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Stored Program Controlled Network:

Prologue

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The rapid introduction of electronic switching systems with Stored Program Control (SPC) has made possible the interconnection of the control processors by high-speed data links to provide common-channel interoffice signaling (CCIS). Not only does this permit higher-speed, lower-cost, more reliable setup of connections, but also the transfer of packets of information for more flexible call control. The papers in this issue describe the evolution of the SPC network concept since the introduction of CCIS in 1976 and the first new services which will exploit the power of this new network capability.

I. INTRODUCTION

This special issue of *The Bell System Technical Journal* covers Stored Program Controlled (SPC) network structure and the innovative new service capabilities that this structure makes possible. It follows a series of special issues that have covered individual SPC switching systems and the common-channel interoffice signaling (CCIS) system, which is being deployed at a rapid rate to interconnect them.

The first step in the evolution of the SPC network was the introduction of No. 1 ESS in Succasunna, New Jersey, in 1965. The principal emphasis in No. 1 ESS design was the use of SPC to replace the earlier wired logic that had been employed in electromechanical switching systems. The use of SPC allowed the introduction of significant new service features, as well as reductions in operating expense. No. 1 ESS was followed by No. 2 ESS and No. 3 ESS, designed to cover suburban and rural segments of the local switching market. Today, more than 2500 local ESSs are in operation, providing nearly 50 percent of Bell System lines with modern circuit switching of voice bandwidth signals.

In parallel with the introduction of local ESS, effort began on the application of SPC to a large toll switching machine. To meet this toll need, a second-generation ESS, No. 4 ESS, was introducted in 1976 in Chicago, Illinois. It included the use of a time division network, rather than the space division network used in the first generation switches. This produced a synergy between digital transmission and digital switching which has been responsible for much of the motivation for introducing No. 4 ESS at a rapid pace. Within a short period of five years, deployment has grown to 65 systems, with 1.5 million trunk terminations carrying more than 100 million calls per day. However, the key feature from the standpoint of the role of No. 4 ESS in the SPC network structure is not time division digital switching, but the use of SPC.

Stored program control systems incorporate the intelligence of a built-in digital computer, which gives the systems great flexibility. Service features are more easily incorporated by issues of software generics than was ever possible with wired logic systems. Once it was recognized that the network of SPC switching systems is really a network of special-purpose processors, an early objective became the interconnection of these processors in a way that would generate still broader capabilities than possible in individual SPC systems.

The first step in this networking was accomplished in May 1976, with the introduction of common-channel interoffice signaling (CCIS) between a 4A toll crossbar system in Madison, Wisconsin, and No. 4 ESS in Chicago. This signaling system provided a high-speed, high-capacity link between the central processors of the systems and made possible faster, more reliable call setup and supervision than had ever been possible before. Historically, the functions of initiating and terminating connections and passing forward address or control information had been accomplished in the same channel as that used for talking. The CCIS system accomplishes these same functions by multiplexing the signaling information for many channels on a separate 2400- or 4800-b/s data link.

The most obvious way of organizing a CCIS network would be to associate a data link with every trunk group interconnecting SPC systems. While this might be economic for large trunk groups, it is not an attractive approach for serving the vast majority of smaller trunk groups that exist in the public switched network. Actually, the CCIS network has evolved as an overlay structure involving 20 signal transfer points, two in each region of the switching hierarchy. These signal transfer points act as packet switches which route signaling information from one SPC system to another for performing supervisory and control functions.

While originally conceived as a means of communicating between processors at the opposite ends of trunk groups to obviate the need for in-channel signaling, the packet transport nature of the CCIS network allows for the direct transmission of messages between any two points interconnected by the network of CCIS links and signal transfer points. This opens up many possibilities for exploiting the CCIS capability to accomplish objectives other than the higher-speed, lower-cost, more reliable setup of connections for which it was originally intended. These possibilities include access to data bases, the forwarding of calling numbers to the destination, and flexible routing to systematically modify traffic patterns. The immediate plans for exploiting the power of the SPC network include the addition of centralized data bases in the network for billing validation on direct dial credit card calling and for more flexible routing options in INWATS, now known as 800 Service. These new features for the SPC network are the vanguard of a long list of service capabilities likely to be introduced in the future.

The first three papers in this special issue provide an overview of the SPC network, a technical description of its basic elements, and the interconnection plan. Subsequent articles describe how the basic CCIS capabilities and features have evolved since the introduction of this concept in 1976, including the plans for extension to local SPC switching systems. Then the first new services that exploit the power of SPC switching systems interconnected by a CCIS network are described, in particular, direct dial credit card calling and 800 Service. The final article discusses the new administrative challenges introduced by these new services and how they are being met.

Organizing the SPC network for these services is one of the broadest projects ever undertaken by Bell Laboratories in terms of its impact on elements of the public switched network. To make it all happen, new capabilities are being deployed on a coordinated basis throughout the network. It would not have been possible to accomplish this without the support of many individuals and groups within the Bell System who share the common vision of the future telephone network as a network of distributed processors with an almost unlimited ability to serve customer needs for information transport.