Cisco IOS Software Release 12.2(33)SXI, New Features and Hardware Support

PB503086

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This Product Bulletin introduces Cisco IOS® Software Release 12.2(33)SXI and includes the following sections:

1. Cisco IOS Software Release 12.2(33)SXI Introduction
2. Release 12.2(33)SXI Packaging, Migration, Service Module Support, and Software Modularity Considerations
3. Release 12.2(33)SXI Highlights
4. Release 12.2SX Additional Information

1. Cisco IOS Software Release 12.2(33)SXI Introduction

Release 12.2SX provides new features and hardware support for the Cisco Catalyst 6500 Series Switch. Cisco IOS Software Release 12.2(33)SXI, the latest 12.2SX release, delivers new Cisco Catalyst 6500 Series hardware and software innovations that span multiple technology areas, including high availability, MPLS and VPNs, IPv6 support, advanced IP routing and multicast, integrated security, and embedded management.

The broad range of hardware-enabled services (IPv6, MPLS, NAT/PAT, GRE, Bidirectional Protocol Independent Multicast) and Cisco IOS Software Release 12.2SX software features (NSF/SSO, software modularity) makes the Cisco Catalyst 6500 Series the most comprehensive switching platform available today.

For detailed information about the features and hardware supported in Release 12.2SX and 12.2(33)SXI, refer to the Cisco IOS Software Release 12.2SX release notes and customer documentation at the following website http://www.cisco.com/en/US/products/ps6017/tsd_products_support_series_home.html.

Not all features may be supported on all platforms. Use the Cisco Feature Navigator to find information about platform support and Cisco IOS Software image support http://tools.cisco.com/ITDIT/CFN/jsp/index.jsp. You must have an account on Cisco.com to access the Cisco Feature Navigator.

Cisco IOS Release 12.2SX is developed for and intended to run on Cisco Catalyst 6500 Series Switches only.

2. Release 12.2(33)SXI IP Version 6 (IPV6) Repackaging

For years, Cisco IOS has expanded support of IPv6 to the majority of its technology areas and hardware platforms. Originally added to the former IP Plus packaging, IPv6 support is currently available in Advanced IP Services, Enterprise Services and above features sets. Due to market trends such as available IPv4 address pool exhaustion and regional registries issuing advisory to the Internet community to adopt IPv6 and national mandates, Cisco IOS packaging for IPv6 is now evolving. Cisco is investing and offers IPv6 support for more and more technologies in order to accelerate and increase deployments based on Cisco IOS Software release. Cisco is taking this a step further by offering packaging parity for IPv6 with IPv4 such that IPv6 feature support for a technology will be packaged in the same feature set as IPv4. For example, IPv6 feature support for BGP will be packaged in IP Services where BGP for IPv4 resides today. This new IOS packaging for IPv6 is starting on Cisco IOS Software Release 12.2(33)SXI, and will get propagated to other IOS release trains in future.

Catalyst 6500 images starting with Release 12.2(33)SXI will support the new IPv6 packaging as follows:

- **IPbase image**—IPv6 Host features like:
  - IPv6 addressing
  - ICMPv6 and redirect
  - IPv6 Maximum Transmission Unit (MTU) path discovery
  - IPv6 Neighbor discovery
  - Syslog over IPv6
  - Simple Network Management Protocol (SNMP) over IPv6
  - Telnet over IPv6
  - SSH over IPv6
- **IPservices image**—Same IPv6 features as supported in advipservicesk9 images in prior releases, including EIGRPv6, IPv6 multicast, IPv6 tunneling, DHCPv6 and 6VPE

Benefits

Customers do not need to purchase new Release 12.2(33)SXI (or later Release 12.2SX releases) feature sets to obtain IPv6 support.

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2.1. Release 12.2(33)SXI Migration

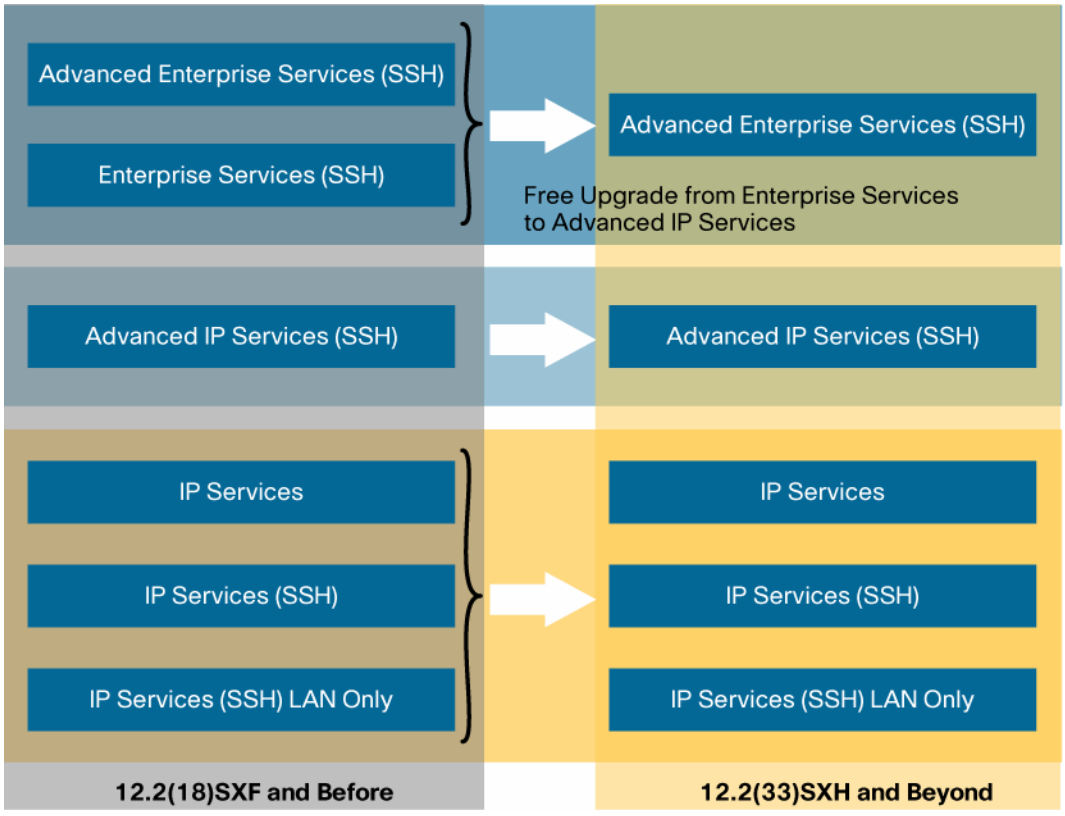
Cisco IOS Software Release 12.2(33)SXI for the Cisco Catalyst 6500 offers the Cisco IOS Software Modular images as a feature set in addition to the Cisco IOS Native images, with full feature parity between them. The Release 12.2(33)SXI Software Release provides new feature functionality and introduces additional hardware support for the Cisco Catalyst 6500 Series Switch, which allows customers to deploy it within the Enterprise campus, Data Center, WAN aggregation, and Service Provider edge networks.

Cisco IOS Software Release 12.2(33)SXI is the next Extended Maintenance (EM) release, and will be supported for a period of 24 months for Cisco Catalyst 6500 Series Switches. For more details on Release 12.2SX Standard and Extended Maintenance releases please visit http://www.cisco.com/en/US/prod/collateral/switches/ps5718/ps708/prod_bulletin0900aecd804f0694.html.

Cisco IOS Software Release 12.2(33)SXI offers the following images for the Supervisor Engine 720, Supervisor Engine 32 and ME 6524:

- **Supervisor-720 IOS Software images:**
  - Cisco Catalyst 6500 Supervisor 720 IOS IP Services
  - Cisco Catalyst 6500 Supervisor 720 IOS IP Services (MODULAR)
  - Cisco Catalyst 6500 Supervisor 720 IOS IP Services (SSH) LAN ONLY
  - Cisco Catalyst 6500 Supervisor 720 IOS IP Services (SSH) LAN ONLY (MODULAR)
  - Cisco Catalyst 6500 Supervisor 720 IOS IP Services (SSH)
  - Cisco Catalyst 6500 Supervisor 720 IOS IP Services (SSH) (MODULAR)
  - Cisco Catalyst 6500 Supervisor 720 IOS Advanced IP Services (SSH)
  - Cisco Catalyst 6500 Supervisor 720 IOS Advanced IP Services (SSH) (MODULAR)
  - Cisco Catalyst 6500 Supervisor 720 IOS Advanced Enterprise services (SSH)
  - Cisco Catalyst 6500 Supervisor 720 IOS Advanced Enterprise services (SSH) (MODULAR)

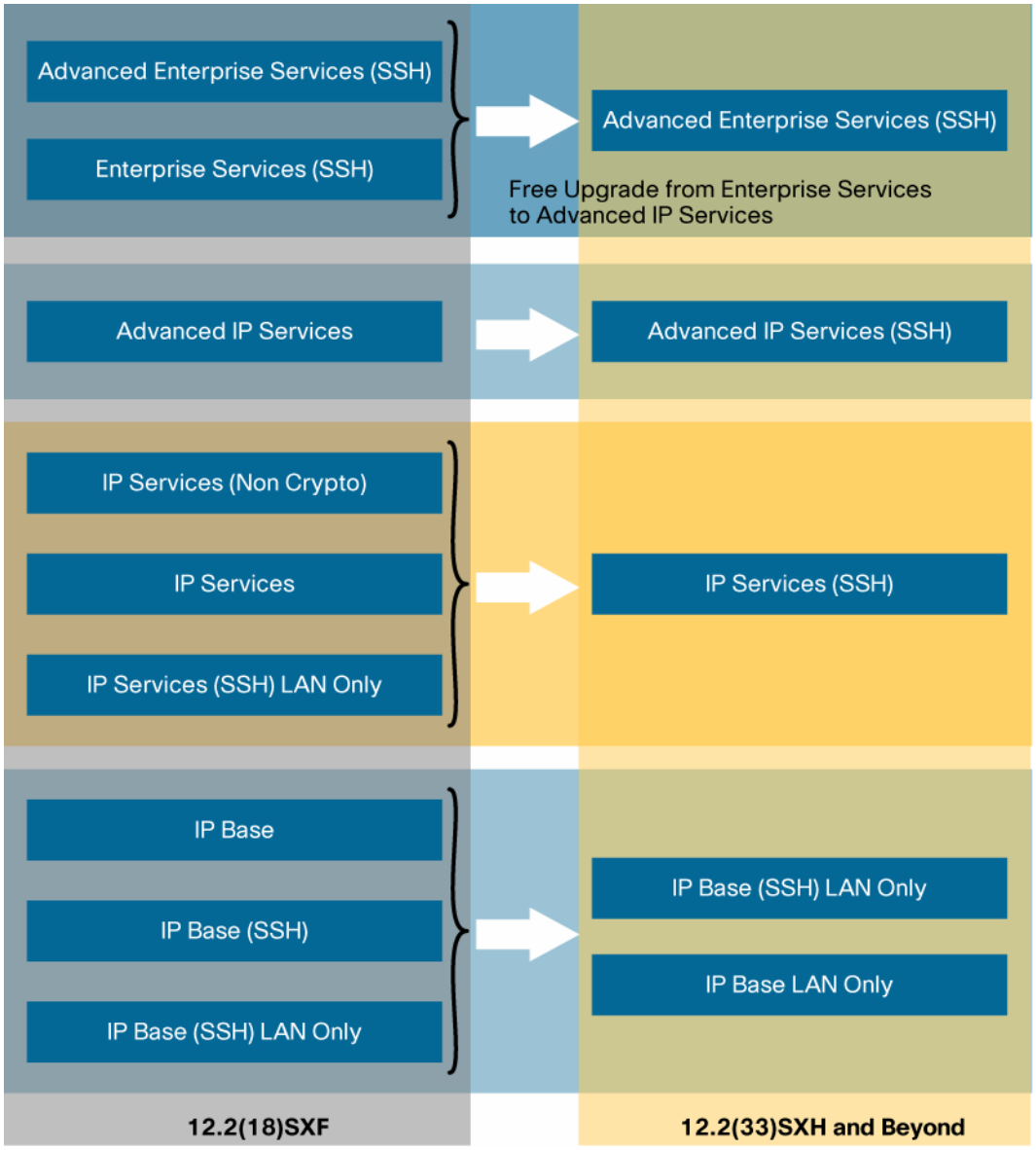
Figure 1. Supervisor-720 Software Image Upgrade to 12.2(33)SXI



- **Supervisor-32 IOS Software images:**

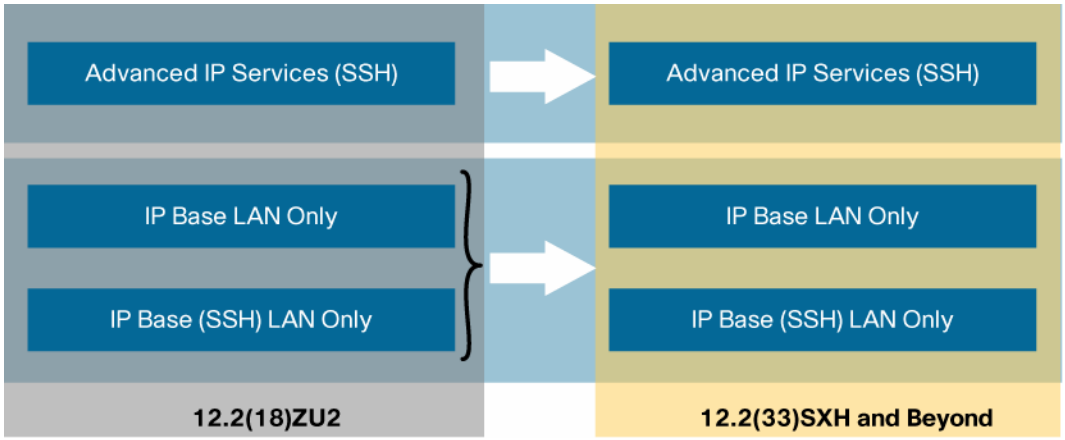
- Cisco Catalyst 6500 Supervisor 32 IOS IP Base LAN ONLY
- Cisco Catalyst 6500 Supervisor 32 IOS IP Base LAN ONLY (MODULAR)
- Cisco Catalyst 6500 Supervisor 32 IOS IP Base (SSH) LAN ONLY
- Cisco Catalyst 6500 Supervisor 32 IOS IP Base (SSH) LAN ONLY (MODULAR)
- Cisco Catalyst 6500 Supervisor 32 IOS IP Services SSH
- Cisco Catalyst 6500 Supervisor 32 IOS IP Services SSH (MODULAR)
- Cisco Catalyst 6500 Supervisor 32 IOS Advanced IP Services (SSH)
- Cisco Catalyst 6500 Supervisor 32 IOS Advanced IP Services (SSH) (MODULAR)
- Cisco Catalyst 6500 Supervisor 32 IOS Advanced Enterprise Services (SSH)
- Cisco Catalyst 6500 Supervisor 32 IOS Advanced Enterprise Services (SSH) (MODULAR)

Figure 2. Supervisor-32 Software Image Upgrade to 12.2(33)SXI



- **ME6524 Software Feature sets:**
  - Cisco ME 6524 IOS IP Base (SSH) LAN ONLY
  - Cisco ME 6524 IOS IP Base (SSH) LAN ONLY (MODULAR)
  - Cisco ME 6524 IOS IP Base LAN ONLY
  - Cisco ME 6524 IOS IP Base LAN ONLY (MODULAR)
  - Cisco ME 6524 IOS Advanced IP Services (SSH) LAN ONLY
  - Cisco ME 6524 IOS Advanced IP Services (SSH) LAN ONLY (MODULAR)

Figure 3. Catalyst 6500 ME-6524 Software Image Upgrade to 12.2(33)SXI



2.2. Catalyst 6500 Series Switch Service Module Support in Release 12.2(33)SXH and Release 12.2(33)SXI

Release 12.2(33)SXH and Release 12.2(33)SXI provides supports for the following Service and WAN modules:

Table 1.

Service Module	Description
ACE10-6500-K9	Application Control Engine Service Module
ACE20-MOD-K9	Application Control Engine 20 Hardware
WS-SVC-CMM	COMMUNICATION MEDIA MODULE
WS-SVC-FWM-1-K9	Firewall blade for 6500 and 7600, VFW License Separate
WS-SVC-IDS2-BUN-K9	600M IDSM-2 Mod for Cat
WS-SVC-NAM-1	Catalyst 6500 Network Analysis Module-1
WS-SVC-NAM-2	Catalyst 6500 Network Analysis Module-2
WS-SVC-WiSM-1-K9	CISCO WIRELESS SERVICES MODULE (WISM)
WS-SSC-600	Cisco Catalyst 6500 Series Services SPA Carrier-600
WS-IPSEC-3	Cisco Catalyst 6500 Series VPN Services Port Adapter
WS-X6582-2PA	Cisco7600/Catalyst6500 Enhanced FlexWAN, Fabric-enabled
7600-SIP-200	Cisco 7600 Series SPA Interface Processor-200
7600-SIP-400	Cisco 7600 Series SPA Interface Processor-400

The service modules that were supported in Release 12.2(18)SXF (and prior releases) and not supported in Release 12.2(33)SXH or Release 12.2(33)SXI are shown below with their migration path:

Table 2.

Service Module	Description	Migration Path	Description
WS-SVC-AGM-1-K9	Catalyst 6500 Cisco Anomaly Guard Module	AGXT-5650-MMF-B-K9 For more information, please visit http://www.cisco.com/en/US/netsol/ns615/networking_solutions_sub_solution.html	Cisco Guard XT 5650, 1000Base-SX MMF, Dual AC, RAID
WS-SVC-ADM-1- K9	Catalyst 6500 Cisco Anomaly Detector Module	ADXT-5600-MMF-B-K9 For more information, please visit http://www.cisco.com/en/US/netsol/ns615/networking_solutions_sub_solution.html	Cisco Traffic Anomaly Detector XT 5600,1000Base MMF
WS-SVC-CSG-1	Content Services Gateway		
WS-SVC-IPSEC-1	IPSec VPN Services Module for Cisco Catalyst 6500 and Cisco 7600 Series Routers	SPA-IPSEC-2G and 7600-SSC-400 For more information, please visit: http://www.cisco.com/en/US/prod/collateral/modules/ps8768/ps4221/prod_end-of-life_notice0900aecd80349e2c_ps8768_Products_End-of-Life_Notice.html	Cisco 7600/Catalyst 6500 IPSec VPN SPA with DES/3DES/AES; Cisco 7600/Catalyst 6500 Services SPA Carrier Card
WS-SVC-WLAN-1-K9	Wireless LAN Services Module, CEF256	WS-SVC-WISM-1-K9 For more information, please visit http://cisco.com/en/US/products/hw/modules/ps2706/prod_eol_notice0900aecd80550b4c.html	Cisco Wireless Services Module (WiSM)

2.3. Release 12.2(33)SXH (and Later 12.2SX Releases) Software Modularity Deployment Considerations

Cisco IOS Software Modularity provides customers multiple benefits in areas of high availability and manageability. The Software Modularity on the Cisco Catalyst 6500 platform has been available to customers starting from the Release 12.2SXF4 release.

Beginning with Release 12.2(33)SXH, customers will receive the following:

- Complete hardware and software feature parity between Cisco IOS Software Modular and Cisco IOS Native images
- Cisco IOS Software Modularity as a feature set of Cisco IOS Native images

Cisco IOS Software Modular images can be deployed across all the different places in the network including Enterprise Campus, Data Centers, WAN, and Carrier Ethernet deployments. However, there are a few scalability considerations for using Software Modular images, mainly in the areas of extremely large deployments. Customers are encouraged to consider the following feature considerations (table below) when planning to deploy Cisco IOS Software Modularity:

Table 3.

Feature	Scalability Consideration
PIM Sparse Mode	16K mroutes
IGMP Groups	2K groups
Bidirectional Protocol Independent Multicast (Bi-Dir PIM)	8K mroutes
OSPF VRF Support	400 VRF's
NetFlow Setup Rate	NetFlow connection rate for a large number of flows can take up to 128 seconds
MSDP	Customers are recommended to use only default timers for MSDP
NSF/SSO	Customers are recommended to use only default timers for routing (OSPF, BGP) and multicast (PIM) protocols
PIM	Customers are recommended to use only default timers for PIM
mVPN	Supports a total of 6k mroutes over 100 VRF's

3. Release 12.2(33)SXI Feature Highlights

The following sections include Release 12.2(33)SXI hardware and software feature highlights.

Release 12.2(33)SXI, like all Release 12.2SX releases, integrates innovations that span multiple technology areas, including Cisco IOS High Availability, Quality of Service, MPLS and VPNs, IP Addressing and Services, IP Multicast and Routing, and Infrastructure and Embedded Management.

Table 4. Release 12.2(33)SXI Highlights

Hardware	MPLS	Ethernet OAM	High Availability
• WS-SSC-600 (jacket card) • VPN Services Port Adapter (VSPA) • SIP-600 and SPA (WAN carrier) • 10GBASE-DWDM • 10GBASE-ZR	• MPLS VPN—VRF CLI for IPv4 and IPv6 VPNs • MPLS VPN—6VPE Support over IP tunnels	• IEEE 802.1ag Ethernet CFM • IEEE 802.3ah Ethernet OAM • Ethernet LMI (E-LMI) • IP SLAs for Ethernet • Ethernet OAM Interworking	• ISSU Phase I • BFD VRF Support

IP Services	Security and Identity	Embedded Management	IP Routing and Multicast
• DHCPv6 Relay Enhancements • HSRP for IPv6 • GLBP for IPv6 • GLBP Client Cache • VRRP SSO • HSRP Gratuitous ARP • EOT/EEM Integration • IPv6 Support on VSPA	• IEEE 802.1x Enhancements: • Flexible Authentication Sequencing • IEEE 802.1x with Open Access • IEEE 802.1x, MAB and Web Authentication with downloadable ACL • CDP enhancement for second port disconnect • Inactivity timer for IEEE 802.1x and MAC Authentication Bypass • Multi-domain authentication • IEEE 802.1x with multi-auth • Centralized Web Authentication • Identity to port description mapping • Inaccessible authentication bypass • Common Session ID • Conditional Logging • Pre-Encryption QoS on VPN Services Port Adapter	• Embedded Event Manager (EEM) Version 2.4 • CatOS Parity MIBs	• EIGRP for IPv6 • Per Interface Mroute State Limit • Bandwidth based Call Admission Control (CAC) for IP Multicast • IPv4/IPv6 Multicast Address Group Range Support • IPv4 Multicast HA Support for Group to RP Mappings

Hardware

Cisco® Dense Wavelength-Division Multiplexing (DWDM) X2 Pluggable Module

The Cisco® Dense Wavelength-Division Multiplexing (DWDM) X2 pluggable module allows Enterprise companies and Service Providers to offer scalable and easy to deploy 10 Gigabit Ethernet services in their networks.

The main features of the Cisco DWDM X2 include:

- The Cisco DWDM X2 supports 10GBASE Ethernet

- The hot-swappable input/output device plugs into an Ethernet X2 port of a Cisco switch or router to link the port with the network
- The Cisco DWDM X2 supports the Cisco Quality Identification (ID) feature, which enables a Cisco switch or router to identify whether or not the module is an X2 module certified and tested by Cisco
- The module supports 32 non-tunable ITU 100-GHz wavelengths compatible with the Cisco ONS DWDM channel plan
- The Cisco DWDM X2 supports digital optical monitoring capability

For Additional Information

- http://www.cisco.com/en/US/prod/collateral/modules/ps5455/ps6576/data_sheet_c78_489725.html

Cisco X2-10GB-ZR Module

The Cisco X2-10GB-ZR Module (Product Number 10GBASE-ZR) supports link lengths of up to about 80 km on standard Single-Mode Fiber (SMF). This interface is not part of the 10 Gigabit Ethernet standards, but is built according to Cisco optical specifications.

For Additional Information

- http://www.cisco.com/en/US/prod/collateral/modules/ps5455/ps6574/product_data_sheet0900aecd801f92aa_ps5251_Products_Data_Sheet.html

Catalyst 6500 Series Shared Port Adapter (SPA) and SPA Interface Processor (SIP) Support Enhancements

The new SPA support in Cisco IOS Software Release 12.2(33)SXI includes the low-speed interfaces on the SIP-400. These SPAs were previously only supported on the SIP-200, but now they are also supported on the SIP-400, allowing customers to deploy both low-speed and high-speed interfaces on a single SIP-400.

The new SIP/SPA support is:

- Previously supported on SIP-200, new support on SIP-400:
  - SPA-8XCHT1/E1
  - SPA-2XT3/E3
  - SPA-4XT3/E3
  - SPA-2XCT3/DS0
  - SPA-4XCT3/DS0
- The ATM SPAs were previously supported in Release 12.2(33)SXH, and is also available in Release 12.2(33)SXI:
  - SPA-2XOC3-ATM
  - SPA-4XOC3-ATM
  - SPA-1XOC12-ATM
  - SPA-1XOC48-ATM
- SIP-600 support is now available with support for the following SPAs:
  - SPA-2XOC48POS/RPR
  - SPX-4XOC48POS/RPR
  - SPA-OC192POS-VSR

- SPA-OC192POS-LR
- SPA-OC192POS-XFP
- SPA-5X1GE
- SPA-10X1GE
- SPA-1XTENGE-XFP
- SPA-10X1GE-V2
- SPA-1X10GE-L-V2

Cisco Catalyst® 6500 Series VPN Services Port Adapter (VSPA)

The Cisco® VPN Services Port Adapter (VSPA) is the next-generation VPN module designed to support next-generation VPN technologies with system bandwidths of 8 Gbps in a modular, flexible, and scalable form factor (refer to Figure 4). The Cisco VSPA requires the Cisco Catalyst® 6500 Series Services SPA Carrier-600 (SSC-600) to operate in Cisco Catalyst 6500 Series Switches. Each SSC-600 module takes up one slot in a Cisco Catalyst 6500 Series Switch and can support up to two Cisco VPN Services Port Adapters. The Cisco VSPA, accompanied with the SSC-600, delivers scalable and cost-effective VPN performance for Cisco Catalyst 6500 Series Switches.

Figure 4. Cisco VSPA

Benefits

- High performance: The Cisco VSPA can deliver up to 8 Gbps of Advanced Encryption Standard (AES) traffic at large packet sizes and 7 Gbps Internet mix (IMIX) traffic
- Modular design and scalability: Terminate up to 16,000 site-to-site or remote-access IPSec tunnels on each VSPA; Up to 10 VSPAs can be combined in a single chassis
- Enhanced Quality of Service (QoS): The VSPA is designed to handle pre-encryption QoS configured on IPsec tunnel interfaces and provides priority, bandwidth, and traffic shaping services
- Scalable IPv6 encryption: Support for multi-gigabit IPv6 networks based on Static Virtual Tunnel Interfaces (sVTIs)
- Support for industry-leading encryption technology: In addition to Data Encryption Standard (DES) and Triple Data Encryption Standard (3DES), the Cisco VSPA also supports AES 192 and 256, the latest standard in encryption technology demanded by most government agencies and the leading financial institutions in the most secure network environments

For Additional Information

- http://www.cisco.com/en/US/prod/collateral/switches/ps5718/ps708/data_sheet_c78_492120_ps8768_Products_Data_Sheet.html

- http://www.cisco.com/en/US/products/ps9893/index.html

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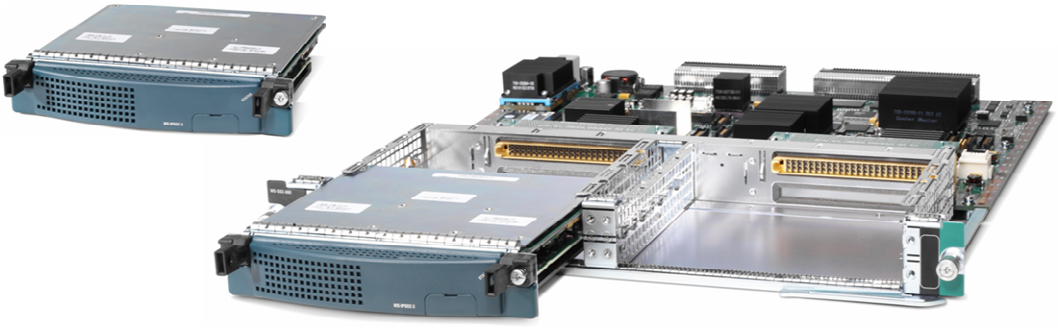
Cisco Catalyst 6500 Series Services SPA Carrier-600 (WS-SSC-600)

The Cisco® Catalyst® 6500 Series Services SPA Carrier-600 helps enable high-performance IP Security (IPSec) VPN services for secure transport of mission-critical data across the network. It provides Enterprises and Service Providers tremendous flexibility and density as they scale their network infrastructure and expand secure, remote services to branch offices and offsite users.

Figure 5. Cisco Services SPA Carrier-600 with Two Cisco VPN Services Port Adapters



Benefits

- Modularity—Creates investment protection and offers flexibility for the Cisco Catalyst 6500 Series Switches
- Scalability—Up to 10 Cisco Services SPA Carrier-600 modules and 10 Cisco VSPAs in a Cisco Catalyst 6500 chassis

For Additional Information

- http://www.cisco.com/en/US/prod/collateral/switches/ps5718/ps708/data_sheet_c78_491727_ps8768_Products_Data_Sheet.html
- http://www.cisco.com/en/US/products/ps9893/index.html

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MPLS

Layer 3 MPLS VPN Feature Enhancements

Cisco IOS Software Release 12.2(33)SXI includes the following new Layer 3 MPLS VPN feature enhancements:

- MPLS VPN—VPN Routing/Forwarding Instance (VRF) Command-Line Interface (CLI) for IPv4 and IPv6 VPNs
- MPLS VPN—IPv6 VPN over MPLS (6VPE) Support over IP tunnels

Benefits

- MPLS VPN—VRF CLI for IPv4 and IPv6 VPNs: Provides a CLI improvement and integration for VRF IPv4 and IPv6 commands

- MPLS VPN 6VPE support over IP tunnels: This new option of the L3VPN solutions suite enables network providers to run IPv6 VPNs over classical IPv4 transport networks without the requirement to run MPLS and LDP/MPLS-TE within the core network

For Additional Information

- http://www.cisco.com/en/US/products/ps6604/products_ios_protocol_group_home.html
- http://www.cisco.com/en/US/products/ps6017/products_feature_guides_list.html

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Ethernet OAM Enhancements

IEEE 802.1ag Ethernet Connectivity Fault Management (CFM)

IEEE 802.1ag Ethernet Connectivity Fault Management (CFM) is comprised of the following four categories of messages that work together to help administrators debug Ethernet networks:

1. Continuity check messages—these are "heartbeat" messages issued periodically by maintenance endpoints. They allow maintenance endpoints to detect loss of service connectivity among themselves. They also allow maintenance endpoints to discover other maintenance endpoints within a domain, and allow maintenance intermediate points to discover maintenance endpoints.
2. Link trace messages—these are transmitted by a maintenance endpoint on the request of the administrator to track the path (hop-by-hop) to a destination maintenance endpoint. They allow the transmitting node to discover vital connectivity data about the path. Link trace is similar in concept to UDP Traceroute.
3. Loopback messages—these are transmitted by a maintenance endpoint on the request of the administrator to verify connectivity to a particular maintenance point. Loopback indicates whether the destination is reachable or not; it does not allow hop-by-hop discovery of the path. It is similar in concept to ICMP Echo (Ping).

Release 12.2(33)SXI includes support for the following functionality:

Maintenance End Points (MEPs) on Switchports (Inward)

Maintenance Intermediate Points (MIPs)

CFM MIP/MEP over EtherChannel

CFM—Outward Facing MEPs on Routed Ports

Release 12.2(33)SXI includes support for the following message types:

- Continuity Check (CC) 3
- Traceroute
- Loopback

Release 12.2(33)SXI includes additional support for the following functionality:

- Crosscheck
- SNMP Traps

Product Management Contact

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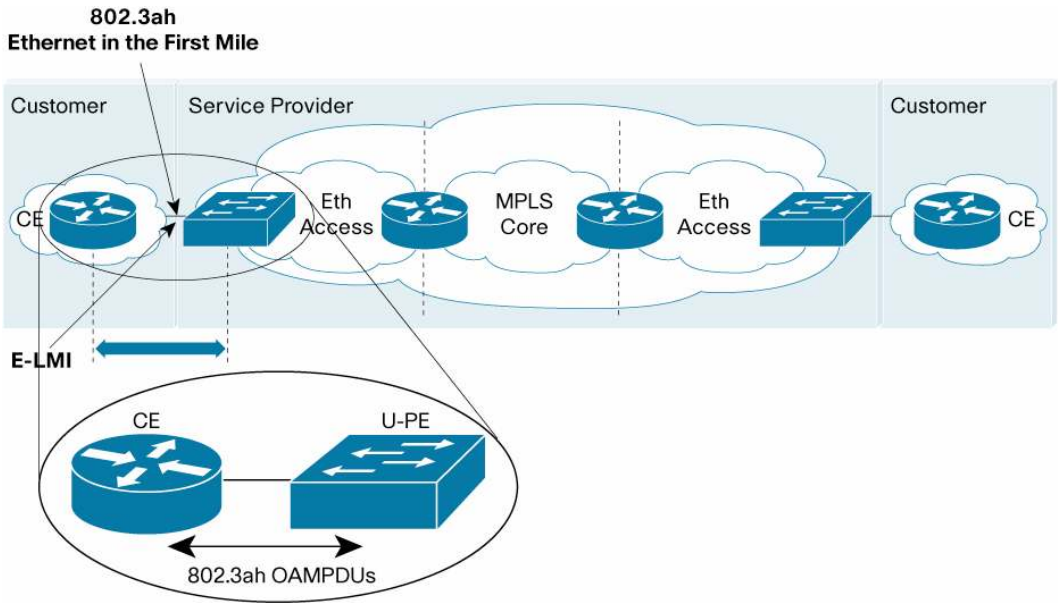
Link Layer OAM—IEEE 802.3ah Ethernet Operations, Administration, and Maintenance (OAM)

Link Layer OAM (as specified in IEEE Standard 802.3ah-2004 Clause 57) can be implemented on any full-duplex point-to-point or emulated point-to-point Ethernet link. OAM Protocol Data Unit (OAMPDU) frames cannot propagate beyond a single hop within an Ethernet network and have modest bandwidth requirements (frame transmission rate is limited to a maximum of 10 frames per second; refer to Figure 6 below).

Figure 6. OAM Protocol Data Units



Release 12.2(33)SXI includes support for the following functionality:

- **OAM Discovery**

  Discovery is the first phase of Link Layer OAM. It identifies the devices at each end of the link along with their OAM capabilities.

- **Link Monitoring**

  Link monitoring OAM serves for detecting and indicating link faults under a variety of conditions. Faults in link connectivity that are caused by slowly deteriorating quality are difficult to detect. Link OAM provides a mechanism for an OAM entity to convey these types of failure conditions to its peer via specific flags in the OAMPDUs. It provides statistics on the number of frame errors (or percent of frames that have errors) as well as the number of coding symbol errors.

- **Remote Loopback**

  An OAM entity can put its remote peer into loopback mode using the loopback control OAMPDU. In loopback mode, every frame received is transmitted back on the same port (except for OAMPDUs needed to maintain the OAM session). This helps the administrator ensure the quality of links during installation or when troubleshooting, and can also be used to test SLA requirements such as delay, jitter, and throughput. This feature is asymmetric, the provider device can put the customer device into loopback mode, but not conversely.

- **Remote Fault Indication (RFI)—Dying Gasp**

  The failure conditions that can be communicated are a loss of signal in one direction on the link, an unrecoverable error (such as a power failure), or some critical event. Currently, Cisco supports the Dying Gasp generation and can receive the Critical Event and Link Fault.

Release 12.2(33)SXI includes support for the following proprietary reason codes:

- Administratively Down
- Error Disabled
- Reload

Reason codes are sent through organization-specific OAMPDU frame structures.

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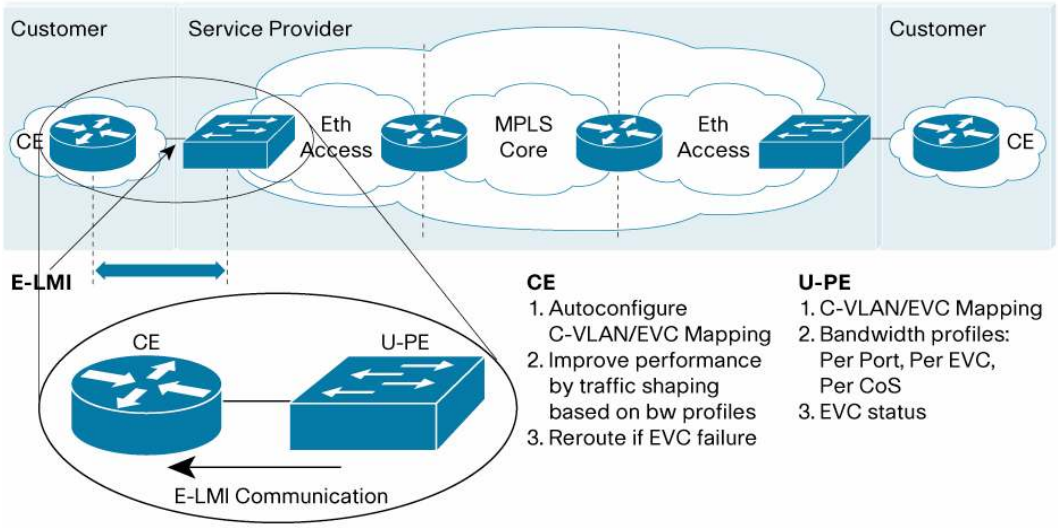
Ethernet Local Management Interface (E-LMI)

E-LMI defines the protocol and procedures that convey the information that allows auto-configuration of the CE device by the Service Provider's User-facing Provider Edge (U-PE) device (see Figure 7). The E-LMI protocol also provides the means for notification of the status of an Ethernet Virtual Circuit (EVC).

Figure 7. Ethernet Local Management Interface



The E-LMI protocol includes the following procedures:

- **Notification to the Customer Edge (CE) device of the addition of an EVC**

  An example use case of this is if a new branch office is connected to headquarters. The CE device at headquarters will be notified via the U-PE of the EVC and the associated VLAN to be configured. Future releases of E-LMI will also support auto-configuration, which provides notable benefits in that the branch office CE device can be deployed at the convenience of the customer and it will begin operation as soon as the Service Provider turns up the service.

- **Notification to the CE device of the deletion of an EVC**

  This is very similar to the previous examples, except the EVC is being removed.

- **CE EVC State notification (active) or (inactive)**

  The primary benefit is that the CE device can take some corrective action, such as re-routing traffic to a different EVC or other WAN service, when informed that an EVC has become inactive.

Release 12.2(33)SXI includes support for the following functionality:

- **EVC and Remote User Network Interface (UNI) Status**

  Remote UNI status is a Cisco proprietary extension which is supported by the OAM Interworking component.

- Traffic Shutdown on CE based on EVC Status

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Cisco Performance Management and Monitoring Through IP SLAs for Ethernet

As Metro Ethernet services are fast becoming the WAN interface of choice, “carrier grade” requirements, such as those found in ATM, are becoming de facto rather than optional for the Enterprises deploying emerging services, such as voice and video. With this, the need for a network provider to provide tight Service Level Agreements (SLAs) is an intrinsic requirement to be able to compete and offer value-added services.

Cisco Performance Management and Monitoring through IP SLAs for Ethernet is a Layer 2 performance monitoring tool that builds upon the popular IP SLAs embedded management application. Cisco IP SLAs for Ethernet solves many problems not currently addressed with native IP performance monitoring and the limited specification on point-to-point performance monitoring as outlined in Y.1731.

Benefits of IP SLAs for Ethernet include:

- A reduction in OPEX by employing:
  - Point-to-Point and Multipoint support
  - Auto-discovery of endpoints (Moves/Adds/Changes)
  - No IP overlay required to manage native Ethernet service
- Hierarchical Performance Management
  - Monitor Customer, Operator and Service Provider networks
  - Monitoring is transparent to lower layers
- In-Band Performance Management using Ethernet Frames
- Policy threshold alerts via SNMP Traps

Cisco IP SLAs for Ethernet reduces OPEX by leveraging the attributes of Connectivity Fault Management (CFM, 802.1ag). By coupling powerful IP SLAs with CFM, a network provider gains the ability to auto-discover endpoints using the Continuity Check Database (CCDB) to identify maintenance endpoints. By doing so, the probes can be set to monitor at a given Maintenance Domain and VLAN level, providing precise measurements for a given service. Other advantages include no need to deploy a separate IP overlay network to monitor services, which adds costly

hardware and subnet management. There is no need to configure a mesh of point to point probes for multipoint services.

Cisco IP SLAs for Ethernet can be configured through the Command-Line Interface (CLI) or through the use of a new MIB.

Product Management Contact

- Eric Matkovich (ematkovi@cisco.com)

Cisco Ethernet OAM Interworking

- **802.3ah to Connectivity Fault Management (CFM) Interworking**

  Many of the OAM technologies today only deal with specific points of failure. Either the Link, the Service, or EVC status can be achieved independently. Cisco advanced OAM Interworking capabilities bridges the gap by providing the glue to complete a truly end-to-end OAM for your transport network, and the services that utilize it. Connectivity Fault Management has the capabilities to provide service level fault notification and fault isolation. 802.3ah provides link level monitoring information. 802.3ah to CFM interworking allows us to interpret errors happening at the link level and communicate it across the network to affected peers. This dramatically reduces the effects of potential black holing of services. This also reduces the time associated with fault isolation and repair.

- **CFM to E-LMI**

  The power of Cisco advanced Ethernet OAM can be fully realized through our OAM manager. The OAM manager is a component that allows for the seamless interworking of various OAM protocols providing the basis for true end-to-end OAM. In this case, the OAM manager handles the interaction between CFM and E-LMI. The E-LMI interaction with the OAM manager is unidirectional, running only from the OAM manager to E-LMI on the User Provider-Edge (UPE) side of the switch. Information is exchanged either as a result of a request from E-LMI or triggered by OAM when it receives notification of a change from the OAM protocol. The following type of information is relayed:

  - EVC name and availability status
  - Remote UNI name and status
  - Remote UNI counts

  You can configure Ethernet Virtual Connections (EVCs), service VLANs, UNI ids (for each CE-to-PE link), and UNI count and attributes. You need to configure CFM to notify the OAM manager of any change to the number of active UNIs, and or the remote UNI ID for a given S-VLAN domain.

  On the UPE side, the OAM manager defines an abstraction layer that relays data collected from OAM protocols (in this case CFM) running within the metro network to the E-LMI switch. CFM can thus be leveraged to notify E-LMI of any remote defects that may affect the active UNI counts in a point-to-point or multipoint service. This will allow E-LMI on the CE side to take the associative action and bring down the affected EVC's interface.

  The information flow is unidirectional (from the OAM manager to the E-LMI) but is triggered in one of two ways:

  - Synchronous data flow triggered by a request from the E-LMI
  - Asynchronous data flow triggered by OAM manager when it receives notification from CFM that the number of remote UNIs has changed

This data includes:

- EVC name and availability status (active, not active, partially active, or not defined)
- Remote UNI name and status (up, disconnected, administratively down, excessive FCS failures, or not reachable)
- Remote UNI counts (the total number of expected UNIs and the actual number of active UNIs)
- The asynchronous update is triggered only when the number of active UNIs has changed

The benefits of a cohesive approach to end-to-end OAM interworking can be realized through reduced time to detect and repair services, reducing overall operating expense (OPEX).

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High Availability

In-Service Software Upgrade Support for Catalyst 6500 Series Switches—Phase I

In-Service Software Upgrade (ISSU) minimizes the impact of upgrading or downgrading Cisco IOS Software images on Catalyst 6500 Series Switches with redundant supervisor engines. Based on Stateful Switchover (SSO), ISSU for Catalyst 6500 Series Switches-Phase I implements Enhanced Fast Software Upgrade (eFSU) and allows users to upgrade or downgrade from one major or maintenance release to another with only a short system outage, similar to that experienced with Route Processor Redundancy Plus (RPR+).

ISSU Phase I enables rapid software upgrades for new line cards, new power supplies, new features, or bug fixes. Software upgrades are accomplished by loading the new release onto the standby supervisor, then performing a hot switchover from the old, active supervisor. The line cards automatically undergo a warm reload to activate the new software, minimizing the outage. Line cards not capable of warm reload will reload normally (see Hardware Support section below).

ISSU for Catalyst 6500 Series Switches—Phase II, which is planned for a future release, will allow non-disruptive upgrades to or downgrades on systems with redundant supervisor engines by adding in-service upgrades of line cards. Together with Nonstop Forwarding/Stateful Switchover (NSF/SSO), ISSU—Phase II will allow forwarding of data packets along known routes without any route flaps or network instabilities during the software upgrade, reducing planned downtime to maximize system and network availability.

Benefits

- Provides the ability to upgrade/downgrade a complete Cisco IOS Software image with minimal system downtime
- Provides streamlined process for software upgrade/downgrade covering maintenance-fixes as well as new features
- Reduces planned downtime and operational expenses

Hardware Support

- All Catalyst 6500 Series chassis are supported
- Catalyst 6500 Supervisor Engines: Sup32-GE, Sup32-10GE, Sup720-GE and Sup720-10GE

- Line Cards with Warm Reload Support: 67xx series cards, SIP200, and SIP400 with 512MB minimum memory

Note: Line cards not capable of warm reload will reload normally

For Additional Information

- http://www.cisco.com/en/US/products/ps7149/products_ios_protocol_group_home.html
- Feature Guide: http://www.cisco.com/en/US/docs/switches/lan/catalyst6500/ios/12.2SX/configuration/guide/issu_efsu.html

Product Management Contact

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Bidirectional Forwarding Detection (BFD) Enhancements

Bidirectional Forwarding Detection (BFD) is a detection protocol designed to provide fast forwarding path failure detection times for all media types, encapsulations, topologies, and routing protocols. This detection is typically accomplished through hardware detection mechanisms. However, not all of the hardware mechanisms have the capability to detect failures, for example Ethernet failures.

BFD also provides a consistent failure detection method for network administrators. Because the network administrator can use BFD to detect forwarding path failures at a uniform rate, rather than the variable rates for different routing protocol hello mechanisms, network profiling and planning is easier, and re-convergence time is consistent and predictable.

The following new BFD feature enhancement is being introduced in Release 12.2(33)SXI for the Cisco Catalyst 6500 Series Switch:

- **Bidirectional Forwarding Detection (BFD) VRF support**

  BFD VRF support extends BFD failure detection capability within a VRF context. It is now possible to run BFD from a VRF based interface, so that any failure in the forwarding path between PE and CE devices can be detected even though the physical link might still be up. The combination of BFD VRF support along with the different embedded OAM MPLS tools such as MPLS Ping and Traceroute give network operators a comprehensive end-to-end solution to address overall network reliability and enhance their L3VPN service availability.

Benefits

- **BFD—VRF aware support:** Offers the capability to improve convergence on the PE-CE link and ultimately improves overall layer 3 VPN network reliability and availability

For Additional Information

- Bidirectional Forwarding Detection Feature Guide: http://cco.cisco.com/en/US/docs/ios/12_0s/feature/guide/fs_bfd.html

Product Management Contact

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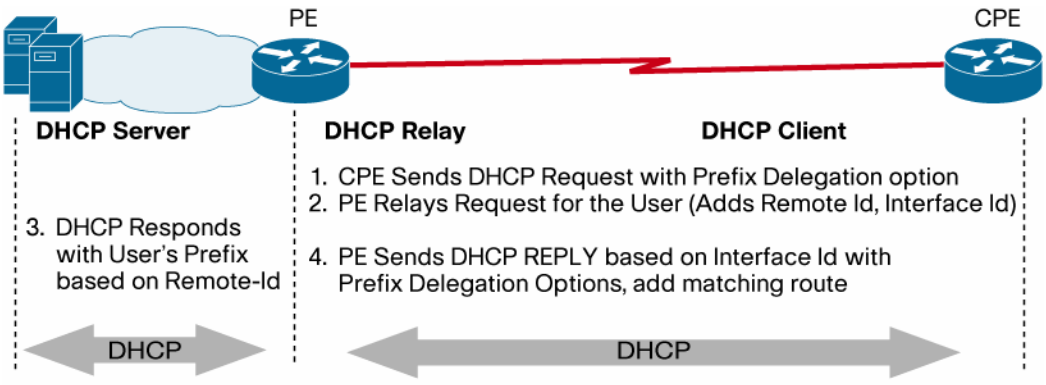
IP Services

Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Relay Enhancements

The DHCPv6 Relay component is enhanced to support a stateless Relay. Remote Id and Interface Id options insertion is performed. DHCPv6 Relay now works in conjunction with Prefix Delegation for adding or removing corresponding routes in the Relay agent routing table.

Figure 8. DHCPv6 Option Handling at the Relay Agent



Benefits

- DHCPv6 Prefix Delegation is now fully deployable when a Relay is involved with route maintenance and Relay options to enable Prefix selection at the Server side (Remote Id) and proper message forwarding at the Relay side (Interface Id).

For Additional Information

- DHCPv6 Configuration Guide: http://www.cisco.com/en/US/docs/ios/ipv6/configuration/guide/ip6-dhcp.html

Product Management Contact

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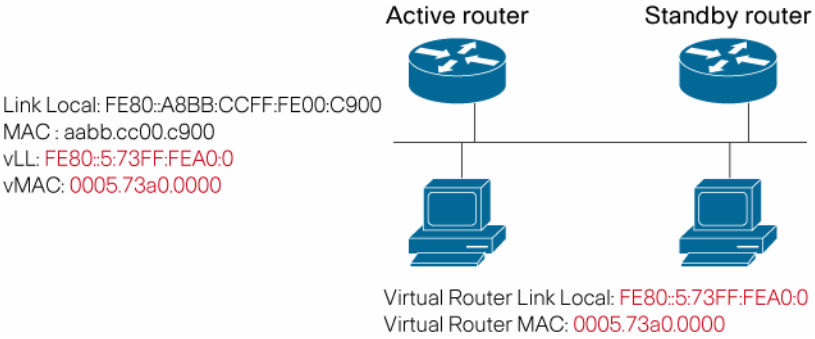
Hot Standby Router Protocol (HSRP) for IPv6

The HSRP is designed to allow for transparent failover of the first-hop IP router. HSRP provides high network availability by providing first-hop routing redundancy for IP hosts on Ethernet configured with a default gateway IP address. HSRP is used in a group of routers for selecting an active router and a standby router. In a group of router interfaces, the active router is the router of choice for routing packets. The standby router is the router that takes over when the active router fails or when preset conditions are met.

Most IPv4 hosts have a single router's IP address configured as the default gateway. When HSRP is used, then the HSRP virtual IP address is configured as the host's default gateway, instead of the router's IP address. In contrast, IPv6 hosts learn of available IPv6 routers through IPv6 neighbor discovery Router Advertisement (RA) messages. These RA messages are broadcasted periodically, or may be solicited by hosts. HSRP is designed to provide only a virtual first hop for IPv6 hosts.

An HSRP IPv6 group has a virtual MAC address that is derived from the HSRP group number, and a virtual IPv6 link-local address that is, by default, derived from the HSRP virtual MAC address. Periodic RAs are sent for the HSRP virtual IPv6 link-local address when the HSRP group is active. These RAs stop after a final RA is sent when the group leaves the active state.

Figure 9. HSRP for IPv6 Topology



Benefits

- Increases network availability by providing protection against router failures
- Decreases outages and their duration

For Additional Information

- Cisco IOS Software Release Specifics for IPv6 Features: http://www.cisco.com/en/US/docs/ios/ipv6/configuration/guide/ip6-fhrp.html

Product Management Contact

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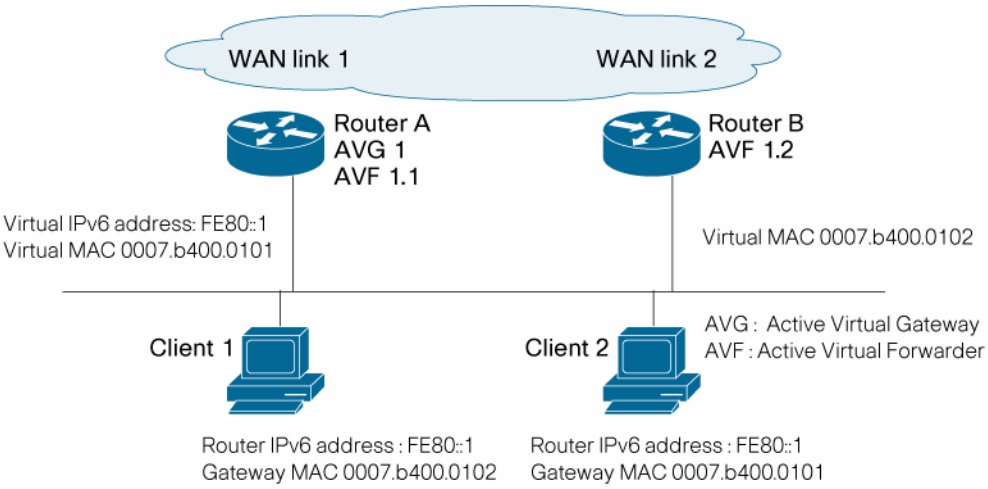
Cisco Gateway Load Balancing Protocol (GLBP) for IPv6

GLBP for IPv6 protects data traffic from a failed router or circuit, while allowing packet load sharing between a group of redundant routers. GLBP differentiates itself from Virtual Router Redundancy Protocol (VRRP) in that GLBP offers the ability to concurrently use more than one gateway, significantly reducing the cost of a First Hop Routing solution.

Multiple first hop routers on the LAN combine to offer a single virtual first hop IPv6 router while sharing the IPv6 packet forwarding load. GLBP performs a similar, but not identical, function for the user as HSRPv6. HSRPv6 protocol allows multiple routers to participate in a virtual router group configured with a virtual IPv6 address. One member is elected to be the active router to forward packets sent to the virtual IPv6 address for the group. These standby routers have unused bandwidth that the protocol is not using. GLBP provides load balancing over multiple routers (gateways) using a single virtual IPv6 address and multiple virtual MAC addresses. Each host receives the same virtual IPv6 address using standard IPv6 ND procedures, and all routers in the virtual router group participate in forwarding packets.

There is no “default gateway” concept in IPv6. The router address is learned through Router Advertisement (RA) messages. On a LAN where a number of routers form a GLBP group, should a router not be configured for GLBP, there would be a risk to see two different RAs reaching the hosts. An RA would be generated by the GLBP virtual gateway and another by the router out of the GLBP group. Hosts would then load balance the packets between the mis-configured router and the GLBP virtual gateway. To prevent this, it is advised to set up the Default Router Selection feature. Setting-up RA priority to “high” on GLBP routers would allow the GLBP routers to be preferred.

Figure 10. GLBP for IPv6 Topology



Benefits

- Increases network availability by providing protection against router failures
- Provides network redundancy and load sharing for IPv6 networks, ensuring that user traffic immediately and transparently recovers from first hop failures in network edge devices or access circuits

For Additional Information

- GLBP for IPv6 Product Literature: http://www.cisco.com/en/US/docs/ios/ipv6/configuration/guide/ip6-fhrp.html

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GLBP Client Cache

The GLBP client cache contains information about network hosts that are using a GLBP group as the default gateway. This enables the capability of displaying more information about individual network clients that are using GLBP as their default gateway:

- How well GLBP clients have been distributed among forwarders
- Which forwarder a particular client is assigned to
- How many clients are assigned to each forwarder
- Which clients are assigned to each forwarder

The following information can be displayed via use of a CLI show command on the Active Virtual Gateway for the group:

- Percentage of all clients currently assigned to each forwarder
- Forwarder assigned to a specified client MAC address
- Number of client assigned to each forwarder
- Information about each client assigned to each forwarder

Benefits

- Manageability and network troubleshooting of GLBP is greatly improved.

For Additional Information

- GLBP Feature Information: http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_glbp.html

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VRRP Stateful Switch Over (SSO)

The SSO Aware VRRP feature enables the Cisco IOS VRRP subsystem software to detect that a standby Route Processor (RP) is installed and the system is configured in SSO redundancy mode. Further, if the active RP fails, no change occurs to the VRRP group itself and traffic continues to be forwarded through the current active gateway router.

Prior to this feature, when the active VRRP router primary RP failed, it would stop participating in VRRP group and trigger another router in the group to take over as the active VRRP router. The SSO-Aware VRRP feature is required to preserve the forwarding path for traffic destined to VRRP virtual IP through a RP switchover. Configuring SSO on the edge router enables the traffic on the Ethernet links to continue during an RP failover without the Ethernet traffic switching over to another VRRP router. With this feature, VRRP SSO information is synchronized to the standby RP, allowing traffic that is sent using the VRRP virtual IP address to be continuously forwarded during a switchover without a loss of data or a path change.

Benefits

- GLBP SSO can detect when a router is failing over to the secondary RP and continue in its current group state, creating an unparallel gateway high availability scheme.

For Additional Information

- VRRP Feature Information: http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_vrrp.html

Product Management Contact

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Enhanced Object Tracking Integration with Embedded Event Manager

Enhanced Object Tracking (EOT) is now integrated with Embedded Event Manager (EEM) to allow EEM to report on status change of a tracked object and to allow Enhanced Object Tracking to track EEM objects.

Benefits

- Access to the richness of Embedded Event Manager events in Enhanced Object Tracking
- Access to Enhanced Object Tracking from Embedded Event Manager

Additional Information (URLs)

- Enhanced Object Tracking Product Literature: http://www.cisco.com/en/US/docs/ios/netmgmt/configuration/guide/nm_eem_overview_ps6441_TSD_Products_Configuration_Guide_Chapter.html

Product Management Contact

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IPv6 Support on VPN Services Port Adapter

The VPN Services Port Adapter (VPSA) brings support for IPv6 site-to-site encryption/decryption not available on the previous generation VPN SPAs.

Benefits

- Dual Stack on egress interface
- Extended Address Space
- Header Simplification
- Auto Config
- No fragmentation done by routers, only by end hosts

For Additional Information

- http://www.cisco.com/en/US/products/ps9893/index.html

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Security and Identity

IEEE 802.1x Feature Enhancements

- **Flexible Authentication Sequencing**

  Flexible authentication sequencing provides a flexible fallback mechanism among IEEE 802.1x, MAC authentication Bypass and Web authentication methods. It also allows switch administrators to control the sequence of the authentication methods. This simplifies the identity configuration by providing a single-set of configuration commands to handle different types of end points connecting to the switch ports. In addition, it allows users to configure any authentication method on a standalone basis ie: MAB can be configured without requiring IEEE 802.1X configuration.

- **IEEE 802.1x with Open Access**

  This feature allows users to have limited network access, such as the Intel Preboot Execution Environment (PXE) boot server, prior to IEEE 802.1x authentication. The limited access is controlled by an ACL that is defined by the switch administrator and applied on the switch port.

- **IEEE 802.1x, MAB and Web Authentication with downloadable ACL**

  This feature allows per-user ACLs to be downloaded from the Cisco ACS server as policy enforcement after authentication using IEEE 802.1x, MAC authentication Bypass or Web authentication.

- **IEEE 802.1x, MAB with QoS Policy**

  This feature allows per-user per-port QoS policy to be applied on the switch port after authentication using IEEE 802.1x or MAC Authentication Bypass.

- **Cisco Discovery Protocol (CDP) enhancement for second port disconnect**

  CDP protocol is enhanced to add a new TLV for the IP phone to indicate the switch in the event of the PC disconnecting from the IP phone. Upon receiving this notification, the switch can clear the security record for the PC.

- **Inactivity timer for IEEE 802.1x and MAC Authentication Bypass**

  This feature provides a local inactivity timer for IEEE 802.1x and MAC Authentication Bypass. If the authenticated devices stay idle for longer than defined period, the switch resets the security record of the devices.

- **Multi-Domain Authentication**

  Multi-Domain Authentication allows an IP Phone (Cisco or non-Cisco) and a PC to authenticate on the same switch port while it places them on appropriate Voice and Data VLANs.

- **IEEE 802.1x with multi-auth**

  Multiple authentication allows more than one host to authenticate on a IEEE 802.1x enabled switch port. With mulit-auth, each host must authenticate individually before it can gain access to the network resources.

- **Centralized Web Authentication**

  This feature allows the switch to redirect users via HTTP URL redirection to a central web authentication server or a guest access server for authentication before accessing the network resources.

- **Identity to port description mapping**

  This feature allows a user-identity based switch interface description to be displayed on the interface to which the user connects.

- **Web authentication enhancement—Inaccessible authentication bypass**

  Web authentication is enhanced to support inaccessible authentication bypass. In the event that the Authentication, Authorization, and Accounting (AAA) servers are unreachable or nonresponsive, user authentication typically fails with the port closed, and the user is denied access. Web Authentication inaccessible authentication bypass provides a configurable alternative on the switch to grant a critical port network access in a locally specified VLAN. After the AAA servers become reachable again, those ports will either remain critically authorized or be reinitialized. Inaccessible authentication bypass can be enabled on a per-port basis for access ports, private VLAN host ports, or routed ports. It is typically enabled on ports connected to critical devices, minimizing business impact for the duration of the AAA server outage.

- **Common Session ID**

  IEEE 802.1X and MAB will use a session ID identifier for all 802.1X and MAB authenticated sessions. This session ID will be used for all reporting purposes such as show commands, MIBs, Syslog and RADIUS messages and allow users to distinguish messages for one session from others.

- **Conditional Logging**

  IEEE 802.1X and MAB will provide a capability to filter debug messages for a range of interfaces, MAC Addresses, IP Addresses or Session IDs to simplify troubleshooting.

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Pre-Encryption QoS on VPN Services Port Adapter

The VPN Services Port Adapter (VPSA) is a IPSec module for the Catalyst 6500 that can deliver a peak rate of 8 Gbps IPSec encryption/decryption. For meaningful QoS support, traffic must be

classified, prioritized, shaped, and policed at all potential bottlenecks in a network where the maximum rate is restricted. The QoS policies on the VSPA are applied before encryption, solving the problem of shaping traffic to avoid a hub from overwhelming a lower capacity spoke. The VSPA will allow the administrator to prioritize traffic on a per tunnel basis as well as configure a shape rate for each tunnel.

Benefits

- Egress congestion will rely on system level QoS policies
- Pre-encryption solves the problem of trying to apply a QoS policy on the egress interface after the traffic has been encrypted
- Solves problem of Anti-Replay drops caused by post-encryption

For Additional Information

- http://www.cisco.com/en/US/products/ps9893/index.html

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Embedded Management

Embedded Event Manager Version 2.4

Cisco IOS Embedded Event Manager (EEM) is a unique subsystem within Cisco IOS Software. EEM is a powerful and flexible tool to automate tasks and customize the behavior of Cisco IOS and the operation of the device. Customers can use EEM to create and run programs or scripts directly on a router or switch. The scripts are referred to as EEM Policies and can be programmed using a simple CLI-based interface or using a scripting language called Tool Command Language (Tcl).

EEM allows customers to harness the significant intelligence within Cisco IOS Software to respond to real-time events, automate tasks, create customer commands and take local automated action based on conditions detected by the Cisco IOS Software itself.

EEM provides a level of embedded systems management not previously seen in Cisco IOS Software. Over fifteen event detectors provide an extensive set of conditions that can be monitored and defined as event triggers. The system is extensible with new capabilities and further subsystem integration is planned.

EEM Version 2.4 Feature Enhancements and Benefits

EEM Version 2.4 ushers in a significant number of enhancements over previous versions:

- **Two new Event Detectors:**
  - **Remote Procedure Call Event Detector**—allows for programs outside of the device to invoke specific device-resident, embedded policies by sending a Simple Object Access Protocol (SOAP) request over an SSHv2 connection. The device-resident policy runs on the device and may reply with information in a subsequent SOAP response.
  - **SNMP Proxy Event Detector**—creates events when a specified SNMP trap or inform is received at the device. This allows for policies to be triggered by events from other devices.
- **Multiple Event Correlation**—EEM Version 2.4 now allows for multiple events to be considered for policy invocation. Previously a single event specification triggered a policy.

Now up to 8 events may be correlated together using logical operators allowing for more granular and very powerful policy triggers.

- **Script Policy Refresh**—This feature allows for easy management, distribution, and update of device resident polices using a pull model.
- **Additional ease of use enhancements and extensions:**
  - **Interface Counter ED**—rate based trigger; Bytecode support; Support for parameters on the event manager run command; Clear command to kill a policy; Registration substitution enhancement; SNMP ED enhancement—delta value; TCL package support

Table 5. EEM 2.4 Features and Benefits

Feature	Benefit
Extensible and Powerful Subsystem Architecture	
Architecture	The EEM subsystem is designed with modularity in mind. It consists of Event Detectors, an Event Manager Server, and action routines called Policies
CLI interface	An interface to the Cisco IOS CLI to allow automated commands and access to any information that can be displayed
Policy Scheduler	EEM policies are scheduled one at a time or concurrently according to the number of threads configured
Built–In Actions	Policies can invoke a number of built-in actions for easy automation
Extensive Set of Event Detectors (ED)	
Application	Custom application events, action script interaction
CLI	CLI command match and run
Counter	Custom counter events
GOLD	Generic Online Diagnostics (GOLD) event detection
Interface	Interface counters and events
Memory Threshold (Deprecated)	Detect memory resource related events
None (by Run Command)	Allows execution of an EEM policy by direct command, event manager run
Object Tracking	Integration with Enhanced Object Tracking (EOT)
OIR	Card Online Insertion and Removal detection
Remote Procedure Call	Allows for authorized programs outside of the device to invoke specific device-resident, embedded policies by sending a SOAP request over an SSHv2 connection.
Resource Threshold	Integration with Embedded Resource Manager, supersedes Memory Threshold ED.
RF	Cisco IOS infrastructure Redundancy Facility (RF) events
SNMP	Detect MIB Variable match and thresholds
SNMP Proxy	Creates events when a specified SNMP trap or inform is received at the device. This allows for policies to be triggered by events from other devices.
Syslog	Regular expression pattern match on emitted Syslog messages
Timer	Custom timed events
IOS Watchdog Monitor	Cisco IOS scheduler, watchdog events
WDSysMon	Cisco IOS Software Modularity: System monitor event
Secure System Operation	
EEM Scripts Run within System Constraints	Protects system from harm.ie: A looping script will not stop Cisco IOS.
User Scripts Run in Safe-Tcl mode	Certain programmable options are disabled for protection
Controlled Environment	Only a network administrator with privileged access can define and set up EEM scripts. No one else can install software to compromise the system.
Support for TACACS+/RADIUS	EEM scripts can be associated with a configured User ID and be checked for permission.
EEM is Optional	If you don't want to use this powerful capability, you don't have to enable it.

Feature	Benefit
Online Scripting Community	
Cisco Beyond—Product Extension Community	A place for customers to share and download scripts. Don't reinvent the wheel. Build and extend the work of others. Learn by example. Go to: http://www.cisco.com/go/ciscobeyond .

For Additional Information

- For more information about Cisco IOS EEM go to http://cisco.com/go/eem or contact your local Cisco account representative.

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Catalyst OS Software (CatOS) Parity MIBs in Release 12.2(33)SXI

The following new MIBs were introduced in Release 12.2(33)SXI for CatOS MIB parity:

1. CISCO-MODULE-AUTO-SHUTDOWN-MIB
2. CISCO-IGMP-SNOOPING-MIB
3. CISCO-PACKET-CAPTURE-MIB

This new support complements the existing CatOS MIB parity in Release 12.2(33)SXH:

1. CISCO-VTP-MIB
2. CISCO-L2-TUNNEL-CONFIG-MIB
3. MAU-MIB
4. CISCO-MAU-EXT-MIB

For additional information:

- http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

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IP Routing and Multicast

EIGRP for IPv6

Enhanced Interior Gateway Routing Protocol (EIGRP) is a unique Cisco innovation valued for its ease of deployment, fast convergence times, minimal routing traffic overhead, and scalability. First delivered in Cisco IOS Software Release 12.4(20)T, and now available for the Catalyst 6500 in Release 12.2(33)SXI, EIGRP for IPv6 allows fast, seamless IPv6 integration for IPv4 EIGRP users in the Enterprise, public sector (defense, government), and wireless applications by extending EIGRP to support next generation IPv6 infrastructure and services.

Network administrators looking at their IPv4 networks currently face a variety of challenges:

- **IPv4 Address Space Depletion:** Due to the 32 bit limit of IPv4, the availability of Class A, B and C Internet addresses, and the ever growing size of networks, the IPv4 address space available for use is rapidly being consumed and limited in its ability to scale to the requirements of next generation infrastructure requirements.
- **Mobile Wireless:** With the ongoing convergence of video/voice and data on Mobile Wireless devices, there is a rapidly growing demand for IP address space from these mobile devices that exceeds the capabilities of current IPv4 networks.

- **Mobile Networks:** New applications such as mobile networks using mobile platforms such as automobiles, ships, trains, and planes add to the pressure on IPv4 address space availability.
- **Public Sector:** Many parts of the US Government have created memos (DoD memo June 2003, OMB Memo M-05-22), task forces (Commerce Department task force on IPv6), and recommendations (GAO-05-471) to transition from IPv4 to IPv6 based networking solutions by 2008.
- **Higher Education/Research Networks:** These networks are pushing the limits of networking technology and applications. As such, they require networking equipment and protocols that can extend beyond the boundaries of existing IPv4 based solutions.

All of these factors are pushing IPv6 as a next generation infrastructure technology capable of overcoming the limitations of IPv4 and allowing for the delivery of next generation services such as mobile wireless.

In order to make the transition from IPv4 to IPv6, there are two important issues that need to be considered:

- **Supportability of IPv4 and IPv6:** The migration to IPv6 will be a gradual one and administrators will require the flexibility to keep both their IPv4 users and IPv6 users on the same network infrastructure at the same time. Hence, the network needs to be able to support both IPv4 and IPv6.
- **EIGRP for IPv4:** EIGRP is an area of continual innovation by Cisco with support for such functionality as:
  - Nonstop Forwarding (NSF) with Stateful Switchover (SSO)
  - Stub Routing; MPLS VPN PE-CE with Site of Origin (SoO)
  - Route Redistribution Limiting and Max-Prefix Limits
  - SNMP MIBs
  - Enhanced Route Map support

The strong protocol support and ongoing innovation for EIGRP leads to the following major customer benefits:

- **Ease of Use:** EIGRP is simple to learn, configure, and deploy compared to other major Interior Gateway Protocols (IGPs). This a major source of time saving for EIGRP customers.
- **Scalability:** EIGRP contains functionality that allows it be suitable and scalable for deployment in multiple scenarios including hub and spoke, broadcast domains, and meshed architectures.
- **Sub-Second Convergence:** Backup routes are pre-computed and instantaneously used in case of failure.
- **High Availability:** Provides comprehensive support for High Availability improves the reliability of network and minimizes downtime.
- **Investment Protection:** Since EIGRP is widely available across Cisco platforms suitable for both Enterprises and Service Providers, it provides a significant degree of capital

investment protection for customers needing different routers to meet their networking needs.

As a result of these benefits, over 52% of Cisco Enterprise networks in a wide range of industries, such as Financial Services, Energy and Utilities, Manufacturing, Health Care, Public Sector/ Government/ Defense, Retail, Transportation, and Hospitality, use EIGRP as their interior routing protocol in their IPv4 implementations. For these customers, migration to IPv6 requires a clear path and strategy to preserve the benefits from their existing EIGRP for IPv4.

To solve the issue of integrating IPv6 into EIGRP based IPv4 networks, Cisco is offering support for EIGRP for IPv6. This functionality will allow an EIGRP IPv4 customer (as shown in Figure 12) to integrate EIGRP for IPv6 support into their network infrastructure (as shown in Figure 13). The old IPv4 network was only capable of handling IPv4 users with IPv4 address prefixes. The new network can handle both IPv4 users as well as IPv6 users with IPv6 prefixes. This is possible since the single EIGRP IPv4 routing table in the old network has been supplemented with an EIGRP IPv6 routing table in the new network. In this manner, the IPv4 and IPv6 networks operate in a dual stack or `ships in the night' mode. The new network offers users a seamless integration of their IPv4 and IPv6 networks, while allowing them to retain all the benefits of using EIGRP.

Figure 11. Routing Domain Based Upon EIGRP for IPv4

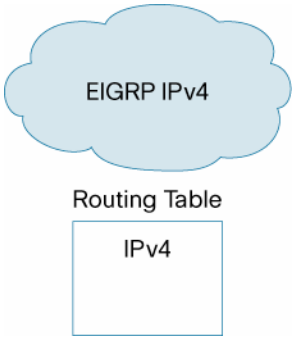
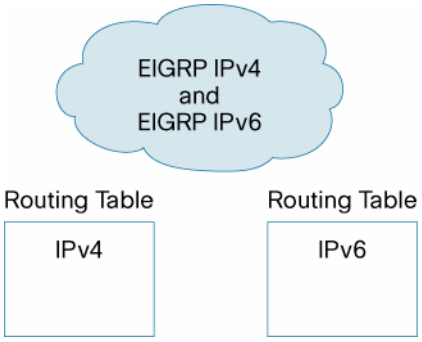


Figure 12. Routing Domain Integrating EIGRP Based IPv4 and IPv6



Benefits

- Extends key EIGRP benefits, including ease of use, fast convergence times, minimal routing traffic overhead, and scalability, to IPv6 environments.
- Fast, seamless IPv6 Integration: Allows existing EIGRP IPv4 customers to integrate IPv6 based upon EIGRP into their network. This is important for applications in Enterprises, public sector (government/defense), and wireless networks.

- Delivery of IPv6 Services: Enables the creation of next-generation IPv6 infrastructure to deliver services such as Mobile Wireless or Mobile Networks.

Product Management Contact

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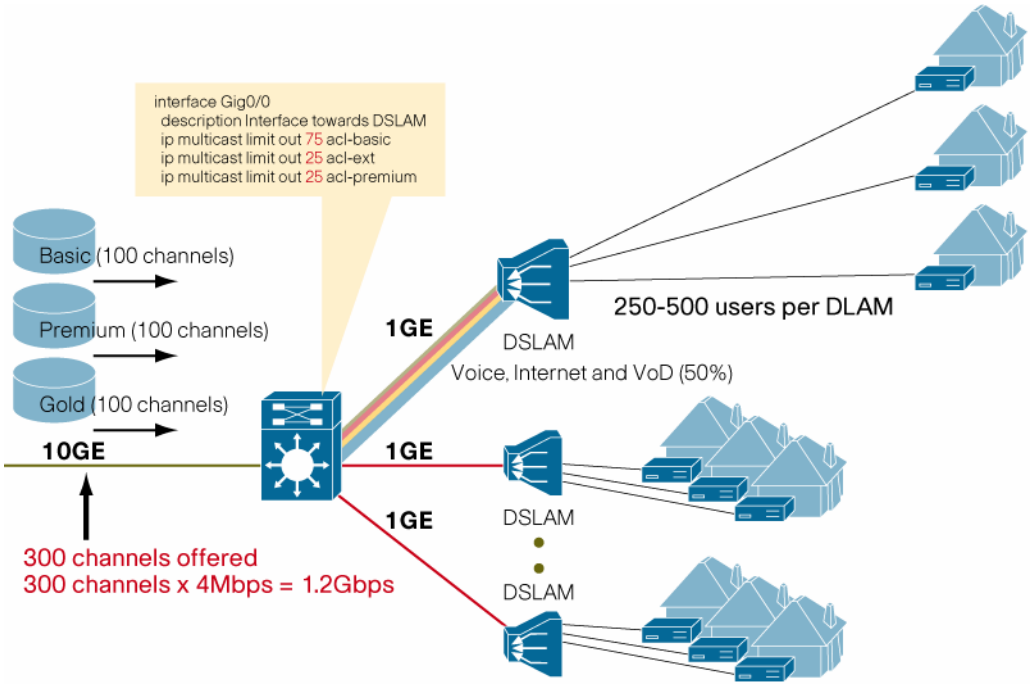
Per Interface Multicast Route (Mroute) State Limit

The Per Interface Mroute State Limit feature provides the capability to limit the amount of multicast route (Mroute) states on an interface for different Access Control List (ACL)-classified sets of multicast traffic. This feature can be used to prevent Denial-of-Service (DoS) attacks, or to provide a multicast Call Admission Control (CAC) mechanism in network environments where all the multicast flows roughly utilize the same amount of bandwidth. It allows specification of limits according to the direction of traffic; it allows specification of limits for outgoing interfaces, incoming interfaces, and for incoming interfaces having directly connected multicast sources.

Figure 13. Example Use of Per Interface Mroute State Limit for Admission Control



Benefits

- Extends the benefits of Ethernet as a last-mile technology
- Offers more granular DoS attack prevention
- Provides a multicast Call Admission Control (CAC) mechanism

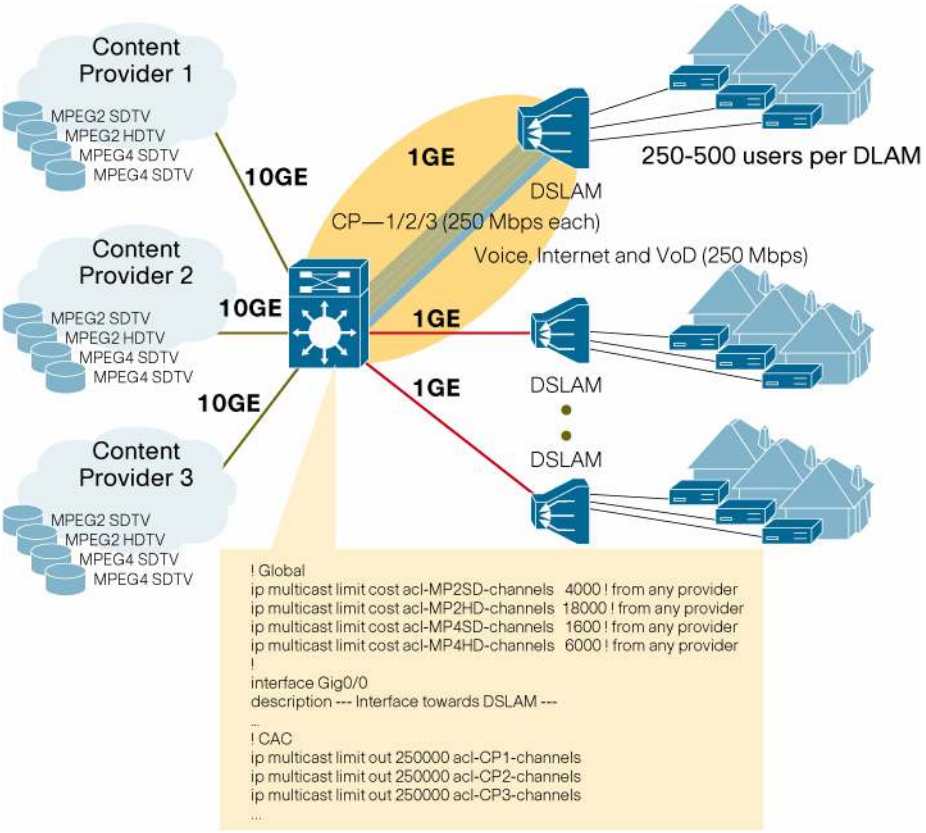
Product Management Contact

- Ritesh Mukherjee, (ritmukhe@cisco.com)

Bandwidth based Call Admission Control (CAC) for IP Multicast

The bandwidth based Call Admission Control (CAC) for IP Multicast feature enhances the Per Interface Mroute State Limit feature by implementing a way to count per interface Mroute state limiters, using cost multipliers. This feature can be used to provide bandwidth-based CAC on a per interface basis in network environments where the multicast flows utilize different amounts of bandwidth.

Figure 14. Example Use of Per Interface Mroute State Limit for Admission Control



Benefits

- Provides a bandwidth based multicast Call Admission Control (CAC) mechanism
- Operates when multicast flows utilize different amounts of bandwidth

Product Management Contact

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Multicast Address Group Range Support

The Multicast Address Group Range Support feature disables IPv4 multicast protocol actions and traffic forwarding for unauthorized groups or channels on all the interfaces in a router for a range of groups. The functionality provides access-control in multicast with ability to disable PIM, IGMP and MSDP control plane actions and traffic forwarding for selected multicast groups.

Benefits

- Provides ability to disable PIM, IGMP and MSDP control plane actions
- No IGMP (cache), PIM, MRIB/MFIB state created for denied groups
- Drops all data packets for denied groups

Product Management Contact

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IPv6: Multicast Address Group Range Support

The Multicast Address Group Range Support feature disables IPv6 multicast protocol actions and traffic forwarding for unauthorized groups or channels on all the interfaces in a router for a range of groups. The functionality provides access-control in multicast with ability to disable Protocol

Independent Multicast for IPv6 (PIMv6), Multicast Listener Discovery (MLD), and Multicast Source Discovery Protocol (MSDP) control plane actions and traffic forwarding for selected multicast groups.

Benefits

- Provides ability to disable PIMv6, MLD and MSDP control plane actions
- No MLD (cache), PIMv6, Multicast Routing Information Base (MRIB)/Multicast Forwarding Information Base (MFIB) state created for denied groups
- Drops all data packets for denied groups

Product Management Contact

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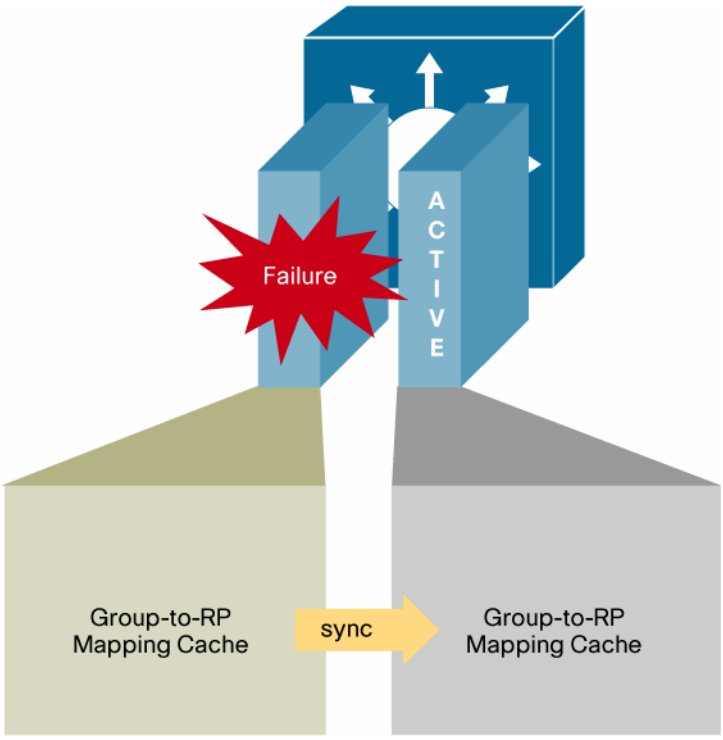
IPv4 Multicast High Availability (HA) Support for Group to Rendezvous Points (RP) Mappings

The IPv4 Multicast HA support for group to RP mappings feature enhances multicast HA functionality by providing SSO capabilities for dynamically learned RPs. This functionality provides standby route processor synching of RP/group mapping information, and bidirectional PIM RP information.

Figure 15. Syncing of group-to-RP mapping cache



Benefits

- Reduces multicast data stream interruption times following a switchover to levels that will be transparent to most applications

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4. Release 12.2SX Additional Information

Cisco IOS Software Information

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

Release 12.2SX Information

- http://www.cisco.com/en/US/products/ps6017/tsd_products_support_series_home.html
- http://www/en/US/products/hw/switches/ps708/prod_bulletin0900aecd804f0694.html

Cisco IOS Software Product Lifecycle Dates and Milestones

- http://www.cisco.com/en/US/prod/collateral/iosswrel/ps8802/ps6969/ps1835/prod_bulletin0900aecd801eda8a_ps6441_Products_Bulletin.html

Cisco IOS Software Center

- Download Cisco IOS Software releases and access software upgrade planners. http://www.cisco.com/public/sw-center/

Cisco Software Advisor (Requires Cisco.com Account)

- Determine the minimum supported software for platforms. http://tools.cisco.com/Support/Fusion/FusionHome.do

Cisco Feature Navigator (Requires Cisco.com Account)

- A Web-based application that allows you to quickly match Cisco IOS Software releases, features, and hardware. http://tools.cisco.com/ITDIT/CFN/jsp/index.jsp

Cisco IOS Planner (Requires Cisco.com Account)

- View all major releases, all platforms, and all software features from a single interface. http://www.cisco.com/pcgi-bin/Software/Iosplanner/Planner-tool/iosplanner.cgi

Cisco MIB Locator

- MIB Locator finds MIBs in Cisco IOS Software releases. http://tools.cisco.com/ITDIT/MIBS/servlet/index

Cisco Bug Toolkit (Requires Cisco.com Account)

- Search for known bugs based on software version, feature set and keywords. http://www.cisco.com/pcgi-bin/Support/Bugtool/launch_bugtool.pl

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