CHAPTER 1

Overview

Everything in the telecommunications network is based on signaling—call setup, connection, teardown, and billing. The two forms of signaling used by the network are:

- Channel Associated Signaling (CAS)
- Common Channel Signaling (CCS)

Signaling System Number Seven (SS7) is a form of common channel signaling, that provides intelligence to the network, and allows quicker call setup and teardown—saving time and money.

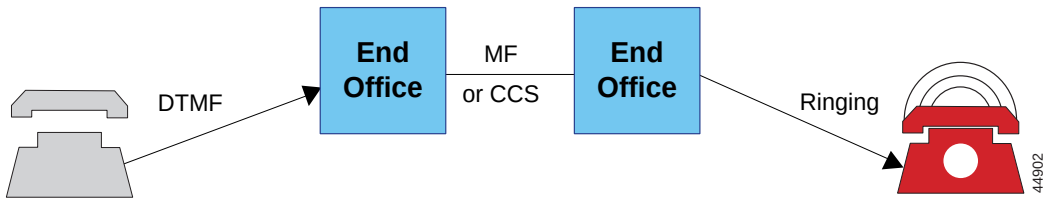
PSTN Signaling

In order to route telephone traffic through the Public Switched Telephone Network (PSTN), it is necessary to communicate with the switches that make up the PSTN. Signaling is a means for transferring network-related information between switching nodes, and also between the end office switches and their subscribers. (See Figure 1-1.)

Signaling is used to do the following:

- Request service from the central office switch (via going off-hook).
- Provide central office switch with the information necessary to route a telephone call (via DTMF addressing digits in a specific format).
- Alert destination address of incoming call (ringing).
- Provide status information and call supervision for billing.
- Manage network lines/trunks (set up and teardown calls).

Figure 1-1 End-to-End Signaling



Channel Associated Signaling (CAS)

When used for in-band signaling:

- Call setup information (off-hook, dialtone, address digits, ringback, busy) is transmitted in the same band of frequencies as used by the voice signal.
- Voice (talk) path is cut over only when the call setup is complete, using the same path that the call setup signals used.
- SF (single-frequency) signaling uses tones to represent on-hook or payphone deposits.
- MF (multi-frequency) signaling is used for switch-to-switch call setup

The principal advantage of CAS is that it is inexpensive to implement and can be used on any transmission medium.

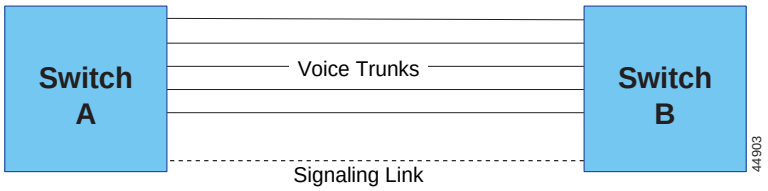
However, CAS has the following disadvantages:

- Fraud— “phone freaks” can build boxes to play call setup and teardown tones.
- Interference is possible between signaling tones used by the network and frequencies of human speech patterns.
- Speed—call setup and teardown is slower, less efficient use of resources.

Common Channel Signaling (CCS)

CCS employs a separate, dedicated path for signaling. (See Figure 1-2.) Voice trunks are used only when a connection is established, not before. Call setup time is quicker because resources are more efficiently used. CCS is the technology that makes ISDN and SS7 possible.

Figure 1-2 Common Channel Signaling



ISDN-PRI

Integrated Services Digital Network— Primary Rate Interface (ISDN-PRI) divides digital transport services into bearer channels (B-channels) for voice and data transmission and data channels (D-channels) for signaling data. (See Figure 1-3.)

In North America T1-PRI employs 24 channels (23B+1D at 64 Kbps per PCM channel) with an aggregate bandwidth of 1.536 Mbps. In Europe E1-PRI employs 32 channels (30B+2D at 64 Kbps per PCM channel) with an aggregate bandwidth of 2.048 Mbps.

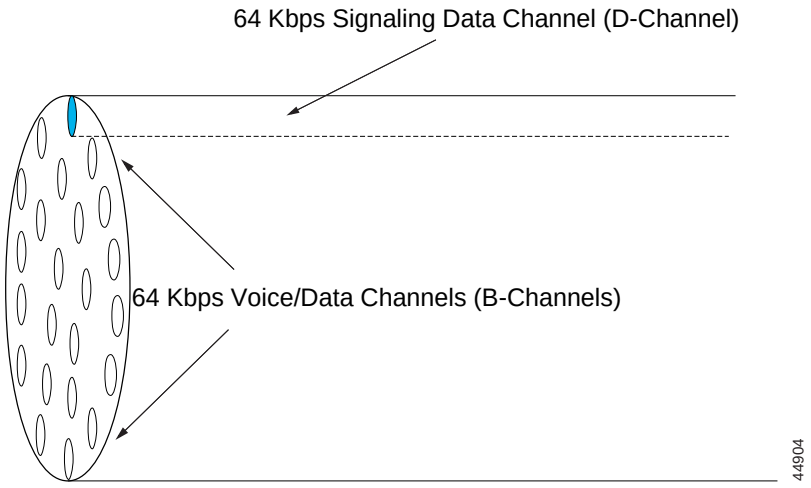
ISDN-PRI offers the following advantages:

- Data links running at either 56 or 64 Kbps are much quicker than outpulsing MF address digits.
- Signaling is possible at any time during the call, rather than only during call setup.

- Voice trunks are used more efficiently—others can use them during call setup.
- Allows better control over fraud.
- Supports enhanced services.

The principal disadvantage of ISDN-PRI is its use of Associated Signaling mode, which only works with directly trunked switches.

Figure 1-3 ISDN Bearer Vs. Data Channels



SS7

While similar to ISDN-PRI, Signaling System Number Seven (SS7) uses different messaging for call setup and teardown. SS7 lets any SS7-enabled node to talk to any other, regardless of whether they have direct trunk connections between them.

The preferred mode of signaling for SS7 networks is Quasi-Associated, whereas ISDN-PRI uses Associated Signaling mode.

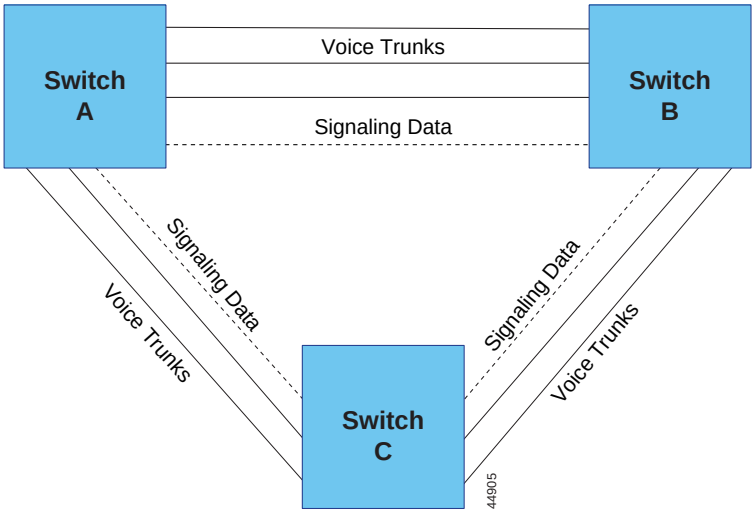
Signaling Modes

- **Associated Signaling**—Uses one dedicated path between switches as the signaling link. Examples: ISDN-PRI and E1-CAS.
- **Non-Associated Signaling**—Uses separate logical paths and multiple nodes.
- **Quasi-Associated Signaling**—Uses a minimal number of nodes (preferred for SS7, causes less delay).

Associated Signaling

With this type of signaling, the signaling link directly parallels associated voice trunks. Thus, dedicated links must be provisioned between every interconnected switch. (See Figure 1-4.)

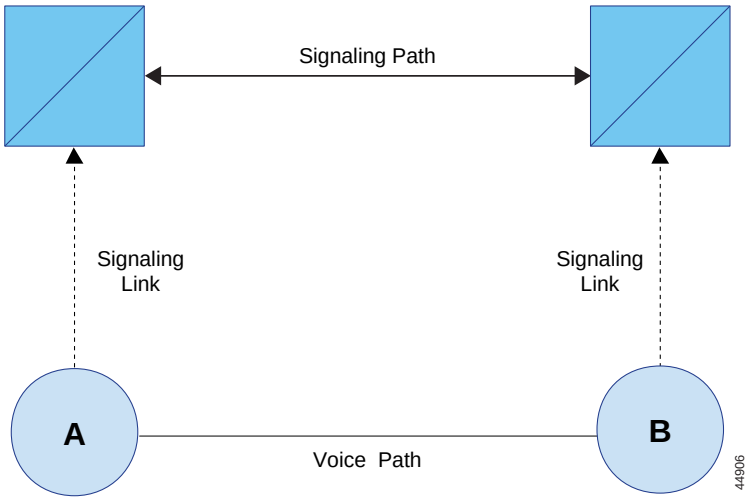
Figure 1-4 Associated Signaling



Non-Associated Signaling

With this type of signaling, voice/data and signaling are carried on separate, logical paths. Multiple nodes in the signaling path to the final destination can causes delays. Although used in the SS7 network, it is not preferred. (See Figure 1-5.)

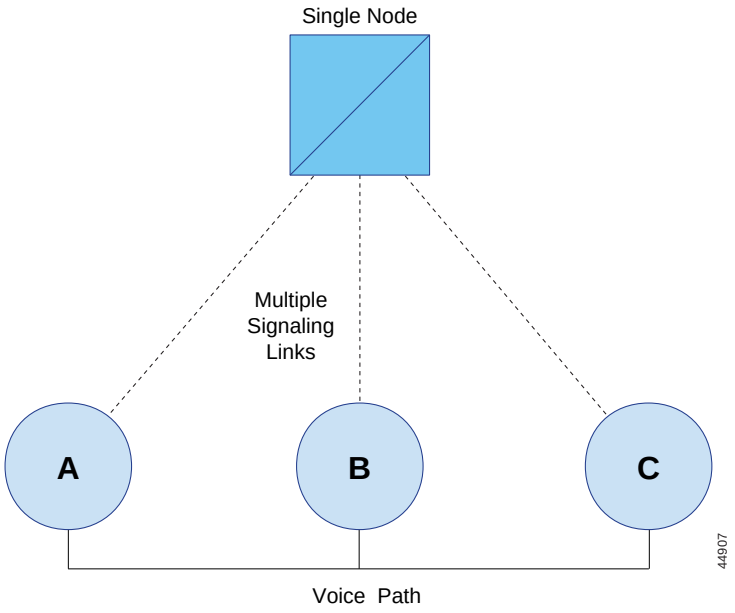
Figure 1-5 Non-Associated Signaling



Quasi-Associated Signaling

This type of signaling employs a minimal number of nodes, thus minimizing delays. Quasi-associated signaling is the preferred signaling mode for SS7. (See Figure 1-6.)

Figure 1-6 Quasi-Associated Signaling



The Evolution of SS7

In the mid-1960s, the CCITT (now the ITU) developed a digital signaling standard called Signaling System #6. SS6 was based on a packet-switched, proprietary data network. SS6 used 2.4 Kbps data links to send packets of data to distant switches to request services.

This was the first use of packet switching in the PSTN. SS6 packets consisted of 12 signal units of 28 bits each placed into a data block.

SS7 began deployment in 1983, and gradually phased out SS6. It was initially used only in the interoffice network (from central office to central office), but has gradually expanded and is now deployed in local central offices as well. SS7 provides a global standard for call setup, routing, and control.

SS7 Features

- High-speed data links (56 Kbps – national; 64 Kbps – international).
- Variable length signal units with a maximum size limitation.
- Plans to increase link speed to T1 and E1 speeds to be able to handle the increased demands required of the SS7 network.

SS7 Uses

The first use of SS7 was not for call setup and teardown, but rather for accessing databases. 800 numbers provided a problem for switches in that they could no longer route based on area code. A second “real number” for each 800 number needed to be placed in a centralized database which multiple central offices could access.

The call flow of an 800 number is as follows:

- 800 number dialed, CO switch receives digits and routes the call to a remote database via data link.
- “Real number” is determined from the database via SS7 message packet.
- Database responds with response message packet.
- Database provides routing number for call and billing information.
- CO switch is then able to route the call in the conventional manner.

SS7 Expansion

When 800 number lookups via SS7 proved successful, the network was expanded to include the ability to do call setup, teardown, and other services. Call setup/teardown is done using the ISDN User Part (ISUP) protocol. Database lookup uses the Transactional Capabilities Application Part (TCAP) protocol.

800, 900, 911 services, custom calling features, caller ID, and enhanced services are provided by SS7 and the Advanced Intelligent Network (AIN).

SS7 Deployment Planes

SS7 is deployed on two distinct levels or planes:

- International—ITU-TS standard
- National – country specific (North America—US and Canada - uses the ANSI standard)

Bellcore is an extension of the ANSI protocol and ensures the ability to interoperate with Bell Operating Company (BOC) networks.

Gateways convert national versions of SS7 to ITU-TS versions so that the networks of all nations can interoperate with each other.

Local Number Portability (LNP)

Prior to SS7, 800 numbers were not portable. If a company moved, they had to get a new number. The Telecom Act of 1996 mandated that personal phone numbers should also be portable. Telcos are required to support the porting of telephone numbers within a geographic area, increasing the demands on the SS7 network.

Seamless Roving

Seamless roving in cellular networks uses SS7 to share subscriber information from Home Location Registers (HLRs) so users do not have to register their cell phones with other providers when they travel. All cellular providers can access each others databases via SS7, enabling their subscribers to roam seamlessly from one network to another, while still allowing the home network to track and bill for all calls.

Summary

- SS7 is the world's largest data network. It links telcos, cellular, and long-distance networks nationwide and worldwide.
- SS7 interconnects thousands of telephone company providers into one common signaling network.
- SS7 will continue to evolve as new features are added to the Advanced Intelligent Network.

Review: Fundamentals

1. Name the two types of signaling used in the PSTN.
2. Which signaling type categorizes SS7?
3. How is ISDN-PRI similar to SS7?
4. What is an advantage of common channel signaling?
5. Name the three modes of common channel signaling.
6. Which mode is preferred for SS7? Why?
7. From which network was SS7 derived?
8. How fast are SS7 links?
9. What is the ISUP protocol used for?
10. What is the TCAP protocol used for?
11. What are the two versions of SS7?
12. What version of SS7 is used in the United States?
13. What function does an SS7 gateway perform?
14. How do cellular networks utilize SS7?
15. What is the AIN?