CHAPTER 3

SS7 Protocol Stack

This chapter describes the components of the SS7 protocol stack. A stack is a set of data storage locations that are accessed in a fixed sequence. The SS7 stack is compared against the Open Systems Interconnection (OSI) model for communication between different systems made by different vendors.

Figure 3-1 shows the components of the SS7 protocol stack.

SS7 Level 1: Physical Connection

This is the physical level of connectivity, virtually the same as Layer 1 of the OSI model. SS7 specifies what interfaces will be used, both Bellcore (Telecordia) and ANSI call for either the DS0A or the V.35 interface.

Because central offices are already using DS1 and DS3 facilities to link one another, the DS0A interface is readily available in all central offices, and is preferred in the SS7 network. As the demands on the SS7 network increase (local number portability), and as the industry migrates toward ATM networks, the DS1 interface will become the link interface.

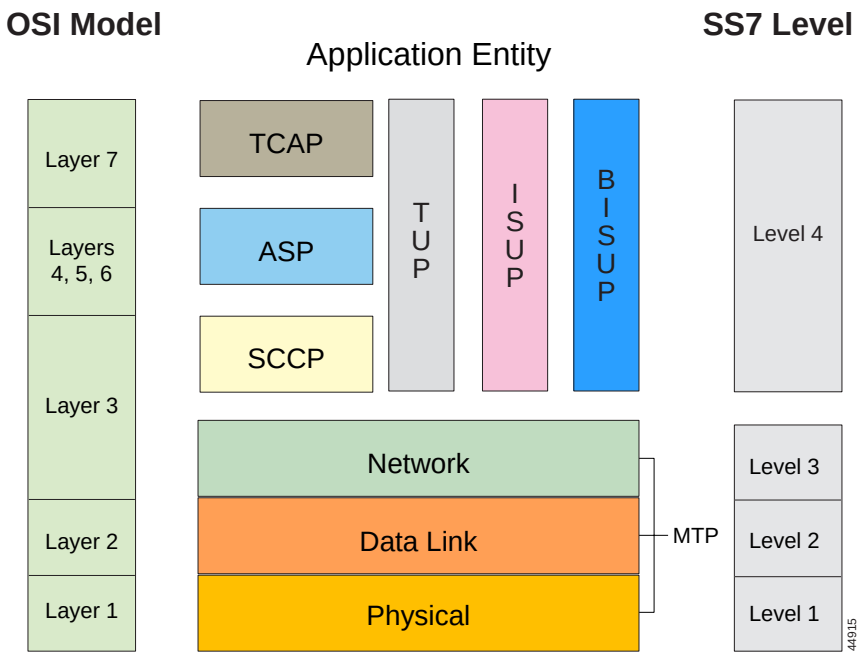
SS7 Level 2: Data Link

The data link level provides the network with sequenced delivery of all SS7 message packets. Like the OSI data link layer, it is only concerned with the transmission of data from one node to the next, not to its final destination in the network.

Sequential numbering is used to determine if any messages have been lost during transmission. Each link uses its own message numbering series independent of other links.

SS7 uses CRC-16 error checking of data and requests retransmission of lost or corrupted messages. Length indicators allow Level 2 to determine what type of signal unit it is receiving, and how to process it.

Figure 3-1 SS7 Protocol Stack



TCAP: Transaction Capabilities Application Part
ASP: Application Service Part
SCCP: Signaling Connection Control Part
TUP: Telephone User Part
ISUP: ISDN User Part
BISUP: Broadband ISDN User Part
MTP: Message Transfer Part

SS7 Level 3: Network Level

The network level depends on the services of Level 2 to provide routing, message discrimination and message distribution functions.

- Message Discrimination determines to whom the message is addressed.
- Message Distribution is passed here if it is a local message.
- Message Routing is passed here if it is not a local message.

Message Discrimination

This function determines whether a message is local or remote using the point code and data contained in a lookup table. Messages to remote destinations are passed to the message routing function for additional processing.

Message Distribution

Message distribution provides link, route and traffic management functions.

Link Management

This function uses the Link Status Signal Unit (LSSU) to notify adjacent nodes of link problems. Level 3 will send LSSUs via Level 2 to the adjacent node, notifying it of the problems with the link and its status.

Diagnostics consists of realigning and resynchronizing the link.

- **Realignment**—All traffic is removed from the link, counters are reset to zero, timers are reset and Fill-In Signal Units (FISUs) are sent in the meantime (called the proving period).
- **Proving Period**—Amount of time FISUs are sent during link realignment. The duration of the proving period depends on the type of link used. Bellcore specifies the proving period for a 56 Kbps DS0 link is 2.3 seconds for normal proving and 0.6 seconds for emergency proving.

Another form of link management uses changeover and changeback messages sent using Message Signal Units (MSUs). MSUs advise the adjacent node to send traffic over another link within the same linkset. The alternate link must be within the same linkset.

The bad link is being realigned by Level 3 while traffic is rerouted over alternate links. Changeback message is sent to advise the adjacent node that it can use the newly restored link again. Changeback messages are typically followed by a changeback acknowledgement message.

Route Management

This function provides a means for rerouting traffic around failed or congested nodes. Route management is a function of Level 3 and works together with link management.

Route management informs other nodes of the status of the affected node. It uses Message Signal Units (MSUs) generated by adjacent nodes and is not usually generated by the affected nodes. (Link management only informs adjacent nodes.)

Traffic Management

This function provides flow control if a node has become congested. It allows the network to control the flow of certain messages based on protocol. Traffic management deals with a specific user part within an affected node.

For example, if ISUP is not available at a particular node, a traffic management message can be sent to adjacent nodes informing them that ISUP is not available, without affecting TCAP messages on the same node.

Message Routing

Message discrimination in Level 3 will pass messages to message routing if it determines the message is not local. Message routing reads the called and calling party addresses to determine the physical address in the form of a point code.

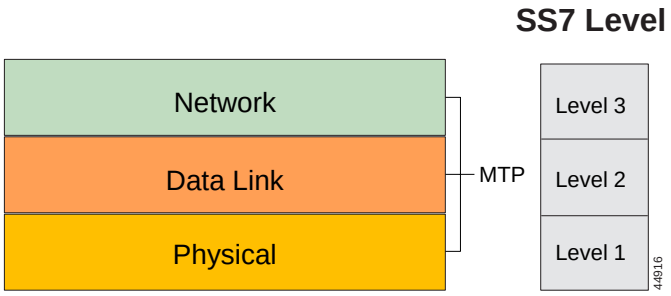
Every SS7 node must have its own unique point code. Message routing determines the point code from an address contained in the routing table.

Message Transfer Part

Protocols are used within the layers (levels) of the SS7 protocol to accomplish functions called for at each level. Levels 1, 2 and 3 are combined into one part, the Message Transfer Part (MTP). (See Figure 3-2.)

MTP provides the rest of the levels with node-to-node transmission, including basic error detection and correction schemes and message sequencing. It provides routing, message discrimination and distribution functions within a node.

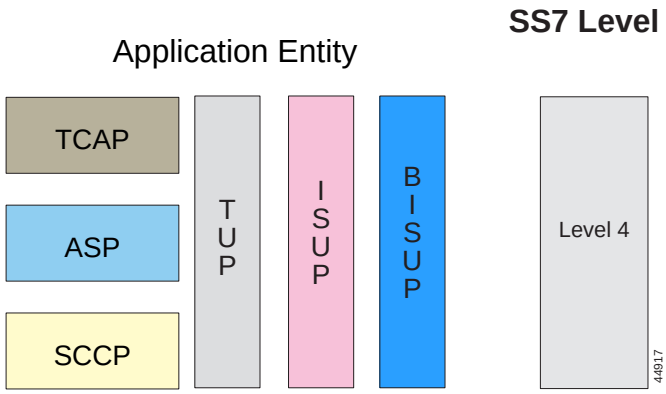
Figure 3-2 Message Transfer Part Components



SS7 Level 4: Protocols, User and Application Parts

Level 4 consists of several protocols, user parts and application parts. (See Figure 3-3.)

Figure 3-3 SS7 Level 4 Protocols, User and Application Parts



TCAP

Transactional Capabilities Application Part (TCAP) facilitates connection to an external database. Information/data received is sent back in the form of a TCAP message. TCAP also supports remote control—ability to invoke features in another remote network switch.

OMAP (Operations, Maintenance and Administrative Part) is an applications entity that uses TCAP services for communications and control functions through the network via a remote terminal.

MAP (Mobile Application Part) is used to share cellular subscriber information among different networks. It includes information such as the mobile identification number (MIN), and the serial number of the cellular handset. This information is used by the IS-41 protocol during cellular roaming.

ASP

Application Service Part (ASP) provides the functions of Layers 4 through 6 of the OSI model. These functions are not presently required in the SS7 network, and are under further study. However, the ITU-T and ANSI standards do reference ASP as viable.

SCCP

Signaling Connection Control Part (SCCP) is a higher level protocol than MTP that provides end-to-end routing. SCCP is required for routing TCAP messages to their proper database.

TUP

Telephone User Part (TUP) is an analog protocol that performs basic telephone call connect and disconnect. It has been replaced by ISUP, but is still used in some parts of the world (China).

ISUP

ISDN User Part (ISUP) supports basic telephone call connect/disconnect between end offices. Used primarily in North America, ISUP was derived from TUP, but supports ISDN and intelligent networking functions. ISUP also links the cellular and PCS network to the PSTN.

BISUP (Broadband ISUP) will gradually replace ISUP as ATM is deployed.

BISUP

Broadband ISDN User Part (BISUP) is an ATM protocol intended to support services such as high-definition television (HDTV), multilingual TV, voice and image storage and retrieval, video conferencing, high-speed LANs and multimedia.

Review: Protocol Stack

1. Define MTP and describe its components.
2. What is the preferred interface for MTP Level 1? Why?
3. How does the data link level (MTP Level 2) determine if any messages have been lost during transmission?
4. What method does MTP Level 2 use for error checking?
5. Identify three functions performed by message distribution.
6. What type of signal unit does link management use?
7. When a problem occurs with a link, which nodes does link management notify?
8. Identify the types of diagnostics available to link management.
9. What happens during the link alignment process?
10. FISUs are used for what function?
11. Define proving period.
12. What type of signal unit sends changeover and changeback messages?
13. Describe the function of a changeover message.
14. What is the expected response to a changeover message?
15. What is the function of route management?
16. Define flow control.
17. What does the message discrimination function do with non-local messages?
18. Define ISUP and describe its functions.
19. Define TCAP and describe its functions.
20. Define SCCP and describes its functions.
21. What are the differences between TUP, ISUP and BISUP?