OPERATOR SERVICES FEATURE OF THE *5ESS*® SWITCH

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The operator services position system (OSPS) is a feature of the 5ESS switch that provides operator services as a stand-alone function or as an integrated part of the centralized switching function of the 5ESS switch. Operation of the OSPS is based on Integrated Services Digital Network (ISDN) capabilities of the 5ESS switch and represents a new generation in operator services.

Introduction

This issue of the *AT&T Technical Journal* is devoted to the *operator services position system* (OSPS), a feature of the 5ESS switch that provides operator services as a stand-alone function or is integrated with the centralized switching function provided by the 5ESS switch.[1] (For a complete list of acronyms in this issue, see page 2.) AT&T introduced its first stored-program-controlled operator services system in January 1969. That system, named the *traffic service position system* (TSPS),[2] provides only stand-alone operator services capability. The OSPS, designed to replace TSPS, provides the new and expanded operator services capabilities required by telephone administrations worldwide. In this first paper of the issue, we review the OSPS and introduce the papers that follow.

The OSPS uses hardware and transmission channels provided by the 5ESS switch for the Integrated Services Digital Network (ISDN) to connect operator positions to the switch. This arrangement allows simultaneous voice and data transmission and access to external data bases. Operation of the OSPS is based on the ISDN capabilities of the 5ESS switch.

Telephone service providers can use the OSPS to handle their traditional applications of directory, toll, and operator assistance services. One switch with the OSPS can serve up to 128 teams of operators handling different applications.

The OSPS can be deployed as a stand-alone system, or it can be integrated with centralized switch functions such as toll, tandem, or gateway. By using a special remote integrated services line unit, operator centers can be located hundreds of miles from the switching system site.

The OSPS provides a set of standard capabilities, as well as

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application and country-specific features; it operates with the various types of international trunking and signaling.

Design Goals

So that state-of-the-art operator services are provided, the design of the OSPS has been based on the following key goals:
- Reducing operator, administrative, and maintenance costs
- Improving network design efficiency
- Creating new service opportunities
- Meeting the needs of the global marketplace.

Each of these goals is explained below.

Operator Expense Savings. By reducing the average amount of time operators take to handle a call, expenses can be cut by millions of dollars. The OSPS design emphasizes achieving this goal. Particular attention has been given to automation, optimizing operator performance, minimizing operator training time, and maximizing operator comfort, convenience, and safety at the operator position.

Administrative and Maintenance Savings. Centralizing the administration of operator services for multiple locations and serving teams reduces expenses. The efficiencies of large serving teams (thousands of operators) are possible with the large capacity of the OSPS. Switch administrative and maintenance costs are minimized through use of standard 5ESS switch procedures and equipment and a common maintenance work force.

Savings through Network Design Efficiency. Network planners must efficiently and reliably bring the operator services traffic from wide geographic areas to where the available operator work force is located. The 5ESS switch has several flexible remote capabilities that allow operator service centers to be located hundreds of miles from the host switch. The OSPS may be added to a 5ESS switch dedicated to varied types of operator services, or it may be integrated into a network switch serving other international gateway, toll, tandem, or local traffic. Traf-

fic also can be routed dynamically from one OSPS to another so that operator services centers can close down during low traffic periods.

Revenues through New Service Opportunities. ISDN and open interfaces are vital to making a switch owner-customizable, independent, and flexible and to developing new service opportunities. ISDN provides packet-switched access to a variety of databases and support systems from the OSPS operator terminals. These open interfaces facilitate adding new services and customizing services for individual telephone service providers.

Globalization. The OSPS is easily utilized by telephone administrations all over the world. The OSPS meets the needs of global telephone administrations by including varied signaling systems, supporting multiple languages, using international standards, offering specific country/customer features, and providing customized displays on operator terminals.

Technical Challenges

The papers in this issue explain the overall design of the OSPS and emphasize our approach to resolving several major technical issues, common to many projects. In developing the OSPS, significant technical challenges were overcome in the following areas.

Integrated System but Separate Application. The architecture of the OSPS has to satisfy the needs of two distinctly different end-user groups: the switch owner and the operator services provider. From the viewpoint of the switch owner, the OSPS appears completely integrated with the 5ESS switch and ISDN platform. Such integration is required for the owner to maintain and administer the switch efficiently as a regular part of the owner's network. For the operator services provider, the OSPS also offers a separate application viewpoint that emphasizes the call handling and administrative capabilities available to the operator services centers.

Commonality and Customization. The OSPS is designed to offer several types of operator services for a

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variety of different operator services providers. The design of the OSPS is based on a common foundation and includes various components specific to the service provider and the application.

Integrated Services Digital Network. The OSPS fully exploits the power of ISDN technology. Directory assistance and toll assistance services that were formerly separate can be integrated to allow operators to provide combined services. With the OSPS, multiple systems can also be digitally networked together to cooperatively serve large geographic areas.

Stringent Ergonomic Performance Objectives. The operator interface is optimized for many aspects of human factors design, including system response time and the ergonomics of the terminals themselves.

Intelligent Network and Open Connectivity. The OSPS design provides open interfaces for a variety of databases and call processing functions. Both X.25 and Signaling System 7 interfaces are used to connect to other intelligent nodes in the network.

Very Large Scale Software Development. The OSPS includes over one-half million lines of source code resident in administrative processors, operator terminals, and the switch.

Development Approach

The OSPS project has been organized and managed as a separate application of the 5ESS switch development project. This organizational structure has provided developers a strong customer focus for the specialized operator services market; it also has allowed the OSPS development organization to work as a close partner with the corresponding OSPS product management, systems engineering, systems performance, and customer support organizations. Although the OSPS has a separate product focus, development is tightly coordinated with and integrated into the overall 5ESS switch development process. The OSPS has been developed by using the 5ESS switch development methodology and

quality management system with modifications. These modifications improve the process, and many have been adopted by the 5ESS switch project. Some of these major improvements are summarized below.

Integration Process. Smaller feature-oriented deliverables, or test units, have been introduced as the basis for integration testing. This formalizes the project integration plan and provides independent testing earlier in the process. It also extends development organization responsibility for integrating all OSPS features as a complete package before they are released for system verification.

Software Load-Building Process. Independent software load-building and load bring-up procedures common to the OSPS package are introduced before code is submitted to the public 5ESS switch load. This OSPS common load ensures more timely and stable loads for developers and eliminates the need for multiple developer private loads.

Coding and Testing Process. Code inspections are emphasized as the first step in testing. Inspections are held in two phases. First, the new or changed modules are inspected in a linear fashion. Then, the code is "walked through" in the sequence in which it would be executed for several integration tests. These code inspections and walk-throughs result in code quality sufficient for submission to the OSPS load without extensive testing of low-level code coverage, thereby allowing more efficient, higher-level functional testing to start earlier in the process.

Requirements and Design Process. Early prototyping of the operator and user interfaces establish the correct design from a human factors point of view. The operator terminal is first connected to a 3B2 computer to form a portable simulator that demonstrates operator position call handling. The simulator gives early feedback on requirements. Next, individual requirements are clearly specified as numbered list items and are traced through the development process to ensure coverage in the final

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product. Specialized checklists also are used to ensure complete fulfillment of requirements. System performance is analyzed during high-level design by using simulation models to ensure that the design meets the objectives of capacity and response time.

Test Environment Process. The stability and productivity of the system laboratories are improved through a formal process for planning, implementing, and managing the OSPS test environment. OSPS developers also make extensive use of the 5ESS switch execution environment, a simulator that allows 5ESS switch software to be executed on a mainframe support computer. The effectiveness and realism of this testing have been extended by connecting the OSPS operator terminals directly to the mainframe through adapters.

OSPS Architecture

OSPS architecture is presented at two levels: the position and placement of the OSPS in the network, and the design of the overall system architecture. The OSPS connects to the network through incoming trunks from local or toll exchanges. These trunks have specialized signaling for the operator services call types. International OSPS signaling includes specialized dial access codes for each type of service. The OSPS provides the desired automated or operator-assisted services. Calls are completed over outgoing trunks to the network. If required, the OSPS also generates the billing record for a call.

The OSPS network architecture is determined by the following factors, each shown with the corresponding characteristic of the OSPS:

- Large serving team of operators. The OSPS serves large geographic areas.
- Specialized incoming trunking. The OSPS supports concentration of incoming traffic from remote areas.
- Location of operator work force. The OSPS supports remote operator service centers.
- Type and capacity of the tandem/toll/gateway office. The OSPS may be a stand-alone system, or it may be

integrated with a 5ESS (tandem/toll/gateway) switch.

The OSPS builds on the unique ability of the 5ESS switch system architecture to distribute functions across wide geographic areas and to support large system capacities. This arrangement gives network designers great flexibility in positioning the OSPS functions in the network.

The OSPS architecture shown in Figure 1 has been designed and built on the existing ISDN architecture of the 5ESS switch. The switch consists of three major hardware modules that handle administration, communications, and switching. Of the two types of switching modules (SMs), one handles normal analog voice calls; the other—an ISDN module—handles digital voice and data as well as analog voice calls. The ISDN SM is the interface between operator positions and the switch. Subsequent papers in this issue refer to the ISDN SM with operator positions as the *position SM* (PSM).

The administrative module (AM) provides system administration functions and supports automatic call distribution (ACD) to operators. Hardware and software are added to the basic switch to perform automated and manual operator functions. Different types of operator terminals are furnished for different OSPS applications. An OSPS administrative processor also is provided. The operator terminals allow operators to receive and control calls and to send and receive data through the switch. Functionally, these are ISDN terminals with simultaneous voice and data communications capability.

The operator terminals are connected by ISDN basic rate interfaces (BRIs) to the switch's integrated services line unit (ISLU) or to a remote ISLU (RISLU) when the operator services center is a distance from the host switch. The ISLU (or RISLU) acts as an operator position controller. Operator terminals may be located several miles from the position controller; the exact distance depends on the application and the type of interface. Where the RISLU is used, links from multiple positions are combined at the RISLU and multiplexed onto
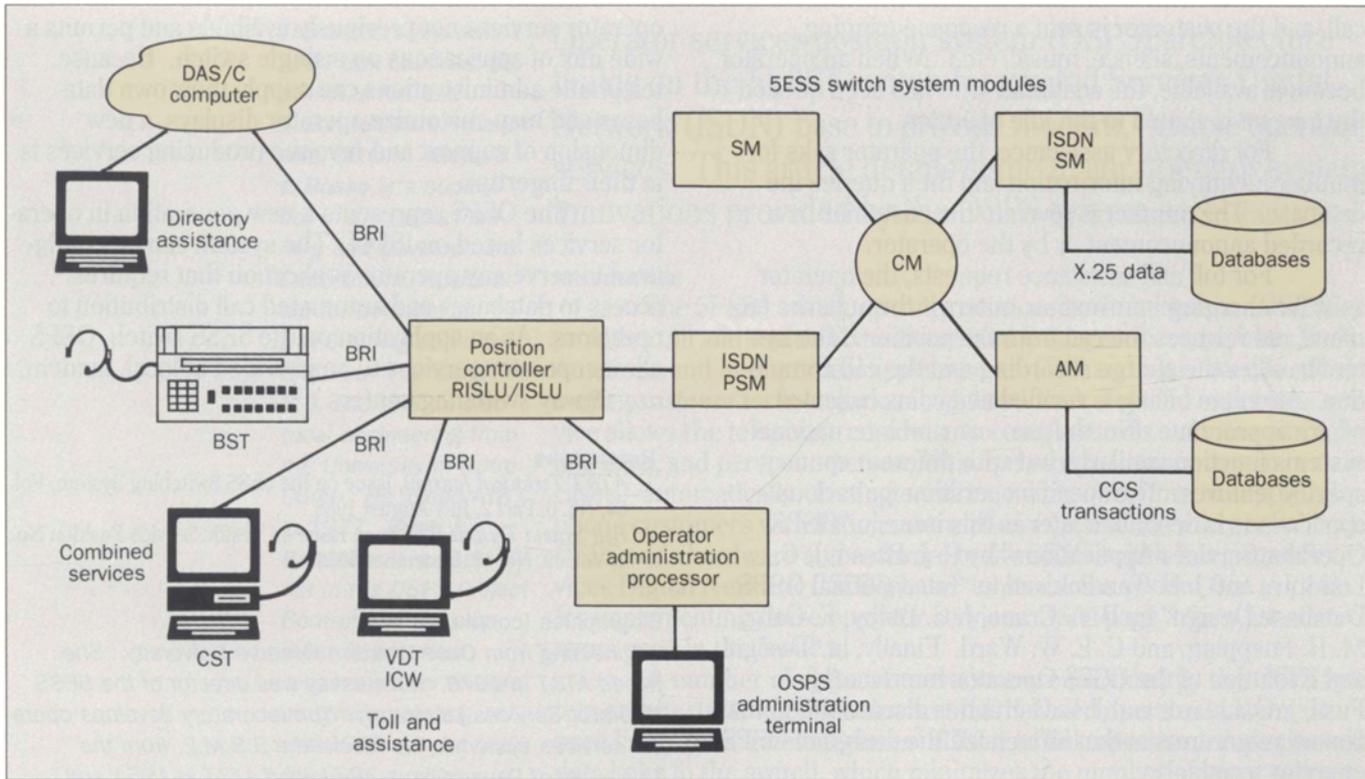
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Figure 1. Architecture for the 5ESS switch operator services position system.

digital facilities that connect to the host 5ESS switch.

The OSPS connects to other vendors' or telecommunications administrations' databases, as well as to other 5ESS switches. The connections to other switches make available remote capability for complete call handling. The administration may choose to use these connections as paths among switches to provide call processing at the originating switch and operator services at another switch. An SM also may be remoted from the host to provide remote concentration of traffic. More details are given later in this issue in "OSPS System Architecture" by R. J. Basso, H. J. Beuscher, I. S. Dowden, R. J. Piereth, and S. M. Salchenberger.

System Operation

The heart of the OSPS is a full-featured, flexibly administered automatic call distributor. Depending on parameters such as its incoming trunk and the dialed digits, a call coming into an OSPS is selected for a particular operator serving team. The originating switching module determines the call type and gives the ACD the information needed to select the proper serving team. If operators on this team are available, the call is routed to the one who has been idle the longest. If an operator is not available in that serving team, the ACD queues the

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call, and the customer is sent a response (ringing, announcements, silence, music, etc.). When an operator becomes available, the customer who has been queued the longest is routed to the idle operator.

For directory assistance, the operator asks for number-identifying information and then queries the database. The number is given to the customer by a recorded announcement or by the operator.

For toll and assistance requests, the operator asks for charging information, enters it through the terminal and releases the call from the position. The system handles the charge recording and the call completion. Alternate billing is verified and coins collected where appropriate. North American and international systems function similarly, but with different country-specific features. The specific operation for various applications is described later in this issue in "OSPS Operator Services Applications" by R. J. Basso, J. C. Lund, Jr., and J. H. Tendick and in "International OSPS Database Design" by B. A. Crane, J. C. Dalby, K. Garg, M. H. Poepping, and C. E. W. Ward. Finally, in "Design and Evolution of the OSPS Operator Interface," J. A. Fuss, J. G. Liuzzo, and J. L. Ostrander discuss the human factors requirements that influenced the design of OSPS operator terminals.

Summary

The enhanced OSPS design allows operators to be located hundreds of miles from the switch. OSPS features reduce a telephone service provider's costs in the areas of operator time, administration and maintenance, and network design. The OSPS includes many operator services not previously available and permits a wide mix of applications on a single switch. Because telephone administrations can supply their own databases and may customize operator displays, a new dimension of support and revenue-producing services is at their fingertips.

The OSPS represents a new generation in operator services based on ISDN. The system can be configured to serve any operator application that requires access to databases and automated call distribution to operators. As an application on the 5ESS switch, OSPS allows operator services to be provided at local, tandem, or gateway switching centers.

References

1. *AT&T Technical Journal*, Issue on the 5ESS Switching System, Vol. 64, No. 6, Part 2, July-August 1985.
2. *Bell System Technical Journal*, Issue on Traffic Service Position No. 1, Vol. 49, No. 10, December 1970.

Biographies (continued)

engineering from Case Western Reserve University. She joined AT&T in 1978. Mr. Kaskey was director of the 5ESS Operator Services Laboratory. The laboratory develops operator services systems. He received a B.S.M.E. from the University of Pennsylvania. He joined AT&T in 1951 and retired in 1989.

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