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Stored Program Controlled Network:

Overview

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This paper describes the evolution and architecture of the Stored Program Controlled (SPC) Network. The critical role of common-channel interoffice signaling (CCIS) is discussed, both as an improved method for providing the traditional signaling functions, and as the key to a wide range of new service opportunities. These are made possible by the ability to interrupt call progress and, in real-time, interrogate a distant data base and modify the subsequent call handling based on the information returned. The underlying architecture by which these services are implemented is based on the objectives of providing ubiquitous service with limited deployment of essential network capabilities and creating a structure which permits customized services by modifying the contents of a centralized data base.

I. INTRODUCTION

Two major trends in the North American telecommunications network today are the evolution to an Integrated Services Digital Network (ISDN) and the Stored Program Controlled (SPC) Network, which is an important component of the ISDN. The first is a product of the digital revolution and is driven by the fact that digital technology is increasingly becoming the economic choice for conventional voice applications while, at the same time, being the driving force for a wide range of data applications. In contrast, the term SPC network is the label given to a quiet but profound revolution in network intelligence, which is expanding the potential of our telecommunication network for both voice and data applications. More specifically, the SPC network refers to the set of SPC switching systems which is interconnected by common-channel interoffice signaling (CCIS).

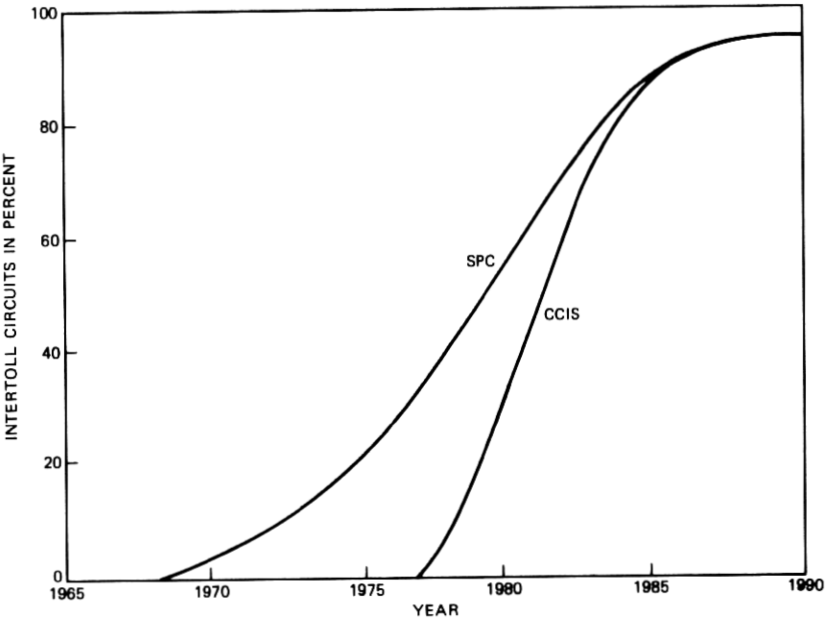

Fig. 1—Bell System intertoll circuits served by SPC.

II. DEPLOYMENT OF SPC NETWORK

The deployment of the SPC network started in the toll portion of the network with the introduction of CCIS in 1976, coincident with the introduction of the No. 4 ESS high-capacity, time-division toll switching system. CCIS was introduced into the toll network on selected systems to maximize trunk connectivity, while satisfying the constraint of making a positive economic contribution. Savings in expensive in-band signaling equipment and faster call setup supported the initial deployment, while new features, such as improved 800 Service, were made possible by the rapid CCIS penetration and buildup in connectivity. Figure 1 shows a recent view of SPC and CCIS intertoll projections.

In 1981, CCIS was introduced on TSPS to provide the capability to exchange CCIS messages between TSPS and network control points (NCPS), which contain centralized network data bases capable of supporting a variety of customer-specific service offerings. The first application of this capability was Mechanized Calling Card Service, an automated credit card calling capability that allows customers at *Touch-Tone** stations to place calls billed to their credit cards without operator assistance. Savings in reduced operator work time are ex-

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pected to support the capital and software investments required and represent an important contribution to the Bell System goal of most effectively utilizing the operator work force, while providing buildup of TSPS coverage along with the associated CCIS capability. Figure 2 shows the projected penetration of TSPS and its CCIS capability.

The extension of CCIS capability to local switching systems presents a different set of opportunities and challenges. The projected benefits associated with local CCIS are great and include the provision of capabilities which extend further the range of customized services which could be supported. These include alternate routing based on the busy/idle status of a line and selective treatment of calls based on the calling number (e.g., distinctive ringing, selective call forwarding). In addition, significant improvements in network operation are possible, including faster and more economical call setup, and the use of traveling class marks to identify calls requiring special handling. To capitalize on these opportunities, it must be recognized that despite an aggressive modernization program, the relatively large number of Class 5 offices (≃10,000 for the Bell System alone) extends the time required to penetrate this part of the network compared with the relatively short time required to introduce CCIS into TSPS and toll switching systems. The initial introduction of local CCIS is planned for 1981 with

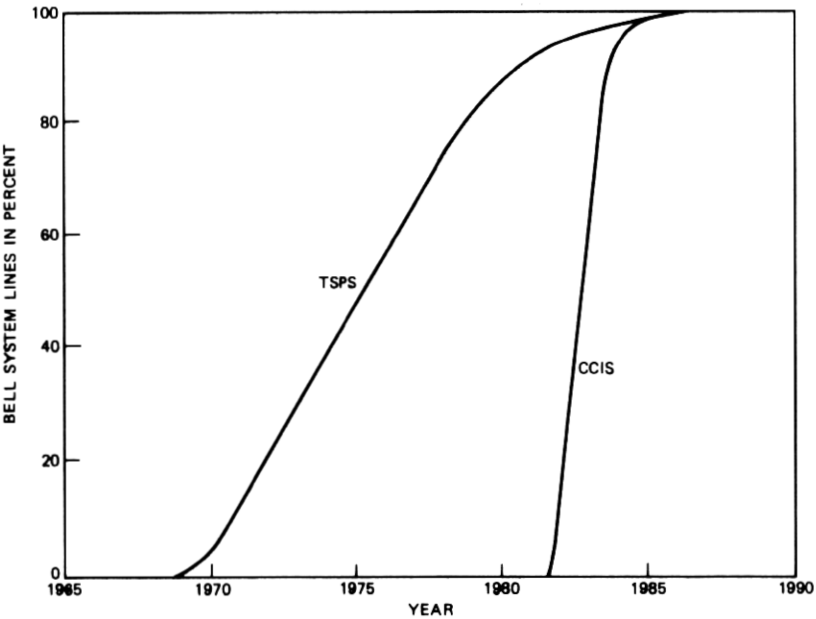

Fig. 2—Bell System lines served by TSPS.

the current projection of the buildup shown in Fig. 3, along with the corresponding projection of local SPC coverage of customer lines.

The network control point (NCP) was introduced in 1981 and is intended to support a wide range of SPC network applications. The first of these is an improved version of 800 Service and Mechanized Calling Card Service. A wide variety of other applications are currently being considered.

Figure 4 shows a simplified block diagram of the SPC network with these building blocks in place where the signal transfer point (STP) refers to the high-capacity packet switches which serve the CCIS network.

The growth of the CCIS network needed to support improved call setup and other applications is suggested by Fig. 5, which provides a projection of the growth of signaling network loads until 1995. To appreciate the size of this network, it is worth noting that, despite the apparent low load level shown in 1981, the message volume supported would probably classify it as the highest capacity data network in the world.

III. POTENTIAL SPC NETWORK BENEFITS

As indicated previously, the benefits of the SPC network tend to fall into two categories: improved network operation and the support of

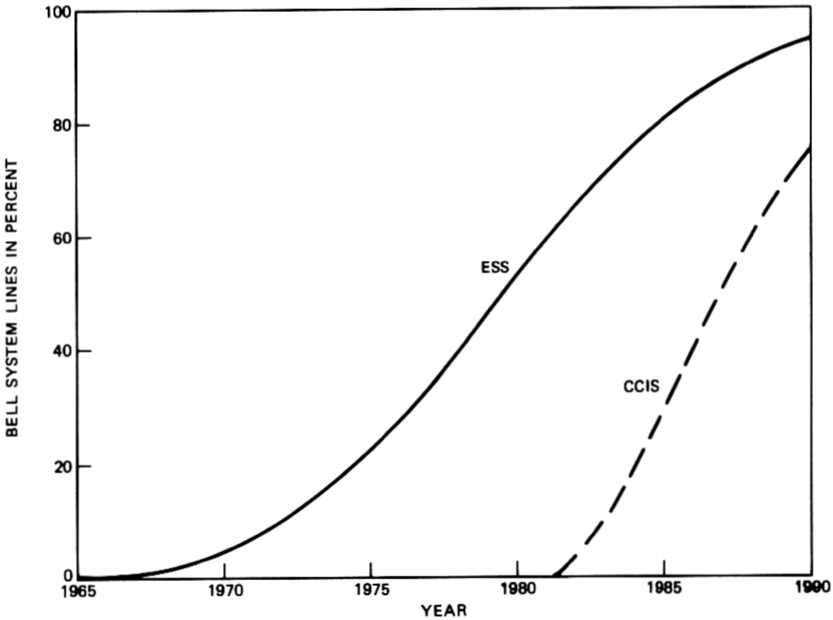

Fig. 3—Bell System lines served by ESS.

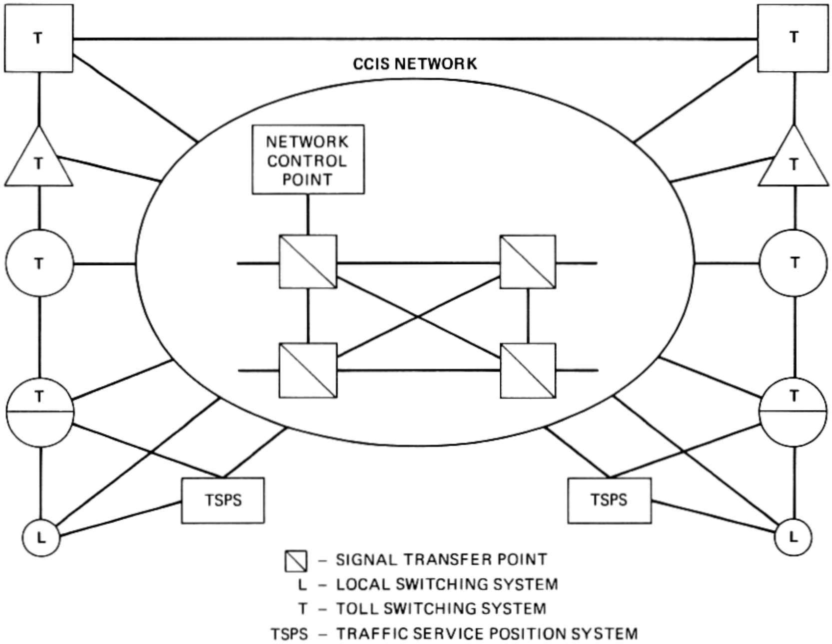

Fig. 4—Stored Program Controlled Network.

new customer services. While it will only scratch the surface of the potential opportunities ahead of us, a brief discussion of each of these areas will serve to illustrate the possibilities.

To begin with, the elimination of in-band signaling equipment provides an opportunity to reduce capital expenditures. In addition, network performance is improving as a result of the reduced call setup time associated with CCIS when contrasted with conventional signaling approaches. Figure 6 illustrates this improvement for a typical New York City to Chicago call. This provides direct customer benefits, as well as reducing capital expenditures for facilities as a result of the shorter circuit holding time. Additional reductions in capital expenditures also will result from the ability to determine the busy/idle status of the terminating line before setting up a voice path. This will eliminate the need to establish talking paths to busy destinations. The SPC network also makes the use of nonhierarchical network routing schemes, which can more efficiently utilize plant investment, a practical reality. Expense savings opportunities also exist. They include such possibilities as the reduction in average operator work time because of Mechanized Calling Card Service and utilitization of a "look-ahead-for-busy" capability. In addition, losses because of fraud will be reduced as a result of the ability to provide improved credit

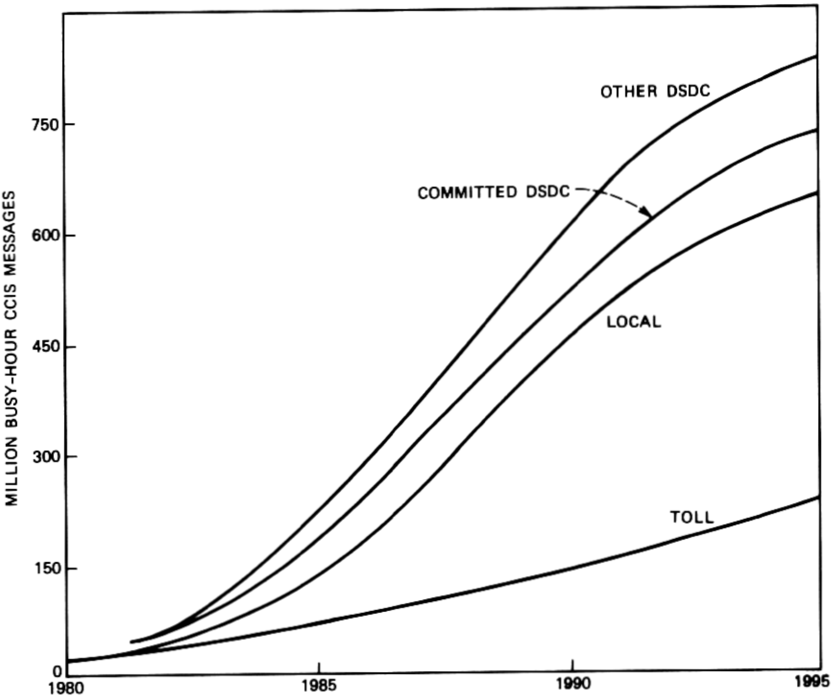

Fig. 5—Signaling network projected loads.

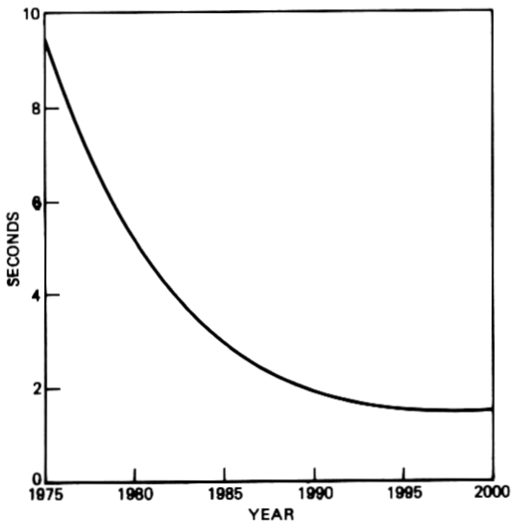

Fig. 6—Common-channel interoffice signaling impact—average call setup time, New York City-Chicago.

card and third-number billing checks. In addition to these benefits, the use of traveling class marks provides opportunities for improved network management and special handling of classes of calls (e.g., satellite avoidance).

In the area of new services which can be supported, the possibilities are limited only by the imagination. Improved 800 Service serves to illustrate these capabilities and is shown in Fig. 7. A customer-dialed 800 number is routed to an appropriately equipped CCIS node (designated an action point or ACP). Call setup is momentarily interrupted, while a message is sent via the CCIS network to query a data base (located at the NCP) for instructions on the desired routing of the call. These instructions are returned to the ACP where call routing progress continues. The illustration shows the case where the data base maintains real-time busy/idle status information of the terminating lines. Another possible new service would allow friends, family, and business associates to reach a subscribing customer wherever that customer might be. A possible implementation for such a person locator service is shown in Fig. 8. Customers would be given special telephone numbers (not associated with a particular line) and would enter into the NCP the phone number of the location where they could be reached. Terminating-end office features which could provide selective treatment of calls based on the calling number (e.g., distinctive ringing) further expand the range of possible services which can be supported. To allow customers control over the services they desire requires an innovative approach to the underlying network architecture.

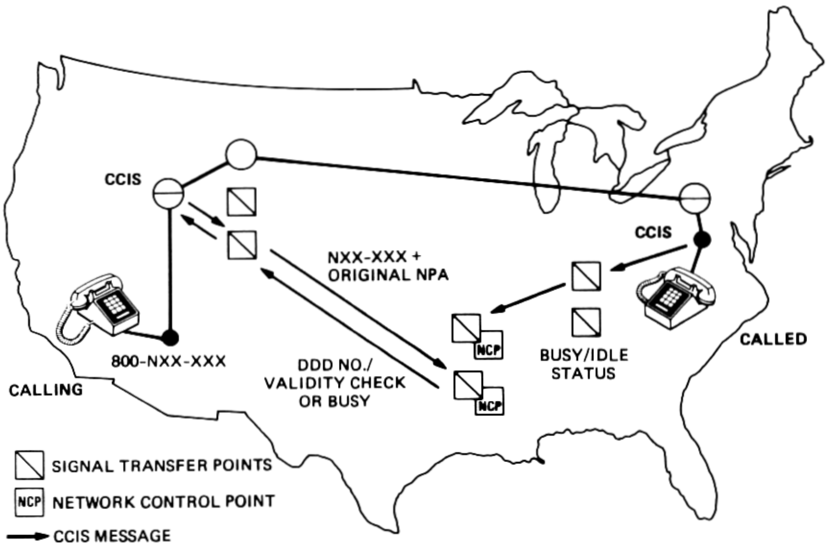

Fig. 7—Stored Program Controlled Network 800 Service.

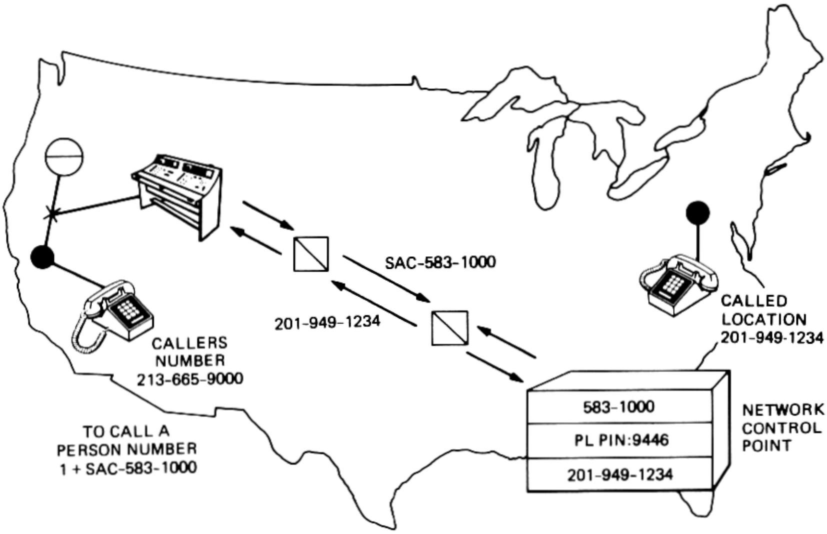

Fig. 8—A person locator example.

IV. SPC NETWORK ARCHITECTURE

The architecture of the SPC network has been designed to meet a number of fundamental objectives. Principal among these is the desire to provide flexibility which permits customers to configure services tailored to their specific needs, along with rapid response in providing ubiquitous availability of new capabilities as they are introduced. The two characteristics of the architecture which support the first of these objectives are: (*i*) the use of a set of basic network capabilities which can be combined under administrative control to define a wide range of services, and (*ii*) the introduction of a centralized data base which contains customer-specific data needed to define individual services from these capabilities. The set of switching primitives utilized includes such building blocks as "collect N digits," "send a CCIS message to the NCP," "make a billing record," and "provide announcement K." The problem of providing rapid ubiquitous deployment of new capabilities is intimately related to the number of systems in which the capabilities must be deployed. To circumvent some of the difficulties of achieving rapid ubiquitous deployment, the architecture permits ubiquitous access to capabilities that have limited deployment. Migration of the capabilities to additional network nodes as economics and time permit can then be accomplished in a manner which is transparent to the customer. This migration concept is shown in Fig. 9, which illustrates the migration of the action point (ACP—the collection of basic capabilities, located at appropriate SPC switching systems, which support

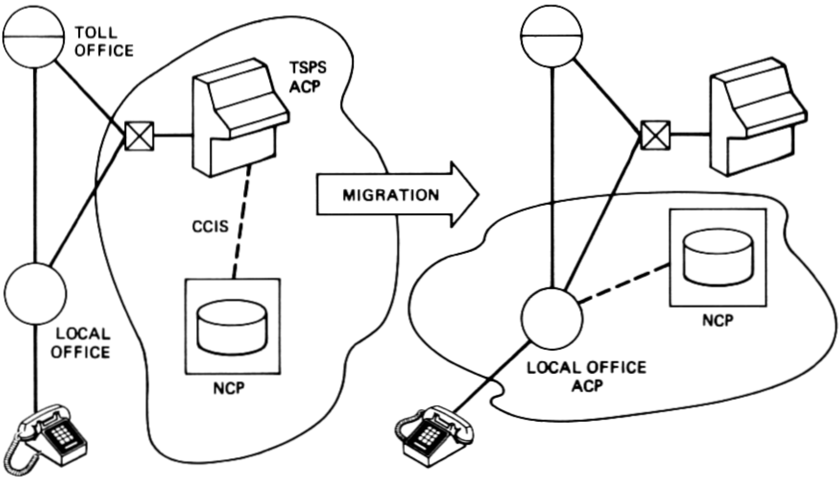

Fig. 9—Action point migration.

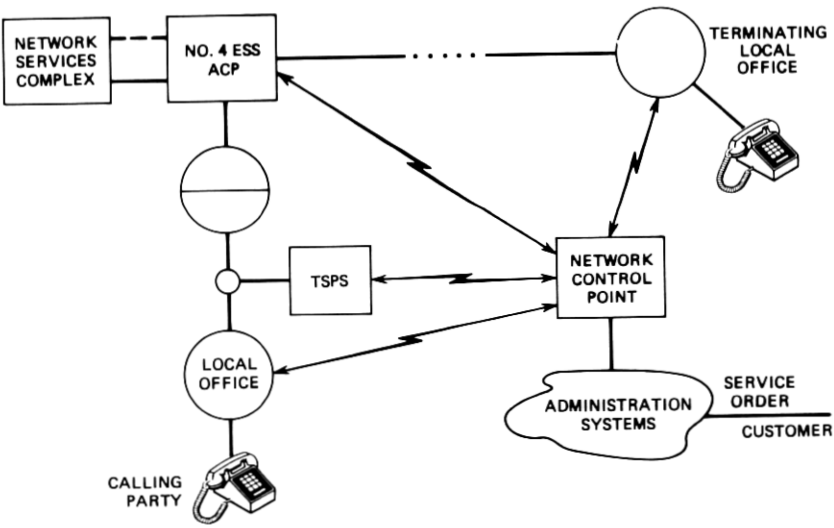

Fig. 10—Direct services dialing capabilities.

the variety of potential network services) from a TSPS site to a local SPC office. The set of SPC network capabilities which support this architecture are known as Direct Services Dialing Capabilities (DSDC). They are shown in Fig. 10.

V. SUMMARY

This paper has provided an overview of the SPC network, its structure, status, and potential. With the introduction and rapid penetration of the SPC network, the North American telecommunications network can properly be viewed as a large, distributed processing system, capable of providing efficient, intelligent communications capabilities to its customers. Despite its recent introduction, the SPC network is spreading rapidly and is already undergoing major modernization. As an example, planning is in progress for the transition of the CCIS network to a higher capacity CCITT-based signaling system to support the growing potential applications.

This paper is also intended to provide a general background and should serve as an introduction to the papers that follow. They present a more detailed technical view of the current status of the SPC network.