

Cisco Catalyst **2950** Series Switches— with Enhanced Image Software

Product Overview

Cisco Catalyst® 2950 Series Switches are fixed-configuration, stackable models that provide wire-speed Fast Ethernet and Gigabit Ethernet connectivity for small and midsize networks. The Catalyst 2950 Series is an affordable product line that brings intelligent services, such as enhanced security, high availability, and advanced quality of service (QoS), to the network edge—while maintaining the simplicity of traditional LAN switching. When a Catalyst 2950 Switch is combined with a Catalyst 3550 Series Switch, the solution can enable IP routing from the edge to the core of the network. Embedded in Catalyst 2950 Series switches is the Cisco Cluster Management Suite (CMS) Software, which allows users to simultaneously configure and troubleshoot multiple Catalyst desktop switches using a standard Web browser. In addition to CMS, Cisco Catalyst 2950 switches provide extensive management tools using Simple Network Management Protocol (SNMP) network management platforms such as CiscoWorks.

This product line offers two distinct sets of software features and a range of configurations to allow small, midsized, and enterprise branch offices to select the right combination for the network edge. The Standard Image software offers Cisco IOS® functionality for basic data, video, and voice services. For networks with requirements for additional security, advanced QoS and high availability, the

Enhanced Image software delivers intelligent services such as rate limiting and security filtering for deployment at the network edge.

The Cisco Catalyst 2950 Series Switches consists of the following devices—which are only available with the Enhanced Image (EI) Software for the Catalyst 2950 Series.

- **Catalyst 2950G-48**—48 10/100 ports and 2 Gigabit Interface Converter (GBIC)-based Gigabit Ethernet ports
- **Catalyst 2950G-24**—24 10/100 ports and 2 GBIC ports
- **Catalyst 2950G-24-DC**—24 10/100 ports, 2 GBIC ports, DC power
- **Catalyst 2950G-12**—12 10/100 ports and 2 GBIC ports
- **Catalyst 2950T-24**—24 10/100 ports and 2 fixed 10/100/1000BASE-T uplink ports
- **Catalyst 2950C-24**—24 10/100 ports and 2 fixed 100BASE-FX uplink ports

This complete set of switches offers network managers flexibility when selecting a migration path to Gigabit Ethernet. The two built-in Gigabit Ethernet ports on the Catalyst 2950G-12, 2950G-24, and 2950G-48 accommodate a range of GBIC transceivers, including the Cisco GigaStack® GBIC, 1000BASE-SX, 1000BASE-LX/LH, 1000BASE-ZX, 1000BASE-T, and CWDM GBICs. The dual GBIC-based Gigabit Ethernet implementation provides customers with tremendous deployment

flexibility—allowing customers increased availability with the redundant uplinks. In sum, the configuration permits customers to implement one type of stacking and uplink configuration today, while preserving the option to migrate to another configuration in the future. High levels of stack resiliency can also be implemented by deploying dual redundant Gigabit Ethernet uplinks, a redundant GigaStack GBIC loopback cable, UplinkFast and CrossStack UplinkFast technologies for high-speed uplink and stack interconnection failover, and Per VLAN Spanning Tree Plus (PVST+) for uplink load balancing.

In addition, the Catalyst 2950T-24 offers small and midsized enterprises server connectivity and an easy migration path to Gigabit by using existing copper cabling infrastructure. Implementing Gigabit Ethernet over copper allows network managers to boost network performance and maximize infrastructure investments in Category 5 copper cabling.

Other Catalyst 2950 Series Switches

Catalyst 2950 Series with Standard Image:

The Cisco Catalyst® 2950SX-24, 2950-24, and 2950-12 are also members of the Cisco Catalyst 2950 Series switches. They are standalone, fixed-configuration, and managed 10/100 switches providing basic workgroup connectivity for small to midsized companies. These wire-speed desktop switches come with Standard Image (SI) Software features and offer Cisco IOS® functionality for basic data, video, and voice services at the edge of the network.

Catalyst 2950 Long-Reach Ethernet (LRE) Switches

- **Catalyst 2950ST-24-LRE**—24 Long-Reach Ethernet (LRE) ports and 2 fixed 10/100/1000BASE-T ports and 2 Small Form Factor Pluggable (SFP) ports (two of the four uplinks active at one time)
- **Catalyst 2950ST-8-LRE**—Eight LRE ports and two fixed 10/100/1000BASE-T ports and two SFP ports (two of the four uplinks active at one time)

The Cisco Catalyst 2950 LRE solution delivers cost-effective, high-performance broadband access over existing phone wiring in enterprise campus environments and multitenant buildings (for example, hotels, apartment buildings, and office buildings). The Catalyst 2950 LRE switches come with the EI Software features enabling enterprise and service provider customers to extend intelligent services over legacy wiring (category 1/2/3) to distances up to 5000 feet. Cisco is the only company with the breadth of technologies that allow customers to deliver intelligent network services across any combination of wired and wireless infrastructures. Refer to the Catalyst 2950 LRE Series Data Sheet for more information.

Intelligence in the Network

Networks of today are evolving to address four new developments at the network edge:

- Increase in desktop computing power
- Introduction of bandwidth-intensive applications
- Expansion of highly sensitive data on the network
- Presence of multiple device types, such as IP phones and wireless LAN access points

These new demands are contending for resources with many existing mission-critical applications. As a result, IT professionals must view the edge of the network as critical to effectively manage the delivery of information and applications.

As companies increasingly rely on networks as the strategic business infrastructure, it is more important than ever to ensure their high availability, security, scalability, and control. By adding Cisco intelligent functionality to the wiring closet, customers can now deploy network-wide intelligent services that address these requirements in a consistent way from the desktop to the core and through the WAN.

With Cisco Catalyst switches, Cisco enables companies to realize the full benefits of adding intelligent services into their networks. Deploying capabilities that make the network infrastructure highly available to accommodate time-critical needs, scalable to accommodate growth, secure enough to protect confidential information, and capable of differentiating and controlling traffic flows are key to further optimizing network operations.

Network Security Through Advanced Security Features

The Cisco Catalyst 2950 Series switches offer enhanced data security through a wide range of security features. These features allow customers to enhance LAN security with capabilities to secure network management traffic through the protection of passwords and configuration information; to provide options for network security based on users, ports, and MAC addresses; and to enable more immediate reactions to intruder and hacker detection. The security enhancements are available free-of-charge by downloading the latest software release for the Catalyst 3550 and 2950 switches.

Secure Shell (SSH) and Simple Network Management Protocol version 3 (SNMPv3) protects information from being tampered with or eavesdropped by encrypting information being passed along the network, thereby guarding administrative information. Private VLAN Edge isolates ports on a switch, ensuring that traffic travels directly from the entry point to the aggregation device through a virtual path and cannot be directed to another port. Local Proxy Address Resolution Protocol (ARP) works in conjunction with private VLAN edge to minimize broadcasts and maximize available bandwidth.

Port-based Access Control Parameters (ACPs) restrict sensitive portions of the network by denying packets based on source and destination MAC addresses, IP addresses, or TCP/UDP ports. ACP lookups are done in hardware; therefore, forwarding performance is not compromised when implementing this type of security in the network. In addition, Time-based ACLs allow configuration of differentiated services based on time periods. ACLs can also be applied to filter traffic based on DSCP values. Port security provides another means to ensure the appropriate user is on the network by limiting access based on MAC addresses.

For authentication of users with a Terminal Access Controller Access Control System (TACACS+) or RADIUS server, 802.1x provides port-level security. 802.1x in conjunction with a RADIUS server allows for dynamic port-based user authentication. 802.1x-based user authentication can be extended to dynamically assign a VLAN based on a specific user regardless of where they connect on the network. This intelligent adaptability allows IT departments to offer greater flexibility and mobility to their stratified user populations. By combining access control and user profiles with secure network connectivity, services, and applications, enterprises can more effectively manage user mobility and drastically reduce the overhead associated with granting and managing access to network resources.

With the multilayer Cisco Catalyst 2950 switches, network managers can implement high levels of console security. Multilevel access security on the switch console and the Web-based management interface prevents unauthorized users from accessing or altering switch configuration. TACACS+ or RADIUS authentication enables centralized access control of the switch and restricts unauthorized users from altering the configuration. Deploying security can be done through Cisco CMS Software Security Wizards, which ease the deployment of security features that restrict user access to a server, a portion of the network, or access to the network.

Network Control Through Advanced Quality of Service and Rate Limiting

The Catalyst 2950 Series Switches offer superior and highly granular QoS based on Layer 2–4 information to ensure that network traffic is classified, prioritized, and congestion is avoided in the best possible manner. Configuration of QoS is greatly simplified through automatic QoS (auto-QoS), a feature that detects Cisco IP phones and automatically configures the switch for the appropriate classification and egress queuing. This optimizes traffic prioritization and network availability without the challenge of a complex configuration.

The Catalyst 2950 Series Switches can classify, reclassify, police (determine if the packet is in or out of predetermined profiles and affect actions on the packet), and mark or drop the incoming packets before the packet is placed in the shared buffer. Packet classification allows the network elements to discriminate between various traffic flows and enforce policies based on Layer 2 and Layer 3 QoS fields.

To implement QoS, these switches first identify traffic flows, or packet groups, and classify or reclassify these groups using the DiffServ Code Point (DSCP) field in the IP packet and/or the 802.1p class of service (CoS) field in the Ethernet packet. Classification and reclassification can also be based on criteria as specific as the source/destination IP address, source/destination MAC address, or the Layer 4 Transmission Control Protocol (TCP)/User Datagram Protocol (UDP) ports. At the ingress (incoming port) level, the Catalyst switches will also perform policing and marking of the packet.

After the packet goes through classification, policing, and marking, it is then assigned to the appropriate queue before exiting the switch. The Catalyst 2950 Series Switches support four egress (outgoing port) queues per port, which allows the network administrator to be more discriminating and specific in assigning priorities for the various applications on the LAN. At the egress level, the switch performs scheduling, which is an algorithm/process that determines the order in which the queues are processed. The switches support Weighted Round Robin (WRR) scheduling or strict priority scheduling. The WRR scheduling algorithm ensures that the lower priority packets are not entirely starved for bandwidth and are serviced without compromising the priority settings administered by the network manager. Strict priority scheduling ensures that the highest priority packets will always get serviced first, ahead of all other traffic, and that the other three queues will be serviced using WRR best effort.

These features allow network administrators to prioritize mission-critical and/or bandwidth-intensive traffic, such as ERP (Oracle, SAP, and so on), voice (IP telephony traffic) and CAD/CAM over less time-sensitive applications such as FTP or e-mail (SMTP). For example, it would be highly undesirable to have a large file download destined to one port on a wiring closet switch and have quality implications such as increased latency in voice traffic, destined to another port on this switch. This condition is avoided by ensuring that voice traffic is properly classified and prioritized throughout the network. Other applications, such as Web browsing, can be treated as low priority and handled on a best-efforts basis.

The Catalyst 2950 Series Switches are capable of allocating bandwidth based on several criteria including MAC source address, MAC destination address, IP source address, IP destination address, and TCP/UDP port number. Bandwidth allocation is essential in network environments requiring service-level agreements or when it is necessary for the network manager to control the bandwidth given to certain users. The Catalyst 2950 Series switches support up to 6 policers per Fast Ethernet port and up to 60 policers on a Gigabit Ethernet port. This gives the network administrator very granular control of LAN bandwidth.

Network Availability

To provide efficient use of resources for bandwidth-hungry applications like multicasts, the Cisco Catalyst 2950 Series Intelligent Switches support Internet Group Management Protocol (IGMP) snooping in hardware. Through the support and configuration of IGMP snooping via the Cisco CMS Software, Catalyst 2950 Series Switches deliver outstanding performance and ease of use in administering and managing multicast applications on the LAN.

The IGMP snooping feature allows the switch to “listen in” on the IGMP conversation between hosts and routers. When a switch hears an IGMP join request from a host for a given multicast group, the switch adds the host’s port number to the Group Destination Address (GDA) list for that group. And, when the switch hears an IGMP leave request, it removes the host’s port from the Content Addressable Memory (CAM) table entry.

PVST+ allows users to implement redundant uplinks while also distributing traffic loads across multiple links. This is not possible with standard Spanning-Tree Protocol implementations. Cisco UplinkFast technology ensures immediate transfer to the secondary uplink, much better than the traditional 30 to 60 second convergence time. This is yet another enhancement of the Spanning-Tree Protocol implementation. An additional feature that enhances performance is Voice VLAN. This feature allows network administrators to assign voice traffic to a VLAN dedicated to IP telephony—simplifying phone installations and providing easier network traffic administration and troubleshooting.

Multicast VLAN Registration (MVR) is designed for applications using wide-scale deployment of multicast traffic across an Ethernet ring-based service provider network (for example, the broadcast of multiple television channels over a service-provider network). MVR allows a subscriber on a port to subscribe and unsubscribe to a multicast stream on the network-wide multicast VLAN.

Network Management

The Cisco CMS is Web-based software that is embedded in Catalyst 3550, 2950, 3500 XL, 2900 XL, and 2900 LRE XL switches. Through Cisco Switch Clustering technology, users access Cisco CMS with any standard Web browser to manage up to 16 of these switches at once, regardless of their geographic proximity—with the option of using a single IP address for the entire cluster if desired. With the addition of the Catalyst 3550 switches, Cisco CMS Software can now extend beyond routed boundaries for even more flexibility in managing a Cisco cluster.

Cisco CMS provides an integrated management interface for delivering intelligent services, such as multilayer switching, QoS, multicast and security access control lists (ACLs). Thus, CMS allows administrators to take advantage of benefits formerly reserved for only the most advanced networks without having to learn the command-line interface (CLI) or even the details of the technology.

The new Guide Mode in Cisco CMS leads the user step-by-step through the configuration of advanced features and provides enhanced online help for context-sensitive assistance. In addition, Cisco AVVID (Architecture for Voice, Video and Integrated Data) Wizards provide automated configuration of the switch to optimally support video streaming or videoconferencing, voice over IP (VoIP) and mission-critical applications. These Wizards can save hours of time for network administrators, eliminate human errors, and ensure that the configuration of the switch is optimized for these applications.

Cisco CMS Software supports standards-based connectivity options such as Ethernet, Fast Ethernet, Fast EtherChannel, Gigabit Ethernet, and Gigabit EtherChannel connectivity. Because Cisco Switch Clustering technology is not limited to a single stack of switches, Cisco CMS Software expands the traditional cluster domain beyond a single wiring closet and saves time and effort for network administrators.

Catalyst 2950 switches can be configured either as “command” or “member” switches in a Cisco switch cluster. Cisco CMS also allows the network administrator to designate a standby or redundant command switch, which takes the commander duties should the primary command switch fail. Other key features include the ability to configure multiple ports and switches simultaneously, as well as perform software updates across the entire cluster at once, and clone configurations to other clustered switches for rapid network deployments. Bandwidth graphs and link reports provide useful diagnostic information and the topology map gives network administrators a quick view of the network status.

In addition to CMS, Cisco Catalyst 2950 switches provide extensive management tools using SNMP network management platforms such as CiscoWorks for Switched Internetworks.

The Cisco Catalyst 2950 Switches deliver a comprehensive set of management tools to provide the required visibility and control in the network. Managed with CiscoWorks, Catalyst family switches can be configured and managed to deliver end-to-end device, VLAN, traffic, and policy management. Coupled with CiscoWorks, Cisco Resource Manager Essentials, a Web-based management tool, offers automated inventory collection, software deployment, easy tracking of network changes, views into device availability, and quick isolation of error conditions.

Cisco Catalyst 2950 Switches



Figure 1

Product Features and Benefits

Feature	Benefit
Availability	
Superior Redundancy for Fault Backup	<ul style="list-style-type: none"> • IEEE 802.1D Spanning-Tree Protocol support for redundant backbone connections and loop-free networks simplifies network configuration and improves fault tolerance. • Support for Cisco Spanning-Tree Protocol enhancements such as UplinkFast, BackboneFast, and PortFast technologies ensure quick fail-over recovery enhancing overall network stability and availability. • IEEE 802.1w Rapid Spanning-Tree Protocol (RSTP) provides rapid convergence of the spanning tree independent of spanning-tree timers. • Cisco CrossStack UplinkFast technology extends UplinkFast to a stack to ensure quick fail-over recovery enhancing network stability and availability. • Support for Cisco's optional, 300-watt redundant AC power system provides a backup power source for up to four units for improved fault tolerance and network uptime. • Redundant stacking connections provide support for a redundant loopback connection for top and bottom switches in an independent stack backplane cascaded configuration. • Command switch redundancy enabled in the Cisco CMS Software allows customers to designate a backup command switch that takes over cluster management functions if the primary command switch fails. • Provides unidirectional link detection (UDLD) and Aggressive UDLD for detecting and disabling unidirectional links on fiber-optic interfaces caused by incorrect fiber-optic wiring or port faults.
Integrated Cisco IOS® Features for Bandwidth Optimization	<ul style="list-style-type: none"> • Bandwidth aggregation up to 4 Gbps (2 ports full duplex) through Gigabit EtherChannel® technology and up to 16 Gbps (8 ports full duplex) through Fast EtherChannel technology enhances fault tolerance and offers higher-speed aggregated bandwidth between switches, to routers and individual servers. Port Aggregation Protocol (PAgP) is available to simplify configuration. • Per-port broadcast, multicast, and unicast storm control prevents faulty end stations from degrading overall systems performance. • Per virtual LAN (VLAN) Spanning Tree Plus (PVST+) allows for Layer 2 load sharing on redundant links to efficiently utilize the extra capacity inherent in a redundant design. • IEEE 802.1s Multiple Spanning-Tree Protocol (MSTP) allows a spanning tree instance per VLAN enabling Layer 2 load sharing on redundant links. • VLAN Trunking Protocol (VTP) pruning limits bandwidth consumption on VTP trunks by flooding broadcast traffic only on trunk links required to reach the destination devices. Dynamic Trunking Protocol (DTP) enables dynamic trunk configuration across all ports in the switch. • IGMP snooping provides for fast client joins and leaves of multicast streams and limits bandwidth-intensive video traffic to only the requestors. MVR, IGMP filtering and fast-join and immediate leave are available as enhancements. • MVR continuously sends multicast streams in a multicast VLAN while isolating the streams from subscriber VLANs for bandwidth and security reasons. • Supports additional frame formats: Ethernet II (tagged and untagged), 802.3 (SNAP encapsulated tagged and untagged frames)
Security	

Feature	Benefit
Network-Wide Security Features	<ul style="list-style-type: none"> • Filtering of incoming traffic flows based on Layer 2, Layer 3, or Layer 4 ACPs prevents unauthorized data flows. <ul style="list-style-type: none"> – The following Layer 2 ACPs or a combination can be used for security classification of incoming packets: source Media Access Control (MAC) address, destination MAC address, and 16-bit Ethertype. – The following Layer 3 and Layer 4 fields or a combination can be used for security classification of incoming packets: source IP address, destination IP address, TCP source or destination port number, UDP source, or destination port number. ACLs can also be applied to filter based on DSCP-values. – Time-based ACLs allow configuration of differentiated services based on time-periods. • A private VLAN edge provides security and isolation between ports on a switch, ensuring that voice traffic travels directly from its entry point to the aggregation device through a virtual path and cannot be directed to a different port. • Support for the 802.1x standard allows users to be authenticated regardless of which LAN port they are accessing, and provides unique benefits to customers who have a large base of mobile (wireless) users accessing the network. <ul style="list-style-type: none"> – 802.1x with VLAN assignment allows a dynamic VLAN assignment for a specific user regardless of where the user is connected. – 802.1x with an ACL assignment allows for specific security policies based on a user regardless of where the user is connected. – 802.1x with voice VLAN to permit an IP phone access to the voice VLAN irrespective of the authorized or unauthorized state of the port. – 802.1x with port security for authenticating the port and managing network access for all MAC addresses, including that of the client. • SSH and SNMPv3 provides network security by encrypting administrator traffic during Telnet and SNMP sessions —SSH and the crypto version of SNMPv3 require a special crypto software image due to US export restrictions. • Port Security secures the access to a port based on the MAC address of a user’s device. The aging feature removes the MAC address from the switch after a specific timeframe to allow another device to connect to the same port. • MAC Address Notification allows administrators to be notified of new users added or removed from the network. • Spanning-tree root guard (STRG) prevents edge devices not in the network administrator’s control from becoming Spanning-Tree Protocol root nodes. • The Spanning-Tree Protocol PortFast/bridge protocol data unit (BPDU) guard feature disables access ports with Spanning-Tree Protocol PortFast-enabled upon reception of a BPDU, and increases network reliability, manageability, and security. • Multilevel security on console access prevents unauthorized users from altering the switch configuration. • TACACS+ and RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration. • The user-selectable address-learning mode simplifies configuration and enhances security. • Trusted Boundary provides the ability to trust the QoS priority settings if an IP phone is present and disable the trust setting in the event that the IP phone is removed, thereby preventing a rogue user from overriding prioritization policies in the network. • IGMP Filtering provides multicast authentication by filtering out non-subscribers and limits the number of concurrent multicast streams available per port. • Support for dynamic VLAN assignment through implementation of VLAN Membership Policy Server (VMPS) client functionality provides flexibility in assigning ports to VLANs. Dynamic VLAN enables fast assignment of IP address. • Cisco CMS Software Security Wizards ease the deployment of security features for restricting user access to a server, a portion of the network or access to the network.
QoS	
Overview	<ul style="list-style-type: none"> • The switches support the aggregate QoS model by enabling classification, policing/metering, and marking functions on a per-port basis at ingress and queuing/scheduling function at egress. • The switches support configuring QoS ACPs on all ports to ensure proper policing and marking on a per-packet basis using ACPs. Up to four ACPs per switch are supported in configuring either QoS ACPs or security filters. • Automatic QoS (Auto-QoS) greatly simplifies the configuration of QoS in VoIP networks by issuing interface and global switch commands that allow the detection of Cisco IP phones, the classification of traffic, and egress queue configuration.

Feature	Benefit
QoS Classification Support at Ingress	<ul style="list-style-type: none"> • The switches support QoS classification of incoming packets for QoS flows based on Layer 2, Layer 3, and Layer 4 fields. • The following Layer 2 fields or a combination can be used for classifying incoming packets to define QoS flows: source MAC address, destination MAC address, 16-bit Ethertype. • The switches support identification of traffic based on Layer 3 ToS field—DSCP values. • The following Layer 3 and 4 fields or a combination can be used to classify incoming packets to define QoS flows: source IP address, destination IP address, TCP source or destination port number, UDP source or destination port number.
QoS Metering/ Policing at Ingress	<ul style="list-style-type: none"> • Support for metering/policing of incoming packets restricts incoming traffic flows to a certain rate. • The switches support up to 6 policers per Fast Ethernet port, and 60 policers on a Gigabit Ethernet port. • The switches offer granularity of traffic flows at 1 Mbps on Fast Ethernet ports, and 8 Mbps on Gigabit Ethernet ports.
QoS Marking at Ingress	<ul style="list-style-type: none"> • The switches support marking/re-marking packets based on state of policers/meters. • The switches support marking/re-marking based on the following mappings: from DiffServ Code Point (DSCP) to 802.1p, and 802.1p to DSCP. • The switches support 14 well-known and widely used DSCP values. • The switches support classifying or reclassifying packets based on default DSCP per port. Also support classification based on DSCP-values in ACL. • The switches support classifying or reclassifying frames based on default 802.1p value per port. • The switches support 802.1p override at ingress.
QoS Scheduling Support at Egress	<ul style="list-style-type: none"> • Four queues per egress port are supported in hardware. • The WRR queuing algorithm ensures that low-priority queues are not starved. • Strict-priority queue configuration via Strict Priority Scheduling ensures that time-sensitive applications such as voice always follow an expedited path through the switch fabric.
Sophisticated Traffic Management	<ul style="list-style-type: none"> • The switch supports up to 6 policers per Fast Ethernet port and up to 60 policers on a Gigabit Ethernet port. • The switch offers granularity of traffic flows at 1 Mbps on Fast Ethernet ports and 8 Mbps on Gigabit Ethernet ports. • The switch offers the ability to limit data flows based on MAC source/destination address, IP source/destination address, TCP/UDP port numbers, or any combination of these fields. • The switch offers the ability to manage data flows asynchronously upstream and downstream from the end station or on the uplink.
Management	
Superior Manageability	<ul style="list-style-type: none"> • An embedded Remote Monitoring (RMON) software agent supports four RMON groups (history, statistics, alarms, and events) for enhanced traffic management, monitoring, and analysis. • The switch supports all nine RMON groups through the use of a Cisco SwitchProbe[®] Analyzer (Switched Port Analyzer [SPAN]) port, permitting traffic monitoring of a single port, a group of ports, or the entire switch from a single network analyzer or RMON probe. • A SPAN port monitors traffic of a single port from a single network analyzer or RMON probe. • Remote Switch Port Analyzer (RSPAN) allows network administrators to locally monitor ports in a Layer 2 switch network from any other switch in the same network. • The Domain Name System (DNS) provides IP address resolution with user-defined device names. • Trivial File Transfer Protocol (TFTP) reduces the cost of administering software upgrades by downloading from a centralized location. • Network Timing Protocol (NTP) provides an accurate and consistent timestamp to all switches within the intranet. • Layer 2 traceroute eases troubleshooting by identifying the physical path that a packet takes from the source device to a destination device. • Crash Information support enables switch to generate a crash file for improved troubleshooting. • Show-interface-capabilities provides information on configuration capabilities of any interface. • RTTMON-MIB allows users to monitor network performance between a Catalyst switch and a remote device. • Multifunction LEDs per port for port status, half-duplex/full-duplex, 10BASE-T/100BASE-TX/1000BASE-T indication, as well as switch-level status LEDs for system, redundant power supply, and bandwidth utilization provide a comprehensive and convenient visual management system.

Feature	Benefit
Cisco CMS	<ul style="list-style-type: none"> • Cisco CMS Software allows the user to manage up to 16 inter-connected Cisco Catalyst 3550, 2950, 3500 XL, 2900 XL, and 2900 LRE XL switches without the limitation of being physically located in the same wiring closet, and with the option of using a single IP address for the entire cluster if desired. Full backward compatibility ensures any combination of the above switches can be managed with a Cisco Catalyst 2950 switch. • Cisco AVVID Wizards use just a few user inputs to automatically configure the switch to optimally handle different types of traffic: voice, video, multicast, and/or high-priority data. • A security wizard is provided to restrict unauthorized access to servers and networks, and restrict certain applications on the network. • One-click software upgrades can be performed across the entire cluster simultaneously, and configuration cloning enables rapid deployment of networks. • Cisco CMS Software has been extended to include multilayer feature configurations such as access control parameters (ACPs) and QoS parameters. • Cisco CMS Guide Mode assists users in the configuration of powerful advanced features by providing step-by-step instructions. • Cisco CMS provides enhanced online help for context-sensitive assistance. • Easy-to-use graphical interface provides both a topology map and front panel view of the cluster. • Multidevice and multiport configuration capabilities allow network administrators to save time by configuring features across multiple switches and ports simultaneously. • Ability to launch the Web-based management for a Cisco Aironet Wireless Access Point by simply clicking on its icon in the topology map. • User-personalized interface allows users to modify polling intervals, table views, and other settings within CMS and retain these settings the next time they use CMS. • Alarm notification provides automated e-mail notification of network errors and alarm thresholds.
Support for CiscoWorks	<ul style="list-style-type: none"> • Manageable through CiscoWorks network management software on a per-port and per-switch basis providing a common management interface for Cisco routers, switches, and hubs. • SNMP v1, v2, and v3 (non-crypto) and Telnet interface support delivers comprehensive in-band management, and a CLI-based management console provides detailed out-of-band management. • Cisco Discovery Protocol (CDP) Versions 1 and 2 enable a CiscoWorks network management station to automatically discover the switch in a network topology. • Supported by the CiscoWorks LAN Management Solution.
Ease of Use and Ease of Deployment	<ul style="list-style-type: none"> • The Cisco GigaStack[®] GBIC delivers a hardware-based, independent stacking bus with up to 2-Gbps forwarding rate in a point-to-point configuration, or 1-Gbps forwarding bandwidth when daisy chained with up to nine switches. • Auto-configuration eases deployment of switches in the network by automatically configuring multiple switches across a network via a boot server. • Automatic QoS (Auto-QoS) greatly simplifies the configuration of QoS in VoIP networks by issuing interface and global switch commands that allow the detection of Cisco IP phones, the classification of traffic, and egress queue configuration. • Auto-sensing on each non-GBIC port detects the speed of the attached device and automatically configures the port for 10-, 100-, or 1000-Mbps operation, easing the deployment of the switch in mixed 10, 100, and 1000BASE-T environments. • Auto-negotiating on all ports automatically selects half- or full-duplex transmission mode to optimize bandwidth. • Cisco VTP supports dynamic VLANs and dynamic trunk configuration across all switches. • Voice VLAN simplifies telephony installations by keeping voice traffic on a separate VLAN for easier network administration and troubleshooting. • DTP enables dynamic trunk configuration across all ports in the switch. • PAgP automates the creation of Cisco Fast EtherChannel[®] or Gigabit EtherChannel groups, enabling linking to another switch, router, or server. • Link Aggregation Control Protocol (LACP) allows the creation of Ethernet channeling with devices that conform to IEEE 802.3ad. This is similar to Cisco's EtherChannel and PAgP. • IEEE 802.3z-compliant 1000BASE-SX, 1000BASE-LX/LH, 1000BASE-ZX, and 1000BASE-T physical interface support through a field-replaceable GBIC module provides customers unprecedented flexibility in switch deployment. • The default configuration stored in Flash ensures that the switch can be quickly connected to the network and can pass traffic with minimal user intervention. • The switches support non-standard Ethernet frame sizes (mini-giants) up to 1542 bytes (configurations with GBIC ports only).

Product Specifications

Feature	Description
Performance	<ul style="list-style-type: none"> • 13.6-Gbps switching fabric • Catalyst 2950G-48: 13.6-Gbps maximum forwarding bandwidth • Catalyst 2950G-24: 8.8-Gbps maximum forwarding bandwidth • Catalyst 2950G-24-DC: 8.8-Gbps maximum forwarding bandwidth • Catalyst 2950G-12: 6.4-Gbps maximum forwarding bandwidth • Catalyst 2950T-24: 8.8-Gbps maximum forwarding bandwidth • Catalyst 2950C-24: 5.2-Gbps maximum forwarding bandwidth (Forwarding rates based on 64-byte packets) • Catalyst 2950G-48: 10.1-Mpps wire-speed forwarding rate • Catalyst 2950G-24: 6.6-Mpps wire-speed forwarding rate • Catalyst 2950G-24-DC: 6.6-Mpps wire-speed forwarding rate • Catalyst 2950G-12: 4.8-Mpps wire-speed forwarding rate • Catalyst 2950T-24: 6.6-Mpps wire-speed forwarding rate • Catalyst 2950C-24: 3.9-Mpps wire-speed forwarding rate • 8-MB memory architecture shared by all ports • Up to 16-MB SDRAM and 8-MB Flash memory • Configurable up to 8000 MAC addresses • Configurable maximum transmission unit (MTU) of up to 1530 bytes (Catalyst 2950G switches only)
Management	<ul style="list-style-type: none"> • BRIDGE-MIB • CISCO-BULK-FILE-MIB • CISCO-2900-MIB • CISCO-CDP-MIB • CISCO-CLASS-BASED-QOS-MIB • CISCO-CLUSTER-MIB • CISCO-CONFIG-COPY-MIB • CISCO-CONFIG-MAN-MIB • CISCO-ENVMON-MIB • CISCO-FLASH-MIB • CISCO-FTP-CLIENT-MIB • CISCO-IMAGE-MIB • CISCO-IPMROUTE-MIB • CISCO-MAC-NOTIFICATION-MIB • CISCO-MEMORY-POOL-MIB • CISCO-PAGP-MIB • CISCO-PING-MIB • CISCO-PROCESS-MIB • CISCO-PRODUCTS-MIB • CISCO-RTTMON-MIB • CISCO-SMI • CISCO-STACKMAKER-MIB • CISCO-STP-EXTENSIONS-MIB • CISCO-SYSLOG-MIB • CISCO-TC • CISCO-TCP-MIB • CISCO-VLAN-MEMBERSHIP-MIB • CISCO-VTP-MIB • ENTITY-MIB • IANAifType-MIB • IF-MIB (RFC 1573) • OLD-CISCO-CHASSIS-MIB • OLD-CISCO-CPU-MIB

Feature	Description
	<ul style="list-style-type: none"> • OLD-CISCO-INTERFACES-MIB • OLD-CISCO-IP-MIB • OLD-CISCO-MEMORY-MIB • OLD-CISCO-SYSTEM-MIB • OLD-CISCO-TCP-MIB • OLD-CISCO-TS-MIB • RFC1213-MIB (MIB-II) • RFC1398-MIB (ETHERNET-MIB) • RMON-MIB (RFC 1757) • RS-232-MIB • SNMPv2-MIB • SNMPv2-SMI • SNMPv2-TC • TCP-MIB • UDP-MIB
Standards	<ul style="list-style-type: none"> • IEEE 802.1x support • IEEE 802.1w • IEEE 802.1s • IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports • IEEE 802.1D Spanning-Tree Protocol • IEEE 802.1p CoS prioritization • IEEE 802.1Q VLAN • IEEE 802.3 10BASE-T specification • IEEE 802.3u 100BASE-TX specification • IEEE 802.3ab 1000BASE-T specification • IEEE 802.3ad • IEEE 802.3z 1000BASE-X specification • 1000BASE-X (GBIC) • 1000BASE-T (GBIC) • 1000BASE-SX • 1000BASE-LX/LH • 1000BASE-ZX • 1000BASE-CWDM GBIC 1470nm • 1000BASE-CWDM GBIC 1490nm • 1000BASE-CWDM GBIC 1510nm • 1000BASE-CWDM GBIC 1530nm • 1000BASE-CWDM GBIC 1550nm • 1000BASE-CWDM GBIC 1570nm • 1000BASE-CWDM GBIC 1590nm • 1000BASE-CWDM GBIC 1610nm • RMON I and II standards • SNMPv1, SNMPv2c, SNMPv3 (planned future support for v3)
Y2K	<ul style="list-style-type: none"> • Y2K compliant
Connectors and Cabling	<ul style="list-style-type: none"> • 10BASE-T ports: RJ-45 connectors; two-pair Category 3, 4, or 5 unshielded twisted-pair (UTP) cabling • 100BASE-TX ports: RJ-45 connectors; two-pair Category 5 UTP cabling • 1000BASE-T ports: RJ-45 connectors; two-pair Category 5 UTP cabling • 100BASE-FX ports: MT-RJ connectors, 50/125 or 62.5/125 micron multimode fiber-optic cabling • 1000BASE-T, 1000BASE-SX, -LX/LH, -ZX GBIC-based ports: SC fiber connectors, single-mode or multimode fiber • Cisco GigaStack GBIC ports: copper-based Cisco GigaStack cabling • Management console port: 8-pin RJ-45 connector, RJ-45-to-RJ-45 rollover cable with RJ-45-to-DB9 adapter for PC connections; for terminal connections, use RJ-45-to-DB25 female data-terminal-equipment (DTE) adapter (can be ordered separately from Cisco, part number ACS-DSBUASYN=)

Feature	Description
MT-RJ Patch Cables for Catalyst 2950C-24 Switch	<p>Type of Cable, Cisco Part Number</p> <ul style="list-style-type: none"> • 1-meter, MT-RJ-to-SC multimode cable, CAB-MTRJ-SC-MM-1M • 3-meter, MT-RJ-to-SC multimode cable, CAB-MTRJ-SC-MM-3M • 5-meter, MT-RJ-to-SC multimode cable, CAB-MTRJ-SC-MM-5M • 1-meter, MT-RJ-to-ST multimode cable, CAB-MTRJ-ST-MM-1M • 3-meter, MT-RJ-to-ST multimode cable, CAB-MTRJ-ST-MM-3M • 5-meter, MT-RJ-to-ST multimode cable, CAB-MTRJ-ST-MM-5M
Power Connectors	<p>Customers can provide power to a switch by using either the internal power supply or the Cisco Redundant Power System (RPS) 300. The connectors are located at the back of the switch.</p> <p>Internal Power Supply Connector</p> <ul style="list-style-type: none"> • The internal power supply is an auto-ranging unit. • The internal power supply supports input voltages between 100 and 240 VAC. • Use the supplied AC power cord to connect the AC power connector to an AC power outlet. <p>Cisco RPS Connector</p> <ul style="list-style-type: none"> • The connector offers connection for an optional Cisco RPS 300 that uses AC input and supplies DC output to the switch. • The connector offers a 300-watt redundant power system that can support six external network devices and provides power to one failed device at a time. • The connector automatically senses when the internal power supply of a connected device fails and provides power to the failed device, preventing loss of network traffic. • Attach only the Cisco RPS 300 (model PWR300-AC-RPS-N1) to the redundant-power-supply receptacle.
Indicators	<ul style="list-style-type: none"> • Per-port status LEDs: link integrity, disabled, activity, speed, and full-duplex indications. • System status LEDs: system, RPS, and bandwidth utilization indications.
Dimensions and Weight (H x W x D)	<ul style="list-style-type: none"> • 1.72 x 17.5 x 9.52 in. (4.36 x 44.5 x 24.18 cm) (Catalyst 2950T-24, 2950C-24, 2950G-12, and 2950G-24) • 1.72 x 17.5 x 13 in. (4.36 x 44.5 x 33.02 cm) (Cisco Catalyst 2950G-48) • 1.0 rack-unit high • 6.5 lb (3.0 kg) (Catalyst 2950T-24, 2950C-24, 2950G-12, and 2950G-24) • 10 lb (4.5 kg) (Cisco Catalyst 2950G-48)
Environmental Ranges	<ul style="list-style-type: none"> • Operating temperature: 32 to 113°F (0 to 45°C) • Storage temperature: -13 to 158°F (-25 to 70°C) • Operating relative humidity: 10 to 85% (non-condensing) • Operating altitude: Up to 10,000 ft (3000 m) • Storage altitude: Up to 15,000 ft (4500 m) • Not intended for use on top of desktops or in open office environments
Power Requirements	<ul style="list-style-type: none"> • Power consumption: 30W maximum, 102 BTUs per hour (Catalyst 2950T-24, 2950C-24, 2950G-12, and 2950G-24) • Power consumption: 45W maximum, 154 BTUs per hour (Catalyst 2950G-48) • AC input voltage/frequency: 100 to 127/200 to 240 VAC (auto-ranging), 50 to 60 Hz • DC Input Voltages for Cisco RPS 300 RPS: +12V @ 4.5A
Acoustic Noise	<ul style="list-style-type: none"> • ISO 7770, bystander position—operating to an ambient temperature of 30 degrees Celsius: • WS-C2950-24, WS-C2950-12, WS-C2950C-24, WS-C2950T-24: 46dBa • WS-C2950G-12, WS-C2950G-24: 46 dBa • WS-C2950G-48: 48 dBa
Mean Time Between Failure (MTBF)—Predicted	<ul style="list-style-type: none"> • 482,776 hours (Catalyst 2950G-12) • 468,884 hours (Catalyst 2950G-24) • 479,086 hours (Catalyst 2950G-24-DC) • 159,026 hours (Catalyst 2950G-48) • 297,144 hours (Catalyst 2950T-24) • 268,292 hours (Catalyst 2950C-24)

Feature	Description
Fiber-Port Specifications for Catalyst 2950C-24 Switch	Fiber-Port Power Levels: <ul style="list-style-type: none"> • Optical transmitter wavelength: 1300 nanometers • Optical receiver sensibility: -14dBm2 • Optical transmitter power: -19dBm to -14dBm • Transmit: -19dBm to -14dBm
Regulatory Agency Approvals	
Safety Certifications	<ul style="list-style-type: none"> • UL 1950/CSA 22.2 No. 950 • IEC 950-EN 60950 • AS/NZS 3260, TS001 • CE Marking
Electromagnetic Emissions Certifications	<ul style="list-style-type: none"> • FCC Part 15 Class A • EN 55022: 1998 Class A (CISPR22 Class A) • EN 55024: 1998 (CISPR24) • VCCI Class A • AS/NZS 3548 Class A • CE Marking • CNS 13438 • BSMI Class A • MIC
NEBS (For WS-C2950G-24-EI-DC only)	<ul style="list-style-type: none"> • Bellcore • GR-1089-CORE • GR-63-CORE • SR-3580 Level 3
Warranty	<ul style="list-style-type: none"> • Limited lifetime warranty

Service and Support

The services and support programs described in the table below are available as part of the Cisco Desktop Switching Service and Support solution, and are available directly from Cisco and through resellers.

Service and Support	Features	Benefits
Advanced Services		
<i>Total Implementation Solutions (TIS)</i> —available direct from Cisco <i>Packaged Total Implementation Solutions (Packaged TIS)</i> —available through resellers	<ul style="list-style-type: none"> • Project management • Site survey, configuration deployment • Installation, test, and cutover • Training • MAC • Design review and product staging 	<ul style="list-style-type: none"> • Supplements existing staff • Ensures functionality meets needs • Mitigates risk
Technical Support Services		
<i>SMARTnet and SMARTnet Onsite (OS)</i> —available direct from Cisco <i>Packaged SMARTnet</i> —available through resellers	<ul style="list-style-type: none"> • 24x7 access to software updates • Web access to technical repositories • Telephone support through the Technical Assistance Center • Advance replacement of hardware parts 	<ul style="list-style-type: none"> • Enables proactive or expedited issue resolution • Lowers cost of ownership by utilizing Cisco expertise and knowledge • Minimize network downtime

Ordering Information

Model Numbers	Configuration
WS-C2950G-48-EI	<ul style="list-style-type: none"> • 48 10/100 ports + 2 1000BASE-X ports • EI Software installed
WS-C2950G-24-EI	<ul style="list-style-type: none"> • 24 10/100 ports + 2 1000BASE-X ports • EI Software installed
WS-C2950G-24-EI-DC	<ul style="list-style-type: none"> • 24 10/100 ports + 2 1000BASE-X ports, DC power • EI Software installed
WS-C2950G-12-EI	<ul style="list-style-type: none"> • 12 10/100 ports + 2 1000BASE-X ports • EI Software installed
WS-C2950T-24	<ul style="list-style-type: none"> • 24 10/100 ports + 2 1000BASE-T ports • EI Software installed
WS-C2950C-24	<ul style="list-style-type: none"> • 24 10/100 ports + 2 100BASE-FX ports • EI Software installed
WS-C2950ST-24-LRE	<ul style="list-style-type: none"> • 24 LRE ports and 2 fixed 10/100/1000BASE-T ports and 2 Small Form Factor Pluggable (SFP) ports • EI Software installed
WS-C2950ST-8-LRE	<ul style="list-style-type: none"> • 8 LRE ports and 2 fixed 10/100/1000BASE-T ports and 2 SFP ports • EI Software installed

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