THE BELL SYSTEM TECHNICAL JOURNAL
Vol. 57, No. 2, February 1978
Printed in U.S.A.

Common Channel Interoffice Signaling:

An Overview

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(Manuscript received May 7, 1977)

In May of 1976, a new Common Channel Interoffice Signaling (CCIS) system linked together the last new No. 4A toll crossbar office in Madison, Wisconsin and the first No. 4 ESS toll office in Chicago, Illinois. This was a major milestone in a long-range program to achieve a nationwide Stored-Program Controlled (SPC) network of stored-program controlled switching offices interconnected by a new high-speed, high-capacity interoffice signaling system, CCIS. The SPC network will provide faster, more reliable communications and will make possible a myriad of new communication services. An evolutionary transition to the SPC network is in progress. CCIS is now being implemented in the toll or long-distance network. It will subsequently be extended to Traffic Service Position System (TSPS) units and to Electronic Switching System (ESS) local switching offices to provide customer-to-customer CCIS service.

This issue of the Bell System Technical Journal is devoted to CCIS. This overview and the following articles cover the inception and goals of the program and the implementation of CCIS in the toll network.

In telephony, interoffice signaling has two functionally different components: supervisory signaling, used to initiate and terminate connections, and to indicate call status; and address or control signaling, used to communicate the destination of a call. Supervisory signaling requires two-way communication, and address signaling is usually restricted to one-way forward operation. Historically, with minor exceptions, interoffice signaling for each call has been carried on the same transmission channel which is used for talking. Until the technology required for CCIS became available, this per-channel signaling has been the most practicable and economical approach even though it limited the flexibility and capability of signaling systems.

The early automatic switching systems employed dc signaling techniques, which are still in use today. In dc signaling, the supervisory information is communicated by level or direction of current flow; information content for address purposes is expanded by introducing another variable, such as the time factor in dial pulsing.

The advent of carrier transmission systems, which precluded dc signaling, necessitated the use of some form of ac signaling. This need was filled by development of Single Frequency (SF) systems in which the on and off states of a tone provide the equivalent of two dc states. SF systems require equipment at both ends of each voice channel. They are currently used primarily to provide supervisory signaling in the long-haul analog carrier plant. Another type of ac signaling, the Multifrequency (MF) system, is widely used for address signaling between register-sender type switching offices. This uses combinations of two out of six tones in the voice-frequency range to represent ten digits and up to six control signals. These two systems, SF and MF, now dominate signaling in the intertoll plant, in which analog carrier systems are the predominant transmission facilities. In exchange areas, supervisory signaling is largely provided by dc methods or by digital signals derived from T-carrier channels. MF is widely used for address signaling between types of local switching offices which can utilize it.*

For the past 25 years these per-circuit signaling techniques, with evolutionary changes to improve performance and reduce cost, have worked well during the multifold expansion of the network and the phenomenal growth of direct distance dialing. However, for many years it has been evident that SF-MF signaling has serious limitations with respect to foreseeable service needs of Bell System customers. These limitations are:

Slow speed

The signaling speed is inadequate for present and future needs. While the interoffice link signaling time averages about 1 to 2 seconds, the connection time on multilink calls may be 10 to 20 seconds, most of which is due to signaling.

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* See Reference 1 for a full discussion of signaling methods and fields of application.

Limited signals

The signaling capability is essentially limited to bidirectional supervision and unidirectional address information. The system precludes transmission of additional information, such as class marks for special routing and handling of calls, and bidirectional signals needed to provide special services. The inability to signal (except disconnect) during a call limits flexibility to provide some special services.

Susceptibility to interference

The use of voice-frequency signaling on the circuits which are used by customers makes the signaling vulnerable to interference and susceptible to fraud. With SF signaling, carrier failure effects which result in multiple simultaneous tone-off signals can seriously disrupt the operation of switching offices.

Cost

It is expensive to provide relatively complex signaling equipment at each end of every voice channel.

While these limitations have been widely recognized for years, a continuing study effort did not find a solution which appeared viable in the environment of electromechanical switching offices largely because the SF-MF signaling was well matched to electromechanical switching systems and represented a very large investment in existing plant.

However, the opportunity and incentive for a breakthrough came in the early 1960s when it was recognized that the radically new electronic switching systems then under development would ultimately predominate in the network and would need a new signaling system to realize their full potential. This led to intensified studies which culminated in the plan and proposal for the system now known as Common Channel Interoffice Signaling, which provides direct processing-to-processor communication. These studies were coordinated with concurrent planning by the Consultative Committee on International Telegraph and Telephone (CCITT) in Geneva, which produced a specification for an almost identical international signaling system known as CCITT No. 6.

As the planned evolutionary transition to an SPC network is achieved, a series of benefits will be realized:

(*i*) The toll CCIS implementation program which is now under way, in combination with some network rearrangements, or rehoming, will provide CCIS signaling for about 80 percent of intertoll trunks by 1985. This will cut call setup time, improve signaling reliability, reduce effects from external interference, and make possible some new services such as more versatile INWATS.

(*ii*) Extension of CCIS to TSPS is a particularly effective way to make new services available to a large body of Bell System customers. By 1985, it is expected that 96 percent of all customers will be served by TSPS. With CCIS, it will be possible to automate such services as credit-card calls, collect calls, and bill-to-third-party calls by accessing a data base to verify customer-dialed information.

(*iii*) By 1985, it is expected that over 60 percent of all customer lines will be handled by ESS local switching offices. Extension of CCIS to these offices will cut call setup time to about two seconds on CCIS-controlled long-distance calls and make it feasible to pass a variety of additional information about each call between the originating and terminating switching offices or data bases. With this capability, it is possible to provide many new services. For example, the calling number can be sent to a distant office where special treatments such as priority ringing can be provided.

(*iv*) The interconnection of stored-program controlled switching offices by a reliable, high-speed, high-capacity signaling system will also permit more efficient usage and control of the network. For example, the increased call routing flexibility which can be achieved with CCIS will make it feasible to route calls up or down the hierarchy and to systematically modify routing patterns to take advantage of characteristic time differences in busy hours on different routes. The CCIS network can also be used to transmit network management signals (such as dynamic overload controls) to control overloads and congestion rapidly and effectively. The CCIS network may also be useful for the collection and transmission of billing data and some maintenance data.

CCIS is now in service and expanding rapidly in the Bell System domestic toll network. Network evolution is being guided to bring into being the SPC network which will offer important new service capabilities. International CCIS service using CCITT No. 6 in a No. 4 ESS office is expected to start in 1978. Extension of CCIS to local ESS offices is planned for the early 1980s. The story of the development and implementation program which brought this about is contained in the following articles of this issue of the B.S.T.J. It reflects a team effort by hundreds of individuals in Bell Laboratories, AT&T, Western Electric Company, and the operating telephone companies to bring the benefits of modern signaling to Bell System customers in the second century of telephony.

REFERENCE

1. C. Breen and C. A. Dahlbom, "Signaling Systems for Control of Telephone Switching," B.S.T.J., *34,* No. 6 (November 1960), pp. 1381–1444.