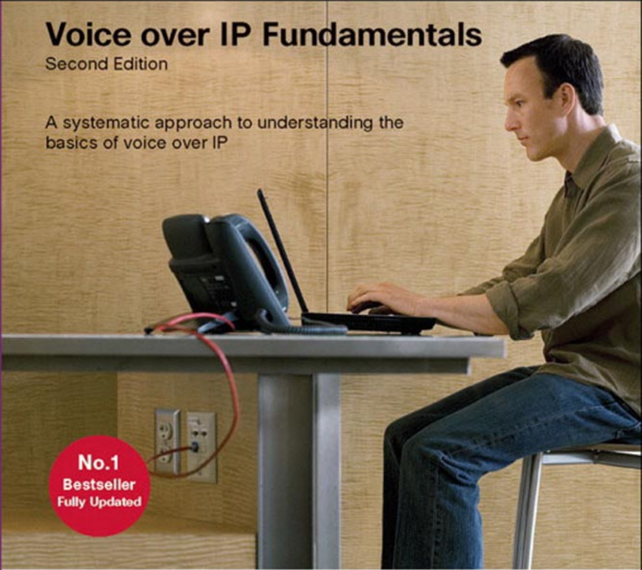
CISCO SYSTEMS

Voice over IP Fundamentals

Second Edition

A systematic approach to understanding the basics of voice over IP



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SCCP Connectionless Example

This example demonstrates ways you can use SCCP services and messages in a typical 800 call:

1. When the end office switch receives a call setup for an 800 number, it launches a query to a database. TCAP passes the calling and called address parameters to SCCP, which then fills the appropriate fields in the UDT and sets the routing indicator bit indicating that a GTT is required. The SCCP addresses the query to the home STP and passes the message to MTP. MTP in the end office switch creates the MSU and forwards the message to the STP.
2. The SCCP function in the STP receives the query and, using its translation tables, re-addresses the message with the Subsystem Number of the database. The SSN includes the DPC and the database subsystem address. The MTP in the STP then forwards the query to the SCP serving the database.
3. The SCCP in the SCP passes the message to TCAP, which queries the database. The database translates the functional number into the routing number and passes the information to the SCCP, which sets the DPC and sends the response back to the originating end office. The SCCP also sets the routing indicator bit indicating to MTP that the routing should be based on the DPC.

SCCP Management Functions

SCCP management functions maintain the transfer of SCCP messages during failure conditions, including network and subsystem failures. SCCP management processes alert SCCP users, such as TCAP or ISUP, during these failure conditions. SCCP management has interfaces to MTP, SCCP connectionless control, and the subsystems (SCCP users). SCCP management uses the unit data connectionless message format.

The SCCP management function is divided into three groups:

- Signaling Point Status—Relies on MTP services. MTP pause, resume, and status information is sent to the SCCP management process.
- Subsystem Status—Each subsystem provides information directly to the SCCP management process. This enables SCCP management to maintain the status of each subsystem.
- Traffic Management—Consists of rerouting messages from one subsystem to another duplicate subsystem. This ensures that services are not lost when one subsystem fails.

TUP

TUP was the first SS7 user part defined when all calls were considered voice calls. TUP supports physical circuit connections but is unable to handle the virtual connections and bearer circuits used in today’s digital networks. North America was first to implement ISUP as opposed to TUP. The

ISUP protocol was defined to inter-work with ISDN and offers increased capabilities and services over TUP. For this reason, this chapter focuses on ISUP rather than TUP.

ISUP

ISUP connects, manages, and disconnects all voice and data calls in the PSTN. ISUP sets up and tears down the circuits used to connect PSTN voice and data subscribers. The subscribers include ISDN, analog, and ISDN-to-analog users. ISUP also is used in cellular or mobile networks for trunking connections. ISUP is widely implemented in North America and is preferred over TUP . Internationally, ISUP also is widely adopted, although several national variations exist. ISUP offers increased capabilities and services over TUP. The broadband ISUP (BISUP) signaling protocol for broadband network services is not covered in this book.

ISUP information is transferred in MTP3 messages similar to the other L4 protocols. The ISUP section covers the following topics:

- ISUP Services—Basic and Supplementary
- End-to-end Signaling—Pass-along and SCCP
- Call Setup and Teardown
- ISUP Message Format
- ISUP Call Control Messages

The "SS7 Examples" section later in this chapter provides basic call setup and teardown examples that include ISUP messages.

ISUP Services

ISUP services provide the capability to reach an endpoint destination in the PSTN. The two types of ISUP services are:

- ISUP Basic Service—Provides the setup, management, and teardown of voice and data calls in the PSTN.
- ISUP Supplementary Services—Services used to support voice and data connections such as caller ID and call forward. The end office exchanges have access to databases where subscriptions to these services are stored.

End-to-End Signaling

End-to-end signaling procedures establish, maintain, and release connections. They also enable signaling endpoints to exchange information using the Information Request (INR) and Information (INF) messages, which are detailed in the "ISUP Call Control Messages" section later in this chapter.

The originating and terminating endpoints exchange signaling capabilities using call indicators. The originating end office indicates its signaling capabilities in the forward call indicators field of the Initial Address Message (IAM). The terminating end office indicates its capabilities in the backward call indicators field of the Address Completion Message (ACM), ANswer Message (ANM), or Call Progress (CPG) message.

ISUP uses two methods for passing end-to-end signaling: the pass-along method and the SCCP method.

In the pass-along method, signaling information travels from the originating switch to each intermediate switch until it reaches the terminating end office. The initial setup information uses the same path used for all subsequent information relating to this circuit.

The SCCP method is an alternative to the pass-along method. In this case, ISUP uses the SCCP to route signaling information through the network. The signaling path does not have to be the same for messages related to a particular circuit. SCCP enables ISUP messages to be routed directly from the originating to the terminating end office.

Call Setup and Teardown

ISUP capabilities are more easily understood after you understand the basics of setting up and releasing calls in the SS7 network. For the purposes of this exercise, assume that the call is destined for a remote end office, ISUP signaling is available end to end, only one intermediate switch is available, and the dialed digits do not require queries from a database.

The following describes a basic call setup and teardown in the SS7 network:

1. The subscriber initiates an off-hook, and the local end office sends the caller a dial tone. The caller dials the desired digits, and the local end office collects the digits dialed.
2. The local end office determines how to connect the call based on its routing tables. The routing tables identify the circuits available to establish an end-to-end connection. The originating office creates and sends an IAM to the switch that provides the first connection (the pass-along method) and indicates the circuit to be used.

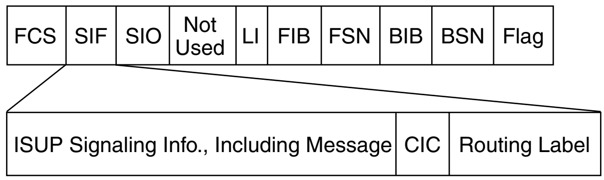
3. When it receives the IAM, the intermediate switch responds by sending an ACM to the originating switch. The ACM is a confirmation that the intermediate switch reserved the same circuit that the originating end office designated in the IAM. The ACM also alerts the originating office to provide a ringback tone to the calling party.
4. While sending the ACM, the intermediate switch prepares to set up the next connection by creating an IAM containing the called and calling information provided by the originating end office. The intermediate switch forwards the IAM to the terminating office using its routing tables.
5. Upon receipt of the IAM, the terminating switch determines whether the called party is busy.

   If the called party is not busy. the terminating switch responds by sending an ACM to the intermediate switch. Following the ACM, the terminating switch signals the subscriber's (called party) line by ringing the telephone. When the called party answers the call, the terminating office cuts through the voice path and sends an ANM along the same path to the intermediate switch.
6. The intermediate switch in turn cuts through the voice path and sends an ANM to the originating switch. Now the originating switch can connect the voice path and enable the conversation to begin.
7. For this example, the called party goes on-hook first and initiates the release procedures at the terminating exchange. The terminating exchange immediately sends a SUSPEND (SUS) message to the intermediate switch, and in turn, the intermediate switch sends an SUS message to the originating switch.
8. When the calling party goes on-hook, the originating switch sends a Release (REL) message toward the terminating switch using the same path as the other signaling messages. The intermediate and terminating switches acknowledge the release with a RELEASE COMPLETE (RLC) message. The RLC message also signifies that each circuit returned to an idle state.

ISUP Message Format

The message type value in the ISUP message indicates the type of message carried in the MSU and is illustrated in Figure 4-14. The circuit identification code (CIC) identifies the circuit being set up or released.

Figure 4-14 *ISUP Message*



ISUP Call Control Messages

Table 4-4 identifies the most important ISUP call control signaling messages. All ISUP signaling messages contain the ISUP message type parameter.

Table 4-4 *ISUP Messages and Message Types*

ISUP Signaling Message	Message Type Value
IAM	00000001
ACM	00000110
ANM	00001001
REL Message	00001100
RLC Message	00010000
Continuity Test (COT)	00000101
CPG Message	00101100
SUS Message	00001101
Resume (RES) Message	00001110
Forward Transfer (FOT) Message	00001000
INR Message	00000011
INF Message	00000100

Source: ITU-T Q.763 (9/97)

The ISUP call control message formats, including signaling parameters, optional and mandatory fields, and field lengths, are listed in Appendix A, "ISUP Messages/Types Formats."

Each ISUP call control message is explained as follows:

- IAM is the first message used to initiate a call setup. The IAM typically contains the complete called number, also called the *en-bloc address signal*. An o*verlap address signal* occurs when the called number is sent in more than one message.

- ACM is a backward message the terminating end office sends to indicate that the end office is ringing the called subscriber. Tandem offices also can send an ACM to signify that an outgoing trunk was seized where ISUP signaling is not supported. The terminating switch sends a *backward message*, whereas the originating switch sends a *forward message*. ANM is a backward message the terminating end office sends to indicate that the called subscriber answered.
- REL is a forward or backward message requesting an immediate release of a connection. The forward and backward nature of the REL message is based on the ability of the called and calling users to initiate a release. You also use the REL message when the tandem or terminating end office cannot set up a call.
- RLC is a forward or backward message indicating that the exchange released the trunk at its end.
- COT is a forward message used to perform a continuity test on an outgoing trunk.
- CPG is a backward message used to report an occurrence, such as an alert, during call setup. The CPG message is sent only after an ACM.
- SUS is a backward message used to suspend a call while its connections are kept intact.
- RES is a message used to resume a suspended call. The SUS and RES messages share the same message format and parameters.
- FOT is a message an outgoing operator uses to request the assistance of an incoming operator.
- INR is a message used to obtain additional call-related information. Usually, the terminating end office sends this message to the originating end office.
- INF is a message used to provide the information requested in the INR.

TCAP

TCAP provides the transaction capabilities carried out by non-circuit based messages used to access remote databases and invoke remote feature capabilities in network elements.

TCAP was first used for 800-number translation. TCAP messages carry the instructions SCPs use to query databases for specific information. TCAP also provides the mechanism to carry the queries and responses from switch to switch. TCAP uses SCCP and MTP protocols to route messages end-to-end. This is different from ISUP, which passes messages from switch to switch. The TCAP protocol provides the means for an application in one signaling point to communicate to an application in another signaling point.