

Cisco Catalyst 2950 LRE 997 Solution for Metro Access



Figure 1. Cisco Catalyst 2950 LRE 997 Solution

Product Overview

The Cisco® Catalyst® 2950 Long-Reach Ethernet (LRE) 997 solution enables service providers to extend Metro Ethernet services over existing phone and legacy wiring (Figure 1). Service providers now have a cost-effective solution that leverages their existing copper infrastructure to deliver intelligent network services at the metro access edge, enabling service breadth, availability, security, and manageability. Designed for service provider central office deployments, the Cisco Catalyst 2950 LRE 997 Switch features DC power and is compliant with the European Telecommunications Standards Institute (ETSI) very-high-bit-rate DSL (VDSL) 997 bandplan standard. As an important component of the Cisco Metro Ethernet Switching portfolio, this solution is ideal for service providers looking to deliver profitable Ethernet services to the small and medium-sized enterprise, and to residential and small office home office (SOHO) markets. Featuring advanced rate limiting, voice virtual LAN (VLAN) support, and multicast management, this solution supports metro services such as Internet access, voice-over-IP (VoIP), and broadcast video.

Cisco LRE technology dramatically extends the reach of Ethernet up to 1500 meters over existing Category 1, 2, and 3 wiring at speeds from 4 to 12 Mbps symmetric. LRE coexists on the same medium as basic telephone service (POTS), digital telephone, and ISDN traffic, and coexists with asymmetric DSL (ADSL) in the same wire bundle, allowing service providers to provision LRE to buildings where broadband services already exist. The Cisco 2950 LRE 997 solution includes the Cisco Catalyst 2950 LRE 997 Switch (based upon the Cisco Enhanced Image (EI) IOS® Software for the Cisco Catalyst 2950 Series) and the Cisco 576 Customer Premises Equipment (CPE). Each LRE link is terminated with the Cisco 576 LRE CPE, and a POTS splitter is required when POTS traffic coexists with the LRE link over the same line.



The Cisco Catalyst 2950 LRE 997 solution consists of the following devices:

- Cisco Catalyst 2950 24 LRE 997 Switch—24 LRE ports, two 10/100/1000BASE-T ports, two small form-factor pluggable (SFP) ports (two of the four uplinks active at one time), and DC power.
- Cisco 576 LRE 997 CPE—Translates LRE into 10/100 Ethernet; one RJ-45 Ethernet port and two RJ-11 ports

The Cisco Catalyst 2950 24 LRE 997 Switch and Cisco 576 LRE 997 CPE are not interoperable with Cisco Catalyst 2950 LRE Series switches (Catalyst 2950ST-24-LRE and Catalyst 2950ST-8-LRE), the Cisco 575 and 585 LRE CPE devices, and the Cisco LRE 48-port POTS splitter.

The two built-in Gigabit Ethernet SFP ports support 1000BASE-SX, 1000BASE-LX, and 1000BASE-ZX modules. The dual SFP-based and copper Gigabit Ethernet implementation provides customers with tremendous deployment flexibility—allowing customers increased availability with the redundant uplinks. High levels of stack resiliency can also be implemented by deploying dual redundant Gigabit Ethernet uplinks and Cisco UplinkFast technologies for high-speed uplink and stack interconnection failover, and Per VLAN Spanning-Tree Plus (PVST+) for uplink load balancing. This Gigabit Ethernet flexibility makes the Cisco Catalyst 2950 24 LRE 997 Switch an ideal metro access edge complement to the Cisco 7600 Series Internet Router and Cisco Catalyst 6500 Series switches.

LRE Technology

LRE technology employs quadrature amplitude modulation (QAM), which uses both signal amplitude and phase to define each symbol. LRE uses the most sophisticated QAM technology with various QAM modulations (QAM-256, QAM-128, QAM-64, QAM-32, QAM-16, QAM-8, and QAM-4). The system administrator may choose profiles that use different modulations and frequency plans, according to the line specification and rate definition. LRE is designed to support multi-QAM to achieve performance as close to the physical limit as possible, while maintaining low cost and low power.

Cisco LRE facilitates the transport of symmetrical, bidirectional data over unshielded, copper twisted-pair telephone wires originally intended for the frequency band between 300 Hz and 3.4 KHz. The system employs Frequency Division Duplexing (FDD) to separate the downstream channel, the upstream channel, and POTS, ISDN, or PBX signaling services in the frequency domain. This enables service providers to overlay LRE on existing POTS, ISDN, or analog PBX signaling services without disruption. LRE, POTS, ISDN, and analog PBX services may be transmitted over the same line without interfering with each other.

The Cisco Catalyst 2950 LRE 997 solution is compliant with the VDSL 997 frequency plan and ETSI standards for power-spectral density and upstream power backoff. The 997 frequency plan is designed for symmetric data rates and is well-suited for commercial-grade services beyond Internet access, such as VPNs.



Intelligence at the Metro Access Edge—Enabling Profitable Ethernet Services

Service providers that address the small to medium-sized enterprise, residential, and SOHO markets face the continual challenge of offering compelling value-added services. While alternative broadband technologies such as DSL can offer bandwidth at speeds ranging up to 1.5 Mbps, the monthly subscriber fees can be too costly for most users. As a result, compelling high-quality services such as high-speed Internet access, VoIP, or broadcast video are often not viable propositions over these technologies. With the Cisco Catalyst 2950 LRE 997 solution, service providers can deliver higher-bandwidth symmetric intelligent services and leverage their existing phone infrastructures. By taking advantage of the simplicity and cost benefits of Ethernet, revenue growth through voice, video, and data services becomes a reality. When considering the deployment of Ethernet services, service providers must consider the following issues:

- Building cost-effective, highly available, scalable metro Ethernet networks
- Providing profitable new services while reducing operational and capital costs
- Having the network flexibility to move up-market to enterprise and small and medium-sized business services

These issues are especially relevant at the metro access edge. As service providers look to provide profitable Ethernet services such as high-speed Internet access, voice, and video, Cisco intelligent functions such as advanced quality of service (QoS), granular rate limiting, and multicast management is essential in the provider's customer located equipment. In addition, availability and security concerns at the access edge are addressed with intelligent features such as subsecond Spanning-Tree Protocol convergence and 802.1x support. With the Cisco Catalyst 2950 LRE 997 solution, Cisco delivers the ideal balance of affordability and intelligence, enabling profitable Ethernet service breadth, availability, security, and manageability.

Most importantly, the Cisco Catalyst 2950 LRE 997 solution is a critical component of the Cisco Metro Ethernet Switching portfolio. With this portfolio, service providers can offer numerous residential and commercial services over the same network. For regional metro, metro aggregation, and metro access, Cisco Metro Ethernet Switching enables service providers to deliver profitable, comprehensive Ethernet services. With the effective integration of existing WAN services, such as Frame Relay and ATM, Cisco Metro Ethernet Switching offers an unmatched breadth of service delivery mechanisms. Cisco also helps service providers minimize total cost of ownership for new services with its extensive automated operations support. Through technology leadership, financial stability, and a commitment to customer support, Cisco helps to ensure service success from “start-to-scale.”



Service Breadth Through Advanced QoS, Rate Limiting, and Voice and Multicast Features

To achieve profitability, service providers that service small to medium-sized enterprises and residential and SOHO markets must offer value-added services such as voice and video in addition to basic high-speed Internet connectivity to increase revenue per subscriber. However, these services are only compelling when service quality matches that of competing voice and video offerings.

The Cisco Catalyst 2950 LRE 997 solution offers superior and highly granular QoS to ensure that network traffic is classified and prioritized, and that congestion is avoided in the best possible manner. The Cisco Catalyst 2950 LRE 997 switch 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 to enforce policies based on Layer 2 and Layer 3 QoS fields.

To implement QoS, this switch first identifies traffic flows, or packet groups, and classifies or reclassifies 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 be based on criteria as specific as the source or destination IP address, the source or destination MAC address, or the Layer 4 Transmission Control Protocol/User Datagram Protocol (TCP/UDP) ports. At the ingress, the Cisco Catalyst switch 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 Cisco Catalyst 2950 LRE 997 Switch supports four egress (outgoing port) queues per port, which allows the network manager to be more discriminating and specific in assigning priorities for the various applications on the metro Ethernet network. At the egress, the switch performs Weighted Round Robin (WRR) or strict priority scheduling to determine the order in which the queues are processed. The WRR queuing 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 scheduling.

In terms of rate limiting, the Cisco Catalyst 2950 LRE 997 Switch is capable of allocating bandwidth based on several criteria, including MAC source or destination address, IP source or destination address, and TCP/UDP port number. Bandwidth allocation is essential in network environments requiring service-level agreements (SLAs), or when it is necessary for the network manager to control the bandwidth given to certain subscribers. The Cisco Catalyst 2950 LRE 997 Switch supports up to 6 policers per LRE port and up to 60 policers on a Gigabit Ethernet port. Traffic policing can be done in 1-Mbps increments on LRE ports and 8-Mbps increments on Gigabit Ethernet ports, giving the network manager granular control of network bandwidth.

The Cisco Catalyst 2950 LRE 997 switch provides important voice and video service features with Auxiliary VLAN for VoIP services and hardware-based Internet Group Management Protocol (IGMP) snooping, which allows the switch to “listen” to 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. When the switch hears an “IGMP leave” request, it removes the host’s port from the list. Together with the superior QoS and rate-limiting features, service providers can build a flexible network with the Cisco Catalyst 2950 LRE 997 solution to provide voice, video, and data services all in one network architecture.



Service Availability Through Resiliency Enhancements and Network Redundancy

The Cisco Catalyst 2950 LRE 997 solution provides a rich set of resiliency enhancement features to help ensure quick failover recovery and to create a high-availability network. The IEEE 802.1w Rapid Spanning-Tree standard allows the service provider to achieve subsecond spanning-tree convergence time to maximize network stability and reliability. The IEEE 802.1s Multiple Spanning-Tree standard can be deployed in conjunction with 802.1w to improve the scalability of the Spanning-Tree Protocol by grouping VLANs into spanning-tree instances, as well as to provide backward compatibility to devices running the 802.1D Spanning-Tree Protocol.

Service providers can also enable Bridge Protocol Data Unit (BPDU) guard and Spanning-Tree Root Guard (STRG) to enhance the reliability of their networks. BPDU guard allows the service provider to shut down Spanning-Tree Protocol PortFast-enabled interfaces to avoid receiving BPDUs from customer networks. STRG prevents customer devices outside of the service provider's network from becoming Spanning-Tree Protocol root nodes.

The Cisco Catalyst 2950 LRE 997 solution enables the service provider to build a highly redundant network. PVST+ allows the service provider to implement Layer 2 load sharing on redundant links, efficiently using the extra capacity inherent in a redundant design. Service providers can also use Cisco EtherChannel® technology to aggregate up to 4 Gbps through Gigabit EtherChannel and up to 192 Mbps over the LRE links using Port Aggregation Protocol (PAgP). Cisco EtherChannel and PAgP technology enhance fault tolerance and offer higher-speed aggregated bandwidth between switches and to routers.

Metro network scalability is also enhanced by the Cisco Catalyst 2950 LRE 997 solution's support of 4096 VLAN IDs and 256 active VLANs per switch.

Service Security Through Cisco Access Control Parameters and Enhanced Security Features

The Cisco Catalyst 2950 LRE 997 solution offers enhanced data security through the use of access control parameters (ACPs). By denying packets based on source and destination MAC addresses, IP addresses, or TCP/UDP ports, users can be restricted from sensitive portions of the network. Also, because all ACP lookups are performed in hardware, forwarding performance is not compromised when implementing ACP-based security in the network.

Service providers can also implement higher levels of data security with a private VLAN edge. This provides security and isolation between ports on a switch, helping to ensure that traffic travels directly from its entry point to the aggregation device through a virtual path and cannot be directed to a different port. Local Proxy Address Resolution Protocol (ARP) works in conjunction with private VLAN edge to minimize broadcasts and maximize available bandwidth.

With the Cisco Catalyst 2950 LRE 997 solution, service providers can implement high levels of console security. Multilevel access security on the switch console and the Web-based management interface prevent unauthorized users from accessing or altering switch configuration. TACACS+ authentication enables centralized access control of the switch and restricts unauthorized users from altering the configuration.

Service providers are also able to enhance their network security by adding 802.1x port-based authentication for authenticating individual customers, and port security with MAC address aging for limiting the concurrent MAC addresses allowed per port.



Service Management Through Cisco CNS 2100 Series Intelligence Engine and SNMP

The Cisco Catalyst 2950 LRE 997 solution provides outstanding service management capabilities through Cisco CNS 2100 Series Intelligence Engine support and Simple Network Management Protocol (SNMP). Service providers will be able to integrate the Cisco Catalyst 2950 LRE 997 solution into their operational support systems (OSSs) and enable improved flow-through provisioning.

The Cisco CNS 2100 Series network device allows service providers to effectively manage a network of Cisco IOS Software devices, including the Cisco Catalyst 2950 LRE 997 solution. It is a self-contained unit that includes a task-oriented Web graphical user interface (GUI), a programmable extensible markup language (XML) interface, configuration template management, and an embedded repository. Network operators can use the Web GUI to quickly turn existing Cisco IOS Software command-line interface (CLI) configuration files into reusable templates. The Cisco IE 2100 Series supports easy integration into existing customer OSSs/business support systems (BSSs) and provisioning systems using its external repository support and the event-based Cisco IOS XML interface that effectively “workflow-enables” Cisco device deployment.

Service providers can also manage the Cisco Catalyst 2950 LRE 997 solution using SNMP versions 2 and 3, and the Telnet interface for comprehensive in-band management. A CLI-based management console provides detailed out-of-band management.

A comprehensive set of Management Information Bases (MIBs) is provided for the service provider to collect traffic information on the Cisco Catalyst 2950 LRE 997 solution for various billing methods.



Product Features and Benefits

Feature	Benefit																																																
Performance																																																	
Robust Performance Over Existing Telephone Wiring	<ul style="list-style-type: none"> • 4 to 12 Mbps symmetric bandwidth over Category 1, 2, 3, or 5 single-pair copper wiring over distances up to 1500 meters • All profiles are compliant with plan 997 VDSL (ETSI TS 101 270-1 and ETSI TS 101 270-2) • Profiles available for optimizing upstream and downstream bandwidth requirements (actual achievable data rates depend on cable quality, noise, and cross-talk environment) 																																																
	<table border="1"> <thead> <tr> <th>Profile Name</th> <th>Downstream</th> <th>Upstream</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td>LRE-12-9</td> <td>12</td> <td>9</td> <td></td> </tr> <tr> <td>LRE-12-3</td> <td>12</td> <td>3</td> <td></td> </tr> <tr> <td>LRE-9</td> <td>9</td> <td>9</td> <td></td> </tr> <tr> <td>LRE-9-6</td> <td>9</td> <td>6</td> <td></td> </tr> <tr> <td>LRE-9-4</td> <td>9</td> <td>4</td> <td></td> </tr> <tr> <td>LRE-9-3</td> <td>9</td> <td>3</td> <td></td> </tr> <tr> <td>LRE-6</td> <td>6</td> <td>6</td> <td>Default Profile</td> </tr> <tr> <td>LRE-6-4</td> <td>6</td> <td>4</td> <td></td> </tr> <tr> <td>LRE-6-3</td> <td>6</td> <td>3</td> <td></td> </tr> <tr> <td>LRE-4</td> <td>4</td> <td>4</td> <td></td> </tr> <tr> <td>LRE-4-3</td> <td>4</td> <td>3</td> <td></td> </tr> </tbody> </table>	Profile Name	Downstream	Upstream	Notes	LRE-12-9	12	9		LRE-12-3	12	3		LRE-9	9	9		LRE-9-6	9	6		LRE-9-4	9	4		LRE-9-3	9	3		LRE-6	6	6	Default Profile	LRE-6-4	6	4		LRE-6-3	6	3		LRE-4	4	4		LRE-4-3	4	3	
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	<ul style="list-style-type: none"> • Rate selection automates the process of selecting a profile that is optimal on a given interface, greatly improving the ease of installation and optimizing the bandwidth for a given environment; profiles are grouped into sequences that can be configured by the customer • Flexibility to use either 10BASE-T/100BASE-TX/1000BASE-T autosensing ports, or SFPs for fiber connectivity to support LRE switch daisy-chaining, aggregation, or server or router connectivity • Full-duplex operation on all ports, delivering up to 12 Mbps symmetric on LRE ports and up to 1000 Mbps symmetric on 10/100/1000 and SFP ports • Reed-Solomon Forward Error Correction (FEC) and high interleaver protect data payload and header information in noisy environments • LRE link persistence allows configuration of delay duration before dynamic MAC addresses are removed from the MAC address table due to LRE link drops (enabled by default) • Diagnostic link monitoring allows customers to track conditions on the LRE link and take system-defined actions after certain thresholds are reached 																																																



Service Breadth	
Advanced QoS	<ul style="list-style-type: none">• This feature enables end-to-end QoS in the network by extending the QoS trust boundary to the edge of the network• The switch supports configuring QoS ACPs on all ports to help 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
	<p>QoS classification support at ingress</p> <ul style="list-style-type: none">• The switch supports QoS classification of incoming packets for QoS flows based on Layer 2, 3, and 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, or 16-bit Ethertype• 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, or UDP source or destination port number
	<p>QoS metering or policing at ingress</p> <ul style="list-style-type: none">• Support for metering or policing of incoming packets restricts incoming traffic flows to a certain rate• The switch supports up to 6 policers per LRE port and 60 policers on a Gigabit Ethernet port• The switch offers granularity of traffic flows at 1 Mbps on LRE ports and 8 Mbps on Gigabit Ethernet ports
	<p>QoS marking at ingress</p> <ul style="list-style-type: none">• The switch supports:<ul style="list-style-type: none">– Marking and remarking packets based on state of policers or meters– Marking and remarking packets based on the following mappings: from DSCP to 802.1p and from 802.1p to DSCP– 14 widely used DSCP values– Classifying or reclassifying packets based on default DSCP per port– Classifying or reclassifying frames based on default 802.1p value per port 802.1p override at ingress
	<p>QoS scheduling support at egress</p> <ul style="list-style-type: none">• Four queues per egress port are supported in hardware• The WRR queuing algorithm helps to ensure that low-priority queues are not starved• Strict-priority queue configuration ensures that time-sensitive applications such as voice always follow an expedited path through the switch fabric
Granular Rate Limiting	<ul style="list-style-type: none">• The switch supports up to 6 policers per LRE port and up to 60 policers on a Gigabit Ethernet port• The switch offers granularity of traffic flows at 1 Mbps on LRE ports and 8 Mbps on Gigabit Ethernet ports• The switch offers the ability to limit data flows based on MAC source or destination address, IP source or 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
Voice and Video	<ul style="list-style-type: none">• 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 GDA list for that group. When the switch hears an IGMP leave request, it removes the host's port from the list• Multicast VLAN registration continuously sends multicast streams in a multicast VLAN while isolating the streams from subscriber VLANs for bandwidth and security reasons• IGMP filtering provides the control of the set of multicast groups to which a user on a switch port can belong• Voice VLAN (auxiliary VLAN) support for VoIP application allows the creation of data and voice VLANs on the same physical port



Service Availability

Resiliency and Reliability

- IEEE 802.1w RSTP takes advantage of point-to-point wiring and provides rapid convergence of the spanning tree independent of spanning-tree timers. Reconfiguration of the spanning tree can occur in less than 1 second, which is critical for networks carrying delay-sensitive traffic such as voice and video
- IEEE 802.1s MSTP, which uses RSTP for rapid convergence, enables VLANs to be grouped into a spanning-tree instance, with each instance having a spanning-tree topology independent of other spanning-tree instances. This architecture provides for multiple forwarding paths for data traffic, enables load balancing, and reduces the number of spanning-tree instances required to support a large number of VLANs
- Cisco UplinkFast and BackboneFast technologies help to ensure quick failover recovery, enhancing overall network stability and reliability
- Redundant stacking connections provide support for a redundant loopback connection for top and bottom switches in an independent stack backplane cascaded configuration
- BPDU guard shuts down Spanning-Tree Protocol PortFast-enabled interfaces when BPDUs are received to avoid accidental spanning-tree topology changes
- STRG prevents edge devices not in the network administrator's control from becoming Spanning-Tree Protocol root nodes
- Unidirectional link detection (UDLD) detects and disables unidirectional links on fiber-optic interfaces caused by incorrect fiber-optic wiring or port faults. Aggressive UDLD allows precautionary disabling of port on bidirectional links
- Per-port broadcast, multicast, and unicast storm control prevent faulty end stations from degrading overall systems performance
- Support for the optional Cisco Redundant Power System (RPS) 300, which provides superior internal power source redundancy for up to six Cisco networking devices resulting in improved fault tolerance and network uptime

Redundancy

- Bandwidth aggregation up to 4 Gbps through Gigabit EtherChannel technology and up to 192 Mbps through PAgP technology enhances fault tolerance and offers higher-speed aggregated bandwidth between switches, to routers, and to individual servers
- IEEE 802.1D Spanning-Tree Protocol support for redundant backbone connections and loop-free networks simplifies network configuration and improves fault tolerance
- PVST+ allows for Layer 2 load sharing on redundant links to efficiently use the extra capacity inherent in a redundant design
- 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

Scalability

- Support for up to 4096 VLAN IDs with 250 active VLANs per switch; and up to 64 spanning-tree instances per switch



Service Security

Networkwide Security Features

- Filtering of incoming traffic flows based on Layer 2, 3, or 4 ACPs prevents unauthorized data flows. Up to four ACPs are supported in configuring either QoS or security filters
- The following Layer 2 ACPs (or a combination) can be used for security classification of incoming packets: source or 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 or destination IP address, TCP source or destination port number, or UDP source or destination port number
- Private VLAN edge provides security and isolation between ports on a switch, helping to ensure 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
- IEEE 802.1x for dynamic port-based security
- Support for “secure ports,” preventing unauthorized stations from accessing the switch by restricting the number of concurrent MAC addresses allowed to access the port. Up to 132 addresses can be configured per port
- STRG prevents edge devices not in the network administrator’s control from becoming Spanning-Tree Protocol root nodes
- The Spanning-Tree Protocol PortFast/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 enable centralized control of the switch and restrict unauthorized users from altering the configuration



Service Management

Superior Manageability

- Cisco CNS 2100 support for flow-through provisioning and integration with OSS applications through programmatic interfaces
- SNMP v1, v2c, and v3 and Telnet interface support delivers comprehensive in-band management, and a CLI-based management console provides detailed out-of-band management
- Comprehensive MIBs are provided for the service provider to collect traffic information on the Cisco Catalyst 2950 LRE 997 solution for various billing methods
- 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
- Remote SPAN (RSPAN) allows network administrators to remotely 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
- Multifunction LEDs per port for port status, 10BASE-T/100BASE-TX/1000BASE-T indication, and switch-level status LEDs for system and redundant power supply provide a comprehensive and convenient visual management system
- MIB support for LRE profiles and Fast Ethernet port on LRE CPE

Ease of Use and Ease of Deployment

- Autoconfiguration eases deployment of switches in the network by automatically configuring multiple switches across a network using a boot server
- Autosensing on each 10BASE-T/100BASE-TX/1000BASE-T 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
- Autonegotiating on all ports automatically selects half- or full-duplex transmission mode to optimize bandwidth
- Cisco Discovery Protocol versions 1 and 2 enable a CiscoWorks network management station to automatically discover the switch in a network topology
- Cisco VTP supports dynamic VLANs and dynamic trunk configuration across all switches
- Support for dynamic VLAN assignment through implementation of the VLAN Membership Policy Server (VMPS) client provides flexibility in assigning ports to VLANs
- Dynamic Trunking Protocol (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
- IEEE 802.3z-compliant 1000BASE-SX, 1000BASE-LX, and 1000BASE-ZX physical interface support through a field-replaceable SFP module provides customers with unprecedented flexibility in switch deployment
- The default configuration stored in Flash memory helps to ensure that the switch can be quickly connected to the network and can pass traffic with minimal user intervention
- The switch supports nonstandard Ethernet frame sizes (mini-giants) up to 1542 bytes



Product Specifications

Feature	Description
Performance	Cisco Catalyst 2950ST-24-LRE 997: <ul style="list-style-type: none">• 8.8-Gbps switching fabric• 4.7-Gbps maximum forwarding bandwidth (forwarding rates based on 64-byte packets)• 3.5-Mpps wire-speed forwarding rate• 8-MB memory architecture shared by all ports• Up to 32 MB SDRAM and 8 MB Flash memory• Configurable up to 8000 MAC addresses• Configurable maximum transmission unit (MTU) of up to 1536 bytes
MIBs	Cisco Catalyst 2950 LRE specific: ETHER-LIKE-MIB CISCO-VDSL-LINE-MIB IF-MIB (RFC 1573) support for CPE Ethernet ports RMON-MIB (RFC 1757) support for CPE Ethernet ports Cisco Catalyst 2950 Series: BRIDGE-MIB CISCO-2900-MIB CISCO-CDP-MIB CISCO-CLUSTER-MIB CISCO-CONFIG-MAN-MIB CISCO-FLASH-MIB CISCO-IMAGE-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)



Product Specifications

(Continued)

Feature	Description
MIBs (continued)	OLD-CISCO-CHASSIS-MIB OLD-CISCO-CPU-MIB 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	IEEE 802.1x 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 802.3z 1000BASE-X specification 1000BASE-SX (SFP) 1000BASE-LX (SFP) 1000BASE-ZX (SFP) RMON I and II standards SNMPv1, v2c, and v3
Y2K	Y2K compliant



Product Specifications

(Continued)

Feature	Description
Connectors and Cabling	<p>Cisco Catalyst 2950ST-24-LRE 997:</p> <ul style="list-style-type: none"> • LRE ports: RJ-21 connector; one-pair Category 1, 2, or 3 unshielded twisted-pair (UTP) cabling • 10BASE-T ports: RJ-45 connectors; two-pair Category 3, 4, or 5 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 • 1000BASE-SX, -LX, and -ZX SFP-based ports: SC fiber connectors, single-mode or multimode fiber • 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=) <p>Cisco 576 LRE 997 CPE:</p> <ul style="list-style-type: none"> • One 10BASE-T/100BASE-TX port: RJ-45 connector; telephony ports: two RJ-11 connectors
Power Connectors	<p>Customers can provide power to a switch by using either the internal power supply or the Cisco RPS 300. The internal power supply connector is located in the front of the switch and the RPS connector is 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 autorangeing unit • The internal power supply supports input voltages between -36Vdc and -72Vdc • Use the supplied four pin, dual input DC terminal block <p>Cisco RPS 300 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 RPS 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 RPS receptacle
Indicators	<p>Cisco Catalyst 2950ST-24-LRE 997:</p> <ul style="list-style-type: none"> • Per-port status LEDs: Link integrity, disabled, activity, and speed (uplinks only) indications • System status LEDs: System and RPS indications <p>Cisco 576 LRE 997 CPE:</p> <ul style="list-style-type: none"> • READY: CPE link to switch present • ACT: Ethernet activity • ETH: Ethernet link present • POWER: Power indicator
Dimensions and Weight (H x W x D)	<p>Cisco Catalyst 2950ST-24-LRE 997:</p> <ul style="list-style-type: none"> • 1.72 x 17.5 x 9.7 in. (4.36 x 44.5 x 24.6 cm) • 1 rack-unit high • 8.5 lb (3.9 kg) <p>Cisco 576 LRE 997 CPE:</p> <ul style="list-style-type: none"> • 1.7 x 5.0 x 6.0 in. (43.2 x 127 x 152 mm) (without cable guard) • 1.7 x 5.0 x 6.5 in. (43.2 x 127 x 165 mm) (with cable guard) • 0.5 lb (0.2 kg) (with cable guard and no cables)

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Product Specifications

(Continued)

Feature	Description
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 percent (noncondensing) Operating altitude: Up to 10,000 ft (3000 m) Storage altitude: Up to 15,000 ft (4570 m)
Power Requirements	<ul style="list-style-type: none"> Cisco Catalyst 2950ST-24-LRE 997 power consumption: 45W maximum, 154 BTUs per hour DC input voltage: -36 to -72 VDC @ 1A
Predicted Mean Time Between Failure (MTBF)	<ul style="list-style-type: none"> Cisco Catalyst 2950ST-24-LRE 997: 324,854 hours Cisco 576 LRE 997 CPE: 943,831 hours
Regulatory Agency Approvals	Cisco Catalyst 2950 LRE 997 (WS-C2950LRE-24-997)
Safety Certifications	UL mark to UL60950 CUL mark to CAN/CSA C22.2 No. 60950-00 TUV GS mark to EN60950 CE mark
Electromagnetic Compatibility Certifications	FCC Part 15 Class A EN 55022: 1998 Class A (CISPR22 Class A) EN 55024: 1998 (CISPR24) CE Marking CNS 13438
Regulatory Agency Approvals	CISCO 576 LRE 997 CPE
Safety Certifications	UL 1950/CSA 22.2 No. 950 EC 950/EN 60950 CE Mark
Electromagnetic Compatibility Certifications	FCC Part 15 Class B EN 55022 Class B (CISPR 22 Class B) CE Mark
Warranty	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		
Total Implementation Solutions (TIS) Available direct from Cisco Packaged TIS Available through resellers	<ul style="list-style-type: none"> • Project management • Site survey, configuration deployment • Installation, test, and cutover • Training • Major moves, adds, and changes • Design review and product staging 	<ul style="list-style-type: none"> • Supplements existing staff • Ensures that functions meet customer needs • Mitigates risk
Technical Support Services		
Cisco SMARTnet [®] and SMARTnet Onsite Available direct from Cisco Packaged Cisco SMARTnet Service Available through resellers	<ul style="list-style-type: none"> • 24-hour access to software updates • Web access to technical repositories • Telephone support through the Cisco 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 using Cisco expertise and knowledge • Minimizes network downtime

Ordering Information

Model Numbers	Configuration
WS-C2950LRE-24-997	24 LRE ports, two 10/100/1000BASE-T ports, 2 SFP ports (2 of the 4 uplinks active at one time), and DC power Based upon the Cisco Catalyst 2950 Series Enhanced Image (EI) Software
CISCO576-LRE997	One RJ-45 Fast Ethernet port and two RJ-11 ports
CISCO576-LRE997-6	One RJ-45 Fast Ethernet port and two RJ-11 ports (6 pack)
CISCO576-LRE997-24	One RJ-45 Fast Ethernet port and two RJ-11 ports (24-pack)
GLC-SX-MM(=)	1000BASE-SX SFP
GLC-LH-SM(=)	1000BASE-LX SFP
GLC-ZX-SM(=)	1000BASE-ZX SFP

For More Information

United States and Canada: 800-553-NETS (6387)

Europe: 32-2-778-4242

Australia: 612-9935-4107

Other: 408-526-7209

<http://www.cisco.com>

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Printed in the USA