private VLAN on trunk isolated, community and promiscuous ports
- Provides Layer 2 isolation over Layer 2 trunk ports
- VLAN re-usability
- Spoofing protection



IP Source Guard

- **Dynamically prevents source IP address spoofing on edge ports, increasing network security**
- **Enforces valid source IP address usage on ports connected to end stations**
  - **“uRPF check” on a per-switchport basis**
  - **Applies only to IP traffic**
- **Leverages DHCP snooping binding table**
  - **DHCP snooping supported since Cisco IOS Release 12.2(18)SXE**
- **Static bindings also supported**



Agenda

- Introducing Cisco IOS® Software Release 12.2SX
- Release 12.2(33)SXH Highlights
- Release 12.2SX Availability and Migration
- Summary

Catalyst 6500 Series Switch Cisco IOS Software

Recently Shipped Releases - Highlights

12.2(18)SXE
April 2005

- WS-CF-UPG=
- SPA-IPSEC-2G
- WS-C6504-E chassis
- SIP-200 and SIP-400
- BFD
- DOM
- ERSPAN
- 128 Etherchannels
- Multicast over GRE
- Layer 2 traceroute
- Bridged NetFlow
- Show top N

12.2(18)SXF
September 2005

- Sup32 Native
- WS-6148A-GETX
- WS-6148A-RJ45
- WS-6148A-FE-SFP
- WS-6196-RJ-21
- WS-6148X2-RJ-45
- SIP-600
- NAC L2 IP
- NetFlow v9
- Show sanity
- Show capacity

12.2(18)SXF5
July 2006

- Cisco IOS Software Modularity for Sup720 and Sup32
- 8 port 10GE linecard
- IGMP Static Group Enh
- DHCP Snooping Enh
- SRR on Sup32 Uplinks
- ME-C6524 (shipped on a Release 12.2(18)SXF3 base in August 2006)
- PISA – Release 12.2(18)ZY based on Release 12.2(18)SXF7

12.2(33)SXH

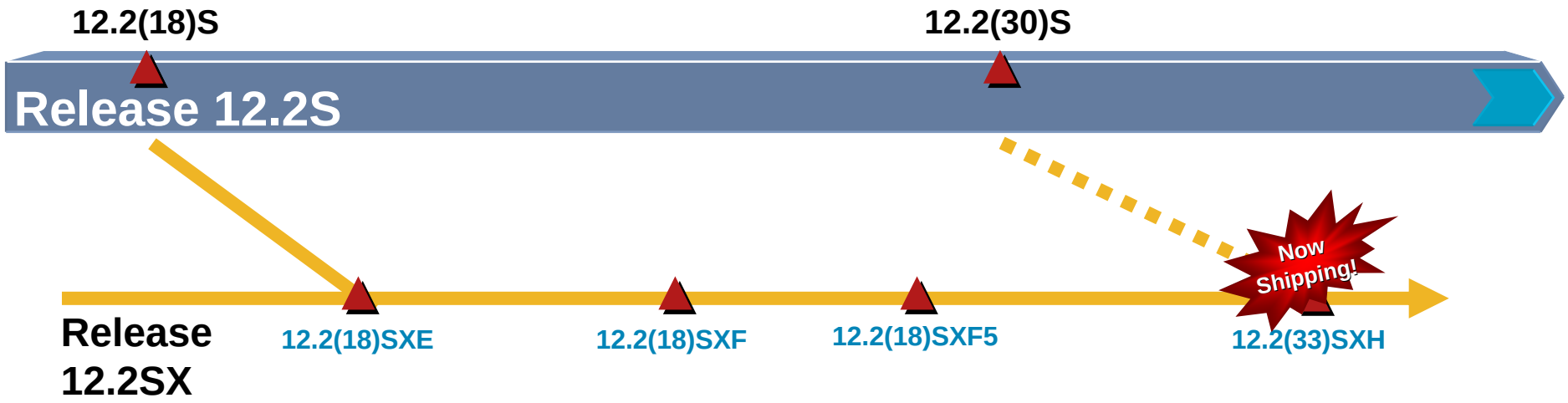
- DFC3C/3CXL
- SIP-200, SIP-400, and Enhanced FlexWAN support with Software Modularity
- FHRP - Enhanced Object Tracking
- GLBP and HSRP NSF/SSO
- OER
- IPv6 Multicast Enhancements
- LLDP-MED

http://www.cisco.com/en/US/products/hw/switches/ps708/prod_release_note09186a00801c8339.html

Why Should Cisco Customers Migrate to Release 12.2SX?

- Release 12.2SX is the target release for Catalyst 6500 Enterprise features and next-generation hardware support, such as the Supervisor Engine 720
- Release 12.2SX provides the infrastructure for Cisco IOS Software modularity, increasing operational efficiency and minimizing downtime
  - Minimizes unplanned downtime through self-healing processes
  - Simplifies software changes through subsystem In-Service Software Upgrades (ISSU)
  - Enables process-level, automated policy control by integrating Embedded Event Manager (EEM)

Release 12.2SX for Cisco Catalyst 6500 Series Switch



Derived from Release 12.2(30)S, Release 12.2(33)SXH provides Release 12.2S functionality, as well as new features and hardware for the Cisco Catalyst 6500 Series Switch

Catalyst 6500 IOS Release Strategy for 12.2SX:
Standard Maintenance (SM) and Extended Maintenance (EM) Releases

- **Standard Maintenance (SM) Release**
  - Ideal for latest feature and hardware support until the next EM release is available
  - <12 months of critical fixes for bugs with no operational workaround or business impacting Sev 1 and 2 issues
  - 6 more months of PSIRT support
  - May get Safe Harbor tested
  - Same internal shipping quality criteria as EM release
- **Extended Maintenance (EM) Release**
  - Ideal for long term maintenance support and also incorporating all the features and hardware support of previous SM and EM releases
  - 24 months of ongoing regular maintenance releases (approx. one every 3 months)
  - Six additional months of PSIRT support
  - Safe Harbor tested
  - 6-12 months of overlap with next EM release to allow for smooth transitions
- **Release 12.2(18)SXF is the first EM Release**
- **For more information visit:**

  http://www/en/US/products/hw/switches/ps708/prod_bulletin0900aecd804f0694.html

Catalyst 6500 IOS Release Strategy for Release 12.2SX - Benefits

- Predictable maintenance cycles with regular maintenance releases approximately every 3 months for EM releases
- Proactive notification on support model for upcoming Release 12.2SX
- Simplifies Release 12.2SX software upgrade planning
- Upgrades are only required once every 18-24 months from one Release 12.2SX to another for new features and continued software maintenance support

For more information visit:
http://www.cisco.com/en/US/products/hw/switches/ps708/prod_bulletin0900aecd804f0694.html

Agenda

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Summary

Cisco IOS Software Release 12.2(33)SXH

- **Provides leading-edge new features, software modularity, high availability, and hardware support for the Cisco Catalyst 6500 Series Switch**
- **Delivers features that support scalable, end-to-end LAN and WAN solutions for Enterprises, as well as Service Provider deployments such as Metro Ethernet**
- **Integrates Cisco IOS Software innovations spanning multiple technology areas, including Security, High Availability, QoS, MPLS and VPNs, IP Addressing and Services, IPv6, IP Routing & Multicast, and Embedded Management**
- **Leverages Release 12.2S family infrastructure innovation and technology leadership**

References

- **Cisco IOS Software Releases**

  http://www.cisco.com/en/US/products/sw/iosswrel/products_ios_cisco_ios_software_category_home.html

- **Cisco IOS Software Release 12.2SX**

  http://www.cisco.com/en/US/products/ps6017/index.html

- **Cisco Catalyst 6500 Series Switches**

  http://www.cisco.com/en/US/products/hw/switches/ps708/index.html

- **Cisco IOS Software Product Lifecycle & Milestones**

  http://www.cisco.com/en/US/products/sw/iosswrel/ps1838/prod_bulletin0900aecd801eda8a.html

- **Standard and Extended Maintenance Releases for Cisco IOS Software Release 12.2SX on the Cisco Catalyst 6500 Series**

  http://www.cisco.com/en/US/products/hw/switches/ps708/prod_bulletin0900aecd804f0694.html

- **Cisco IOS Software Center**

  www.cisco.com/kobayashi/sw-center/