OSPS OPERATOR SERVICES APPLICATIONS

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Toll and assistance and listing services are two important applications of the operator services position system (OSPS). These applications are built on the distributed architecture of the 5ESS® switch and use the building blocks provided by the OSPS software architecture to incorporate new features easily. This article focuses on two toll and assistance features, interflow and more efficient call handling (MECH), as well as the listing services application and a combination of the two applications through the combined services feature to demonstrate the power of the OSPS software architecture.

Introduction

The 5ESS® switch OSPS supports both *toll and assistance* and *listing services* applications for the North American market. (For a complete listing of all OSPS acronyms used in this issue, see page 2.) Toll and assistance service allows a telephone customer to complete calls such as coin, calling card, and person-to-person with operator assistance (or, in certain cases, automatically). Listing services enables operators to supply telephone customers with listing information, such as directory numbers. These applications are designed to make operator services more efficient.

The OSPS architecture provides building blocks upon which additional features can be developed. (Basso et al. discuss the basic architecture of OSPS elsewhere in this issue.[1]) Two toll and assistance application features (*interflow* and *MECH*), the listing services application, and the combination of these two applications through the combined services feature, demonstrate the power of this architecture. The interflow feature uses cooperative call processing between two switches to provide operator handling on a call. The MECH feature removes the operator from a call when not needed. The *combined services feature* provides both toll and assistance and listing services from the same operator terminal.

Providing Efficient Service with OSPS

Operator services is a labor-intensive business. As Dowden et al. show, even a slight reduction in the average time operators take to

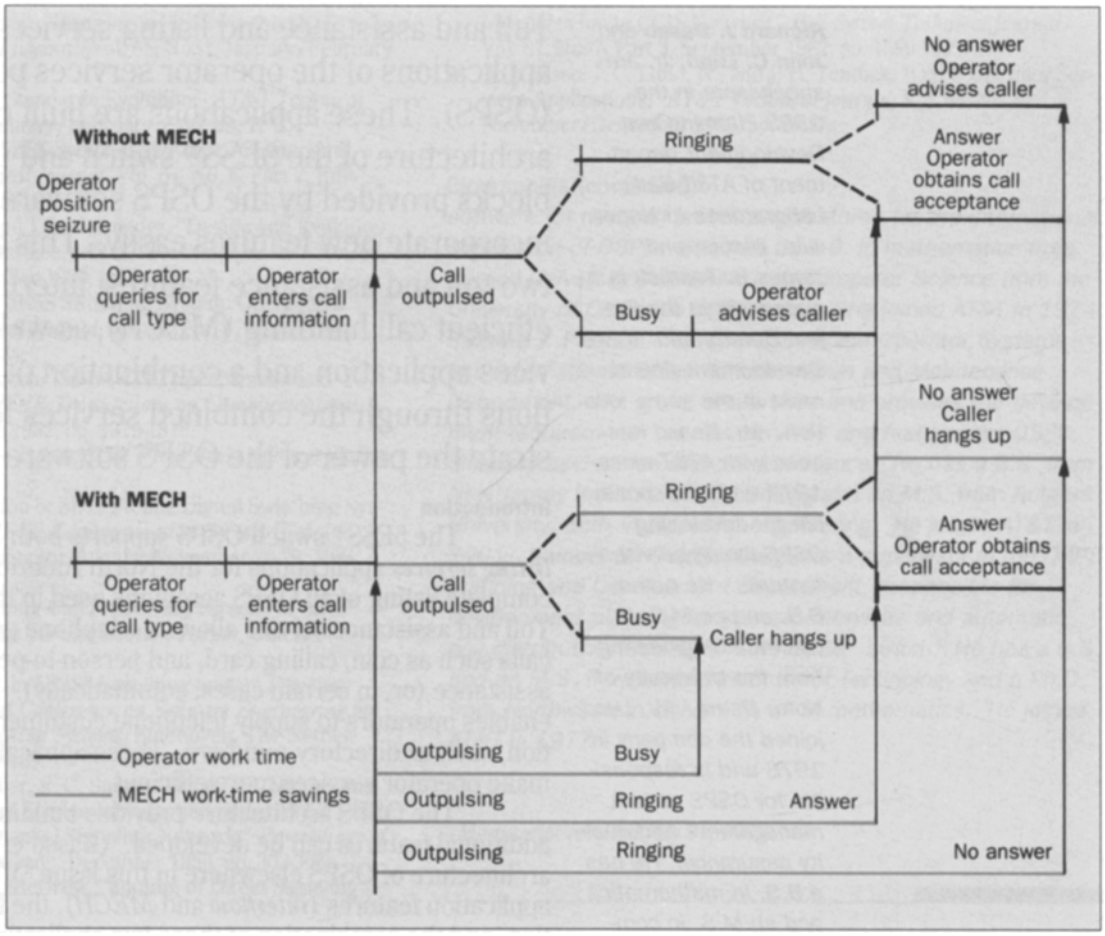


Figure 1. Comparison of operator work time for a toll and assistance collect call with and without the MECH feature.

handle a call can reduce expenses by millions of dollars.[2] The OSPS design allows operator services to be more automated, flexible, and efficient.

Automation. Automating operator services can make them more efficient; however, it is important to provide the customer with service quality that is at least equal to service provided by a human operator. Two examples of fully automated services are the automated calling card service (ACCS) and the automated coin toll service (ACTS). For a discussion of these services, see Basso et al.[1]

Serving Team Efficiency. OSPS increases operator efficiency for calls that cannot be fully automated by:

1. Minimizing the time an operator spends on a call, including (a) using ergonomically designed operator terminals, (b) minimizing the keystrokes required for

tasks, and (c) having well-designed service protocols.[3]

2. Having an operator connected to a call only when necessary. (The MECH feature uses this strategy.)
3. Using serving team flexibility. (The interflow and combined services features are examples of this method.)

MECH. Not all toll and assistance calls are fully automated and some must be handled by a human operator; however, others do not require an operator for the entire time a call is being handled. For example, after obtaining the initial information for a collect call, both the operator and customer wait for the call to be answered. Until the call is answered, an operator is not needed. If the call is not answered or the line is busy, no further operator assistance is necessary.

When the MECH feature is available, an operator can be removed from the call between call setup and forward party answer for those calls in which an operator must talk with the forward party (collect, person-to-person). Figure 1 shows that, with MECH, the time an operator spends on a call can be reduced significantly. This can be a considerable savings depending on the number of calls that are never completed and the amount of time before answer.

Serving Team Flexibility. OSPS can direct incoming calls to different serving teams based on a combination of call parameters. Parameter choices include:

- Incoming trunk group
- Dialed digits
- Carrier for the call
- Coin or noncoin call
- Interflow
- Call class (initial operator seizure, subsequent seizures, or MECH).

Switch administrators can program these call parameters to send calls to specified call queues.[1] They can also assign different serving teams to each call queue or multiple call queues to one serving team. This flexibility can be used to separate special call types or allow new operators to handle only a few types of calls until they become skilled in OSPS operation. When the interflow and combined services features are added, service becomes even more efficient.

Interflow. Many operator services organizations would like to close one or more operator systems during nonpeak hours (e.g., nights and weekends) and concentrate the traffic on another system. This preserves the efficiency of large serving teams at one location. The interflow feature makes this possible. Because interflow is activated on a serving team basis, it is also possible for only a portion of the operator traffic to be sent from one switch to another. In fact, different serving teams can be interflowed to different switches, with up to 16 unique destinations possible.

Combined services. Traditionally, toll and assistance and listing services are provided by separate groups of operators in different operator service centers. Such an arrangement is inefficient when there is excess traffic at one operator service center and low traffic at the other. To ensure proper service, telephone service providers must reserve enough operators and equipment for maximum traffic loads for each application separately. However, some operators may then be idle during low traffic periods.

With OSPS, an operator at a combined services terminal (CST) can handle listing services and toll and assistance calls either separately, where these types of calls are handled for a specified time (e.g., for an hour), or the calls can be intermixed on a call-by-call basis. In fact, an operator could have a toll and assistance call on hold while handling a listing services call.

Cooperative Call Processing

The complexity of the services needed by today's telephone service providers makes cooperation between multiple systems in the network important. Cooperative call processing can occur between two systems developed by AT&T, as in the interflow feature, or between an AT&T

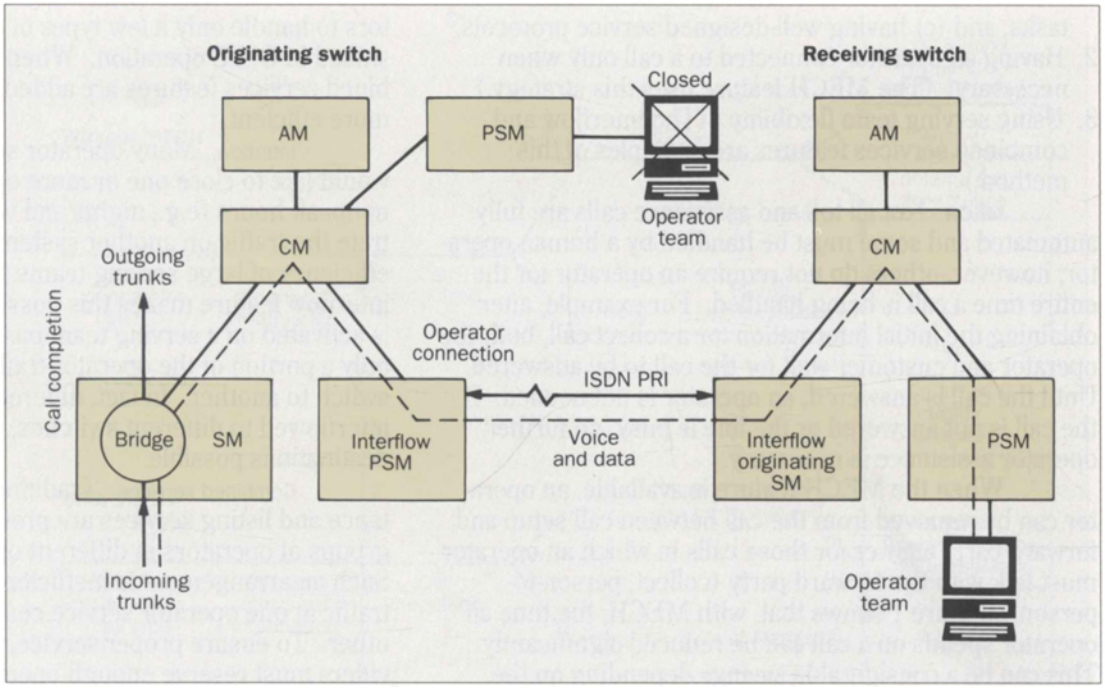


Figure 2. Call flow in a toll and assistance interflow environment. AM = administrative module; CM = communications module; PSM = position switching module; and SM = switching module. ISDN PRI = Integrated Services Digital Network primary rate interface.

system and one provided by another supplier, as in the listing services application.

Toll and Assistance Interflow. In an interflow environment, operator-assisted calls are handled through cooperative call processing of the call by two OSPS switches (Figure 2). Cooperative call processing overcomes several disadvantages of simple rerouting of toll and assistance calls. First, rerouting would require duplicating data in the two switches to ensure proper handling of calls. Second, rerouting could extend the back party to the forward party transmission path when attaching an operator to the call—cooperative call processing does not. Also, if two switches involved in handling a rerouted call reside in different local-access transport areas (LATAs), rerouting of the calls could result in the transmission path between the back and forward parties crossing LATA boundaries without using an inter-LATA carrier, which is not allowed at present.

Cooperative call processing does not extend the back party to the forward party transmission path, but bridges the operator on the call at the originating switch. Additionally, fully automated calls, such as ACTS and ACCS, are processed entirely on the originating switch. This minimizes the transmission facilities required on these calls and avoids the potential problem of inter-LATA calls.

There are two switches involved in processing an interflow call. A call requiring operator assistance arrives at the first OSPS (the originating switch) and is connected to an operator located on the second OSPS (the receiving switch).

All information entered by the operator at the operator terminal on the receiving switch is sent to the originating switch. Information needed for the operator

Panel 1. Handling a Collect Call in an Interflow Environment

1. A customer dials 0 for an operator.
2. The request for an operator is received at the originating switch and the call queue is determined from the characteristics of the call.
3. The automatic call distributor determines that the serving team for this call queue is closed and that calls are being interflowed. The request for an operator is then sent to the receiving switch.
4. When the request is received, the automatic call distributor at the receiving OSPS again determines the call queue based on the characteristics of the call.
5. When an operator is available, the operator receives the call and the operator terminal indicates that this is an interflowed call. The operator asks to assist the caller.
6. The operator enters the requested forward number and a collect class of charge at the operator terminal. This information is sent to the originating switch. A database query is launched on the originating switch to verify that collect billing is allowed for this called number. When there is a valid response from the database, a screen update message is sent to the receiving switch.
7. The "billing OK" indicator is displayed on the operator's terminal at the receiving switch.
8. In parallel, the originating switch outpulses the call to the called party.
9. When the called party answers, the operator verifies acceptance of the charges for the call. The operator then indicates they are ready to release the call. A message is sent back to the originating switch that the operator is ready to release the call and the connection to the operator is removed.
10. The call is now connected through the originating switch, with no interface needed to the receiving switch. When the call is complete, the billing record for the call is made by the originating switch.

displays is transmitted from the originating switch to the receiving switch. Final routing, billing for the call, queries to databases used in processing the call, and bridging of the back and forward parties on the call is done on the originating switch.

Fully automated calls are processed entirely on the originating switch. If the customer asks for an operator on one of these types of calls by, for example, dialing 0 in response to the ACCS prompt to enter a calling card number, the operator handling is provided from the receiving switch.

Panel 1 shows how an operator-assisted collect call in an interflow arrangement without MECH treatment is typically handled. The operator on the receiving switch is connected only long enough to gather the information from the caller and verify that the call will be accepted by the person answering the call. When this is completed, the operator on the receiving switch is removed from the call.

Listing Services. The listing services application provides a telephone operator with access to a variety of external database systems. The most well-known listing services feature is basic directory assistance ("white pages"). New listing services features include yellow pages (business listings), customer name and address, and zip code provision. Customers make listing services calls using the familiar codes 411, 555-1212, and NPA-555-1212. (NPA stands for numbering plan area.) OSPS can accept new codes for other specific services.

Listing services features require access to large databases not resident in OSPS. Thus, a general interface has been developed between the OSPS and external information systems (EISs). Typically, EISs are supplied by one of a small group of manufacturers selected by the telephone operating company. The EIS has access to one or more databases, such as a directory assistance

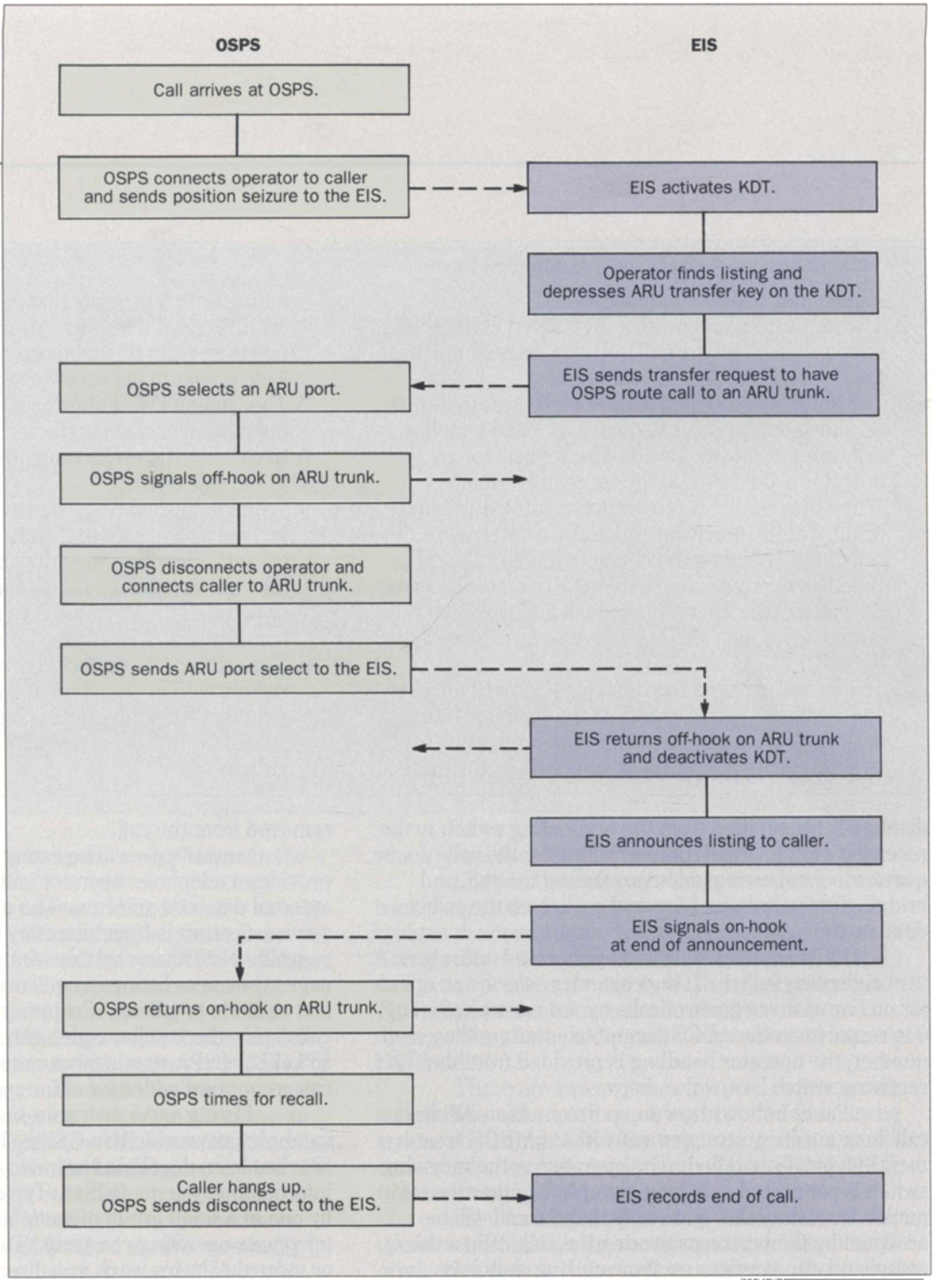


Figure 3. Listing services call with transfer to an external audio response unit (ARU); KDT = keyboard display terminal.

system/computer, and may act as a gateway through which the operator can access many different types of databases.

OSPS and the EIS communicate over call-processing data links using software messages to sequence the events of each call. OSPS can request services of the EIS; and the EIS can request services of OSPS. OSPS (1) interfaces with the telephone network, (2) controls the connections of operators and announcement units to the caller, (3) controls the OSPS operator terminal, (4) outpulses calls, and (5) generates billing records. The EIS (1) retrieves information from one or more large databases, (2) displays the retrieved information to the operator on a keyboard display terminal (KDT) or on AT&T's CST, and (3) announces information to the caller using an audio response unit (ARU) external to OSPS.

Figure 3 shows the sequence of events for a typical listing services call. The caller is connected to an operator and requests information, the operator retrieves the information from the EIS, then transfers the call to an external ARU for announcing the retrieved directory listing to the caller.

Software Architecture Building Blocks

The OSPS software architecture uses the 5ESS switch's distributed architecture to provide software building blocks that allow new features to be incorporated easily. The common OSPS software architecture is shown in Figure 4 and discussed in detail in reference 1. Each component functions as follows:

- The originating terminal process (OTP) controls the interface to the incoming trunk, while the terminating terminal process (TTP) controls the interface to the outgoing trunk.
- The automated terminal process (ATP) controls interaction with the hardware devices used to automate a call.
- The automatic call distributor (ACD) routes calls to operator call queues and maintains the status of operator availability.
- The position terminal process (PTP) provides the interface between the operator and the other processes involved in an operator-assisted call. The PTP has many finite state models for concurrent processing of asynchronous input from multiple sources.

For the toll and assistance application in the PTP, there is a query model in the PTP to interface with external databases in the network that contain call-handling information. The network call-denial database is one example of such a database; it indicates whether a calling number is allowed to use AT&T long distance service. There is also a call coordination model between the operator and the ATP that controls the hardware for automated services, such as automated coin detection.

Toll and Assistance Interflow. The interflow feature provides operator services to a customer whose call originally came into an OSPS that does not have an active serving team for that specific call type. The processing of such a call, however, appears the same to the customer and the operator. Therefore, the existing OSPS processes and models are reused for interflow, but exist on two switches. The software determines which switch an interflowed call is running on and only executes code for functionality required on that particular switch. Because the receiving switch only handles the connection to the operator, the majority of the software is executed on the originating switch.

As Figure 5 shows, the basic interflow architecture is the same; however, there are two new processes, the interflow PTP and the interflow OTP, and one new model. Most other PTP models still exist on both switches.

Because the originating switch has no operators to serve the call being handled, there is an interflow PTP to interface with the OTP on the originating switch and the interflow OTP on the receiving switch. Also, there is an interflow OTP on the receiving switch to interface with both the PTP on the receiving switch and the interflow PTP on the originating switch. Hence, the

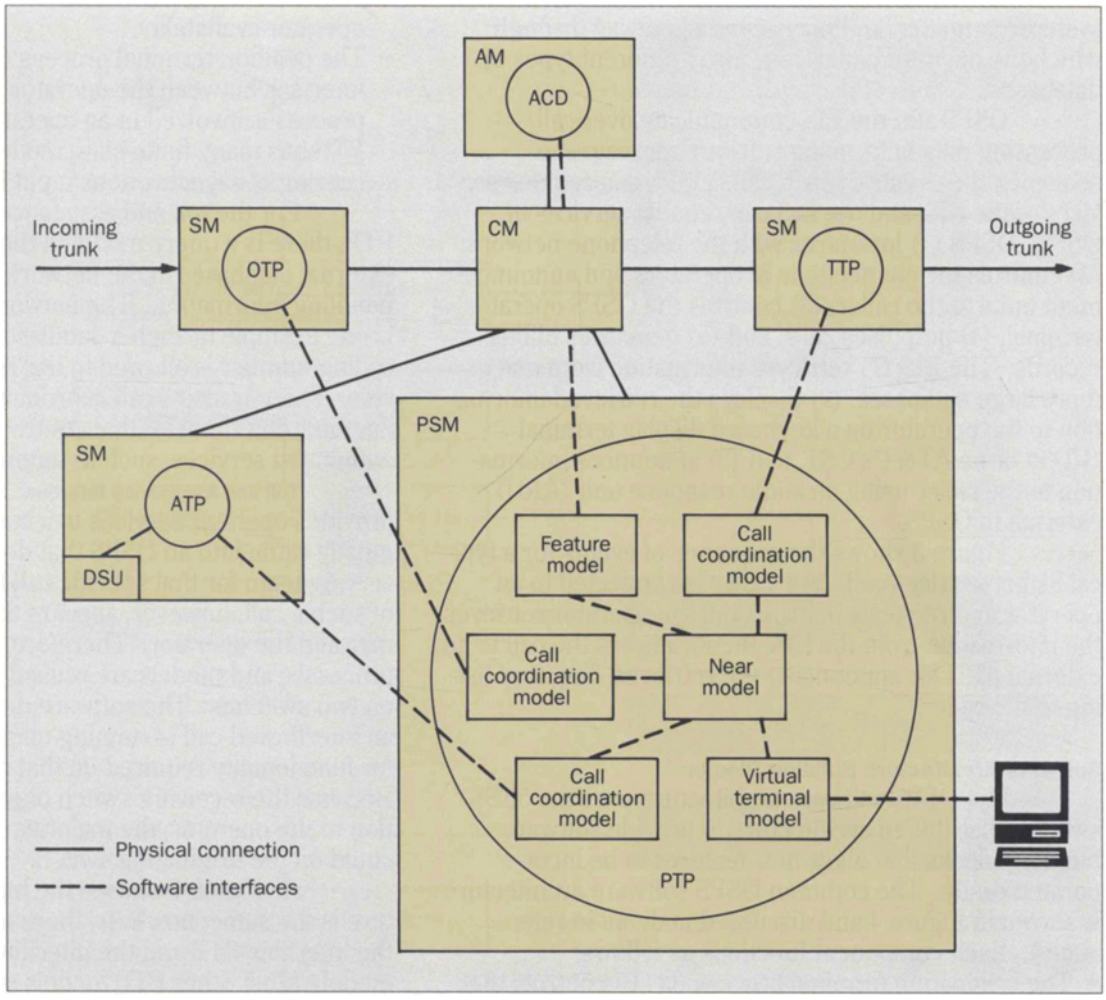


Figure 4. Common OSPS software architecture. Acronyms in this figure and additional OSPS architecture figures are as follows: AM = administrative module; CM = communications module; PSM = position switching module; SM = switching module. ACD = automatic call distributor; ATP = automated terminal process; DSU = digital services unit; OTP = originating terminal process; PTP = position terminal process; TTP = terminating terminal process.

basic arrangement of an OTP, a PTP, and a TTP involved on an operator-assisted OSPS call is preserved.

The PTP models handle input from asynchronous sources and concurrently handle the different interfaces involved.[1] This basic architecture is maintained for interflow. A new model, the interflow message handler, was created for interflow to process messages sent between the two switches. It directs messages coming across the link between the two switches to the appropriate PTP model for processing.

Most PTP models exist on both switches; however, the models only execute code appropriate to that switch. About 75 percent of operator input is processed on the originating switch. For example, when the

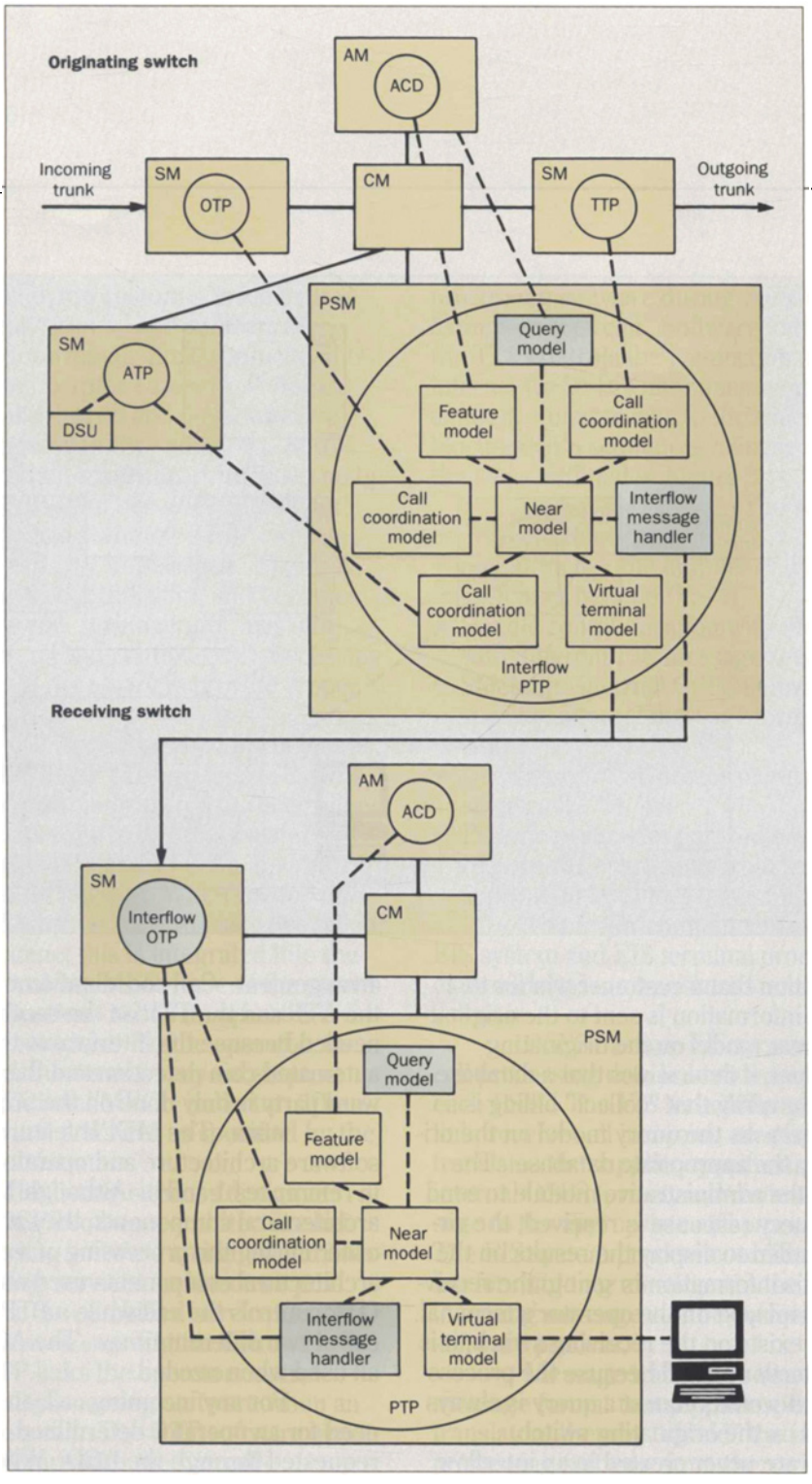
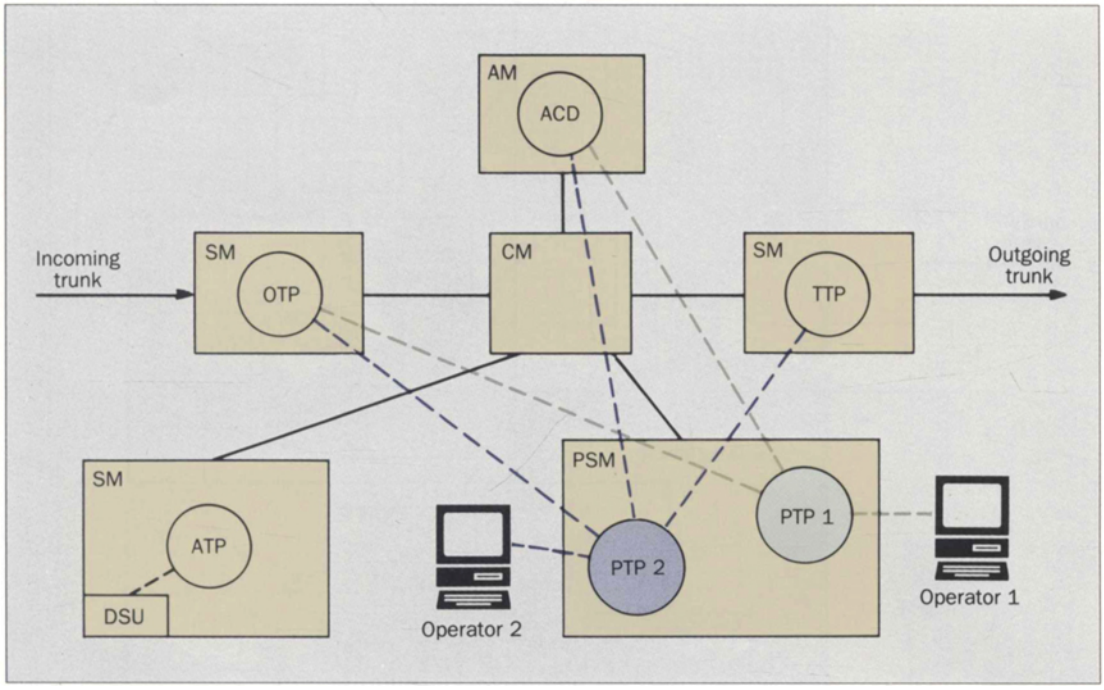


Figure 5. Interflow software architecture.

Figure 6. MECH software architecture.



operator enters information that a customer wishes to make a collect call, this information is sent to the originating switch. When the near model on the originating switch processes the input, it determines that a database query needs to be sent to verify that "collect" billing is allowed. The near model asks the query model on the originating switch to query the appropriate database. The query model then asks the administrative module to send the query. When the query response is received, the virtual terminal model is called to display the results on the operator's terminal. This information is sent to the receiving switch where it is displayed on the operator's terminal. While the query model exists on the receiving switch, it is never entered for an interflowed call because the processing of operator input that would request a query is always done by the near model on the originating switch.

Certain models are never created in an interflow arrangement. Call coordination models to interface with the ATP and the TTP on the receiving switch are not needed because the interface to the hardware for automated coin detection and the connection to the forward party is only done on the originating OSPS.

MECH. The MECH feature preserves the same software architecture and operator interface as described in references 1 and 3. Although MECH uses existing architectural components, they are joined in a different order during the processing of a call. Figure 6 shows the architectural components used on a MECH call. The OTP controls the call while a PTP is brought onto the call at two different times. The ACD, TTP, and ATP are all used when needed.

For any incoming call, an OTP is created, the need for an operator determined, and an operator is requested through the ACD. When an operator is

available, a PTP is attached, the customer voice path is connected to the operator terminal and call data are displayed on the operator terminal. If a customer wants to make a collect call, the operator enters this information. Up to this point, calls that do and do not receive MECH treatment are handled in the same way. At this time, if the call passes certain screening criteria set up by the switch administrator, the call becomes eligible for MECH treatment. This occurs when the PTP indicates to the operator that the call may be released. Typically, the operator releases the call at this point and becomes available to handle a new call. The operator may still choose to remain on the call and continue call processing in the regular way if this is necessary to provide proper service.

As in any other call that is released by an operator, when a call is handled using MECH, the OTP owns the call and stores all relevant information for later billing or possible recall to the operator. A TTP is created, the call is outpulsed, and the OTP (instead of the operator) monitors the connection for answer. When the forward party answers, the OTP asks the ACD to place the call in a high-priority MECH queue; this is integrated into the current architecture by making MECH one of the parameters in call type determination. When an operator is available, a PTP is again attached. To the operator, the second call seizure looks the same as any subsequent seizure except for an additional MECH indicator. Then the operator follows normal practices as specified by the telephone company administration.

Listing Services. The listing services design is based on the common OSPS software architecture but has modified call-processing software and an added interface to the EIS. The listing services architecture provides a building block for the combined services feature.

Listing services call processing. Figure 7 shows how the EIS model in the PTP links the operator control software with the EIS call-processing software when an operator is connected to a call. The OTP software also links the call control software with the EIS call-processing software during the automated portions of a listing services call. Software in the OTP, the ATP, and the TTP controls the connection of operator terminals, of internal (to OSPS) announcement units, and of external announcement trunks to the caller. Using these building blocks, OSPS sequences a listing services call through the steps outlined in Figure 3.

EIS software interface. The software components for the EIS interface can:

- Support a flexible number of data links per position switching module (PSM).
- Handle communication with multiple EISs per PSM with different EIS message sets per EIS supplier.
- Shield the internal OSPS software from the supplier-specific external message formats with message translation.
- Use different call-processing data links during the same call.
- Provide redundant data links with the ability to remove the spare links from service without losing application-level messages (in the fault-free case).

The major components of the interface are the EIS system and EIS terminal processes, the internal-to-external message translators, and the call-processing software.

OSPS has one EIS terminal process for each call-processing data link and one EIS system process for each PSM. The EIS terminal process "owns" the data link, receives all incoming messages from the EIS, translates the supplier-specific message formats to an internal OSPS format, and routes each incoming message to the appropriate call-processing terminal process. The EIS system process coordinates the message routing for outgoing messages to the EIS and distributes incoming messages to the correct call-processing software process.

Message translators convert the internal OSPS message format to a supplier-specific format. Message translators thereby "shield" the internal OSPS call-processing software from the variety of formats and

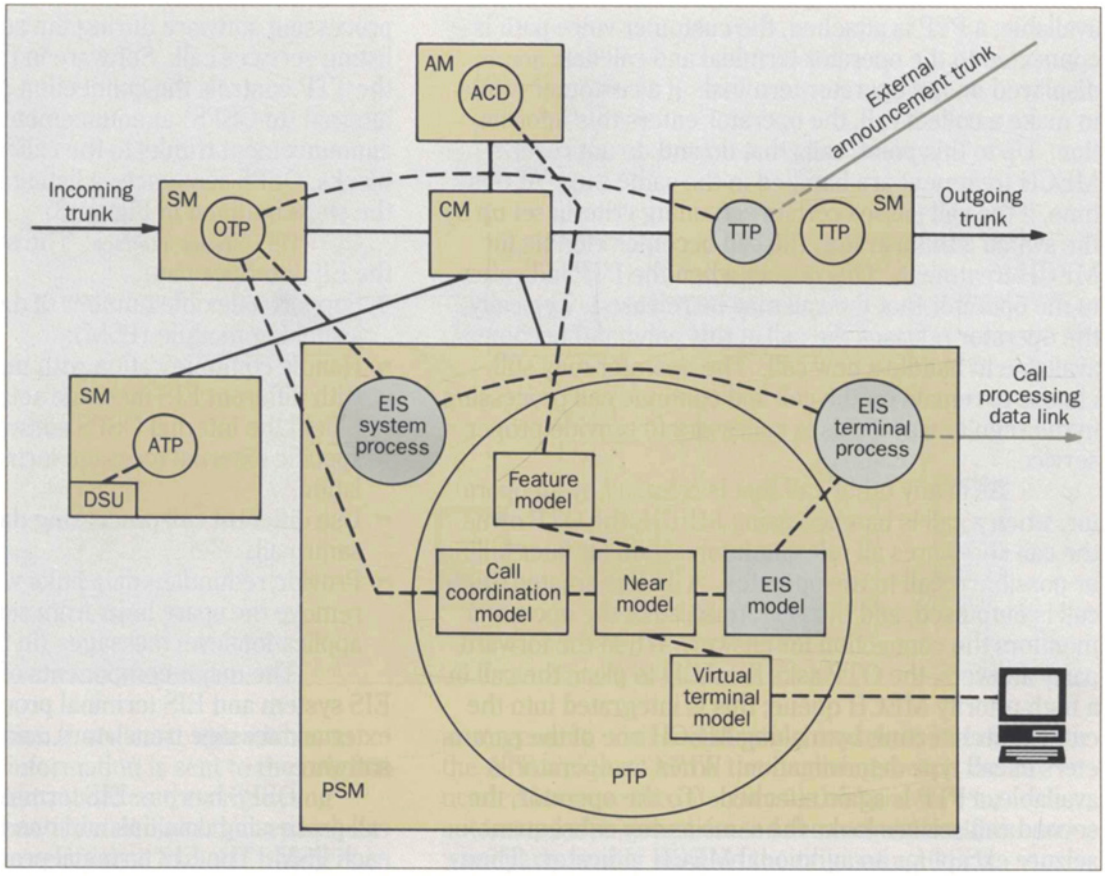


Figure 7. Listing services software architecture.

reduce the need for more interfaces when new systems are added.

New primitives are invoked by call-processing software whenever an event occurs that requires a possible interaction with an EIS. These "call event" primitives determine whether a specific action, such as sending a message or waiting for a message, needs to be taken for a given EIS at this point in the call. The call event primitives shield the OSPS call-processing software from the necessity of knowing each method of interfacing with each EIS.

Under normal circumstances, OSPS and the EIS use the same call-processing data link during the processing of a particular call. However, OSPS can adapt if the EIS switches to a different data link for a call in progress, even if that data link is connected to another PSM. This "link following" capability makes the system flexible enough to handle EISs with a distributed architecture or even handle message traffic in a link failure.

Combined Services. The combined services feature uses the OSPS software building blocks to serve both listing services calls and toll and assistance calls on a

single operator terminal. Thus, this feature uses:

- The listing services call-processing software in the toll and assistance software environment.
- A CST to replace the VDT for toll and assistance calls and to replace the combination of the (OSPS) basic services terminal and the (EIS) keyboard display terminal for listing services calls.
- The multiple database access feature to establish connections between the CST and external databases for exchanging database information.[1]
- The ACD to route diverse incoming call types to the same serving team.[1]

The CST is based on personal computer technology and is described in reference 3. The CST contains all the functions of the VDT for toll and assistance calls, but adds new functions to support listing services calls. The CST has a keyboard that makes it easy to search the EIS database. The CST also provides a custom protocol for minimizing the amount of data sent between the CST and the EIS when generating database-driven displays for the operator.

The multiple database access feature allows the CST to establish connections with one or more external databases. For combined services, the CST normally would communicate with an operator reference database for the toll and assistance calls and with an EIS for listing services calls. To minimize operator work time, the CST automatically displays the EIS "page" on the operator terminal when a listing services call arrives. The page associated with the operator reference database is displayed only by operator request because it is not needed very often for toll and assistance calls.

The ACD allows the telephone company administration to route listing services calls and toll and assistance calls to the same serving team or to route each call type to a separate serving team. A telephone company administrator can transition between dedicated serving teams and combined serving teams by changing the mapping between call types and serving teams.

Summary

The complexity of the services needed by telephone service providers makes cooperation between multiple systems in the network important. With cooperative call processing between systems, OSPS can provide powerful capabilities to the telephone service provider and the calling customer. By using automation, serving team efficiency, and serving team flexibility, OSPS can improve the delivery of operator services. And, with the building blocks of the OSPS architecture, it is easy to incorporate new features into the OSPS system and further automate existing applications.

References

1. R. J. Basso et al., "OSPS System Architecture," *AT&T Technical Journal*, Vol. 68, No. 6, November/December 1989, pp. 9-24.
2. D. C. Dowden, D. E. Herr, and B. Kaskey, "Operator Services Feature of the 5ESS® Switch," *AT&T Technical Journal*, Vol. 68, No. 6, November/December 1989, pp. 3-8.
3. J. A. Fuss, J. G. Liuzzo, and J. L. Ostrander, "Design and Evolution of the OSPS Operator Interface," *AT&T Technical Journal*, Vol. 68, No. 6, November/December 1989, pp. 51-62.

Biographies (continued)

developing toll and assistance call-processing features. He has a B.S. in electrical engineering from the University of Illinois at Champaign-Urbana and an M.S. in electrical engineering from Stanford University.

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