CISCO IP TRANSFER POINT AS THE SIGNALING GATEWAY FOR THE CISCO BTS 10200 SOFTSWITCH

OVERVIEW

The Cisco® BTS 10200 Softswitch incorporates a comprehensive feature set, including call control for local voice services that previously required implementation of large, complex telephone switches. Compared to traditional switching systems, the Cisco BTS 10200 Softswitch generates significant savings in equipment and transmission costs, space, and the required time to deploy services. The Cisco BTS 10200 is a class-independent softswitch, supporting applications for local and transit services.

Version 4.1 brings new features to the Cisco BTS 10200 Softswitch, which, until this version, has interfaced with the Signaling System 7 (SS7) network through a pair of SS7 termination cards inserted into the Cisco BTS 10200 chassis. These cards have limited scalability, flexibility, redundancy, serviceability, and support for open standards. Cisco BTS 10200 Version 4.1 adds the Cisco IP Transfer Point (ITP) as the signaling gateway. Cisco ITP addresses the limitations with proven technology and a carrier-class system.

Cisco ITP was introduced to the service provider market in 2001, and is deployed globally. It supports capabilities that include signaling transfer point (STP), signaling transport over IP and ATM, and signaling gateway for next-generation end nodes such as service switching point (SSP) and service control point (SCP). Cisco ITP is certified by Telcordia as an ANSI STP, is completely based on open standards, and provides STP-class availability. Cisco ITP is offered on multiple platforms and can scale from 4 to 800 links.

This document describes the use of the Cisco ITP as a signaling gateway (ITP-SG) specifically for the Cisco BTS 10200. It discusses the platforms, relevant signaling standards and features, and suggested system configurations.

Additional information about the Cisco ITP can be found at:

http://www.cisco.com/en/US/products/sw/wirelssw/ps1862/index.html

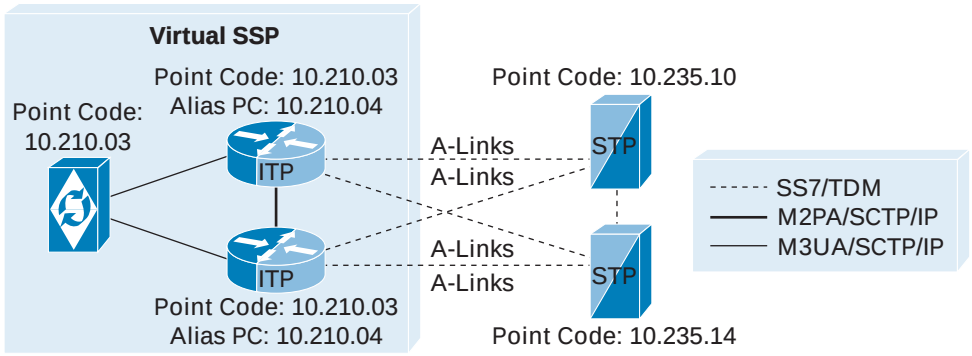
Additional information about the Cisco BTS 10200 Softswitch can be found at:

http://www.cisco.com/en/US/products/hw/vcallcon/ps531/index.html

CISCO ITP-SG WITH THE CISCO BTS 10200 SOFTSWITCH

Using distributed routing technology, the Cisco BTS 10200 and mated-paired Cisco ITP-SG(s) can be configured to appear to the rest of the signaling network as a single SSP; all three devices operate under a single point code (Figure 1). This “virtual SSP” capability greatly simplifies the implementation and management of the Cisco BTS 10200 within the signaling network. Rather than requiring three point codes to be provisioned (one for each Cisco ITP-SG, plus one for the Cisco BTS 10200), only one point is configured in the SS7 network. A-links are connected between the STPs and the ITP-SG mated pairs. The routing tables in the STPs treat this point code as if it were terminating at a single SSP (end node), hence the “virtual” SSP. The Cisco ITP-SG distributed architecture reliably enables this capability.

Figure 1
Cisco BTS 10200 and ITP-SG Share Point Code Using Distributed MTP3



CISCO ITP-SG DISTRIBUTED ARCHITECTURE

Cisco ITP-SG software allows link-sets to span two ITPs, enabling a single point code to be shared among them. The software modules that enable a pair of ITP-SGs to operate like a single device include:

- Interdevice redundancy
- Cisco ITP group feature
  - Distributed Message Transfer Part Level 3 (MTP3)
  - Distributed MTP3 User Adaptation (M3UA)
- Distributed Signaling Gateway Mate Protocol (DSGMP)
- DSGMP redundancy

These modules work together to support load sharing of links within a linkset between two physical ITP-SGs, and yet function as a single ITP-SG device. The distributed architecture of the paired ITP-SGs is controlled by one of the ITP-SGs. When the two ITP-SGs are deployed, they negotiate which will become the “manager” and which will become the “alternate.” The manager handles the synchronization and management messaging. If the manager unit fails, or if connectivity between the two units fails, the alternate immediately takes over its own tasks.

This distributed architecture allows customers to achieve increased availability, non-distributive hardware swaps, and reduced point code use. If work is being performed on one of the Cisco ITP-SG units, the other is capable of handling the traffic load. Neither the Cisco BTS 10200 nor the SS7 are affected, which greatly enhances both availability and serviceability. Cisco 2651XM, 7200VXR, and 7301 routers support this distributed MTP3 feature.

SS7 AND SIGTRAN OPEN STANDARDS

Cisco ITP uses open industry standards for traditional SS7 over time-division multiplexing (TDM) links, as well as for next-generation signaling over ATM (MTP3b) and IP (Signaling Transport [Sigtran]). In addition, Cisco ITP has been successfully tested to interoperate with equipment from 18 other vendors using Sigtran protocols.

Cisco ITP supports the signaling standards shown in Table 1.

Table 1 Protocol Specification Compliance

Protocol	Specification
MTP (1, 2, 3)	ITU-T Q.701-Q.709 White 1996 (interworks with Blue) ANSI T1.111-1996, China, Japan
Signaling Connection Control Part (SCCP)	ITU-T Q.711-Q.719 White 1996 (interworks with Blue) ANSI T1.112-1996, China, Japan
High-speed links (HSLs)	ITU E1: Q.2140, Q.2110, Q.2210, Q.2144 ANSI T1: GR-2878, I.363, I.361
Stream Control Transmission Protocol (SCTP)	IETF RFC 2960: SCTP IETF RFC 3309: SCTP Checksum Change
MTP2 Peer-to-Peer Adaptation Layer (M2PA)	IETF Sigtran SS7 M2PA, March 2, 2001
MTP3 User Adaptation	IETF RFC3332: Sigtran SS7 M3UA
SCCP-User Adaptation (SUA)	IETF Sigtran SS7 SUA Draft Version 16

The IETF created the Sigtran working group to develop a set of standard protocols for transporting legacy SS7 signaling over IP networks (SS7oIP). The standards have been developed to address lower-layer functions first, providing SS7-equivalent redundancy and availability. Building on this foundation, mechanisms for transporting (or backhaul of) SS7 signaling to IP-based endpoints were added.

For more information about Sigtran, visit:

http://www.ietf.org/html.charters/sigtran-charter.html

Operating as the signaling gateway for the Cisco BTS 10200, the Cisco ITP uses Sigtran M3UA/SCTP/IP between the Cisco ITP and Cisco BTS 10200. To the SS7 network, the Cisco ITP will use SS7/TDM, HSL (SS7oATM), or M2PA/SCTP/IP, depending on that service provider's requirements.

SCTP OVERVIEW

SCTP was designed by the IETF Sigtran Working Group. Input for this transport layer was provided by engineers from leading network and switching companies, including Cisco Systems. The IETF realized that existing protocols for transport over IP failed to provide the security and availability required for SS7. SCTP provides these requirements with several new features:

- Multiple streams within a single link association avoid the issue of head-of-line blocking caused by retransmission of messages.
- Messages are delivered in a sequence.
- Supporting selective acknowledgement of message delivery eliminates the retransmission of messages that were successfully delivered, but followed a lost message unit.
- Multi-homing allows for quick retransmission via a different path. There are typically two paths—a primary and a secondary. Normally, the traffic flows via the primary path, and an SCTP "heartbeat" is sent over the secondary path.

- The SCTP heartbeat provides a timely and meaningful reachability check. While several TCP implementations offer a "keep-alive," they have a default interval of once every two hours. The TCP implementation is used for state "clean-up," as opposed to the more frequent SCTP "fast override" objective.
- The SCTP security cookie and four-way handshake protects against SYN attacks—the most common form of denial of service attacks.

These combinations of features are not available in TCP or User Datagram Protocol (UDP) transport protocols. Once SCTP was created, the Sigtran working group had to build protocol stacks to operate on top of SCTP to provide the necessary equivalents to the SS7 stack. Since Sigtran supports SS7 in an IP environment, the Sigtran working group approached this work with the decentralized model of most IP architectures in mind. They developed four Sigtran protocols that are designed for different functions within the signaling network. The Sigtran protocol for a switching end node that requires handling of MTP3 and ISDN User Part (ISUP) traffic (like a local switch or softswitch) requires M3UA.

M3UA AND SUA OVERVIEW

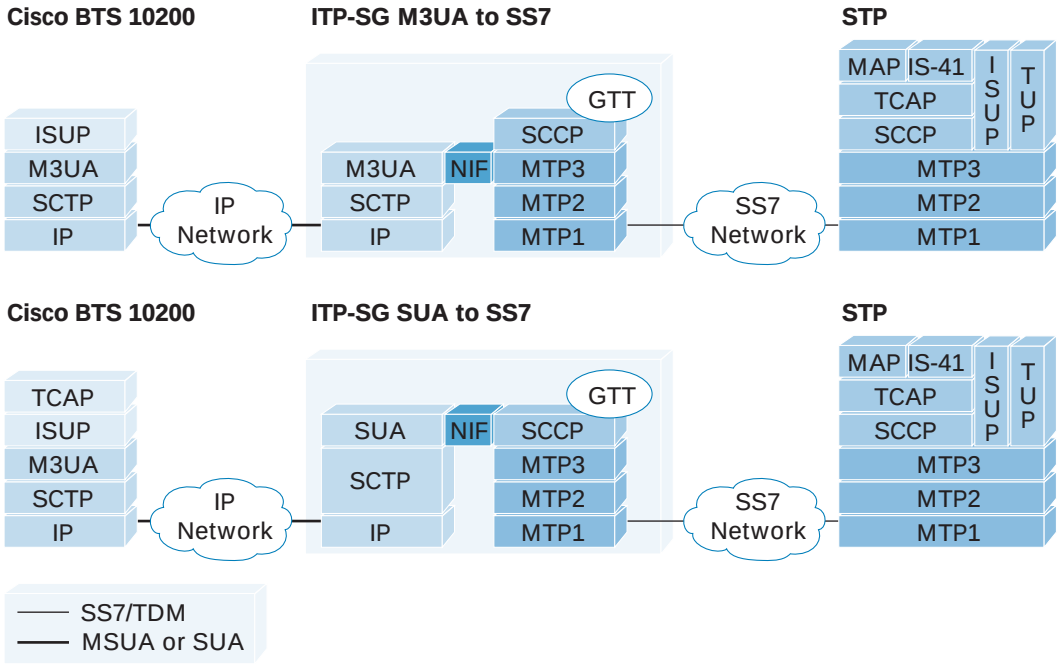
M3UA is a Sigtran protocol designed for delivering SS7 MTP3-User Part messages, as well as supporting certain MTP network management functions over SCTP transport to an IP-based application endpoint. The M3UA signaling gateway terminates the SS7 MTP2 and MTP3 protocol layers and delivers ISUP, SCCP, or any other MTP3 user protocol messages.

SUA is a Sigtran protocol designed for delivering SS7 SCCP and higher-layer messages like Transaction Capabilities Applications Part (TCAP) over SCTP transport to an IP-based application endpoint. The SUA signaling gateway terminates the SS7 MTP and SCCP protocol layers and delivers SCCP or any other user protocol messages.

The Cisco BTS 10200 Softswitch uses M3UA to support ISUP messages and SUA to support SCCP and TCAP messages. The Cisco ITP-SG simultaneously supports both M3UA and SUA, along with the SS7 traffic.

The application server process (ASP) is the Sigtran term for identifying a process or database from which the signaling gateway will send and receive M3UA or SUA traffic. In Figure 2, the ASP represents the IP endpoints of the Cisco BTS 10200.

Figure 2
Protocol Architecture



In Figure 2, the STP on the right uses MTP1, MTP2, and MTP3 for transporting SCCP and ISUP messages into the network. The Cisco ITP-SG terminates the SS7 links, translates the MTP3 and ISUP messages into M3UA messages, and transports them to the Sigtran-ready Cisco BTS 10200 over SCTP/IP. M3UA at the Cisco BTS 10200 delivers ISUP in a manner equivalent to MTP3. Likewise, the Cisco ITP-SG translates the SCCP messages into SUA to be transported between the ITP-SG and the Cisco BTS 10200.

In this network relationship, the Cisco BTS 10200 Softswitch is referred to as the ASP. While the application server is actually a logical entity that is also located on the Cisco BTS 10200, the Cisco ITP-SG maintains an application server state machine that provides the routing context via a specific set of routing keys. These routing keys are used to examine signaling traffic and to make routing decisions. The ITP-SG (application server) can support one or many ASPs. M3UA routing key parameters include:

- Destination point code (DPC) (the minimum requirement)
- Origination point code (OPC)
- Service indicator
- ISUP circuit identifier code (CIC) range*
- Global title

Note: Routing by CIC range is not currently supported on the Cisco BTS 10200.

An ASP is an SCTP endpoint of the Cisco BTS 10200. The ASP is a process instance of an application server—either an active or standby process.

The relevant traffic mode supported by the Cisco BTS 10200 Softswitch is “override.” The Cisco BTS 10200 (ASP) sends the “ASP active” message to the Cisco ITP-SG to indicate that it is ready to process signaling traffic for a particular application server. The ASP indicates its desired traffic mode in the active message. The other Cisco BTS 10200 (ASP) host serves as the standby system.

The override value indicates that the ASP will take over all traffic in an application server, overriding any currently active ASPs in the application server.

ASP BINDINGS

The call setup and teardown process is accomplished with a series of signaling messages sent between the Cisco BTS 10200 and the signaling network. Once such a message string is initiated, it is important that the rest of the string continue across the same route and equipment. To help ensure this process, the Cisco ITP-SG uses ASP bindings, which manage the signaling traffic and any associated management messages to follow a set path. In addition to maintaining local ASP bindings, the ITP-SG manager will maintain the state of the alternate’s ASP bindings. The ITP-SG manager will make all binding establishment decisions for both ITP-SGs. Binding teardown decisions are made unilaterally. Received binding update checkpoint messages for newly active bindings are treated as request or response, based on the ITP’s status. That is, a binding update (active) received by the ITP-SG manager is always a request and an update (active/inactive) received by the alternate is always a response.

A packet received on either Cisco ITP-SG that matches an ASP binding that is locally inactive but active on the other ITP-SG is rerouted to that ITP-SG. Such rerouting takes place regardless of the state of any other ASPs in the application server—rerouting is invoked even if the application server is locally active. This maintains the binding state.

MTP/M3UA MANAGEMENT MESSAGES

MTP management messages are maintained between the M3UA and SS7 environment. Table 2 lists the corresponding messages.

Table 2 MTP Management Messages Between the M3UA and SS7

M3UA Primitive to/from Cisco BTS 10200	MTP Primitive to/from STP
DATA (Payload data)	MTP-Transfer Request
DATA (Payload data)	MTP-Transfer Indication
DUNA (Destination Unavailable)	MTP-PAUSE (TFP)
DAVA (Destination Available)	MTP-RESUME (TFA)
SCON (Network Congestion State)	MTP-STATUS (TFC)
DUPU (Destination User Part Unusable)	MTP-STATUS (UPU)
DRST (Destination Restricted)	MTP-STATUS (TFR)
DAUD (Destination State Audit)	Link status of requested point codes
SPMC Network Congestion	TCF
SPMC Network Unavailable	TFP

MTP/SUA MANAGEMENT MESSAGES

MTP management messages are maintained between the SUA and SS7 environment. Table 3 lists the corresponding messages.

Table 3 MTP Management Messages Between the SUA and SS7

SUA Primitive to/from Cisco BTS 10200	MTP Primitive to/from STP
CLDT (Payload data)	UDT/XUDT
CLDR (Payload data)	UDTS/XUDTS
DUNA (Destination Unavailable)	MTP-PAUSE (TFP) or SSP
DAVA (Destination Available)	MTP-RESUME (TFA) or SSA
SCON (Network Congestion State)	MTP-STATUS (TFC) or SSC
DUPU (Destination User Part Unusable)	MTP-STATUS (UPU)
DRST (Destination Restricted)	MTP-STATUS (TFR)
DAUD (Destination State Audit)	Link or subsystem status
SPMC* Network Congestion	TCF
SPMC* Network Unavailable	TFP

CHOICE OF FLEXIBLE, SCALABLE PLATFORMS

Another benefit of migrating from line cards to the Cisco ITP-SG is flexibility and scalability. The Cisco ITP-SG is available in several platforms, including the Cisco 2651XM, 7200VXR, 7301, 7507, and 7513 routers (Table 4).These platforms incorporate the ability to be fully hardware redundant. The distributed technology that allows mated-paired Cisco ITP-SGs and the Cisco BTS 10200 to share a single point code is supported on all of the following hardware platforms except the Cisco 7500 Series platforms.

Table 4 ITP Hardware Platforms and Link Density

	Dual Power	Dual Processor	Hot-Swap Line Cards	Maximum Number of SS7 Low-Speed Links	Maximum Number of SCTP Link Associations	Maximum Number of T1/E1 Ports
Cisco 2651XM	Yes	No	No	4	100	4
Cisco 7200VXR (NPE 400)	Yes	No	Yes	24	1000	48
Cisco 7301	Yes	No	Yes	48	1000	8
Cisco 7507	Yes	Yes	Yes	240	1000	80
Cisco 7513	Yes	Yes	Yes	800	1000	176

ITP-SG platforms are typically deployed using mated-pair configurations which greatly enhance the system and overall availability.

ADDITIONAL FEATURES

The Cisco ITP can also be configured as an SUA signaling gateway, for signaling over IP (SoIP) and signaling over ATM (SoATM) transport, as a fully functional STP, SS7 probe, and a MAP (Mobile Application Part) proxy for RADIUS/HLR authentication. The Cisco ITP can simultaneously support signaling gateway and STP.

For more information about these features, visit:

http://www.cisco.com/en/US/products/sw/wirelssw/ps1862/index.html

EXAMPLES OF CISCO ITP-SG HARDWARE/SOFTWARE CONFIGURATIONS

Tables 5-7 are sample parts lists of Cisco ITP-SG configurations. Chassis, software, and memory are required. The port cards listed are options available for this product; choose whichever interfaces are required (for example, T1 ports). Additional information about the Cisco ITP can be found at:

http://www.cisco.com/en/US/products/sw/wirelssw/ps1862/index.html

Table 5 Sample Cisco 2651XM-Based ITP-SG Parts List

Detail	Product Number	Description
Chassis, power, 10/100 Ethernet	CISCO2650XM-RPS	High-performance 10/100 modular router with Cisco IOS® IP-RPS ADPT
Cisco ITP-SG software	S26SG-12220SW	Cisco 2600 Series IOS ITP (M3UA/SUA)
Flash memory upgrade	MEM2600XM-32U48FS	32 to 48 MB Flash factory upgrade for the Cisco 2600XM
DRAM memory upgrade	MEM2600XM-64U128D	64 to 128 MB DRAM factory upgrade for the Cisco 265xXM/XM VPN bundles
T1 ports	VWIC-2MFT-T1	2-port RJ-48 multiflex trunk (T1)
Serial ports	WIC-2T	2-port serial WAN interface card (WIC)

Note: The Cisco 2651-ITP supports a maximum of four SS7 links and a maximum of two WICs or virtual WICs (VWICs). Cards supporting SS7 may be T1/E1 or serial. M3UA/SCTP/IP to Cisco BTS 10200 occurs via internal 10/100 Ethernet ports. While dual AC power is shown, Cisco ITPs are available in dual DC power as well.

Table 6 Sample Cisco 7206VXR-Based ITP-SG Parts List

Detail	Product Number	Description
Chassis and 10/100 Ethernet	C7206VXR/400/2FE	Cisco 7206VXR with NPE-400 and I/O controller with two Fast Ethernet/Ethernet ports
Dual power	PWR-7200/2	Cisco 7200 dual AC power supply option, 280W
Power cables	CAB-AC	Power cord, 110V

Table 6 Sample Cisco 7206VXR-Based ITP-SG Parts List (Continued)

Detail	Product Number	Description
Cisco ITP-SG software	S72SG-12220SW	Cisco 7200 Series IOS ITP (M3UA/SUA)
Flash memory upgrade	MEM-I/O-FLD128M	Cisco 7200 I/O PCMCIA Flash disk, 128-MB option
Memory upgrade	MEM-NPE-400-256MB	256 MB memory for NPE-400 in Cisco 7200 Series
T1 ports	PA-MCX-8TE1-M	T1/E1 SS7 link port adapter for Cisco ITP
Serial (v.35) ports	PA-8T-V35	8-port serial v.35 port adapter

Note: The Cisco 7204VXR-ITP and 7206VXR-ITP support a maximum of 24 SS7 links. The 7204 and 7206 can support four or six cards and a maximum of 48 T1 ports. Cards supporting SS7 may be T1/E1 or serial. M3UA/SCTP/IP to Cisco BTS 10200 occurs via internal 10/100 Ethernet ports. While dual AC power is shown, Cisco ITPs are available in dual DC power as well.

Table 7 Sample Cisco 7301-Based ITP-SG Parts List

Details	Product	Description
Chassis and 10/100 Ethernet	CISCO7301	Cisco 7301 chassis, 256 MB memory, AC power, 64 MB of Flash memory
Dual power	PWR-7301/2-AC	Cisco 7301 dual AC power supply option
Power cables	CAB-AC	Power cord, 110V
Cisco ITP-SG software	S73SG-12219SW	Cisco 7301 Series IOS ITP (M3UA/SUA)
Flash memory upgrade	MEM-7301-FLD128	Compact disk Flash for Cisco 7301, 128-MB option
Memory upgrade	MEM-7301-512MB	512 MB memory upgrade for Cisco 7301
T1 ports	PA-MCX-8TE1-M	T1/E1 SS7 link port adapter for Cisco ITP
Serial (v.35) ports	PA-8T-V35	8-port serial v.35 port adapter

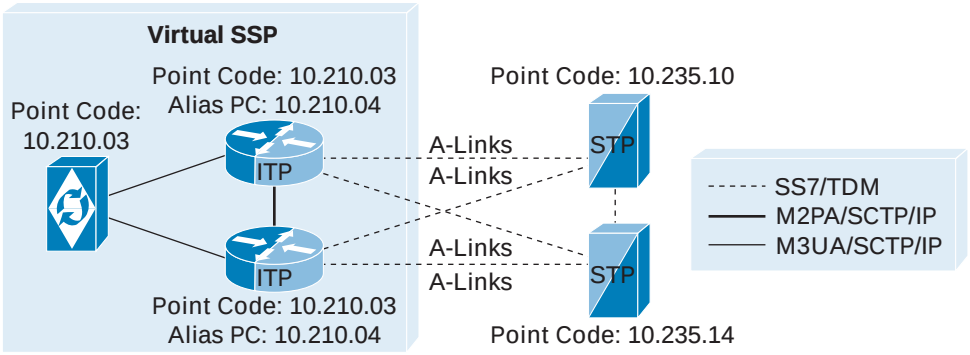
Note: Cisco 7301-ITP supports a maximum of 48 SS7 links, and a maximum of one 8-port adapter card. Cards supporting SS7 may be T1/E1 or serial. M3UA/SCTP/IP to Cisco BTS 10200 occurs via internal 10/100 Ethernet ports. While dual AC power is shown, Cisco ITP is available in dual DC power as well.

EXAMPLES OF CISCO BTS 10200/CISCO ITP-SG CONFIGURATIONS

Example 1:

This example uses A-links to terminate between the ITP-SG and STP. The redundant Cisco BTS 10200 and the mated-paired ITP-SGs all share one point code (Figure 3). The Cisco BTS 10200 Softswitch operates in active/hot standby (override) mode. The Cisco ITP-SG operates in DxUA mode. Routing is by DPC (Destination Point Code) only. In this case, the DPC is the point code shared by the ITP-SG and the Cisco BTS 10200. A-links are used because the SS7 links are between a virtual SSP and an STP.

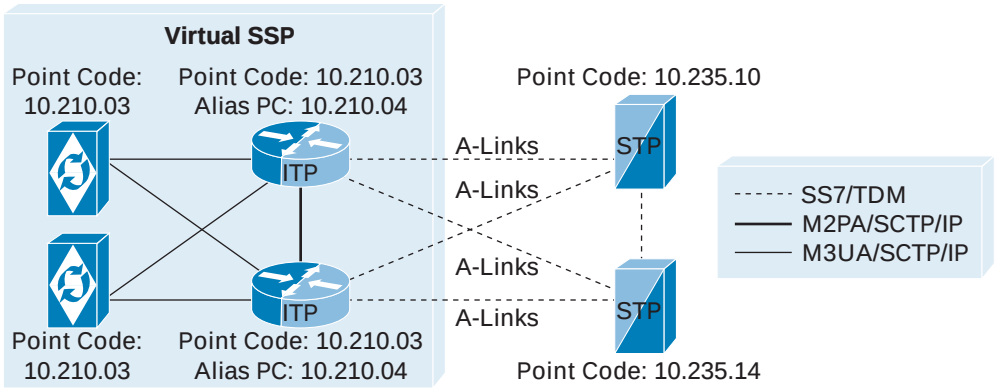
Figure 3
A-Link Termination between ITP-SG and STP—Cisco BTS 10200 and ITP-SG Share Point Code Using Distributed MTP3



Example 2:

This example uses A-links to terminate between the Cisco ITP-SG and STP. Two (redundant) Cisco BTS 10200 softswitches behind mated-paired ITP-SGs all share one point code (Figure 4). The Cisco BTS 10200 operates in load-sharing mode. Cisco ITP-SG operates in DxUA mode. Routing is by DPC only. In this case, the DPC is the point code shared by the Cisco ITP-SG and the Cisco BTS 10200. A-links are used because the SS7 links are between a virtual SSP and an STP.

Figure 4
Load Sharing Across Two or More Cisco BTS 10200 using DPC as the Routing Key



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