Cisco IOS™ Software Strategy

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Network Software and Systems Technology Group
Dec 5th 2006

Cisco IOS Software Update Agenda

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- Cisco IOS™ and Software Strategy
- Cisco IOS Software Delivery
- Key Technical Innovation
- Feedback, Questions & Answers …

Cisco IOS Software – Introduction

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IOS Software Strategy

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IOS Platform Proliferation

IP Convergence
Services
Architecture/
Baselines
Software Flexibility
Definition of Data,
Control and
Management Planes

IOS Infrastructure Evolution

Highly Available IP
Modular Architecture
Systems Security
IP Services
Integration and
Acceleration
IOS Software Family

IOS Applications Platform

Applications
integration/interface

Distributed Multi-
processing

Virtualization

OS Extensibility

2002 2006/2007 2009

Cisco IOS Software

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Cisco IOS Software Update Agenda

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- Cisco IOS™ and Software Strategy
- **Cisco IOS Software Delivery**
- Key Technical Innovation
- Feedback, Questions & Answers …

Cisco IOS Software Family – Releases, Hardware and Applications by Market Segment

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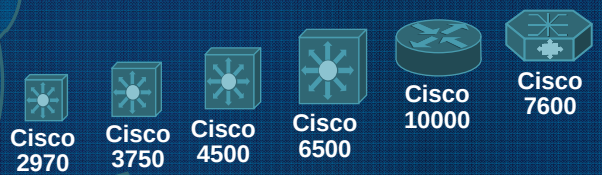
Cisco IOS Software T Releases
Access
(Integrated Services Routers)

Cisco IOS Software 12.2S Releases
Enterprise and Edge
(Cisco Catalyst switches
Cisco 7x00 and 10000 Series)



Cisco IOS XR Software
Service Provider Core
(Cisco 12000 and CRS-1 Series)

IP Services and Ease of Deployment

- Security, Firewall, Intrusion Detection
- IP Telephony
- Wireless Networking
- QoS / Service Assassurance
- IPv4 and IPv6 Routing

IP Services and Infrastructure

- High-End Platform Support
- Core and Edge IP/ MPLS Routing
- MPLS Virtual Private Networks (L2 & L3)
- Enterprise Core Infrastructures

Scale and Availability

- Core IP/MPLS Routing
- Large-Scale Peering
- PoP Consolidation
- Converged Packet Infrastructures
- Continuous System Operation

Cisco IOS Software Release 12.2S Family

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Release 12.2S – provides a common code base and critical infrastructure advancements that are shared across the Release 12.2S Family

Release 12.2SX/12.2SR – delivers high-end Ethernet LAN switching for Enterprise access, distribution, core, and data center deployments, and high-end Metro Ethernet for Service Provider edge

Release 12.2SE/SG – provide mid-range and low-end Ethernet LAN switching for Enterprise access and distribution deployments

Release 12.2SB – delivers mid-range Broadband and Leased-Line Aggregation for Enterprise and Service Provider edge networks

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- **Key Technical Innovation**
- Feedback, Questions & Answers …

Cisco IOS 2006 Software Update

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IOS Infrastructure
- Run-time Modularity
- Embedded Resource Manager
- Embedded Event Manager
- CEF Scalability

Broadband
- Intelligent Edge
- DSL Forum standards

Security
- Network Access Control
- DMVPN
- AutoSecure
- CLI Views
- 802.1x support

High Availability
- In Service Software Upgrade
- Warm-Upgrade
- Stateful IP Services
- GLBP - Load-balancing

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Infrastructure

IP/MPLS Technologies

Integration

Quality-of-Service
- AutoQoS Enhancements
- nBAR Protocol Discovery
- FRF.20 support
- Broadband Integration

Routing
- Multi-Topology Routing (MTR)
- Optimized-Edge Routing (OER)
- Non-Stop Routing

Multicast
- Multicast VPN
- Multicast High Availability
- Multicast Access Control
- Multicast Security

Simplified Operations
- IP Service Level Agreements
- NetFlow Enhancements
- XML Programmatic Interface
- Config Rollback

IPv6
- Integration – 6PE/6VPE
- IPv6 Quality-of-Service
- Modularization and HA
- Mobile IPv6

VPNs
- MPLS Convergence
- Traffic Engineering (inter-AS)
- Path Protection
- MPLS OAM, Ping/TraceRoute
- VPNs over IP Tunnels

IP Multicast
Releases 12.4 and 12.4T Roadmap

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Cisco IOS Software Platforms	Cisco 7301 Router	Cisco 7200 Series	Cisco 3800 & 2800 Series	Cisco 1800 & 800 Series
Release12.4(2)T (Jun 27, 2005)				
IPv6 SSM mapping for MLDv1	X	X	X	
IPv6- ability to configure RP to group mapping at BSR	X	X	X	
MSDP MD5 password authentication	X	X	X	
MLD group limit commands	X	X	X	
Release 12.4(4)T (Oct 31, 2005)				
IPv6 Multicast and AAA Integration (Phase 1)	X	X	X	
Secure Multicast : GDOI and Native IPsec for Multicast	X	X	X	
Release 12.4(6th)T (Feb 2007)				
Bandwidth Based Multicast CAC	X	X	X	
MVPN Scalability Phase 1	X	X	X	
MVPN COS Transparency	X	X	X	
Release 12.5(2nd)T (Q3CY07)				
IPv4 Multicast and AAA Integration (Phase 1)	X	X	X	
IGMP Static Group Range	X	X	X	

IP Multicast
Recently Released 12.2SX Family Roadmap

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Cisco IOS Software Platforms	Cisco 7600 Series	Cisco Catalyst 6500 Series
	12.2SX	12.2SX
NetFlow v9 NDE for Multicast	12.2(18)SXF	12.2(18)SXF
Multicast over GRE over IPsec	12.2(18)SXF	12.2(18)SXF
Multicast Enhancement - Replication Mode Detection	12.2(18)SXF	12.2(18)SXF
Multicast Enhancement - Egress replication performance improvement	12.2(18)SXF	12.2(18)SXF
PIM snooping - Disable flooding to DR	12.2(18)SXF	12.2(18)SXF
IGMP static group range	12.2(18)SXF5	12.2(18)SXF5

Rockies 3 and Vail Releases

IP Multicast
Release 12.2SX Family Roadmap

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Cisco IOS Software Platforms	Cisco Catalyst 6500 Series
	12.2SX
PIM triggered Joins	12.2(33)SXH, Q1CY07
No dense mode fallback	12.2(33)SXH, Q1CY07
Inhibit dense mode flooding on MDT tunnel interface	12.2(33)SXH, Q1CY07
Extended ACL for IGMP (per S,G support)	12.2(33)SXH, Q1CY07
MSDP compliance with IETF RFC 3618	12.2(33)SXH, Q1CY07
MSDP MD5 password authentication	12.2(33)SXH, Q1CY07
IGMP Snooping Filtering	12.2(33)SXH, Q1CY07
IP Mroute STD MIB	12.2(33)SXH, Q1CY07

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IP Multicast
Release 12.2SX Family Roadmap

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Cisco IOS Software Platforms	Cisco Catalyst 6500 Series
	12.2SX
MVPN Extranet	12.2(33)SXH, Q1CY07
Inter-AS support for MVPN	12.2(33)SXH, Q1CY07
MVPN MIB	12.2(33)SXH, Q1CY07
VRF Aware Multicast Syslog Messages	12.2(33)SXH, Q1CY07
IPv6 Multicast address Family for BGP	12.2(33)SXH, Q1CY07
IPv6 Multicast Enhanced (*,G) HW Support	12.2(33)SXH, Q1CY07

Whitney 1 Release – Page 2

Cisco IOS Software

IP Multicast – Radar Features
Release 12.2SX Family Radar

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Cisco IOS Software Platforms	Cisco Catalyst 6500 Series
	12.2SX
Multicast over mGRE	Q4CY07
Multicast and AAA Integration	Q4CY07
Multicast Group Range (limit PIM, IGMP across interfaces)	Q4CY07
Bandwidth Based Multicast CAC	Q4CY07
Per interface Mroute state limit	Q4CY07
Enhanced Multicast Multipath	Q4CY07
Multicast NetFlow over GRE	Q4CY07
IGMP-STD-MIB	Q4CY07
IP MROUTE MIB	Q4CY07

Whitney 2.0 release – Page 1

IP Multicast – Radar Features
Release 12.2SX Family Radar

Cisco IOS Software Platforms	Cisco Catalyst 6500 Series
	12.2SX
IPv6 Multicast: MLD Access Group	Q4CY07
IPv6 Multicast: Explicit Tracking of Receivers	Q4CY07
IPv6 Multicast: Routable Address Hello Option	Q4CY07
IPv6 Multicast: PIM Accept Register	Q4CY07
IPv6 Multicast: RPF Flooding of Bootstrap Router (BSR) Packets	Q4CY07
IPv6 Multicast: Static Multicast Routing (mroute)	Q4CY07
IPv6 Multicast: PIM Embedded RP Support	Q4CY07

Whitney 2.0 release, page 2

IGMP Static-Group Range Support

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- Enhanced functionality which helps significantly reduce static-group configuration overhead
- Leverages Modular QoS CLI (MQC) via class-map
- Released C6500 12.2(18)SXF5
- Will be released in 12.5(2nd)T, Q3 CY07

Cisco IOS Multicast High Availability Strategy: Based on Customer Needs

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Provide continuous access to applications, data and content anywhere anytime

Network Level Resiliency

Cisco IOS Multicast features for fast convergence, protection and restoration.
Multicast subsecond convergence

System Level Resiliency

Cisco IOS software that mitigates fault impact.

System Level Resiliency Overview

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Eliminate single points of failure for hardware and software components

Control/data plane resiliency

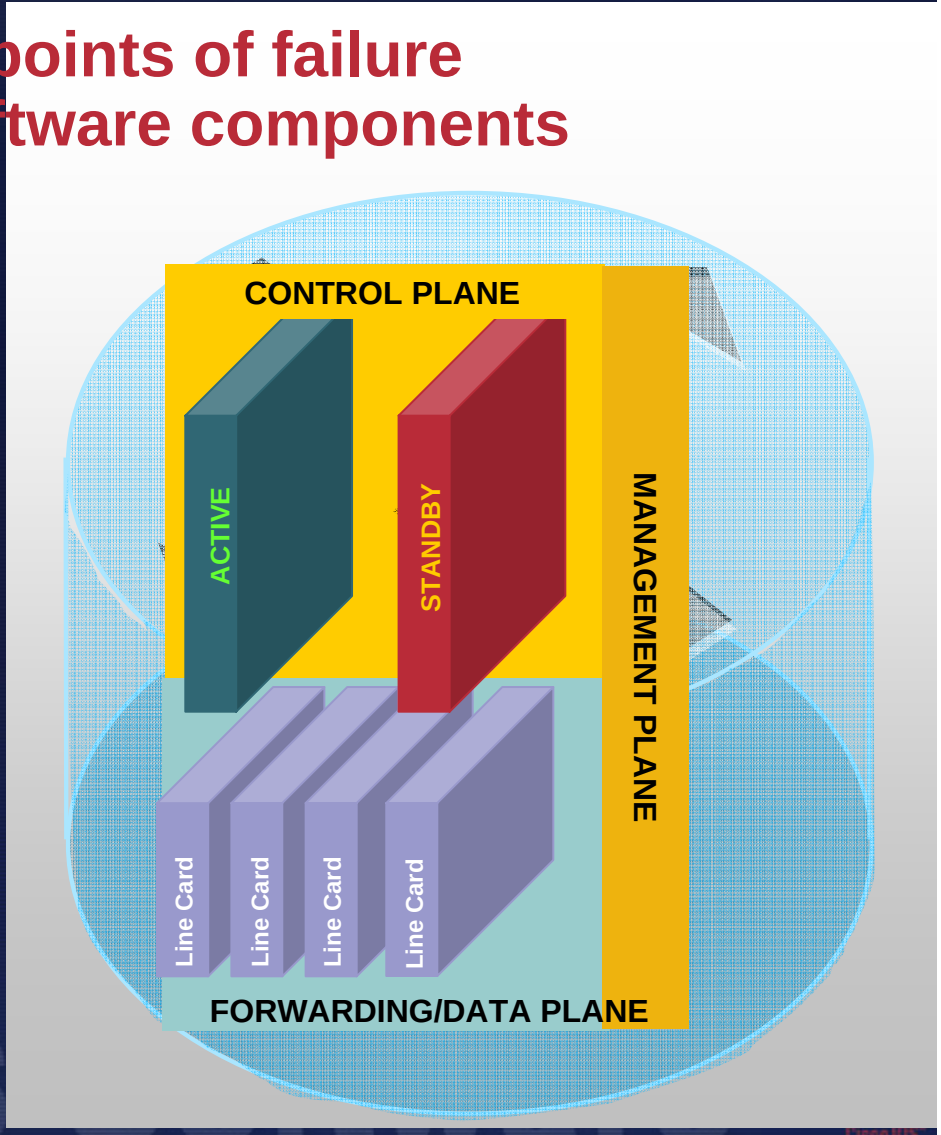
- Separation of control and forwarding plane
- Fault isolation and containment
- Seamless restoration of Route Processor control and data plane failures

Link resiliency

- Reduced impact of Line Card hardware and software failures

Planned outages

- Seamless software and hardware upgrades



Multicast HA: PIM Triggered Join

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What Is It?

Used to protect the state of multicast distribution tree(s)

Benefits:

Help Prevent Mroute State in the Control Plane from Timing Out
Prevent Temporary Blackouts of Multicast Traffic

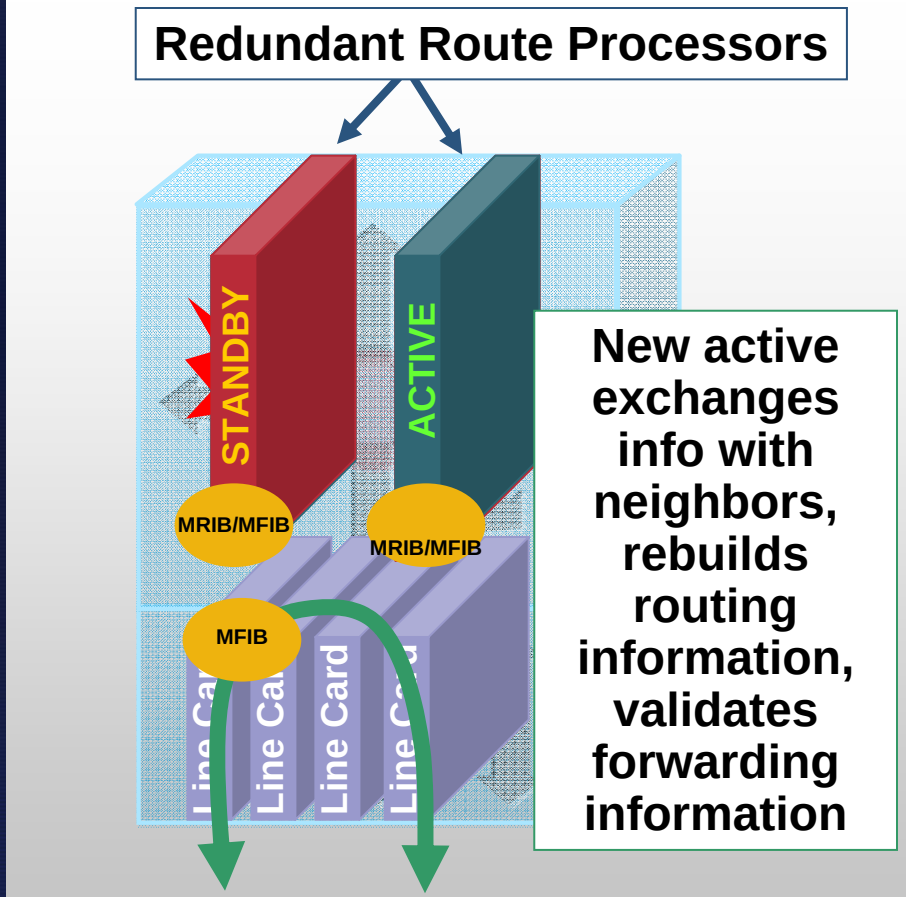
Most Effective During:

- Active Route Processer Failure
  Distribution Tree Change(s)
- Physical topology change(s)
- RPF Change(s)
  Unicast routing table changes

Release 12.0(28)S4, C6500 12.2(33)SXH (whitney 1)

Cisco Multicast Nonstop Forwarding with Stateful Switchover

- Network edge is critical
  - Service Provider and Enterprise edge
  - Often a single point of failure
- NSF/SSO increases availability at key edge points
- Employs dual Route Processors
- Cisco SSO maintains connectivity for Layer 2 protocols
- Nonstop forwarding of packets while control plane is reestablished and routing information is validated
  - Packet forwarding continues using current forwarding information base (MFIB)
  - Layer 3 (PIM and IGMP) recovers routing information from neighbors, rebuilds routing information base (MRIB) and updates MFIB
  - Critical protocol information is checkpointed between RPs (group to RP mapping, DF election)

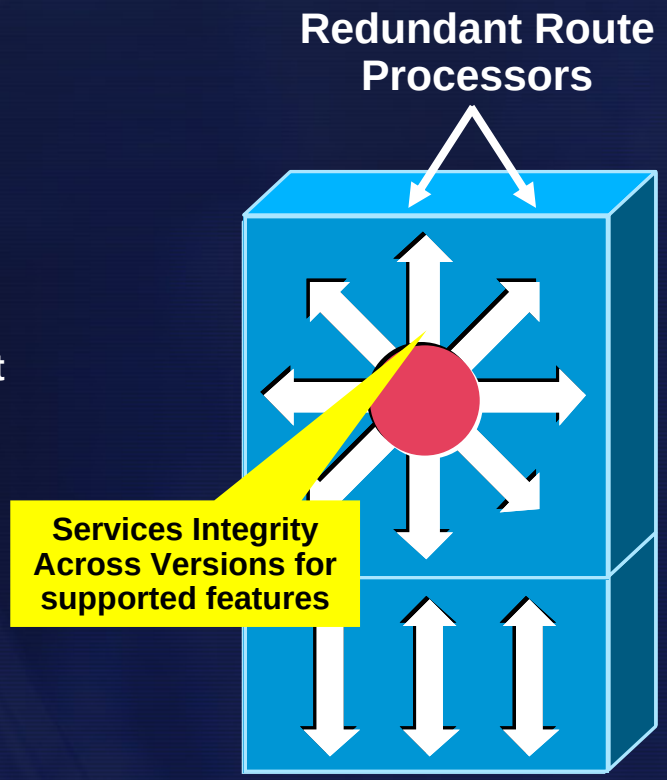


Cisco IOS Multicast In-Service Software Upgrade

Industry's First, Comprehensive, In-Service Software Upgrade solution for the IP/MPLS edge router

Working on a Multicast Solution

- **Ability to upgrade/downgrade complete Cisco IOS software image**
  - **With no impact to control plane and minimal impact to packet forwarding**
- **Leverages dual route processor Cisco NSF with SSO architecture**
- **Comprehensive upgrade solution covering maintenance-fixes as well as new features**
  - **Rapid, non-disruptive deployment of new features and services**
- **Eliminates planned downtime and reduces operational expenses**
  - **Ability to streamline and minimize planned downtime windows**



Minimum Disruption Restart (MDR) for Line Card Upgrade with Minimal Impact

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

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- IGMP is used by hosts to receive and join multicast streams
- IGMP extended ACL 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

  Available in 12.3(7)T and 12.2(33)SXH

MSDP MD5 Password Authentication

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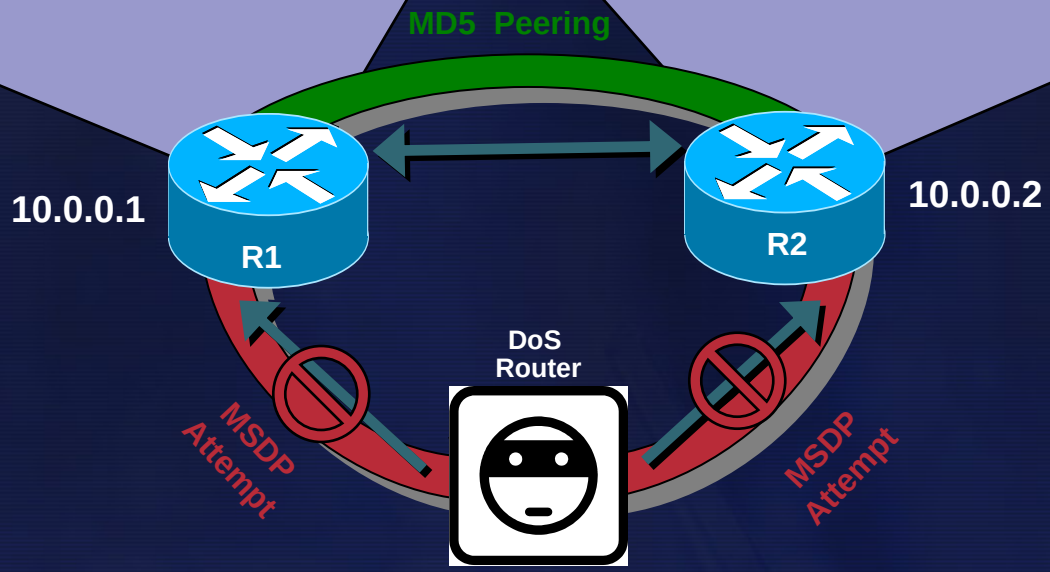
```
R1#
…
ip msdp peer 10.0.0.2
ip msdp password peer 10.0.0.2 0 cisco
…
```

```
R2#
…
ip msdp peer 10.0.0.1
ip msdp password peeer 10.0.0.1 0 cisco
…
```



- R1 is MSDP peering with R2 sourcing from 10.0.0.1
- R2 is MSDP peering with R1 sourcing from 10.0.0.2
- MD5 authentication is enabled for TCP connection between MSDP peers R1 and R2 (pw="cisco")
- Unknown MSDP connection attempt from DoS router is dropped
- First introduced in 12.4(2)T. Integrated in 12.2(18)SXG

Per Interface Mroute State Limit

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What Is It?

Admission control for the creation of mroute entries on a per interface basis.

Problem Description:

Defining a global mroute state limit may be too general in cases where more granularity is required to guarantee no single interface arbitrarily creates more state than others. A more flexible solution is needed.

Solution:

Define new policies that control the creation of mroute entries on a per interface basis.

Benefit:

Flexible safeguard against malicious Denial of Service Attacks

Ability to Disable Multicast Group Ranges

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- **Global Command Extension**
  - **Router drops all Control packets (PIM, IGMP) for denied groups**
  - **Router drops all Data packets for denied groups.**
  - **No IGMP or PIM state created for denied groups.**
  - **Currently available in 12.4(4)T for v6**
  - **V4 releasing in 12.5(2nd)T**

```
Ip multicast [ group-range <std-acl>]
ipv6 multicast [group-range  <std-acl>]
```

Multicast AAA Integration

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What is it?

A centralized method of controlling and tracking multicast receivers

Problem Description:

Techniques used to control and keep track of sources and receivers were tedious, cumbersome and overly complex.

The Solution:

Integrate existing Authentication, Authorization, and Accounting (AAA)

Benefits of Integrating AAA:

- AAA is widely embraced and adopted as an open standard
- AAA is fully supported in IOS
- AAA is manageable and scales to thousands of devices
- Consistent policies, reduced human errors, and ***peace of mind***!

Multicast AAA Integration

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Key Functionality

1. Receiver based authorization

   Profile provisioning characteristics will be based on IGMP/MLD Joins & IGMP/MLD Limit

   Port-based authentication will initially be used

2. Receiver Based accounting

   Associates accounting records to IGMP/MLD Joins and Leaves

   Critical for ***monitoring and billing*** on a per-viewer or per-content basis

Optimized Edge Routing

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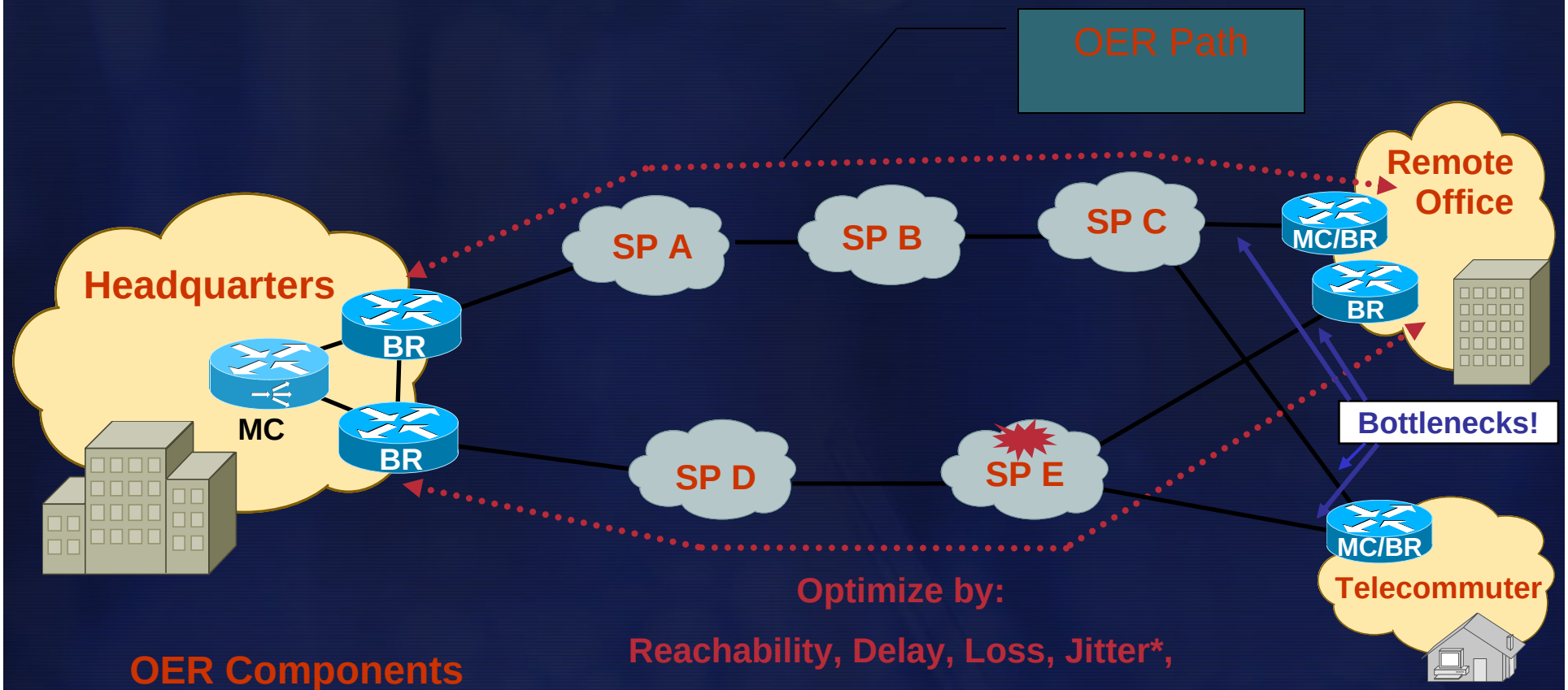

Optimize by:

Reachability, Delay, Loss, Jitter*,

MOS*, Throughput, Load and/or $Cost

OER Components

- BR—Border Router
- MC—Master Controller (decision maker)

The Solution: Cisco Optimized Edge Routing

- Constantly *measures* performance of connected ISPs...
- ...and compares with performance targets (round trip delay, cost, jitter, loss, ...)
- ...then applies user-determined policy to influence routing on a per-address basis
- Builds on many existing IOS capabilities: BGP, NetFlow™, IP SLAs, Network Address Translation
- Currently shipping in IOS 12.4

Key Cisco OER Benefits

- OER has network level view – It knows the capacity, performance and utilization of network resources in real time.
- OER is integrated with routing protocols. It can influence best route selection at the edge.
- OER can prioritize traffic based on policies.
- OER can automatically detect congestion and reroute traffic.
- Automatic performance optimization
- Optimal load balancing
- Reduced Operational expenses
- Improved Application response time
- Improved Voice Quality

NBAR Overview

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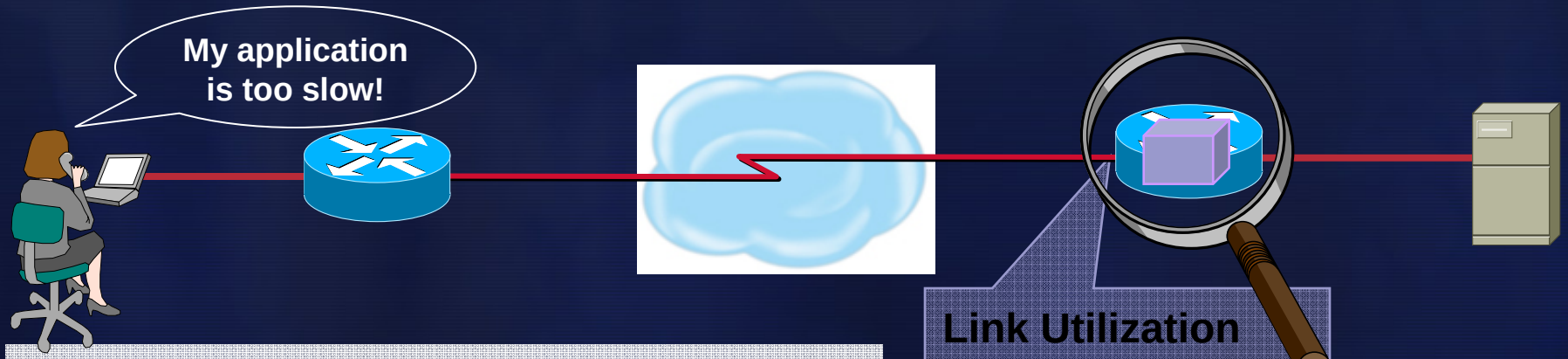

- Full-packet, stateful inspection identifies traffic type
- Protocol discovery analyzes multi-packet behavior and application signatures
- Enables application of QoS policies to traffic flows

Link Utilization

Citrix	25%
Netshow	15%
Fasttrack	10%
FTP	30%
HTTP	20%

Mark Citrix as interactive traffic and police FTP

Assure bandwidth for Citrix!

Cisco NBAR Supported Protocols

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Enterprise Applications	Security and Tunneling	Network Mail Services	Internet
Citrix ICA	GRE	IMAP	FTP
PCAnywhere	IPINIP	POP3	Gopher
Novadigm	IPsec	Exchange	HTTP
SAP	L2TP	Notes	IRC
Routing Protocols	MS-PPTP	SMTP	Telnet
BGP	SFTP	**Directory**	TFTP
EGP	SHTTP	DHCP/BOOTP	NNTP
EIGRP	SIMAP	Finger	NetBIOS
OSPF	SIRC	DNS	NTP
RIP	SLDAP	Kerberos	Print
Network Management	SNNTP	LDAP	X-Windows
ICMP	SPOP3	**Streaming Media**	**Peer-to-Peer**
SNMP	STELNET	CU-SeeMe	BitTorrent
Syslog	SOCKS	Netshow	Direct Connect
RPC	SSH	Real Audio	eDonkey/eMule
NFS	**Voice**	StreamWorks	FastTrack
SUN-RPC	H.323	VDOLive	Gnutella
Database	RTCP	RTSP	KaZaA
SQL*NET	RTP	MGCP	WinMX
MS SQL Server	SIP	**Signaling**	
	SCCP/Skinny	RSVP	
	Skype		

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- Feedback, Questions & Answers …

References

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Cisco IOS Software

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Standards Supported in IOS

http://www.cisco.com/en/US/partner/products/ps6441/prod_bulletin0900aecd802eaa4f.html

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