CHAPTER 1

Product Overview

This chapter provides an overview of Catalyst 4500 series switches and includes the following major sections:

Note For complete syntax and usage information for the switch commands used in this chapter, look at the *Cisco Catalyst 4500 Series Switch Command Reference* and related publications at this location:

http://www.cisco.com/en/US/products/hw/switches/ps4324/index.html

If the command is not found in the Catalyst 4500 Command Reference, it will be found in the larger Cisco IOS library. Refer to the *Catalyst 4500 Series Switch Cisco IOS Command Reference* and related publications at this location:

http://www.cisco.com/en/US/products/ps6350/index.html

Layer 2 Software Features

The following subsections describe the key Layer 2 switching software features on the Catalyst 4500 series switch:

Cisco Discovery Protocol

The Cisco Discovery Protocol (CDP) is a device-discovery protocol that is both media- and protocol-independent. CDP is available on all Cisco products, including routers, switches, bridges, and access servers. Using CDP, a device can advertise its existence to other devices and receive information about other devices on the same LAN. CDP enables Cisco switches and routers to exchange information, such as their MAC addresses, IP addresses, and outgoing interfaces. CDP runs over the data-link layer only, allowing two systems that support different network-layer protocols to learn about each other. Each device configured for CDP sends periodic messages to a multicast address. Each device advertises at least one address at which it can receive Simple Network Management Protocol (SNMP) messages.

For information on configuring CDP, see Chapter 20, “Configuring CDP.”

Cisco Group Management Protocol (CGMP) server

CGMP server manages multicast traffic. Multicast traffic is forwarded only to ports with attached hosts that request the multicast traffic.

EtherChannel Bundles

EtherChannel port bundles allow you to create high-bandwidth connections between two switches by grouping multiple ports into a single logical transmission path.

For information on configuring EtherChannel, see Chapter 19, “Configuring EtherChannel.”

Flexible NetFlow

Flow is defined as unique set of key fields attributes, which might include fields of packet, packet routing attributes, and input and output interface information. A NetFlow feature defines a flow as a sequence of packets that have the same values for the feature key fields. Flexible Netflow (FNF) allows a flow record that specifies various flow attributes to be collected and optionally exported. Netflow collection supports IP, IPv6 and Layer 2 traffic.

For information on configuring Flexible NetFlow, see Chapter 33, “Configuring Flexible NetFlow.”

Internet Group Management Protocol (IGMP) Snooping

IGMP snooping manages multicast traffic. The switch software examines IP multicast packets and forwards packets based on their content. Multicast traffic is forwarded only to ports with attached hosts that request multicast traffic.

Support for IGMPv3 provides constrained flooding of multicast traffic in the presence of IGMPv3 hosts or routers. IGMPv3 snooping listens to IGMPv3 query and membership report messages to maintain host-to-multicast group associations. It enables a switch to propagate multicast data only to ports that need it. IGMPv3 snooping is fully interoperable with IGMPv1 and IGMPv2.

Explicit Host Tracking (EHT) is an extension to IGMPv3 snooping. EHT enables immediate leave operations on a per-port basis. EHT can be used to track per host membership information or to gather statistics about all IGMPv3 group members.

The IGMP Snooping Querier is a Layer 2 feature required to support IGMP snooping in a VLAN where PIM and IGMP are not configured because the multicast traffic does not require routing.

With SSO support, Stateful IGMP Snooping propagates the IGMP data learned by the active supervisor engine to the redundant supervisor engine so that when a switchover occurs, the newly active supervisor engine is aware of the multicast group membership, which alleviates a disruption to multicast traffic during a switchover.

For information on configuring IGMP snooping, see Chapter 21, “Configuring IGMP Snooping and Filtering.”

IPv6 Multicast Listen Discovery (MLD) and Multicast Listen Discovery snooping

MLD is a protocol used by IPv6 multicast devices to discover the presence of multicast listeners (nodes that want to receive IPv6 multicast packets) on its directly attached links and to discover which multicast packets are of interest to neighboring nodes. MLD snooping is supported in two different versions: MLD v1 and MLD v2. Network switches use MLD snooping to limit the flood of multicast traffic, causing IPv6 multicast data to be selectively forwarded to a list of ports that want to receive the data, instead of being flooded to all ports in a VLAN. This lessens the load on devices in the network, minimizing unnecessary bandwidth on links, enabling efficient distribution of IPv6 multicast data.

For information on configuring multicast services, see Chapter 22, “Configuring IPv6 MLD Snooping.”

Jumbo Frames

The jumbo frames feature allows the switch to forward packets as large as 9216 bytes (larger than the IEEE Ethernet MTU), rather than declare those frames “oversize” and discard them. This feature is typically used for large data transfers. The jumbo frames feature can be configured on a per-port basis on Layer 2 and Layer 3 interfaces.

The feature is supported only on the following hardware:

- WS-X4306-GB: All ports
- WS-X4232-GB-RJ: Ports 1-2
- WS-X4418-GB: Ports 1-2
- WS-X4412-2GB-TX: Ports 13-14

- WS-4648-RJ45V-E
- WS-X4648+RJ45V+E
- WS-X4706-10GE linecards
- supervisor engine uplink ports

For information on Jumbo Frames, see Chapter 7, "Configuring Interfaces."

Link Aggregation Control Protocol

LACP supports the automatic creation of EtherChannels by exchanging LACP packets between LAN ports. LACP packets are exchanged only between ports in passive and active modes. The protocol "learns" the capabilities of LAN port groups dynamically and informs the other LAN ports. After LACP identifies correctly matched Ethernet links, it facilitates grouping the links into an EtherChannel. Then the EtherChannel is added to the spanning tree as a single bridge port.

Cisco IOS XE IP Application Services Features in Cisco IOS XE 3.1.0SG

This section lists the IP Application Services software features that are supported in Cisco IOS XE 3.1.0SG. Links to the feature documentation are included.

Feature guides may contain information about more than one feature. To find information about a specific feature within a feature guide, see the Feature Information table at the end of the guide.

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IEEE 802.3ad Link Aggregation (LACP)

http://www.cisco.com/en/US/docs/ios/cether/configuration/guide/ce_lnkbndl.html

Link Aggregation Control Protocol (LACP) (802.3ad) for Gigabit Interfaces

http://www.cisco.com/en/US/docs/ios/ios_xe/cether/configuration/guide/ce_lnkbndl_xe.html

Link Layer Discovery Protocol

To support non-Cisco devices and to allow for interoperability between other devices, the switch supports the IEEE 802.1AB LLDP. Link Layer Discovery Protocol (LLDP) is a neighbor discovery protocol that is used for network devices to advertise information about themselves to other devices on the network. This protocol runs over the data-link layer, which allows two systems running different network layer protocols to learn about each other.

LLDP supports a set of attributes that it uses to discover neighbor devices. These attributes contain type, length, and value descriptions and are referred to as *TLVs*. LLDP supported devices can use TLVs to receive and send information to their neighbors. Details such as configuration information, device capabilities, and device identity can be advertised using this protocol.

For information on configuring LLDP, see Chapter 23, "Configuring LLDP, and LLDP-MED."

Multiple Spanning Tree

IEEE 802.1s Multiple Spanning Tree (MST) allows for multiple spanning tree instances within a single 802.1Q or Inter-Switch Link (ISL) VLAN trunk. MST extends the IEEE 802.1w Rapid Spanning Tree (RST) algorithm to multiple spanning trees. This extension provides both rapid convergence and load balancing within a VLAN environment.

MST allows you to build multiple spanning trees over trunks. You can group and associate VLANs to spanning tree instances. Each instance can have a topology independent of other spanning tree instances. This new architecture provides multiple forwarding paths for data traffic and enables load balancing. Network fault tolerance is improved because a failure in one instance (forwarding path) does not affect other instances (forwarding paths).

For information on configuring MST, see Chapter 17, "Configuring STP and MST."

Per-VLAN Rapid Spanning Tree

Per-VLAN Rapid Spanning Tree (PVRST+) is the implementation of 802.1w on a per-VLAN basis. It is the same as PVST+ with respect to STP mode and runs RSTP protocol based on 802.1w.

For information on configuring PVRST+, see Chapter 17, "Configuring STP and MST."

Quality of Service

The quality of service (QoS) feature prevents congestion by selecting network traffic and prioritizing it according to its relative importance. Implementing QoS in your network makes network performance more predictable and bandwidth use more effective.

The Catalyst 4500 series switch supports the following QoS features:

- Classification and marking
- Ingress and egress policing, including per-port per-VLAN policing
- Sharing and shaping

Catalyst 4500 series switch supports trusted boundary, which uses the Cisco Discovery Protocol (CDP) to detect the presence of a Cisco IP phone (such as the Cisco IP Phone 7910, 7935, 7940, and 7960) on a switch port. If the telephone is not detected, the trusted boundary feature disables the trusted setting on the switch port and prevents misuse of a high-priority queue.

The Catalyst 4500 series switch also supports QoS Automation (Auto QoS), which simplifies the deployment of existing QoS features through automatic configuration.

Cisco Modular QoS command-line-interface

Cisco Modular QoS CLI (MQC) is the framework that implements Cisco IOS software QoS. MQC allows the user to define a traffic class, create a traffic policy (containing the QoS feature to be applied to the traffic class), and attach the traffic policy to an interface. MQC is a cross-Cisco baseline that provides a consistent syntax and behavior of QoS features across multiple product families. MQC enables rapid deployment of new features and technology innovations and facilitates the management of network performance with respect to bandwidth, delay, jitter, and packet loss, enhancing the performance of mission-critical business applications. The rich and advanced QoS features that are supported as part of Supervisor Engine 7-E are enabled using Cisco MQC.

The Two-Rate Three-Color Policing feature (also termed *Hierarchical QoS*) limits the input or output transmission rate of a class of traffic based on user-defined criteria and marks or colors packets by setting the applicable differentiated services code point (DSCP) values. This feature is often configured on the interfaces at the edge of a network to limit the rate of traffic entering or leaving the network. Using this feature, traffic that conforms to user-defined criteria can be sent through the interfaces, while traffic that exceeds or violates these criteria is sent out with a decreased priority setting or even dropped.

For information on QoS and Auto QoS, see Chapter 33, "Configuring Quality of Service."

Spanning Tree Protocol

The Spanning Tree Protocol (STP) allows you to create fault-tolerant internetworks that ensure an active, loop-free data path between all nodes in the network. STP uses an algorithm to calculate the best loop-free path throughout a switched network.

For information on configuring STP, see Chapter 17, "Configuring STP and MST."

The Catalyst 4500 series switch supports the following STP enhancements:

- Spanning tree PortFast—PortFast allows a port with a directly attached host to transition to the forwarding state directly, bypassing the listening and learning states.
- Spanning tree UplinkFast—UplinkFast provides fast convergence after a spanning-tree topology change and achieves load balancing between redundant links using uplink groups. Uplink groups provide an alternate path in case the currently forwarding link fails. UplinkFast is designed to decrease spanning-tree convergence time for switches that experience a direct link failure.
- Spanning tree BackboneFast—BackboneFast reduces the time needed for the spanning tree to converge after a topology change caused by an indirect link failure. BackboneFast decreases spanning-tree convergence time for any switch that experiences an indirect link failure.
- Spanning tree root guard—Root guard forces a port to become a designated port so that no switch on the other end of the link can become a root switch.

For information on the STP enhancements, see Chapter 18, "Configuring Optional STP Features."

Stateful Switchover

Stateful switchover (SSO) enables you to propagate configuration and state information from the active to the redundant supervisor engine so that sub-second interruptions in Layer 2 traffic occur when the active supervisor engine switches over to the redundant supervisor engine.

For information about SSO, see Chapter 9, "Configuring Cisco NSF with SSO Supervisor Engine Redundancy."

SVI Autostate

When an SVI has multiple ports on a VLAN, normally the SVI will go down when all the ports in the VLAN go down. You can design your network so that some ports are not counted in the calculation of SVI "going up or down." SVI Autostate provides a knob to mark a port so that it is not counted in the SVI "going up and down" calculation and applies to all VLANs that are enabled on that port.

UniDirectional Link Detection

The UniDirectional Link Detection (UDLD) protocol allows devices connected through fiber-optic or copper Ethernet cables to monitor the physical configuration of the cables and detect a unidirectional link.

For information about UDLD, see Chapter 24, "Configuring UDLD."

VLANs

A VLAN configures switches and routers according to logical, rather than physical, topologies. Using VLANs, you can combine any collection of LAN segments within an internetwork into an autonomous user group, such that the segments appear as a single LAN in the network. VLANs logically segment the network into different broadcast domains so that packets are switched only between ports within the VLAN. Typically, a VLAN corresponds to a particular subnet, although not necessarily.

For more information about VLANs, VTP, and Dynamic VLAN Membership, see Chapter 13, "Configuring VLANs, VTP, and VMPS."

The following VLAN-related features also are supported:

- VLAN Trunking Protocol (VTP)—VTP maintains VLAN naming consistency and connectivity between all devices in the VTP management domain. You can have redundancy in a domain by using multiple VTP servers, through which you can maintain and modify the global VLAN information. Only a few VTP servers are required in a large network.
- Private VLANs—Private VLANs are sets of ports that have the features of normal VLANs and also provide some Layer 2 isolation from other ports on the switch.

  For information about private VLANs, see Chapter 35, "Configuring Private VLANs."
- Private VLAN Trunk Ports—Private VLAN trunk ports allow a secondary port on a private VLAN to carry multiple secondary VLANs.
- Private VLAN Promiscuous Trunk Ports—Private VLAN promiscuous trunk extends the promiscuous port to a 802.1Q trunk port, carrying multiple primary VLANs (hence multiple subnets). Private VLAN promiscuous trunk is typically used to offer different services or content on different primary VLANs to isolated subscribers. Secondary VLANs can not be carried over the private VLAN promiscuous trunk.
- Dynamic VLAN Membership—Dynamic VLAN Membership allows you to assign switch ports to VLANs dynamically, based on the source Media Access Control (MAC) address of the device connected to the port. When you move a host from a port on one switch in the network to a port on another switch in the network, that switch dynamically assigns the new port to the proper VLAN for that host. With the VMPS Client feature, you can convert a dynamic access port to a VMPS client. VMPS clients can use VQP queries to communicate with the VMPS server to obtain a VLAN assignment for the port based on the MAC address of the host attached to that port.

Virtual Switch System Client

Catalyst 4500 series switches support enhanced PAgP. If a Catalyst 4500 series switch is connected to a Catalyst 6500 series Virtual Switch System (VSS) via a PAgP EtherChannel, the Catalyst 4500 series switch will automatically serve as a VSS client, using enhanced PAgP on this EtherChannel for dual-active detection. This VSS client feature has no impact on the performance of Catalyst 4500 series switches and does not require any user configuration.

For information on VSS, see Chapter 19, "Configuring EtherChannel."

Layer 3 Software Features

A Layer 3 switch is a high-performance switch that has been optimized for a campus LAN or an intranet, and it provides both wirespeed Ethernet routing and switching services. Layer 3 switching improves network performance with two software functions: route processing and intelligent network services.

Compared to conventional software-based switches, Layer 3 switches process more packets faster by using application-specific integrated circuit (ASIC) hardware instead of microprocessor-based engines.

The following sections describe the key Layer 3 switching software features on the Catalyst 4500 series switch:

Cisco Express Forwarding

Cisco Express Forwarding (CEF) is an advanced Layer 3 IP-switching technology. CEF optimizes network performance and scalability in networks with large and dynamic traffic patterns, such as the Internet, and on networks that use intensive web-based applications or interactive sessions. Although you can use CEF in any part of a network, it is designed for high-performance, highly resilient Layer 3 IP-backbone switching.

For information on configuring CEF, see Chapter 28, "Configuring Cisco Express Forwarding."

Enhanced Object Tracking

Before the introduction of the Enhanced Object Tracking feature, the Hot Standby Router Protocol (HSRP) had a simple tracking mechanism that allowed you to track the interface line-protocol state only. If the line-protocol state of the interface went down, the HSRP priority of the router was reduced, allowing another HSRP router with a higher priority to become active.

The Enhanced Object Tracking (EOT) feature separates the tracking mechanism from HSRP and creates a separate standalone tracking process that can be used by other Cisco IOS processes as well as HSRP. This feature allows tracking of other objects in addition to the interface line-protocol state.

A client process, such as HSRP, Virtual Router Redundancy Protocol (VRRP), or Gateway Load Balancing Protocol (GLBP), can now register its interest in tracking objects and then be notified when the tracked object changes state.

For details on EOT, refer to this URL:

http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_eot.html

GLBP

The Gateway Load Balancing Protocol (GLBP) feature provides automatic router backup for IP hosts configured with a single default gateway on a LAN. Multiple first hop routers on the LAN combine to offer a single virtual first hop IP router while sharing the IP packet forwarding load. GLBP devices share packet-forwarding responsibilities, optimizing resource usage, thereby reducing costs. Other routers on the LAN may act as redundant GLBP routers that will become active if any of the existing forwarding routers fail. This improves the resiliency of the network and reduces administrative burden.

For details on GLBP, refer to this URL:

http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_glbp_ps6350_TSD_Products_Configuration_Guide_Chapter.html

Cisco IOS XE IP Application Services Features in Cisco IOS XE 3.1.0SG

This section list the IP Application Services software features that are supported in Cisco IOS XE 3.1.0SG. Links to the feature documentation are included.

Feature guides may contain information about more than one feature. To find information about a specific feature within a feature guide, see the Feature Information table at the end of the guide.

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Gateway Load Balancing Protocol (GLBP), GLBP MD5 Authentication

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

HSRP

The Hot Standby Router Protocol (HSRP) provides high network availability by routing IP traffic from hosts on Ethernet networks without relying on the availability of any single Layer 3 switch. This feature is particularly useful for hosts that do not support a router discovery protocol and do not have the functionality to switch to a new router when their selected router reloads or loses power.

For information on configuring HSRP, refer to the following URL:
http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_hsrp_ps6350_TSD_Products_Configuration_Guide_Chapter.html

Cisco IOS XE IP Application Services: HSRP Features in Cisco IOS XE 3.1.0SG

This section lists the IP Application Services:HSRP software features that are supported in Cisco IOS XE 3.1.0SG. Links to the feature documentation are included.

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HSRP—Hot Standby Router Protocol

http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_hsrp.html

HSRP MD5 Authentication

http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_hsrp.html

HSRP Support for ICMP Redirects

http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_hsrp.html

IP Precedence Accounting

http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_ipserv.html

ISSU—HSRP

http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_hsrp.html

SSO—HSRP

http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_hsrp.html

SSO Aware HSRP

SSO Aware HSRP offers continuous data packet forwarding during a supervisor engine switchover without a path change to the standby HSRP router. During supervisor engine switchover, NSF with SSO continues forwarding data packets along known routes using the HSRP virtual IP address. When both supervisor engines fail on the active HSRP router, the standby HSRP router takes over as the active HSRP router. SSO Aware HSRP extends the reliability and availability offered by NSF with SSO to Layer 3 aggregation with redundant chassis.

In Service Software Upgrade

SSO requires the same version of IOS on both the active and standby supervisor engines. Because of version mismatch during an upgrade or downgrade of the Cisco IOS software, a Catalyst 4500 series switch is forced into operating in RPR mode. In this mode, after the switchover, you can observe link-flaps and a disruption in service. This issue is solved by the In Service Software Upgrade (ISSU) feature that enables you to operate in SSO/NSF mode while performing software upgrade or downgrade.

In Service Softare Upgrade (ISSU) allows an upgrade or downgrade of the Catalyst IOS XE images at different release levels on both the active and standby supervisor engines by utilizing the Version Transformation Framework between the stateful components running on each supervisor engine.

For details, refer to Chapter 6, "Configuring the Cisco IOS XE In Service Software Upgrade Process."

IP Routing Protocols

The following routing protocols are supported on the Catalyst 4500 series switch:

BGP

The Border Gateway Protocol (BGP) is an exterior gateway protocol that allows you to set up an interdomain routing system to automatically guarantee the loop-free exchange of routing information between autonomous systems. In BGP, each route consists of a network number, a list of autonomous systems that information has passed through (called the autonomous system path), and a list of other path attributes.

The Catalyst 4500 series switch supports BGP version 4, including classless interdomain routing (CIDR). CIDR lets you reduce the size of your routing tables by creating aggregate routes, resulting in supernets. CIDR eliminates the concept of network classes within BGP and supports the advertising of IP prefixes. CIDR routes can be carried by OSPF, EIGRP, and RIP.

BGP Route-Map Continue

The BGP Route-Map Continue feature introduces the continue clause to the BGP route-map configuration. The continue clause provides more programmable policy configuration and route filtering. It introduces the capability to execute additional entries in a route map after an entry is executed with successful match and set clauses. Continue clauses allow configuring and organizing more modular policy definitions to reduce the number of policy configurations that are repeated within the same route map.

For details on BGP, refer to this URL:

http://www.cisco.com/en/US/docs/ios/12_4t/ip_route/configuration/guide/t_brbbas.html

EIGRP

The Enhanced Interior Gateway Routing Protocol (EIGRP) is a version of IGRP that combines the advantages of link-state protocols with distance-vector protocols. EIGRP incorporates the Diffusing Update Algorithm (DUAL). EIGRP includes fast convergence, variable-length subnet masks, partially bounded updates, and multiple network-layer support. When a network topology change occurs, EIGRP checks its topology table for a suitable new route to the destination. If such a route exists in the table, EIGRP updates the routing table instantly. You can use the fast convergence and partial updates that EIGRP provides to route Internetwork Packet Exchange (IPX) packets.

EIGRP saves bandwidth by sending routing updates only when routing information changes. The updates contain information only about the link that changed, not the entire routing table. EIGRP also takes into consideration the available bandwidth when determining the rate at which it transmits updates.

Note Layer 3 switching does not support the Next Hop Resolution Protocol (NHRP).

Note Customers can configure Enhanced Interior Gateway Routing Protocol (EIGRP) to route IPv6 prefixes. EIGRP configuration and protocol behavior for both IPv4 and IPv6 prefixes are similar, providing operational familiarity and continuity. EIGRP support for IPv6 will enable customers to use their existing EIGRP knowledge and processes, allowing them to deploy an IPv6 network at a low cost.

For details on EIGRP, refer to this URL:

http://www.cisco.com/en/US/products/ps6630/products_ios_protocol_option_home.html

Cisco IOS XE IP Routing: EIGRP Features in Cisco IOS XE 3.1.0SG

This section lists the IP Routing: EIGRP software features that are supported in Cisco IOS XE 3.1.0SG. Links to the feature documentation are included.

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Enhanced IGRP (EIGRP)

http://www.cisco.com/en/US/docs/ios/iproute_eigrp/configuration/guide/ire_cfg_eigrp.html

EIGRP Stub Routing

http://www.cisco.com/en/US/docs/ios/iproute_eigrp/configuration/guide/ire_cfg_eigrp.html

EIGRP Support for Route Map Filtering

http://www.cisco.com/en/US/docs/ios/iproute_eigrp/configuration/guide/ire_sup_route.html

IP Enhanced IGRP Route Authentication

http://www.cisco.com/en/US/docs/ios/iproute_eigrp/configuration/guide/ire_cfg_eigrp.html

NSF Awareness - EIGRP

http://www.cisco.com/en/US/docs/ios/iproute_eigrp/configuration/guide/ire_nsf.html

OSPF

The Open Shortest Path First (OSPF) protocol is a standards-based IP routing protocol designed to overcome the limitations of RIP. Because OSPF is a link-state routing protocol, it sends link-state advertisements (LSAs) to all other routers within the same hierarchical area. Information on the attached

interfaces and their metrics is used in OSPF LSAs. As routers accumulate link-state information, they use the shortest path first (SPF) algorithm to calculate the shortest path to each node. Additional OSPF features include equal-cost multipath routing and routing based on the upper-layer type of service (ToS) requests.

OSPF employs the concept of an *area*, which is a group of contiguous OSPF networks and hosts. OSPF areas are logical subdivisions of OSPF autonomous systems in which the internal topology is hidden from routers outside the area. Areas allow an additional level of hierarchy different from that provided by IP network classes, and they can be used to aggregate routing information and mask the details of a network. These features make OSPF particularly scalable for large networks.

For details on OSPF, refer to this URL:

http://www.cisco.com/en/US/tech/tk365/tk480/tsd_technology_support_sub-protocol_home.html

Cisco IOS XE IP Routing: OSPF Features in Cisco IOS XE 3.1.0SG

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This is the URL for the IP Routing: OSPF Feature List for Release Cisco IOS XE 3.1.0SG:

http://www.cisco.com/en/US/docs/ios/12_2/ip/configuration/guide/1cfindep.html

RIP

The Routing Information Protocol (RIP) is a distance-vector, intradomain routing protocol. RIP works well in small, homogeneous networks. In large, complex internetworks it has many limitations, such as a maximum hop count of 15, lack of support for variable-length subnet masks (VLSMs), inefficient use of bandwidth, and slow convergence. RIP II does support VLSMs.

For details on RIP, refer to this URL:

http://www.cisco.com/en/US/tech/tk365/tk554/tsd_technology_support_sub-protocol_home.html

IPv6

IPv6 provides services such as end-to-end security, quality of service (QoS), and globally unique addresses. The IPv6 address space reduces the need for private addresses and Network Address Translation (NAT) processing by border routers at network edges.

For more information about IPv6 services supported on the Catalyst 4500 series switch, see Chapter 43, “Support for IPv6.”

Multicast Services

Multicast services save bandwidth by forcing the network to replicate packets only when necessary and by allowing hosts to join and leave groups dynamically. The Catalyst 4500 series switch supports Protocol Independent Multicast (PIM), which is a protocol-independent because it can leverage whichever unicast routing protocol is used to populate the unicast routing table, including EIGRP, OSPF, BGP, or static route. PIM also uses a unicast routing table to perform the Reverse Path Forwarding (RPF) check function instead of building a completely independent multicast routing table.

For information on configuring multicast services, see Chapter 29, "Configuring IP Multicast."

For information on PIM-SSM mapping, see the URL:

http://www.cisco.com/en/US/docs/switches/lan/catalyst6500/ios/15.1SY/config_guide/sup720/ude_udlr.html

NSF with SSO

Non-Stop Forwarding with Stateful Switchover (NSF/SSO) offers continuous data packet forwarding in a Layer 3 routing environment during supervisor engine switchover. NSF extends the reliability and availability offered by the SSO feature to Layer 3 networks. During supervisor engine switchover, NSF/SSO continues forwarding data packets along known routes while the routing protocol information is recovered and validated, avoiding unnecessary route flaps and network instability. With NSF/SSO, IP phone calls do not drop. NSF/SSO is supported for OSPF, BGP, EIGRP, and Cisco Express Forwarding (CEF). NSF/SSO is typically deployed in the most critical parts of an enterprise or service provider network, such as Layer 3 aggregation/core or a resilient Layer 3 wiring closet design. It is an essential component of single chassis deployment for critical applications. NSF/SSO is available for all shipping supervisor engines on redundant chassis.

For information on NSF with SSO, see Chapter 9, "Configuring Cisco NSF with SSO Supervisor Engine Redundancy."

Policy-Based Routing

Traditional IP forwarding decisions are based purely on the destination IP address of the packet being forwarded. Policy Based Routing (PBR) enables forwarding based upon other information associated with a packet, such as the source interface, IP source address, Layer 4 ports, and so on. This feature allows network managers more flexibility in how they configure and design their networks.

For more information on policy-based routing, see Chapter 30, "Configuring Policy-Based Routing."

Unidirectional Link Routing

Unidirectional link routing (UDLR) provides a way to forward multicast packets over a physical unidirectional interface (such as a satellite link of high bandwidth) to stub networks that have a back channel.

For information on configuring unidirectional link routing, refer to the chapter "Configuring Unidirectional Link Routing" in the *Cisco IP and IP Routing Configuration Guide*.

Unicast Reverse Path Forwarding

The Unicast Reverse Path Forwarding (Unicast RPF) feature helps to mitigate problems that are caused by the introduction of malformed or forged (spoofed) IP source addresses into a network by discarding IP packets that lack a verifiable IP source address.

For information on URPF, see Chapter 28, "Configuring Unicast Reverse Path Forwarding."

VRF-lite

VPN routing and forwarding (VRF-lite) is an extension of IP routing that provides multiple routing instances. Along with BGP, it enables the creation of a Layer 3 VPN service by keeping separate IP routing and forwarding tables for each VPN customer. VRF-lite uses input interfaces to distinguish routes for different VPNs. It forms virtual packet-forwarding tables by associating one or more Layer 3 interfaces with each VRF, allowing the creation of multiple Layer 3 VPNs on a single switch. Interfaces in a VRF could be either physical, such as an Ethernet port, or logical, such as a VLAN switch virtual interface (SVI). However, interfaces cannot belong to more than one VRF at any time.

For information on VRF-lite, see Chapter 31, "Configuring VRF-lite."

Virtual Router Redundancy Protocol

Virtual Router Redundancy Protocol (VRRP) is a standard based first-hop redundancy protocol. With VRRP, a group of routers function as one virtual router by sharing one virtual IP address and one virtual MAC address. The master router performs packet forwarding, while the backup routers stay idle. VRRP is typically used in the multivendor first-hop gateway redundancy deployment.

For details on VRRP, refer to this URL:

http://www.cisco.com/en/US/docs/ios/ipapp/configuration/guide/ipapp_vrrp_ps6441_TSD_Products_Configuration_Guide_Chapter.html

The folllowing link is to the VRRP features supported in Cisco IOS XE 3.1.0SG:

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

Management Features

The Catalyst 4500 series switch offers network management and control through the CLI or through alternative access methods, such as SNMP. The switch software supports these network management features:

Cisco Call Home

Call Home provides e-mail-based and web-based notification of critical system events. A versatile range of message formats are available for optimal compatibility with pager services, standard e-mail, or XML-based automated parsing applications. Common uses of this feature may include direct paging of a network support engineer, e-mail notification to a Network Operations Center, XML delivery to a support website, and utilization of Cisco Smart Call Home services for direct case generation with the Cisco Systems Technical Assistance Center (TAC).

The Call Home feature can deliver alert messages containing information on configuration, diagnostics, environmental conditions, inventory, and syslog events.

For more information on Call Home, see Chapter 54, “Configuring Call Home.”

Cisco Energy Wise

Cisco EnergyWise is an energy-management technology added onto Cisco switching solutions to help you measure, report, and reduce energy consumption across your entire infrastructure. With EnergyWise’s management interface, network management applications can communicate with endpoints and each other, using the network as the unifying fabric.

Refer to the following link for more details:

http://www.cisco.com/en/US/docs/switches/lan/energywise/phase2/ios/configuration/guide/ew_v2.html

Cisco Network Assistant

Cisco Network Assistant manages standalone devices, clusters of devices, or federations of devices from anywhere in your intranet. Using its graphical user interface, you can perform multiple configuration tasks without having to remember command-line interface commands. Embedded CiscoView is a device management application that can be embedded on the switch flash and provides dynamic status, monitoring, and configuration information for your switch.

For more information on Cisco Network Assistant, see Chapter 12, “Configuring the Catalyst 4500 Series Switch with Cisco Network Assistant.”

Cisco IOS IP Service Level Agreement

Cisco IOS IP Service Level Agreements (SLAs) allows Cisco customers to analyze IP service levels for IP applications and services by using active traffic monitoring—the generation of traffic in a continuous, reliable, and predictable manner—for measuring network performance. With Cisco IOS IP SLAs, service provider customers can measure and provide service level agreements, and enterprise customers can verify service levels, verify outsourced service level agreements, and understand network performance. Cisco IOS IP SLAs can perform network assessments, verify quality of service (QoS), ease the deployment of new services, and assist with network troubleshooting.

For more information on IP SLA, see Chapter 47, "Configuring Cisco IOS IP SLAs Operations."

Dynamic Host Control Protocol

The Catalyst 4500 series switch uses DHCP in the following ways:

- Dynamic Host Control Protocol server—The Cisco IOS DHCP server feature is a full DHCP server implementation that assigns and manages IP addresses from specified address pools within the router to DHCP clients. If the Cisco IOS DHCP server cannot satisfy a DHCP request from its own database, it can forward the request to one or more secondary DHCP servers defined by the network administrator.
- Dynamic Host Control Protocol autoconfiguration—With this feature your switch (the DHCP client) is automatically configured at startup with IP address information and a configuration file.

  For DHCP server configuration information, refer to the chapter, "Configuring DHCP," in the *Cisco IOS IP and IP Routing Configuration Guide* at the following URL:
  http://www.cisco.com/en/US/docs/ios/ipaddr/configuration/guide/iad_dhcp_rdmp_ps6350_TSD_Products_Configuration_Guide_Chapter.html

Embedded CiscoView

A web-based toos to configure the Catalyst 4500 series switch. Embedded CiscoView is a device management application that can be embedded on the switch flash and provides dynamic status, monitoring, and configuration information for your switch.

For more information on Embedded CiscoView, see Chapter 4, "Administering the Switch."

Embedded Event Manager

Embedded Event Manager (EEM) is a distributed and customized approach to event detection and recovery offered directly in a Cisco IOS device. EEM offers the ability to monitor events and take informational, corrective, or any desired EEM action when the monitored events occur or when a threshold is reached. An EEM policy is an entity that defines an event and the actions to be taken when that event occurs.

For information on EEM, see the URL:

http://www.cisco.com/en/US/products/ps6815/products_ios_protocol_group_home.html

File System Management on Supervisor Engine 7-E

The format command for IOS XE 3.1.0 SG has changed slightly compared to the classic IOS format because the later does not support ext2 format.

For USB flash under IOS XE 3.1.0 SG, there are 3 optional formats, i.e. FAT16, FAT32 and EXT2:

```
Switch# format usb0: ?
   FAT16  FAT16 filesystem type
   FAT32  FAT32 filesystem type
   ext2   ext2 filesystem type
```

For SD card under IOS XE 3.1.0 SG, the default format is FAT16:

```
Switch# format slaveusb0: ?
    FAT16  FAT16 filesystem type
   FAT32  FAT32 filesystem type
   ext2   ext2 filesystem type
```

Forced 10/100 Autonegotiation

This feature allows you to configure a port to limit the speed at which it will autonegotiate to a speed lower than the physically maximum speed. This method of reducing the throughput incurs much less overhead than using an ACL.

Intelligent Power Management

Working with powered devices (PDs) from Cisco, this feature uses power negotiation to refine the power consumption of an 802.3af-compliant PD beyond the granularity of power consumption provided by the 802.3af class. Power negotiation also enables the backward compatibility of newer PDs with older modules that do not support either 802.3af or high-power levels as required by IEEE standard.

For more information on Intelligent Power Management, see the “Intelligent Power Management” section in Chapter 10, “Configuring Power over Ethernet.”

MAC Address Notification

MAC address notification monitors the MAC addresses that are learned by, aged out or removed from the Catalyst 4500 series switch. Notifications are sent out or retrieved via the CISCO-MAC-NOTIFICATION MIB. It is typically used by a central network management application to collect such MAC address notification events for host moves. User configurable MAC table utilization thresholds can be defined to notify any potential DoS or man-in-the-middle attack.

For information on MAC Address Notification, see Chapter 4, “Administering the Switch.”

MAC Notify MIB

The MAC Notify MIB feature monitors network performance, utilization, and security conditions enabling a network administrator to track the MAC addresses that are learned or removed on the switch forwarding the Ethernet frames.

Power over Ethernet

Power over Ethernet (PoE) allows the LAN switching infrastructure to provide power to an endpoint ("powered device") over a copper Ethernet cable. This capability, once referred to as "inline power," was originally developed by Cisco in 2000 to support emerging IP telephony deployments.

IP telephones need power for operation, and Power over Ethernet supports scalable, manageable power delivery and simplifies IP telephony deployments. As wireless networking emerged, Power over Ethernet began powering wireless devices in locations where local power access did not exist.

For more information on Power over Ethernet, see Chapter 10, "Configuring Power over Ethernet."

Secure Shell

Secure Shell (SSH) is a program that enables you to log into another computer over a network, to execute commands remotely, and to move files from one machine to another. The switch may not initiate SSH connections: SSH will be limited to providing a remote login session to the switch and will only function as a server.

Simple Network Management Protocol

Simple Network Management Protocol (SNMP) facilitates the exchange of management information between network devices. The Catalyst 4500 series switch supports these SNMP types and enhancements:

- SNMP—A full Internet standard
- SNMP v2—Community-based administrative framework for version 2 of SNMP
- SNMP v3—Security framework with three levels: noAuthNoPriv, authNoPriv, and authPriv (available only on a crypto image, like cat4000-i5k91s-mz)
- SNMP trap message enhancements—Additional information with certain SNMP trap messages, including spanning-tree topology change notifications and configuration change notifications

For more information on SNMP, see Chapter 51, "Configuring SNMP."

SPAN and RSPAN

Switched Port Analyzer (SPAN) allows you to monitor traffic on any port for analysis by a network analyzer or Remote Monitoring (RMON) probe. You also can do the following:

- Configure ACLs on SPAN sessions.
- Allow incoming traffic on SPAN destination ports to be switched normally.
- Explicitly configure the encapsulation type of packets that are spanned out of a destination port.
- Restrict ingress sniffing depending on whether the packet is unicast, multicast, or broadcast, and depending on whether the packet is valid.
- Mirror packets sent to or from the CPU out of a SPAN destination port for troubleshooting purposes.

For information on SPAN, see Chapter 49, "Configuring SPAN and RSPAN."

Remote SPAN (RSPAN) is an extension of SPAN, where source ports and destination ports are distributed across multiple switches, allowing remote monitoring of multiple switches across the network. The traffic for each RSPAN session is carried over a user-specified RSPAN VLAN that is dedicated for that RSPAN session on all participating switches.

For information on RSPAN, see Chapter 49, "Configuring SPAN and RSPAN."

Universal Power over Ethernet

The IEEE 802.3 Power over Ethernet (PoE) standard sets the maximum power that can be sourced by data terminal equipment (DTE) at 30W. This power is sourced over two pairs out of the four twisted pairs of conductors in a Class D, or better, cabling as specified in ISO/IEC 11801:1995.

Cisco® Universal Power over Ethernet (UPOE) is a Cisco proprietary technology that extends the IEEE 802.3 PoE standard to provide the capability to source up to 60W of power over standard Ethernet cabling infrastructure (Class D or better).

For more information on UPOE, see the "Configuring Universal PoE" section in Chapter 10, "Configuring Power over Ethernet."

XML-PI

eXtensible Markup Language Programmatic Interface (XML-PI) Release 1.0 leverages the Network Configuration Protocol (NETCONF). It provides new data models that collect running configurations and **show** command output down to the keyword level without requiring the technologies or external XML-to-command line interface (CLI) gateways. XML-PI allows you to develop XML-based network management applications to control any number of network devices simultaneously.

Refer to the following link for more details:

http://www.cisco.com/en/US/docs/ios/netmgmt/configuration/guide/nm_xmlpi_v1.html

Security Features

The Catalyst 4500 series switch offers network management and control through the CLI or through alternative access methods, such as SNMP. The switch software supports these security features:

802.1X Identity-Based Network Security

This security feature consists of the following:

- 802.1X protocol—Provides a means for a host that is connected to a switch port to be authenticated before it is given access to the switch services.
- 802.1X with VLAN assignment—Enables you to enable non-802.1X-capable hosts to access networks that use 802.1X authentication.
- 802.1X RADIUS accounting—Enables you to track the usage of network devices.
- 802.1X authentication for Guest VLANs—Enables you to use VLAN assignment to limit network access for certain users.
- 802.1X with MAC Authentication Bypass—Provides network access to agentless devices without 802.1X supplicant capabilities, such as printers. Upon detecting a new MAC address on a switch port, the Catalyst 4500 series switch will proxy an 802.1X authentication request based on the device's MAC address.
- 802.1X with Inaccessible Authentication Bypass—Applies when the AAA servers are unreachable or nonresponsive. In this situation, 802.1X user authentication typically fails with the port closed, and the user is denied access. Inaccessible Authentication Bypass provides a configurable alternative on the Catalyst 4500 series switch to grant a critical port network access in a locally specified VLAN.
- 802.1X with Unidirectional Controlled Port—Allows the Wake-on-LAN (WoL) magic packets to reach a workstation attached to an unauthorized 802.1X switch port. Unidirectional Controlled Port is typically used to send operating systems or software updates from a central server to workstations at night.
- 802.1X Authentication Failed Open Assignment—Enables you to configure a switch to handle the case when a device fails to authenticate itself correctly through 802.1X (for example, not providing the correct password).
- 802.1X with Port Security—Enables port security on an 802.1X port in either single- or multiple-host mode. When you enable port security and 802.1X on a port, 802.1X authenticates the port, and port security manages the number of MAC addresses allowed on that port, including that of the client.
- 802.1X Authentication with ACL Assignment—Downloads per-host policies such as ACLs and redirect URLs to the switch from the RADIUS server during 802.1X or MAB authentication of the host.
- 802.1X Authentication with Per-User ACL and Filter-ID ACL—Allows ACL policy enforcement using a third-party AAA server.
- 802.1X with RADIUS-Provided Session Timeouts—Enables you to specify whether a switch uses a locally configured or a RADIUS-provided reauthentication timeout.
- 802.1X with Voice VLAN—Enables you to use 802.1X security on a port while enabling it to be used by both Cisco IP phones and devices with 802.1X supplicant support.
- 802.1X Convergence—Provides consistency between the switching business units in 802.1X configuration and implementation.

- Multi-Domain Authentication—Allows both a data device and a voice device, such as an IP phone (Cisco or non-Cisco), to authenticate on the same switch port, which is divided into a data domain and a voice domain.

For more information on 802.1X identity-based network security, see Chapter 37, "Configuring 802.1X Port-Based Authentication."

Dynamic ARP Inspection

Dynamic ARP Inspection (DAI) intercepts all ARP requests, replies on untrusted ports, and verifies each intercepted packet for valid IP to MAC bindings. Dynamic ARP Inspection helps to prevent attacks on a network by not relaying invalid ARP replies out to other ports in the same VLAN. Denied ARP packets are logged by the switch for auditing.

For more information on dynamic ARP inspection, see Chapter 42, "Configuring Dynamic ARP Inspection."

Dynamic Host Configuration Protocol Snooping

Dynamic Host Configuration Protocol (DHCP) Snooping is a security feature that is a component of a DHCP server. DHCP snooping provides security by intercepting untrusted DHCP messages and by building and maintaining a DHCP snooping binding table. An untrusted message is a message that is received from outside the network or firewall that can cause traffic attacks within your network.

DHCP snooping acts like a firewall between untrusted hosts and DHCP servers. It also provides a way to differentiate between untrusted interfaces connected to the end-user and trusted interfaces connected to the DHCP server or another switch.

With SSO support, DHCP Snooping propagates the DHCP-snooped data from the active supervisor engine to the redundant supervisor engine so that when a switchover occurs, the newly active supervisor engine is aware of the DHCP data that was already snooped, and the security benefits continue uninterrupted.

For DHCP server configuration information, refer to the chapter, "Configuring DHCP," in the *Cisco IOS IP and IP Routing Configuration Guide* at the following URL:

http://www.cisco.com/en/US/docs/ios/ipaddr/configuration/guide/iad_dhcp_rdmp_ps6350_TSD_Products_Configuration_Guide_Chapter.html

For information on configuring DHCP snooping, see Chapter 41, "Configuring DHCP Snooping and IP Source Guard."

Flood Blocking

Flood blocking enables users to disable the flooding of unicast and multicast packets on a per-port basis. Occasionally, unknown unicast or multicast traffic from an unprotected port is flooded to a protected port because a MAC address has timed out or has not been learned by the switch.

For information on flood blocking, see Chapter 44, "Port Unicast and Multicast Flood Blocking."

Hardware-Based Control Plane Policing

Control Plane Policing provides a unified solution to limit the rate of CPU bound control plane traffic in hardware. It enables users to install system wide control plane ACLs to protect the CPU by limiting rates or filtering out malicious DoS attacks. Control plane policing ensures the network stability, availability and packet forwarding, and prevents network outages such as loss of protocol updates despite an attack or heavy load on the switch. Hardware-based control plane policing is available on Supervisor Engine 7-E, supporting various Layer 2 and Layer 3 control protocols, such as CDP, EAPOL, STP, DTP, VTP, ICMP, CGMP, IGMP, DHCP, RIPv2, OSPF, PIM, TELNET, SNMP, HTTP, and packets destined to 224.0.0.* multicast link local addresses. Predefined system policies or user-configurable policies can be applied to those control protocols.

For information on control plane policing, see Chapter 40, “Configuring Control Plane Policing.”

IP Source Guard

Similar to DHCP snooping, this feature is enabled on an untrusted 12 port that is configured for DHCP snooping. Initially all IP traffic on the port is blocked except for the DHCP packets, which are captured by the DHCP snooping process. When a client receives a valid IP address from the DHCP server, a PVACL is installed on the port, which restricts the client IP traffic only to clients with assigned IP addresses, so any IP traffic with source IP addresses other than those assigned by the DHCP server will be filtered out. This filtering prevents a malicious host from attacking a network by hijacking neighbor host's IP address.

For information on configuring IP Source Guard, see Chapter 41, “Configuring DHCP Snooping and IP Source Guard.”

Local Authentication, RADIUS, and TACACS+ Authentication

Local Authentication, Remote Authentication Dial-In User Service (RADIUS), and Terminal Access Controller Access Control System Plus (TACACS+) authentication methods control access to the switch. For additional information, refer to the following URL:

http://www.cisco.com/en/US/docs/ios/sec_user_services/configuration/guide/sec_cfg_authentifcn_ps6350_TSD_Products_Configuration_Guide_Chapter.html

Network Admission Control

Network Admission Control consists of two features:

- NAC Layer 2 IP validation

  NAC Layer 2 IP is an integral part of Cisco Network Admission Control. It offers the first line of defense for infected hosts (PCs and other devices attached to a LAN port) attempting to connect to the corporate network. NAC Layer 2 IP on the Cisco Catalyst 4500 series switch performs posture validation at the Layer 2 edge of the network for non-802.1x-enabled host devices. Host device posture validation includes antivirus state and OS patch levels. Depending on the corporate access policy and host device posture, a host may be unconditionally admitted, admitted with restricted access, or quarantined to prevent the spread of viruses across the network.

For more information on Layer 2 IP validation, see the URL:

http://www.cisco.com/en/US/docs/net_mgmt/cisco_secure_access_control_server_for_windows/4.1/configuration/guide/nac_conf.html

- NAC Layer 2 802.1X authentication

  The Cisco Catalyst 4500 series switch extends NAC support to 802.1x-enabled devices. Like NAC Layer 2 IP, the NAC Layer 2 802.1x feature determines the level of network access based on endpoint information.

  For more information on 802.1X identity-based network security, see Chapter 37, "Configuring 802.1X Port-Based Authentication."

Network Security with ACLs

An access control list (ACL) filters network traffic by controlling whether routed packets are forwarded or blocked at the router interfaces. The Catalyst 4500 series switch examines each packet to determine whether to forward or drop the packet based on the criteria you specified within the access lists.

MAC access control lists (MACLs) and VLAN access control lists (VACLs) are supported. VACLs are also known as VLAN maps in Cisco IOS.

The following security features are supported:

- MAC address filtering, which enables you to block unicast traffic for a MAC address on a VLAN interface.
- Port ACLs, which enable you to apply ACLs to Layer 2 interfaces on a switch for inbound traffic.

For information on ACLs, MACLs, VLAN maps, MAC address filtering, and Port ACLs, see Chapter 42, "Configuring Network Security with ACLs."

Port Security

Port security restricts traffic on a port based upon the MAC address of the workstation that accesses the port. Trunk port security extends this feature to trunks, including private VLAN isolated trunks, on a per-VLAN basis.

Sticky port security extends port security by saving the dynamically learned MAC addresses in the running configuration to survive port link down and switch reset. It enables a network administrator to restrict the MAC addresses allowed or the maximum number of MAC addresses on each port.

Voice VLAN sticky port security further extends the sticky port security to the Voice-over-IP deployment. Voice VLAN sticky port security locks a port and blocks access from a station with a MAC address different from the IP phone and the workstation behind the IP phone.

For information on port security, see Chapter 38, "Configuring Port Security."

Storm Control

Broadcast suppression is used to prevent LANs from being disrupted by a broadcast storm on one or more switch ports. A LAN broadcast storm occurs when broadcast packets flood the LAN, creating excessive traffic and degrading network performance. Errors in the protocol-stack implementation or in the network configuration can cause a broadcast storm. Multicast and broadcast suppression measures

how much broadcast traffic is passing through a port and compares the broadcast traffic with some configurable threshold value within a specific time interval. If the amount of broadcast traffic reaches the threshold during this interval, broadcast frames are dropped, and optionally the port is shut down.

For information on configuring broadcast suppression, see Chapter 49, "Configuring Storm Control."

uRPF Strict Mode

The uRPF feature mitigates problems caused by the introduction of malformed or forged (spoofed) IP source addresses into a network by discarding IP packets that lack a verifiable IP source address. uRPF deflects denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks by forwarding only packets that have source addresses that are valid and consistent with the IP routing table. This helps to protect the network of the customer, the ISP, and the rest of the Internet. When using uRPF in strict mode, the packet must be received on the interface that the router would use to forward the return packet. uRPF strict mode is supported for both IPv4 and IPv6 prefixes.

For information on configuring broadcast suppression, see Chapter 28, "Configuring Unicast Reverse Path Forwarding".

Utilities

The following untilities are supported on the Catalyst 4500 series switch.

Layer 2 Traceroute

Layer 2 traceroute allows the switch to identify the physical path that a packet takes from a source device to a destination device. Layer 2 traceroute supports only unicast source and destination MAC addresses.

For information about Layer 2 Traceroute, see Chapter 8, "Checking Port Status and Connectivity."

Time Domain Reflectometry

Time Domain Reflectometry (TDR) is a technology used for diagnosing the state and reliability of cables. TDR can detect open, shorted, or terminated cable states. The calculation of the distance to the failure point is also supported.

For information about TDR, see Chapter 8, "Checking Port Status and Connectivity."

Debugging Features

The Catalyst 4500 series switch has several commands to help you debug your initial setup. These commands are included in the following command groups:

- **platform**
- **debug platform**

For more information, refer to the *Catalyst 4500 Series Switch Cisco IOS Command Reference*.

Web-based Authentication

The web-based authentication feature, known as Web Authentication Proxy, enables you to authenticate end users on host systems that do not run the IEEE 802.1X supplicant. When you initiate an HTTP session, this feature intercepts ingress HTTP packets from the host and sends an HTML login page to your. You key in the credentials, which the web-based authentication feature sends to the AAA server for authentication. If authentication succeeds, web-based authentication sends a Login-Successful HTML page to the host and applies the access policies returned by the AAA server.

For information on configuring web-based authentication, see Chapter 37, “Configuring Web-Based Authentication.”