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Stored Program Controlled Network:

Generic Network Plan

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The network of stored program control communication processors interconnected with common-channel interoffice signaling (CCIS) is commonly referred to as the Stored Program Controlled (SPC) Network. The SPC network will result in new call handling and routing improvements and in new network-based services. It is desirable to tailor the services to meet special customer needs and to deploy them rapidly. A generic plan is described which provides a basis for building services from basic functional capabilities that are deployed in network action points and controlled by network control points. Terminating-end office features can be used to provide additional customer service options. Thus, service for a customer can be composed of sequences of actions stored at appropriate network central points using basic switching capabilities deployed in the network. As needs for customer service evolve, new capabilities can be added to the repertoire of existing capabilities. By equipping key nodes with the capabilities described, the generic plan will also allow the SPC network to evolve efficiently to meet future customer needs.

I. INTRODUCTION

The network of stored program control communication processors interconnected with common-channel interoffice signaling (CCIS) is referred to as the Stored Program Controlled (SPC) Network. The potential power of the SPC network is that new nationwide network services can be provided and introduced rapidly. In particular, the SPC network will permit the following:

(*i*) Services on demand, wherein customers will be able to request and receive services quickly, as needed, and terminate them when no longer needed.

(*ii*) Rapid introduction, wherein services are offered in shorter intervals than previously possible for network services.

(*iii*) Widespread availability, where services are offered ubiquitously, both as initially desired by the customer and then modified as dictated by customer needs.

Additionally, the SPC network will permit improved network operations and service, such as improved network management arrangements and faster call setup.

To achieve these objectives, the SPC network is being built with basic functional capabilities called switching primitives, which in various combinations can be used to construct network services desired by customers. Thus, service for a customer can be initiated by invoking the needed sequence of switching primitives at the appropriate points in the network. Since the control of these functions will be centralized, services can be quickly provided and modified, as required.

Switching primitives include the ability to route calls, to make billing records, to collect additional information through prompts, and to give announcements. Since the switching primitives are not tied to a specific service, they will form the foundation for future services through use in different combinations and with new switching primitives that will be added later. The collection of switching primitives are called Direct Service Dialing Capabilities (DSDC).

II. GENERIC MODEL FOR SPC NETWORK SERVICES

Figure 1 is a schematic representation of the SPC network. The switching hierarchy of local and toll switching systems is interconnected by the CCIS network. The CCIS network uses signal transfer points (STPS) to concentrate signaling information and to provide access to network control points (NCPS). The NCPS are equipped with data bases that contain the information relevant to services that customers have requested. Thus, the CCIS network is used for the signaling functions needed for call transport, as well as for communication among switching offices and NCPS. Traffic Service Position Systems (TSPSS) provide automated operator functions and have CCIS access.

The centralization in the NCPS of the information pertaining to customer services and call control permits the rapid provision and changing of customer service records and is the central element in the ability of the SPC network to offer services ubiquitously. An additional important feature of centralizing the intelligence of the SPC network in the NCPS is that data can be compiled on individual calls that would be useful to customers in planning their communication needs. For example, call volumes could be compiled by time of day, day of week, by origin (3, 6, or 10 digits, etc.) and destination (dialed and substituted number). Calls using DSDC are called direct service dialing (DSD) calls.

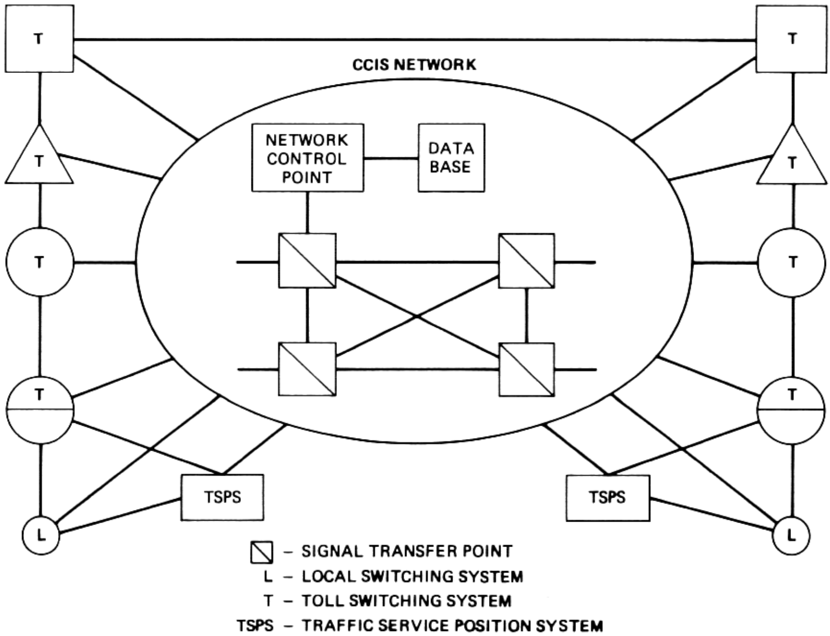

Fig. 1—Stored Program Controlled Network—switching hierarchy.

Functionally, the generic architecture of the SPC network for network services is shown in Fig. 2. A DSD call is identified by the dialed number, which includes a service access code (SAC). This number along with the identity of the calling customer's line [typically referred to as automatic number identification (ANI)] is transmitted to an office which has the capability to process the call. This office is called the action point (ACP). Upon receipt of a call, the ACP recognizes the need for information on how it should be processed and launches a CCIS direct-signaling message to a NCP for instructions. The direct-signaling message contains the dialed number, ANI number, and the identity of the ACP. The ACPs can be local ESS, toll ESS, or TSPSs. The NCPs similarly are stored program control systems. The NCPs contain the customer record and service parameters which specify how calls to the customer location(s) should be handled. Different treatment is possible, depending on calling number plan area, time of day, day of week, busy/idle status of customer line, etc. The proper treatment for call handling is determined by accessing the call-handling instructions resident in the NCP data bases.

The SPC network architecture also includes flexible administration systems that provide the mechanisms to handle customer service requests for changes in SPC network service arrangements. These

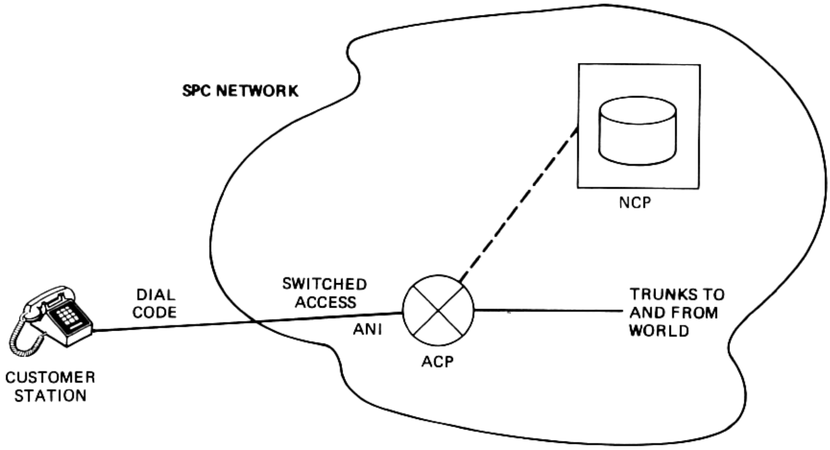

Fig. 2—Elements of a generic service plan.

systems are integral to meeting the SPC network architecture objectives described earlier. For example, the administration systems could handle customer service requests via attendants, service orders, or in many cases directly under customer-controlled *Touch-Tone** dialing. An example of the latter is when a customer directly enters commands to change the routing of calls based on the dialed number or on the time of day.

Referring again to Fig. 2, upon receipt of the initial direct-signaling message from an ACP for a call, the NCP retrieves the customer call-handling instructions resident in the NCP data bases that pertain to the dialed number. These instructions are analyzed by the NCP, and call-handling commands are returned to the ACP. Typical instructions to the ACP are, "route the call to a number supplied by the NCP," "play prompting announcements requesting the customer to enter additional digits," "collect the additional digits," or "create a billing record for the call." In some cases, the initial ACP in a call may not be able to provide the needed capability so the instructions from the NCP might be to hand off the call to another ACP with the desired capability. In other cases, the initial ACP may only temporarily transfer the handling of a call to another ACP—such as for the playing of a change clarification announcement. Such an arrangement is called a service assist. The situations when control of the call is permanently transferred are called hand-offs. Service assists and hand-offs permit the objectives of rapid introduction and widespread availability to be achieved; a few

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ACPs can be equipped with a needed capability and provide universal access to the capability.

The instructions returned from the NCP to the ACP form a command language which can be flexibly used to provide the call handling specified by customers. The command language identifies unique building blocks corresponding to switching primitives which are used to provide services. Examples of switching primitives are shown in Fig. 3. The command language consists of initial inquiries, data messages, exception messages from the ACP to the NCP, and of command, check, and data messages from the NCP to the ACP. Commands received by the ACP are executed sequentially and are completed before another command is processed. As the customer needs change, the command language can be used to specify new orderings of the building blocks (switching primitives) desired. Additionally, the command language is a unique and standard language used throughout the SPC network so that new elements can be introduced smoothly.

Essential roles in the SPC network architecture are played by the family of stored program control local offices. These offices can be queried to determine the status of the terminating (called) customer lines prior to call routing and to determine if the call should be given special handling. For example, as shown in Fig. 3, upon receipt of a service request from an ACP, the NCP could examine the data base records for the call and determine the routing. Before replying to the ACP, the NCP could launch a query to the terminating-end office (TEO) to determine its usage and service complement in effect at that time.

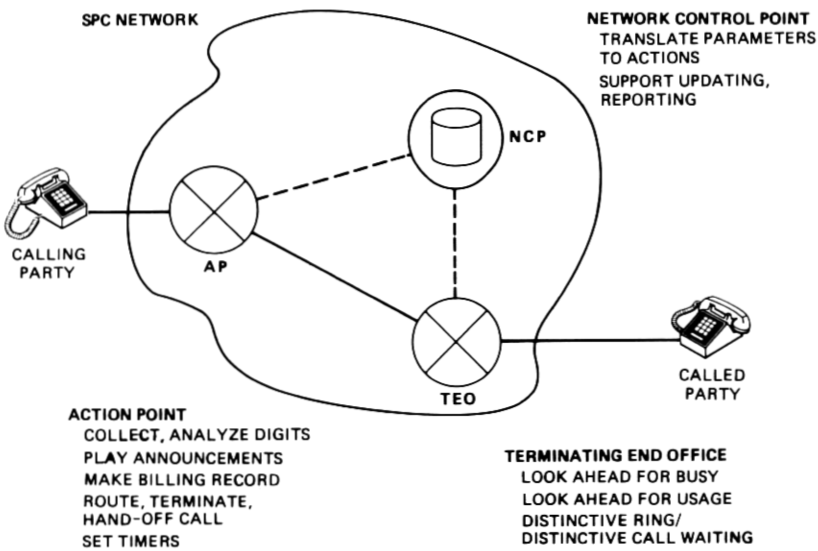

Fig. 3—Stored Program Controlled Network generic architecture.

If, for example, the TEO line were busy, the NCP data base instructions could be programmed to instruct the ACP to route to another destination, thus offering customers flexible control of how their calls are routed and also improving call completion. Alternatively, the NCP data base could eliminate a busy attempt from the rest of the network by instructing the ACP to route the call to a busy tone. In other cases, the NCP may request from the TEO the current number of calls in progress to a given number or group of numbers. The TEO would return the current counter values so that the NCP could determine if an alternate handling of the call is necessary. These network capabilities could be useful for call management purposes. In cases where the customer desired to identify certain incoming calls at the TEO, a call tag arrangement can be invoked. Upon receipt of a query from the NCP, the TEO returns to the NCP a special type of line number identified with the TEO but not used by regular customer lines. This number is then returned to the ACP for routing, and when the call to this number is received by the TEO, the TEO associates this call as the one to be uniquely identified. Alternatively, this same identification of certain incoming calls could be achieved by using traveling class marks (TCMS). In this case, the NCP first queries the TEO to determine if the incoming call should be uniquely identified to the called customer. If so, the NCP directs the ACP to mark the call with a special traveling class mark which remains associated with the call while it is routed to the TEO. This TCM method requires CCIS on all links between the ACP and the TEO, whereas the call tag method does not. The SPC network architecture has been designed to accommodate both methods of operation. Examples of some of the basic SPC network functional capabilities just described are also shown in Fig. 3.

The introduction of ACP capabilities in the network can be managed to help meet the objectives discussed earlier through ACP migration. For example, new ACP capabilities could be introduced in toll and/or TSPSS and later, as service demand increased, the capability could be migrated to local systems. The service-assist and hand-off capabilities discussed earlier will allow migration of capabilities among ACPS in the network without changing the customer's service. This migration can lead to network efficiencies. For example, if the dialed call were destined to be routed to a line served in the same local office as the dialing customer, routing to a toll or TSPS ACP would introduce extra links in the call which would not be needed if the local office were the ACP. Additionally, the cost of transmitting the ANI information to a distance ACP would be eliminated. Modern local systems also offer the advantage of being able to accept extra digits dialed from rotary dials. In cases where a toll or TSPS ACP is used and extra digits are needed, *Touch-Tone* dialing or operator assistance may be required. Therefore, as local offices are added to the SPC network, the ACP function can be migrated to them to accrue these efficiencies.

III. APPLICATION OF ARCHITECTURE TO MEET OBJECTIVES

This section includes discussion of how the SPC network architecture is applied to meet the following objectives stated earlier:

- Services on demand
- Rapid introduction
- Widespread availability
- Improved network operations and service.

First, the basic concepts of offering new network capabilities via the SPC network with switching primitives is illustrated in the open-ended matrix in Fig. 4. Each capability is assigned a row in the matrix. Switching primitives are assigned columns. A mark in the matrix indicates the requirement for a switching primitive for the corresponding capability. The matrix is open-ended because new capabilities may require at least one more switching primitive. The set of switching primitives has been selected to correspond to the repertoire of SPC network capabilities now envisioned as necessary.

Once a matrix has been built, it can be instructive in determining how to develop and deploy SPC network capabilities. For example,

SWITCHING PRIMITIVES

CAPABILITIES	1	2	3	4	5	6	7	8	9	10	11	12	...
1	√			√	√			√	√	√			...
2		√		√				√	√			√	...
3	√		√			√		√			√		...
4				√			√	√	√				...
5	√				√			√		√		√	...
6		√				√	√	√			√		...
7			√		√		√	√					...
8		√	√					√					...
9		√		√						√			...
10						√	√	√					...
11						√	√	√					...
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	

Fig. 4—Determining basic ACP requirements for offering new services.

referring again to the hypothetical matrix in Fig. 4, note that switching primitive No. 8 is needed in almost all the capabilities. This indicates the value of getting it developed for key ACP locations. This concept of deploying certain switching primitives in key ACP locations, coupled with the service-assist and hand-off capabilities explored earlier in this paper, is a means of meeting the objectives of rapid introduction and widespread availability. Note that capabilities Nos. 10 and 11 require the same primitives, which indicates commonality and efficiencies possible by coordinated developments with this plan.

Improved methods of providing network operations are also inputs to the planning process, as primitive switching functions could be developed to improve network efficiency. The look-ahead primitive discussed earlier could be used to improve network efficiency. Often a primitive has application to improve network operation and to meet service needs. For example, the look-ahead primitive can also be used to establish TEO features for a call.

The way the SPC network architecture can be deployed to meet objectives is illustrated in Fig. 5. The starting point is the capability/switching primitive matrix. The plan selected will define which systems will have which capabilities at what time. Each system is represented by a card with a replica of the matrix on it. A mark means the system has that capability. There is a set of cards for each year (or other planning interval).

The transition between the matrix and the selected development plan is accomplished by an analysis based on all relevant factors. Two main factors are areas of application potential and cost, but there are others. For example, capacity of systems in service may be important, having practical, as well as cost, effects on service introduction. Because of the interrelated development alternatives in the SPC network, integrated analysis is done to provide consistency of analysis and the required integration of individual system plans.

In practice, the application of the architecture to meet objectives is planned as follows. First, recall that the central element or feature of the SPC network architecture is the centralization of customer call-handling service records in the NCPs and the ability to easily and quickly change these records. Introduction of new services requires that the NCP first be in place along with the customer administration system needed to handle service requests. Additionally, access to ACPs must be provided so that all originating calls can be routed to an ACP. This could be done by initially deploying ACP capabilities in all No. 4 ESSs and TSPSs. Together, these systems provide ubiquitous access to all customers. Trunking arrangements from originating local offices to these ACPs would be required to transmit the ANI information necessary for the NCP to determine proper call routing. This architecture allows

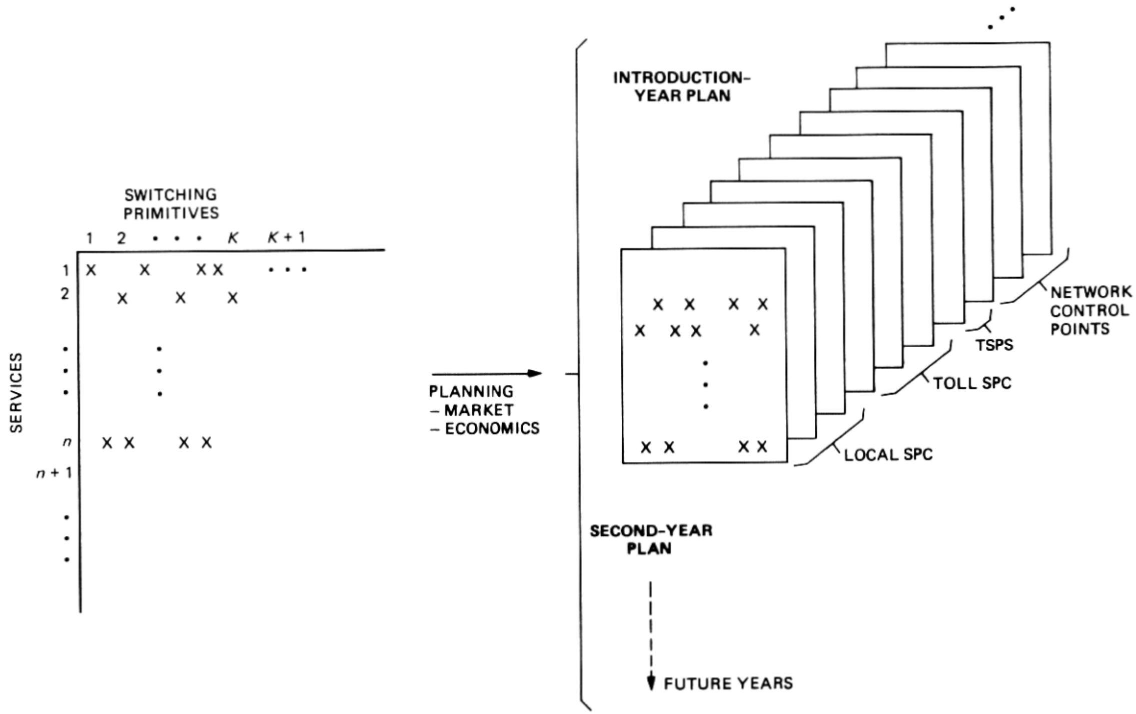

Fig. 5—Service/SPC network switching planning.

customers to get access to network capabilities early, as these capabilities are initially deployed in the network.

Many lines are served by equipment that is located on the customer's premises. This includes private branch exchanges, automatic call distributors, and key telephone systems. Future customer needs may require that new interfaces to the SPC network be developed for these systems.

IV. SUMMARY

The basic elements of a generic SPC network architecture have been described. The architecture allows for introduction of new network capabilities that can be offered ubiquitously and can be changed quickly under customer control. Plans also have been formulated to allow for the addition of new offices into the SPC network to increase the network capabilities and efficiencies without changing how the customer uses the service. Specific examples of these points are given in the companion articles in this issue.