Cisco Signaling Link Terminal

The Cisco® Signaling Link Terminal (SLT) is an integral part of the Cisco PGW 2200 Softswitch node, designed for terminating Signaling System 7 (SS7) signaling traffic and backhauling Message Transfer Part Layer 3 (MTP3), ISDN User Part (ISUP), and higher layers over IP to Cisco Media Gateway Controller (MGC) hosts. The special-purpose Cisco IOS® Software image can run on Cisco 2611 and 2651XM Multiservice Routers as a standalone product or on Cisco AS5350 and AS5400 Universal Gateways in conjunction with voice traffic (integrated SLT).

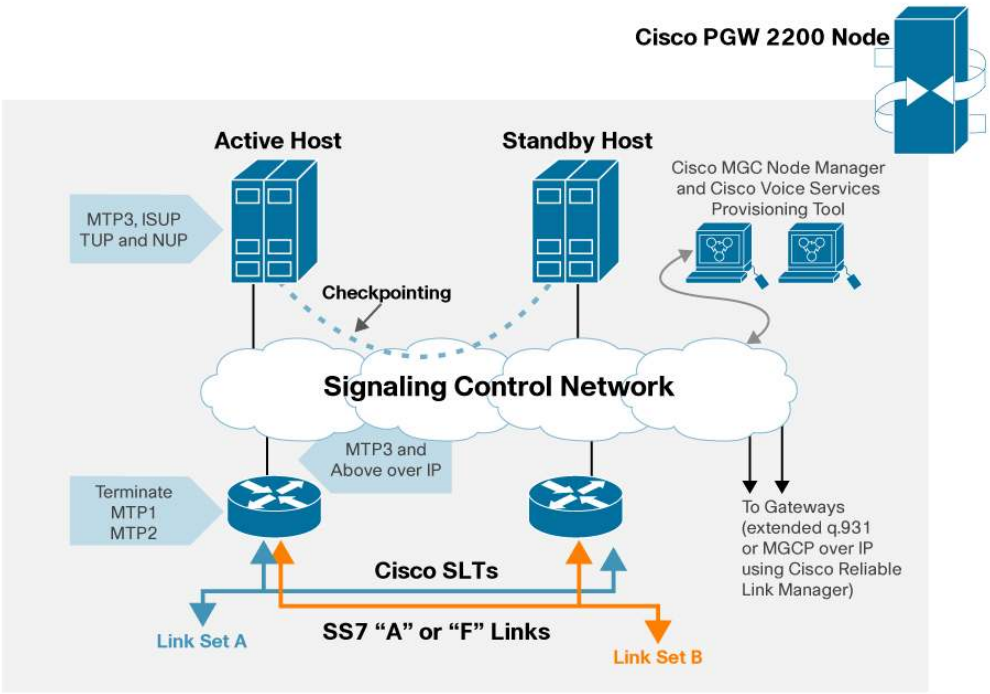
The Cisco SLT provides one of the two available methods for terminating SS7 signaling on the Cisco PGW 2200 Softswitch. Another product that provides SS7 link termination is the Cisco IP Transfer Point (ITP), which can act as both an IP-enabled STP and a signaling gateway.

CISCO PGW 2200 SOFTSWITCH NODE ARCHITECTURE

A Cisco PGW 2200 Softswitch node consists of the Cisco SLTs and redundant Cisco MGC hosts, interconnected through an IP signaling control network.

In Figure 1, access ("A") links or fully associated ("F") links from the SS7 network are physically connected on the Cisco SLT through one of several supported interface cards. The Cisco SLT terminates MTP Layers 1 and 2 of the SS7 protocol stack. Because MTP2 is a message- and processor-intensive layer of SS7 signaling, terminating it on the Cisco SLT frees the Cisco PGW 2200 Softswitch from wasting cycles on lower-layer functions.

Figure 1. Cisco PGW 2200 Softswitch Node Architecture



The Cisco SLT uses the Reliable User Datagram Protocol (RUDP) to backhaul the upper-layer SS7 protocols across an IP signaling control network to the Cisco MGC. Cisco RUDP is a simple, connection-oriented, packet-based transport protocol based on RFC 908 (Reliable Data Protocol) and RFC 1151 (Version 2 of the Reliable Data Protocol).

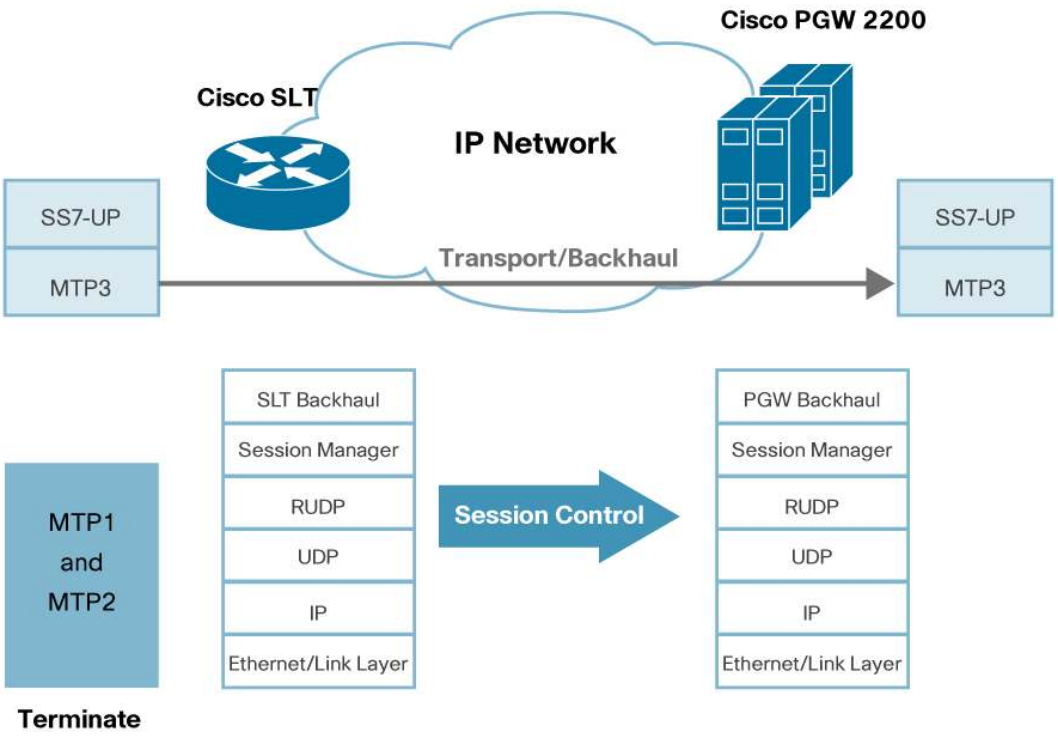
Upper layers forwarded include:

- MTP3
- ISUP
- Signal Connection Control Part (SCCP)
- Transactions Capabilities Applications Part (TCAP)
- Advanced Intelligent Network (AIN)
- Intelligent Network Application (INAP)

The Cisco SLTs use the Cisco IOS® Software SS7 SLT feature set, providing reliable interoperability within the Cisco PGW 2200 Softswitch node.

Cisco Session Manager software manages the communication sessions with the Cisco MGC. When the Cisco SLT feature is used with a redundant pair of controllers, the Cisco Session Manager software maintains separate communication sessions with each controller in the pair. The session between the Cisco SLT and the active controller transports the SS7 traffic, while the session between the Cisco SLT and the standby controller provides backup. Cisco Session Manager software uses Cisco RUDP to communicate between the Cisco SLT and the Cisco MGC. Figure 2 illustrates this concept.

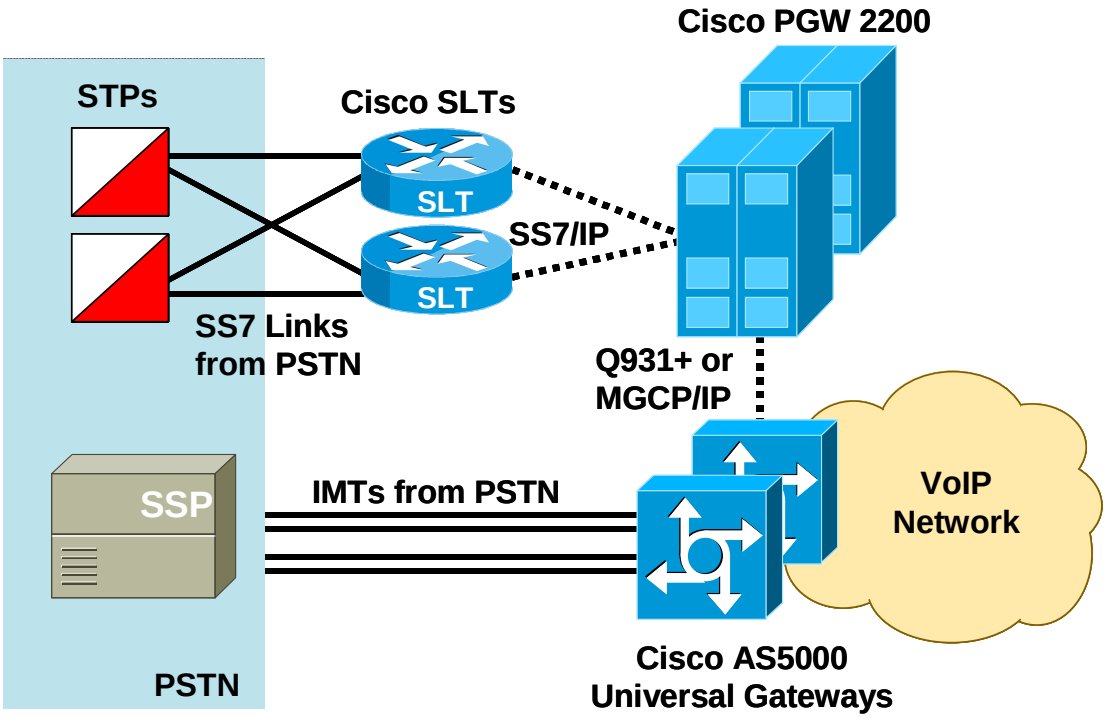
Figure 2. SS7 Signaling Backhaul Architecture



STANDALONE AND INTEGRATED SLT OPTIONS

Designed to meet customers' individual needs, the Cisco SLT is available in both standalone and integrated configurations. The standalone product runs a special-purpose Cisco IOS Software image on the Cisco 2611XM and 2651XM Multiservice Platforms specifically designed to terminate SS7 signaling links. When used with one of the many supported WAN interface cards (WICs) or voice WICs (VWICs), the standalone Cisco SLT provides a high-performance, economical product with which to terminate SS7 facilities. Figure 3 illustrates the standalone Cisco SLT architecture.

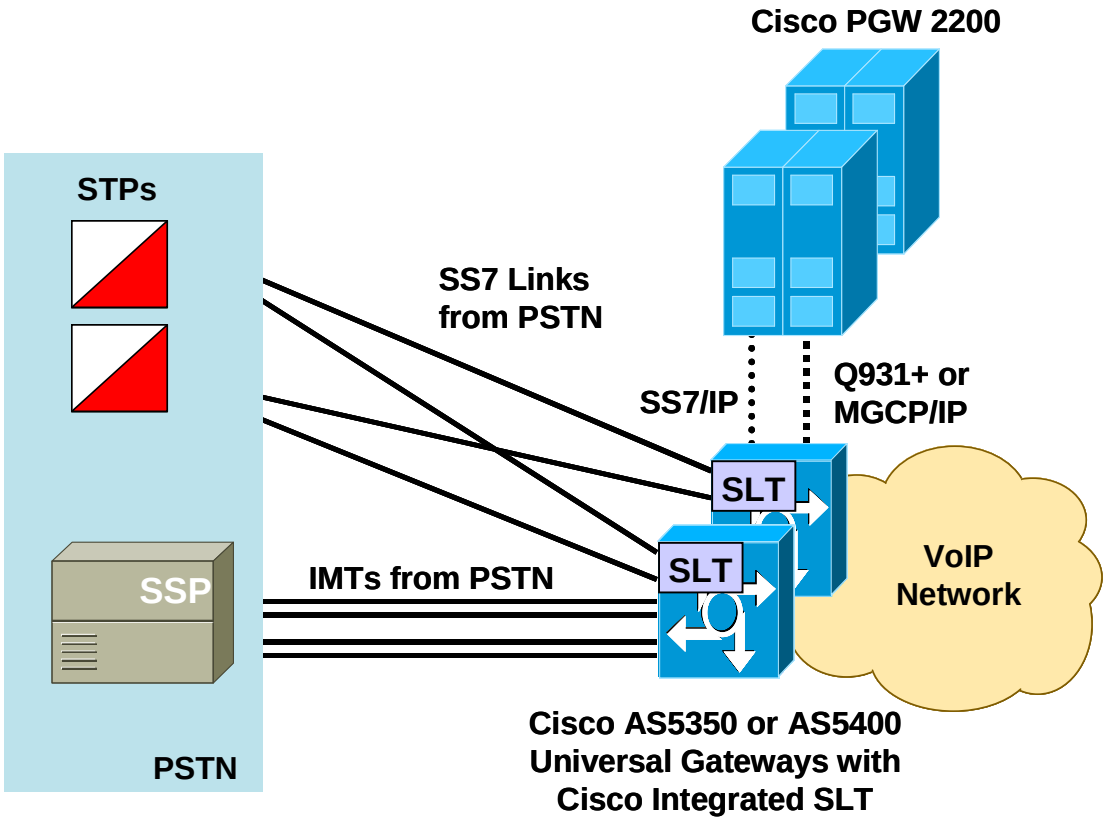
Figure 3. Standalone Cisco SLT Architecture



The Cisco AS5350, AS5400, AS5400HPX, AS5350XM, and AS5400XM Universal Gateways offer, as an option, an integrated version of the Cisco SLT. In this case, the universal gateways can function as network access servers, voice gateways, and SLT. SS7 signaling links and Inter-Machine Trunks (IMTs) are terminated directly on the universal gateway from the public switched telephone network (PSTN). Figure 4 illustrates the integrated Cisco SLT architecture.

The integrated SLT option is appropriate for any voice-over-IP (VoIP) network deployment, but is well suited for smaller, highly distributed networks requiring many small points of presence (POPs) or local interconnect points. Combined with a low-end Sun platform as the Cisco MGC and a Cisco AS5350XM acting as the universal gateway and SLT, it is possible to build a "micro-POP" that can be deployed in as little as 3 rack units (3RUs). Figure 4 illustrates this concept.

Figure 4. Integrated Cisco SLT Architecture



SUPPORTED SS7 NETWORK INTERCONNECT METHODS USING THE CISCO SLT

When the Cisco PGW 2200 Softswitch is used in Cisco VoIP networks, the solution supports common signaling interconnect methods as well as features that exploit the power and savings of transporting SS7 signaling over IP-based networks.

A LINKS

Access or A links are used between the service switching point (SSP), served by the Cisco PGW 2200 Softswitch, and the signaling transfer point (STP) to connect the VoIP network to the PSTN. These links are dedicated to signaling, meaning that no bearer traffic is provisioned on the facility, even if available time slots are not being used for signaling. For reliability, there are generally, at a minimum, two A links provisioned between the SLTs and the home STPs. Although most commonly seen in North America, A links are used in other geographic areas such as Asia and South America, depending on availability of facilities.

F LINKS

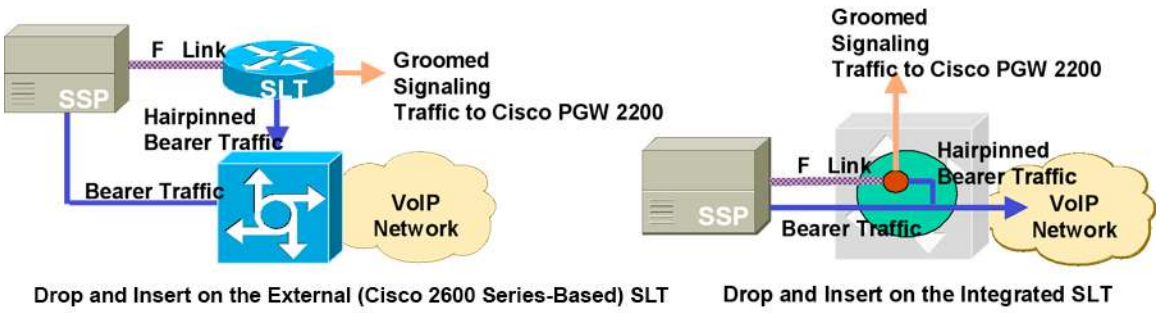
Fully associated or F links are generally deployed when a large volume of traffic exists between two SSPs (between the Cisco PGW 2200 Softswitch and a PSTN switch, for example) or when it is not feasible to connect directly to an STP. F links are not commonly used in North America, but they are widely deployed in Europe, Asia, and South America. Although F links can be provisioned with only signaling on the facility, the most common configuration includes the provisioning of bearer channels on time slots not used by SS7 signaling.

DROP-AND-INSERT OPTION

The “drop-and-insert” application feature, also known as time-division multiplexing (TDM) cross-connect, allows customers to deploy F links with both signaling and bearer traffic on the same facility. This feature grooms the SS7 signaling channels from the facility and backhauls the signaling to a Cisco MGC for processing. Bearer channels are “hairpinned” on the Cisco SLT Interface Card and sent to a voice gateway by connecting a cable between the egress port on the Cisco SLT VWIC and an available T1 or E1 port on a gateway.

The integrated SLT offers an internal drop-and-insert feature that requires no external cabling. All bearer channels are internally hairpinned on the gateway and sent to the VoIP network. Figure 5 depicts both the Cisco SLT and integrated SLT drop-and-insert architectures.

Figure 5. Drop-and-Insert Architectures



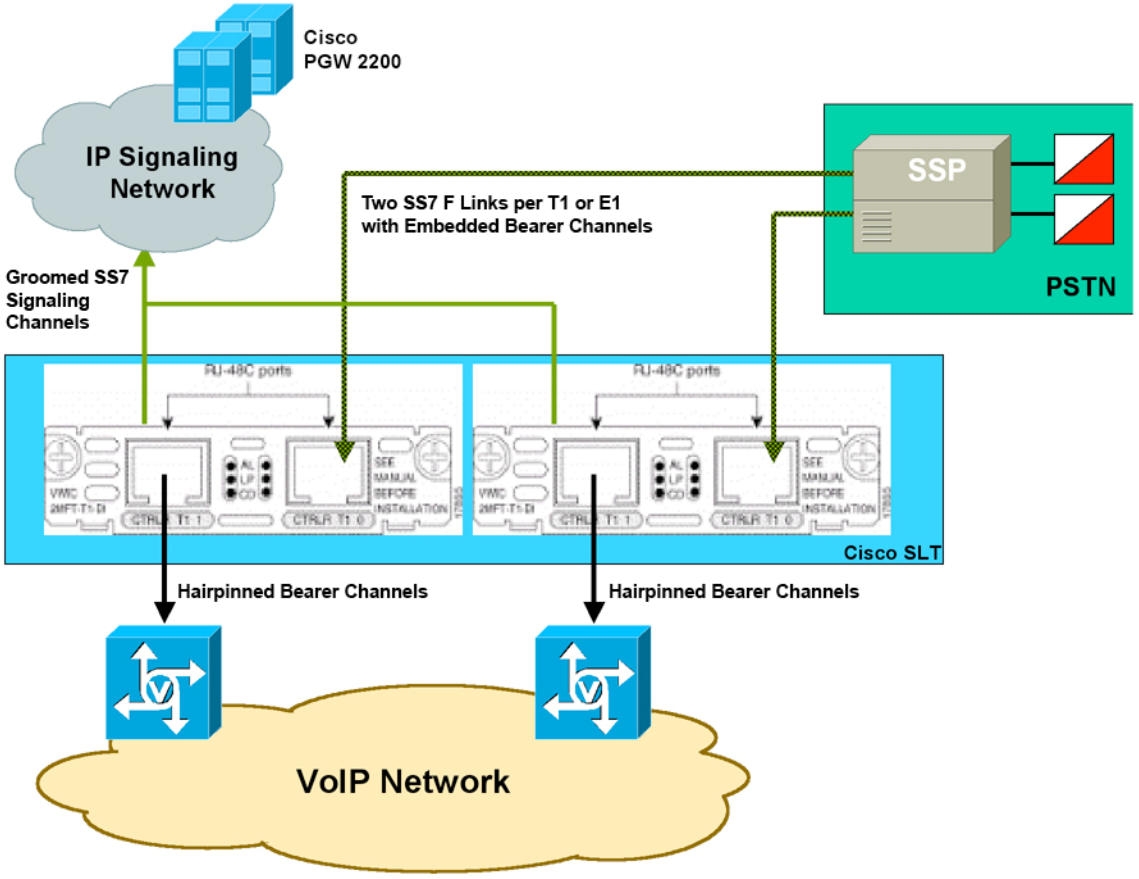
USING THE VWIC DROP-AND-INSERT CARDS TO TERMINATE FOUR F LINKS

The Cisco SLT that is based on the Cisco 2651XM Multiservice Platform can terminate up to four SS7 A or F signaling links. The configuration used to support four links is determined by the WICs chosen to terminate the physical facilities and the SS7 signaling links within those facilities.

Although configuring four links on most of the available WICs and VWICs is intuitive, terminating four F links on the Cisco SLT based on the Cisco 2651XM requires careful consideration. Generally, F links are provisioned with bearers on the available channels not being used by SS7 signaling. Separating the bearer channels from the SS7 signaling channels requires a demultiplexing function, either internal or external to the Cisco SLT. Although external demultiplexing is possible, it is generally more cost-effective to use the drop-and-insert function available on the interface cards with part numbers VWIC-2MFT-TI-DI and VWIC-2MFT-E1-DI.

To terminate four F links with bearers on the Cisco SLT based on the Cisco 2651XM requires installing two of the WICs enabled with the drop-and-insert function in the two available WIC slots (card slots W0 and W1) on the Cisco SLT. Two F links, configured with two signaling channels per facility, are terminated on the SLT on each of the WICs. Figure 6 illustrates this concept.

Figure 6. Terminating Four F Links with 2-Port T1/E1 Multiflex Trunk Interface Cards with Drop-and-Insert Feature

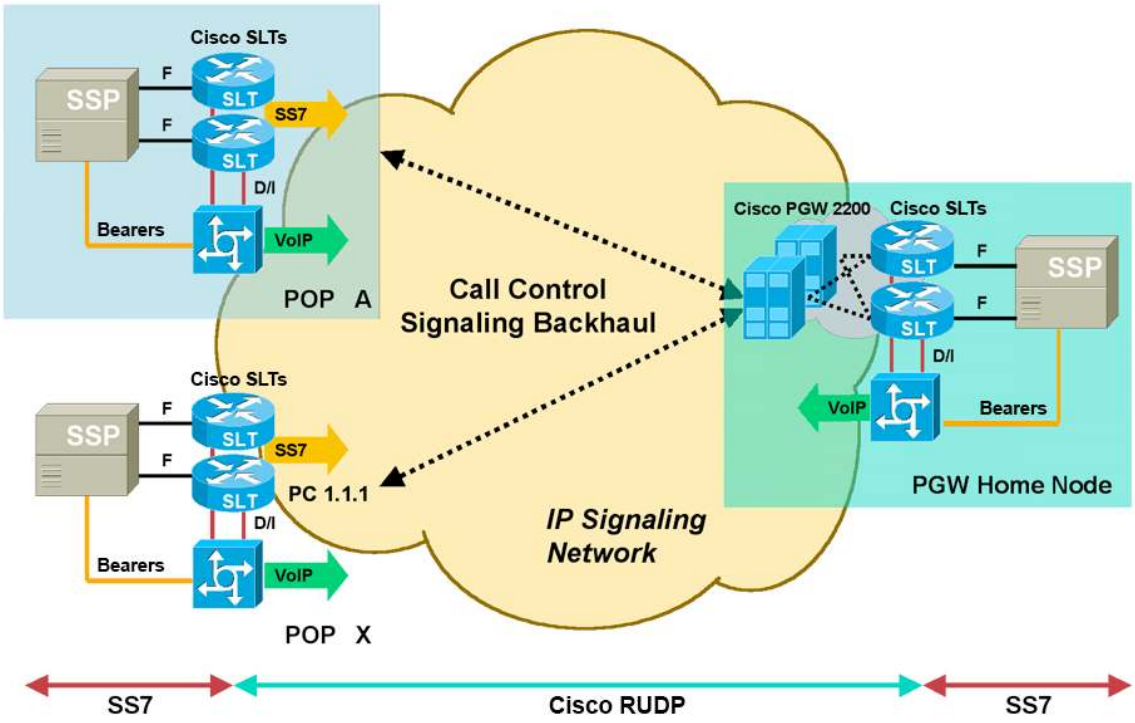


In situations where interconnect regulations permit the provisioning of only one signaling channel per facility on an F link, the Cisco SLT based on the Cisco 2651XM is restricted to supporting a maximum of two F links.

REMOTE SS7 SIGNALING BACKHAUL

The Cisco SLT supports both co-located and remote termination of SS7 signaling links. With co-located configurations, the Cisco SLTs are physically located with the Cisco MGC hosts, and are connected to the host through a LAN. Remote configurations are defined as deployments where the SS7 signaling is backhauled over an IP-based WAN from an SSP or STP to the Cisco PGW 2200 Softswitch. Figure 7 illustrates this concept.

Figure 7. Remote SLT Architecture



Remote SS7 signaling backhaul is well suited for customers who:

- Want to deploy a centralized Cisco MGC controlling multiple POPs
- Have many SS7-enabled POPs distributed over a wide area
- Need to connect to distributed STPs or SSPs
- Need to deploy and run multiple SS7 ISUP variants on a single Cisco MGC

The ability to backhaul SS7 signaling over a wide-area, IP-based network offers cost-savings benefits, including:

- Lowering the overall, initial cost of deploying VoIP networks by reducing equipment costs, especially for rollouts of multiple or distributed POPs over a wide geographic area
- Dramatically reducing recurring telecommunications costs by eliminating dedicated, point-to-point SS7 signaling links

In many countries, the cost of dedicated signaling links can be prohibitive—and they may also be unavailable because of facilities shortages. With the Cisco PGW 2200 Softswitch and its SLT-based architecture, customers can now take advantage of IP-based WANs to backhaul SS7 signaling from STPs and SSPs to the Cisco MGC for call processing.

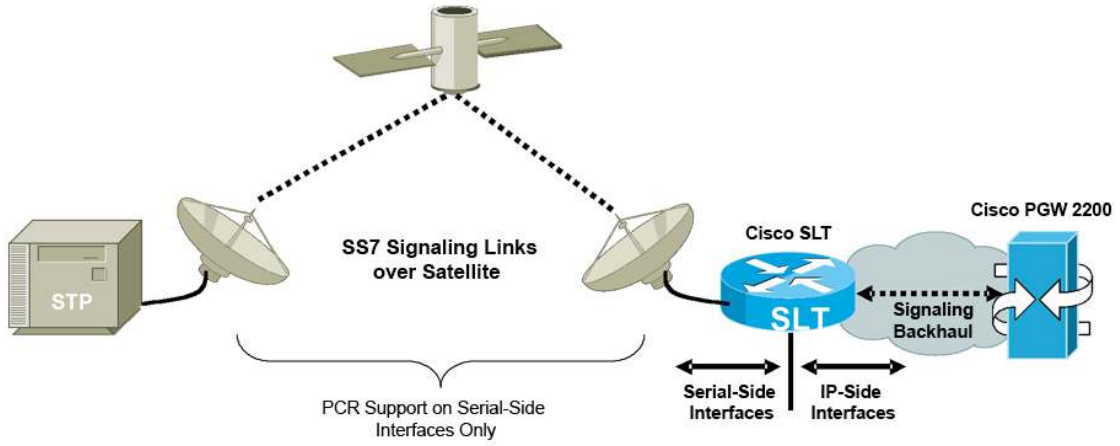
PCR SUPPORT

SS7 offers two methods of error checking: basic and Preventive Cyclic Redundancy (PCR). Basic error detection and correction is used when SS7 is carried over terrestrial signaling links. When an error is detected using basic error detection and correction, a retransmission is requested. The sequence number is provided for the last known signaling unit that was good, permitting the originator of the errored signaling unit to determine which signaling units to retransmit.

Because of the inherent propagation delay when using satellite transmission, as illustrated in Figure 8, PCR method of error-detection is used when SS7 is transmitted over satellite links. When using PCR, all transmitted signaling units are continually retransmitted until they are acknowledged by the distant end. When acknowledged, the signaling units are dropped from the transmission buffer.

PCR is applicable only to the serial-side interfaces of the Cisco SLT (the serial interfaces between the STP and the Cisco SLT). It cannot be applied to the IP-side interfaces between the Cisco SLT and the Cisco MGC.

Figure 8. PCR Support for the Cisco SLT



CISCO SLT FEATURE SET

Table 1 summarizes the feature set available on both the standalone and integrated Cisco SLT.

Table 1. Cisco Signaling Link Terminal

Feature	Description
Physical layer interfaces (MTP1)	• Cisco SLT (Cisco 2611XM-based) ◦ Terminate up to two 64- or 56-kbps SS7 signaling links ◦ Provide T1, E1, V.35, RS-449, or RS-530 physical interfaces to the SS7 network ◦ Support up to 2 SS7 signaling links per T1 or E1 port • Cisco SLT (Cisco 2651XM-based) ◦ Terminate up to four 64- or 56-kbps SS7 signaling links ◦ Provide T1, E1, V.35, RS-449, or RS-530 physical interfaces to the SS7 network ◦ Support up to 2 SS7 signaling links per T1 or E1 port • Integrated SLT (Cisco AS5350, AS5400, and AS5400HPX) ◦ Terminate up to four 64-kbps (E1 interface) or 56-kbps (T1 Interface) SS7 signaling links ◦ Provide Channelized T3 (CT3), T1, E1, and V.35 physical interfaces to the network ◦ Support up to 4 SS7 signaling links per CT3, T1, or E1 port

Termination of processor-intensive MTP2 functions	• Link-state control (LSC) provides the overall coordination of the session. • Initial alignment control (IAC) provides the link alignment processing. • Transmit control provides transmit flow control and processing. • Receive control provides receive flow control and processing. • Congestion control provides congestion onset and abatement processing. • Signal unit error rate monitor (SUERM) provides monitoring of signal unit events. • Signal unit delimitation detects individual signal units. • Signal unit alignment enforces signal unit encoding rules and bit patterns. • Error detection detects bit errors in signal units by using the Cyclic Redundancy Check (CRC) field. • Error correction uses positive and negative acknowledgments and retransmits errored signal units. • Cisco SLT supports both basic error detection and correction and PCR. • An alignment error rate monitor (AERM) monitors link alignment errors.
Standalone Cisco SLT support for multiple serial interface cards (multiflex serial interface cards)	• Channelized T1 interface cards ◦ 1-port T1 multiflex interface card (VWIC-1MFT-T1) ◦ 2-port T1 multiflex interface card (VWIC-2MFT-T1) ◦ 2-port T1 multiflex trunk interface card with drop-and-insert feature (VWIC-2MFT-T1-DI) • Channelized E1 interface cards ◦ 1-port E1 multiflex interface card (VWIC-1MFT-E1) ◦ 2-port E1 multiflex interface card (VWIC-2MFT-E1) ◦ 2-port E1 multiflex trunk interface card with drop-and-insert feature (VWIC-2MFT-E1-DI) • V.35, EIA/TIA-449, and EIA/TIA-530 cards ◦ 1-port high-speed serial interface card (WIC-1T) ◦ 2-port high-speed serial interface card (WIC-2T) • 1-port serial with 4-wire 56-/64-kbps data service unit/channel service unit (DSU/CSU) interface card (WIC-1DSU-56K4)
Feature-rich multiflex interface cards	• One- or 2-port cards have T1 or E1 capability. • E1 versions support both balanced and unbalanced modes. • Cisco SLT offers a physical-layer alarm-forwarding feature between the two T1/E1 ports on 2-port cards. • The drop-and-insert feature (also called TDM cross-connect) between the T1/E1 ports on 2-port cards is used to hairpin bearer channels to a media gateway device and allow the interchange of TDM slots between the ports on a 2-port card. • The interface cards are shared between Cisco 2600 and 3600 Series Routers for common inventory sparing for various network applications.
Integrated Cisco SLT	• Cisco AS5350 and AS5350XM Universal Gateways ◦ 2-port T1 or E1 card ◦ 4-port T1 or E1 card ◦ 8-port T1 or E1 card • Cisco AS5400, AS5400HPX, and AS5400XM Universal Gateways ◦ 2-port T1 or E1 card ◦ 4-port T1 or E1 card ◦ 8-port T1 or E1 card ◦ CT3 card
Platform support	• Standalone Cisco SLT ◦ Cisco 2611XM and 2651XM Multiservice Platforms • Integrated Cisco SLT ◦ Cisco AS5350, AS5350XM, AS5400, AS5400HPX, and AS5400XM Universal Gateways
Protocol compliance	• MTP1 and -2 ◦ ITU-T Q.701–709, including G.732 support ◦ ANSI T1-111 1996 ◦ Japan TTC ◦ Japan NTT • MTP3 and higher backhauled to the MGC over IP

Deployment configurations	• Co-located—The Cisco SLT is physically located with the Cisco MGC hosts and is connected through a LAN. • Remote—The Cisco SLT is physically located somewhere other than with the Cisco MGC hosts (generally with the STP or SSP), and SS7 signaling is backhauled to the node through an IP-based WAN.
Remote SLT general deployment guidelines	• End-to-end delay (one way) must be less than 150 ms. • Packet loss must not exceed 1 percent (preferably below 0.5 percent). • Line error must be less than one E-6. [IS THAT OK?] • Cisco SLT remote guidelines are available at: http://www.cisco.com/univercd/cc/td/doc/product/access/sc/rel9/soln/voip20/impl/impdesn.htm#xtocid3. • The CiscoWorks Internetwork Performance Monitor (IPM) is recommended to measure the quality of IP-based, wide-area backhaul networks.
Cisco IOS Software Release	• Standalone Cisco SLT ◦ 12.3(7)M or later release ◦ Available at www.cisco.com • Integrated Cisco SLT ◦ 12.3(7)M or later release ◦ Available at www.cisco.com **Note:** A feature license is required when using the SLT or integrated SLT function on a Cisco IOS Software gateway.
Memory requirements	• Standalone Cisco SLT ◦ Minimum required DRAM and flash memory to support the standalone Cisco SLT feature set are 64 and 16 MB, respectively. • Integrated Cisco SLT ◦ Minimum required DRAM and flash memory to support the integrated Cisco SLT feature set are 256 and 32 MB, respectively.
Certification	• Standalone Cisco SLT ◦ Network Equipment Building Standards (NEBS) Level 3 and ETSI compliance kit, including 23- or 24-in. rack-mounts, grounding lug kit, shielded LAN cables, and bezel removal kit (for additional unit depth reduction) • Integrated Cisco SLT ◦ NEBS Level 3 ◦ ETSI

CISCO SLT PLATFORM INFORMATION

Cisco 2600XM Series Multiservice Platforms

Cisco 2600XM Series Multiservice Platform information can be found at:
http://www.cisco.com/en/US/products/hw/routers/ps259/index.html.

Cisco AS5350, AS5400, and AS5400HPX Platform Specifications

Cisco AS5400 Series Gateways information can be found at:
http://www.cisco.com/en/US/products/hw/univgate/ps505/index.html.

Cisco AS5300 Series Gateways information can be found at:
http://www.cisco.com/en/US/products/hw/univgate/ps501/index.html.

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Printed in USA C78-338820-00 03/06