ACATS FORUM

ATS Network Newsletter

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Conformance Testing for SS7

The ACATS FORUM has recently been active in implementing and validating SS7 test suites according to the ITU-T and ANSI specifications. This was briefly reported in the ATS Network Newsletter, December issue. This issue aims to provide more insight into these activities.

Download Validated SS7 Test Suites!

ACATS validated test suites for Signalling System 7 (SS7) are now available for download via the ACATS FORUM web site at www.ACATS-FORUM.org/SS7.htm.

There are test suites available for MTP-2 (data link layer), MTP-3 (network layer), SCCP (transport layer), ISUP (transport layer) and TCAP (application layer), based on the ITU-T and ANSI specifications.

Following their implementation, the ACATS SS7 test suites underwent a thorough validation process. They were validated on the Alcatel A8619 Protocol Test System, firstly in virtual environments, with further enhancements made following feedback from live environments at user sites. The validation results have been documented and are also available on the web site.

This interaction has contributed to the quality of SS7 testing, as many points in both the test specifications and companies' testing methods were quickly addressed.

By dealing with these points at an early stage, users will also benefit in terms of cost. Fast feedback on possible errors or ambiguities in specifications helps to reduce testing time and bring products to the market more quickly. It is estimated that the interactive working nature of the ACATS FORUM can cut months out of a development life cycle.

The outcome is greater user confidence in the functionality of tested equipment.

The ATS Network will continue to monitor SS7 activities. It will also continue to interact with its members in adjusting the SS7 test suites according to evolving industrial requirements, such as SS7 over IP.

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SS7 Architecture

Signalling System 7 (SS7) is an architecture for performing out-of-band signalling in the public switched telephone network (PSTN). It supports the call-establishment, billing, routing, and information-exchange functions.

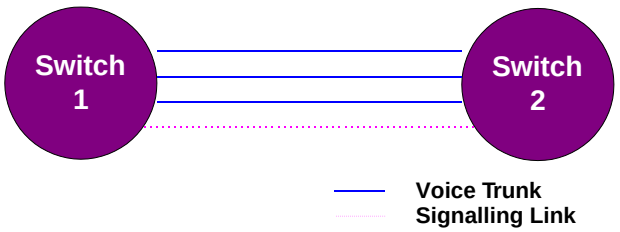
Traditional telephony uses in-band signalling, which is where the signals to establish a call between one switch and another are carried over the same trunk that would eventually support the call.

Out-of-band signalling establishes a separate channel for the exchange of signalling information. This channel is called a signalling link, and is used to carry all the necessary signalling messages between nodes.

When a call is placed, the dialled digits, trunk selected, and other relevant information are sent between switches using their signalling links, rather than the trunks which will ultimately carry the conversation.

Subject to capacity, all signalling traffic between two switches could go over the signalling link. This allows for higher speed traffic and enables signalling to take place during entire calls rather than just at the beginning.

In Europe much of the out-of-band requirements are met by associated signalling. This is a method that allocates as the signalling link one of the paths between each interconnected pair of switches, allowing signalling to be carried on a different path than the voice and data traffic it supports.



This works well as long as a switch's signalling requirements are met between itself and other switches to which it has trunks. If call setup and management were the only application of SS7, associated signalling would meet that need simply and efficiently

In the US however, implementers of SS7 designed a separate network architecture to enable *any* node to exchange signalling with any other SS7-capable node. Associated signalling is then more complicated when used to exchange information between nodes that do not have a direct connection.

To address this, the new US architecture was built out of three components, interconnected by links. These components are signal switching points (SSPs), signal transfer points (STPs), and signal control points (SCPs).

Protocol has been defined between the interconnected elements to facilitate the routing of signalling traffic around any difficulties that may arise in the network. Apart from the physical layer, the underlying layers of the SS7 protocol are MTP-2, MTP-3, SCCP, ISUP and TCAP.

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Message Transfer Part Level 2 (MTP-2)
This provides link-layer functionality. It ensures that the two end points of a link can reliably exchange messages. It incorporates such capabilities as error checking, flow control and sequence checking.

Message Transfer Part Level 3 (MTP-3)
This provides network layer functionality. It ensures that messages can be delivered between points across the SS7 network, regardless of whether they are directly connected. It includes such capabilities as node addressing, routing, alternate routing, and congestion control.

Signalling Connection Control Part (SCCP)
This provides two major functions. The first is the capability to address applications within a signalling point.

The MTP can only receive and deliver messages from a node "as a whole"; it does not deal with separate software applications (subsystems) within a node (e.g. 800 call processing, calling card processing and advanced intelligent network). The SCCP addresses this explicitly.

The second function is the capacity to perform incremental routing, using a capability called "Global Title Translation". With this, STPs maintain a database that enables them to determine to where a query should be routed.

Originating signalling points do not need to know every potential destination to which they might route a message. Instead, they perform "intermediate global title translation", in which they use tables to find another STP further along the route to the destination. That STP, in turn, performs "final global title translation", routing the message to its actual destination. This minimises the need for STPs to maintain extensive information about nodes that are far removed from them.

In addition to routing, Global Title Translation is used to share load among SCPs. To increase the availability of the network, STPs and SCPs are customarily deployed in pairs, so that SSPs can exchange signalling and

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SS7 ACATS Conform!

The ACATS FORUM provides a family of validated test suites to test the layers of the SS7 stack to the protocol standard. Test suites are available for MTP-2, MTP-3, ISUP (Basic Services Version 2), SCCP and TCAP.

The MTP-2, MTP-3 and ISUP test suites can be executed against a test object using a suitable test harness configured for a single primary rate interface, multiple primary rate interfaces and two primary rate interfaces respectively. For ISUP, one MTP link per interface is required.

The SCCP test suite can be executed against a test object using a test harness configured for multiple primary rate interfaces. The test suite follows the standards for connectionless procedures; variations are available according to the configuration of the implementation under test.

To stimulate the required SCCP primitives, it is necessary to communicate with the upper layers (e.g. INAP).

The TCAP test suite can be executed against a test object using a suitable test harness configured for a single primary rate interface. As with the SCCP, it is necessary to communicate with the upper layers in order to stimulate the required primitives.

Variations of the TCAP test suite are also available according to the configuration of the IUT.

The SS7 test suites have been implemented according to the relevant ITU-T and ANSI test specifications. They have been implemented to test the full range of functions as defined in their corresponding protocol specifications.

This ensures that equipment manufacturers and network operators can test for a wide range of possible scenarios. The outcome will be enhanced quality of their end products resulting from more comprehensive testing.

Furthermore, the possibility to test for conformance to both the ITU-T and the ANSI specifications will increase the portability of the end products, thereby boosting competitiveness and opening up larger markets.

ATS	Test Specification		Number of Test Cases		
	ITU-T	*ANSI*	*ITU-T*	*ANSI*	***Total***
MTP-2	Q.781	T1.234	96	96	**192**
MTP-3	Q.782	T1.234	130	166	**296**
SCCP	Q.786	T1.112	27	19	**46**
ISUP (BS V2)	Q.784.1	T1.113	283	283	**566**
TCAP	Q.787	T1.114	181	in progress…	**181**

SS7 over IP

TCP has provided a reliable means of data transfer over IP networks. However, an increasing number of recent applications have found it rather limiting.

The head-of-line blocking offered by TCP causes unnecessary delays in applications which require reliable transfer either without sequence maintenance or with partial ordering of data. The stream-oriented nature of TCP can also sometimes be an inconvenience, as well as the insufficient capability to transfer data using multi-homed hosts.

Transport of PSTN signaling across the IP network is an application for which all of the above is relevant.

SCTP

The Signal Transport (SIGTRAN) working group of the Internet Engineering Task Force (IETF) has designed the Stream Control Transmission Protocol (SCTP) to address the above limitations of TCP. It works on a basis of associations and streams.

An SCTP association is similar to a TCP connection, in that it is designed for the reliable transport of signalling information over a connectionless network. However it can support multiple IP addresses at either or both ends of the link. An SCTP association is also comprised of multiple logical streams, ensuring the sequenced delivery of user datagrams within a single stream.

SS7 Architecture

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complete interswitch calls. While elements of a pair are not generally co-located, they work redundantly to perform the same logical function.

When messages arrive at an STP, the STP can select from the available redundant SCPs. It can select an SCP on a priority basis (referred to as primary -- backup) or to equalise the load across all available SCPs (load sharing).

ISDN User Part (ISUP)
This defines the messages and protocol used in the establishment and tear down of voice and data calls over the public switched network, and to manage the trunk network on which they rely.

In the US (ANSI) version of SS7, ISUP messages rely exclusively on MTP to transport messages between concerned nodes.

Transaction Capabilities Application Part (TCAP)
This defines the messages and protocol used to communicate between applications (deployed as subsystems) in nodes. It is used for database services such as calling card, 800 and AIN, as well as switch-to-switch services including Repeat Dialling and Call Return. As TCAP messages are delivered to individual applications within the nodes they address, they use the SCCP for transport.

The MTP-3, SCCP and TCAP layers of SS7 can also be used in UMTS.

SS7 over IP

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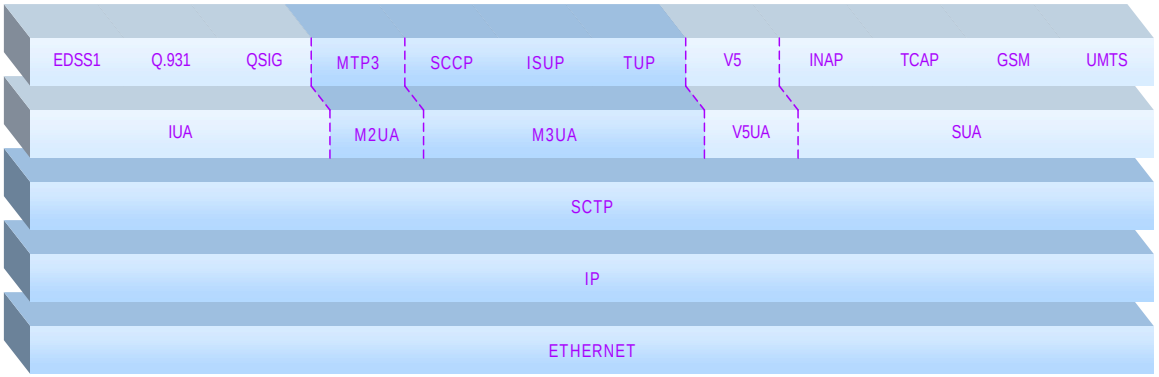
The interface between SCTP and its signalling applications is handled via adaptation layers so that the upper layer signalling protocols of the relevant protocol stack do not need to change the interfaces between the transported protocol and the SCTP.

SS7 uses the M2UA and M3UA adaptation layers to carry SS7 application protocols over IP via the SCTP. The following image highlights the basic architecture



In short, the Signalling Gateway terminates SS7 MTP-2 and MTP-3 protocols and delivers ISUP, SCCP and/or an other MTP-3 User protocol messages over SCTP transport associations to MTP-3 User peers in Media Gateway Controllers or IP-resident Databases.

Because of increased flexibility, the delivery of user/application level protocols over IP connections via adaptation layer modules and the SCTP will be a welcome step forward for industry.

The ACATS FORUM has taken SS7 as a first step. It is communicating with manufacturers implementing the SCTP, M2UA and M3UA protocols, and will help to identify relevant test scenarios at an early stage.

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