THE BELL SYSTEM TECHNICAL JOURNAL
Vol. 58, No. 6, July-August 1979
Printed in U.S.A.

Traffic Service Position System No. 1:

Remote Trunk Arrangement: Overall Description and Operational Characteristics

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(Manuscript received December 11, 1978)

This paper is an introduction to the Remote Trunk Arrangement feature of the Traffic Service Position System. The design permits the TSPS trunk circuit, which connects the subscriber to the operator, to be located in a distant, rural location. All the logic, records, control, and centralized access to the operators remains at the base unit. The Remote Trunk Arrangement is controlled over a data link and up to eight RTA subsystems can be extended from a single TSPS base unit. The addition of the RTA feature, expansion of the geographical area served by TSPS, and the necessity for handling special operator service traffic, affected several TSPS design parameters and required the addition of several new features. These supporting features and the operational characteristics and design aims of RTA are described.

I. INTRODUCTION

The Traffic Service Position System No. 1 (TSPS) helps the operator more efficiently handle toll calls such as collect, credit card, charge to third number, and coin toll calls. Key elements of the system design were to have all calls served by a single large team of operators, to divide the large team into smaller groups of a maximum of 62 operators for administrative purposes, to permit the location of the groups remote from the base unit near good labor markets, and to achieve high concentrations of traffic to fully utilize the expensive equipment needed to handle the complex, detailed toll calls.

The initial market for TSPS was in large metropolitan areas having high traffic density and high employee turnover. As the needs of the metropolitan areas were being met, it became apparent that the benefits of TSPS would be desirable in more sparsely populated areas for two major reasons. The first was that, because of their small size—50 position switchboards and smaller—rural operator teams are less cost effective. Moreover, there is a special need to increase efficiency in off-hours when average traffic might not require the services of a single operator. Providing the supporting personnel facilities for small groups added to the cost. The second reason for providing TSPS service in rural areas was to provide uniformity of service to all customers. An increasingly mobile population anticipates the same type of telephone service nationwide.

To provide the benefits of TSPS operation in rural areas, several approaches were investigated, including a scaled-down version of TSPS and the incorporation of TSPS features in a local switching system. The solution chosen is the Remote Trunk Arrangement (RTA). As the name implies, the design permits the TSPS trunk circuit, which provides the brief transmission bridge to the operator, to be located in a distant, rural location. All the logic, records, control, and centralized access to operators remain at the base unit. The RTA is controlled over a data link and provides all the benefits and features inherent in TSPS. Since traffic from a number of RTAs can be handled by a single base unit in addition to the traffic at the base, efficient utilization of the relatively powerful TSPS is achievable. Also, existing TSPS installations not using all the available capacity can be more fully utilized by reaching out into surrounding rural areas.

One RTA can provide up to 496 TSPS trunks which connect to the base over 64 voice circuits. Control of the RTA is over triplicated data lines. To ensure continuity of service, voice transmission and data facilities are split over diverse routings. The transmission objective of having the operator voice levels equivalent to local operator service limits the maximum allowable distance between the most remote RTA to the most distant operator to 1000 miles via the base unit. Various transmission factors establish this limit as explained in Ref. 2.

The original design of TSPS provided for remoting operator groups using a special version of T1 carrier to provide both voice and data tailored to TSPS. This arrangement has been extensively applied, but it poses a limitation to some operating companies because the maximum remoting distance is 80 miles and T carrier routes are not always available to the desired operator location. Therefore, as part of the RTA development, the data link capability for controlling the RTA was so designed that it could also control a remotely located operator group. This data link arrangement has been named the Peripheral Control Link (PCL). The voice and data circuits from the base to the operator positions can now be provided by using circuits on any standard transmission facility. Also, a new version of the TSPS console was developed to improve the circuit control mechanisms and permit consoles to be used for both training and service. The new console is designated 100C, and the combination of the PCL with the 100C is called Position Subsystem (PSS) No. 2. Position Subsystem No. 2 can be used for both local and remote applications and supersedes the original PSS No. 1. 100C consoles can be located as far as 1000 miles from the base if no RTAs are served by the base.

Several system problems unique to the rural environment had to be solved as part of the RTA development. Closing a rural cord switchboard unit often removed the only 24-hour service unit in the area. Off-hour business service calls, repair service calls, alarms from unattended telephone offices, busy line verification calls, calls from postpay coin telephones and inward assistance calls have been traditionally handled by such switchboards. After due consideration, some of these functions are now handled by new administrative arrangements and some by new designs. A description of the RTA supporting feature designs is contained in Section III of this paper.

The RTA overall description appears in the following sections and the reader is encouraged to consult Refs. 1 and 2 for more details about the hardware and software design.

II. OVERALL DESCRIPTION OF RTA/PSS NO. 2

A simplified view of the RTA is shown in Fig. 1. The TSPS, or base unit, is shown bridging onto toll-connecting trunks between local and toll switching offices. In a similar way, the RTA bridges onto the toll-connecting trunks which home on the toll switching office serving the rural area. The RTA is controlled from the base unit by means of a data link. Voice grade connections between the RTA and the base unit allow the base unit to provide operator assistance as well as other voice frequency functions (e.g., MF digit reception and outpulsing). In this way, all traffic in the complex can be handled by a single operator team and common service circuits. Also, the substantial cost of the TSPS common control equipment is shared by all traffic in the complex.

Although Fig. 1 shows only one RTA, the system is designed to accommodate up to eight RTAs in a single complex. In this way, it has proven possible to pool the traffic of a large geographic area and in some cases to justify a TSPS/RTA complex where a single location is not a candidate for its own TSPS.

Figure 2 shows a more detailed view of RTA. The TSPS base unit is shown in the lower portion of the figure. An RTA, many miles distant, is shown at the top of the figure.

The RTA works under control of the base unit SPC processor and connects to service circuits and positions via the TSPS base unit network. At the RTA location are trunks, a switching network (the

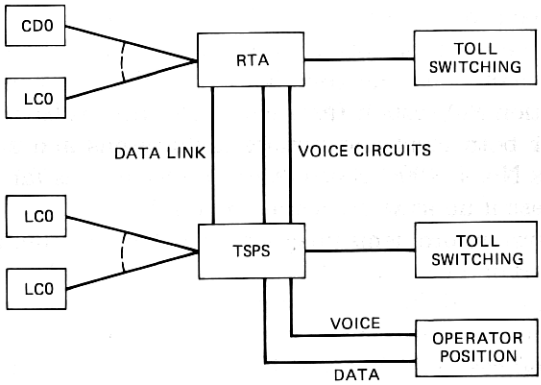

Fig. 1—Simplified diagram TSPS Remote Trunk Arrangement.

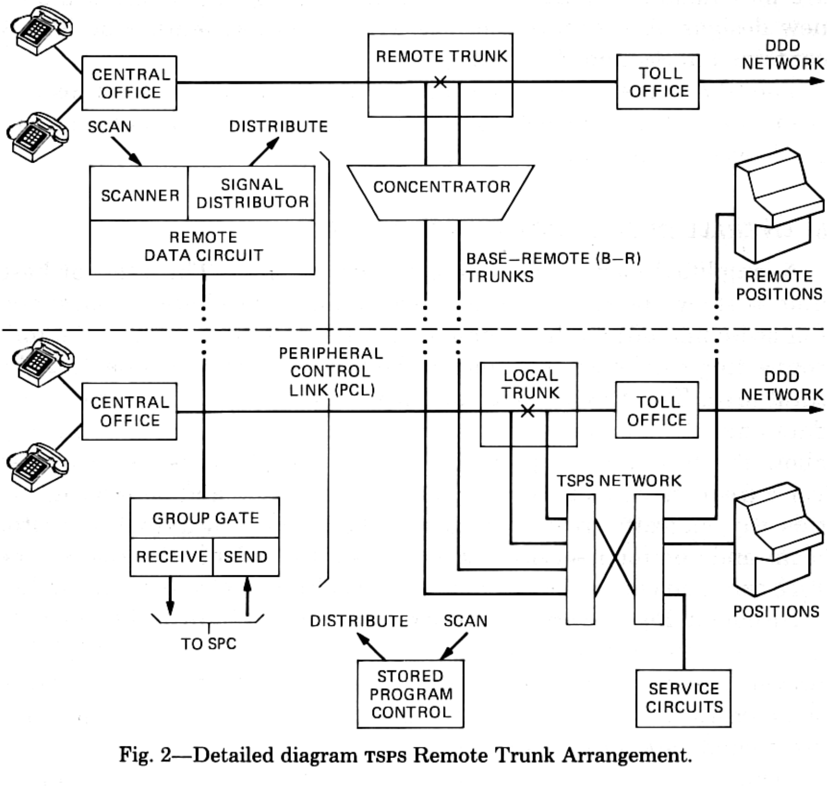

Fig. 2—Detailed diagram TSPS Remote Trunk Arrangement.

concentrator), a test frame, and scanning and signal distribution units. The RTA connects to the base unit over the Peripheral Control Link and over a number of Base-Remote (BR) trunks for voice connection to operators and service circuits.

Solid-state components are used almost exclusively for RTA circuits, and most of these consist of medium-scale TTL integrated circuits. The concentrator matrix, while controlled by integrated circuits, uses small crossbar switches. The compact physical design shown in Fig. 3 is due to this extensive use of integrated circuits. Less than one 20-ft by 20-ft building bay is required to contain an RTA of up to 496 trunks plus up to 64 base-remote trunks. Most of this space is occupied by transmission equipment and trunk frames.

The concentrator to BR trunk connections are engineered to provide a blockage of probability 0.001 to provide minimum delay in connecting operators and service circuits to calls. Since an operator is required on a connection for only a small fraction of the total call duration, a high concentration ratio can be achieved. While this ratio may vary from one site to another, 8:1 is a typical number. This is the reason for supplying a maximum of 64 base-remote trunks. One way of looking at the concentrator is that it is another stage of switching on the base network with very long links (BR trunks) between the first and second stages.

The basic traffic capabilities of TSPS remain essentially unchanged with the addition of RTA. All TSPS features are available to both TSPS

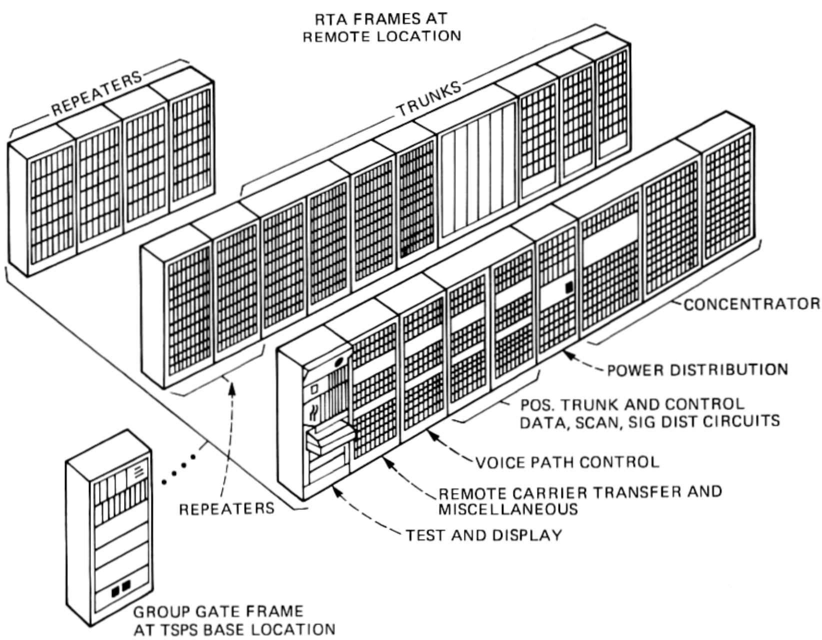

Fig. 3—RTA frames.

base unit customers and RTA customers. The customer will not be able to detect whether service is provided directly by a base unit or through an RTA.

2.1 Peripheral control link

The two-way data capability between the base unit and RTA is provided by a group of elements known collectively as the Peripheral Control Link (PCL) (Fig. 4). The PCL includes the data link itself, the circuits which interface with the data link (group gate and remote data circuit), and the scanning and signal distribution units. The data facilities are standard four-wire voice channels operated full duplex and use 2400-b/s data modems. The Group Gate and Remote Data Circuit perform extensive error detection and provide necessary parallel/serial conversions. Each message over the data link is acknowledged by the receiving end. Messages are retransmitted if mutilated in the original transmission. For reliability, data facilities are provided over two geographically independent routes. Three data lines are provided, with one line serving as a switchable spare for two active lines.

When used with an RTA, the PCL provides the ability to control, via

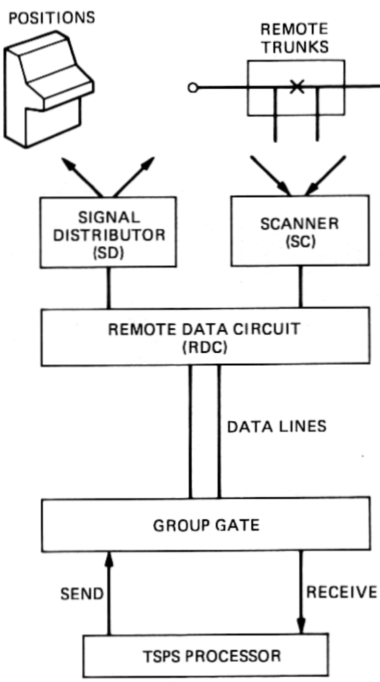

Fig. 4—Peripheral control link.

the signal distributor, the RTA trunk circuits and concentrator. By means of the scanner, the PCL can monitor trunks and report changes of state. This control and monitoring, together with the data communication function of the PCL, provides a set of general capabilities. For the PSS No. 2, the signal distributor and scanner of the PCL are used to control console lamps and detect operator keying actions.

The Position and Trunk Scanner (PTS) is located at the remote end of the PCL. Its function is to autonomously scan key reports from PSS No. 2 positions and DP pulses and supervisory state information from trunks in RTA. This information is reported to the SPC 1A over the data link. The trunks are scanned every 12.5 ms by the PTS which compares this information with last-look data in its memory. For base trunks, timing of supervisory changes of state for the purpose of detecting flashes and disconnects, and filtering out hits (a spurious change of state which must be ignored) is under program control. However, for remote trunks, since delays in transmission of successive changes of state over the data link could distort the relative timing, hit detection and filtering is done for RTA by the PTS. This is accomplished by demanding that changes in supervisory state of trunks persist for at least two successive scans before reporting them to the base unit via the PCL.

The Signal Distributor (SD), located at the remote site, is responsible, for distributing orders to remote trunks, the concentrator, test buffers, a test frame, and to 100C positions. The SD has several features designed to make efficient use of the data link. Commonly used groups of orders from the base to the remote location for control of positions are combined. Hence, one order transmitted from the base has the effect of executing many orders at the remote end. For example, there is a release order which causes all lighted lamps at a 100C position to be extinguished. This saves much data link capacity. A second design feature allows all trunks at an RTA to be initialized with one order. Since there can be as many as 496 trunks at an RTA, this could save as many as 1487 relay orders (three orders per trunk) over the data link. This feaure is used for system initialization. Customer conversations at the time of initialization must be preserved. Therefore, provisions were made in the hardware such that trunks in the talking state are not initialized.

2.2 Circuits controlled by the PCL

The RTA concentrator is controlled from the base unit by call processing software through the PCL signal distributor. The small crossbar switches are arranged in a two-stage network.

The RTA trunk circuits generally provide the same capabilities as the TSPS base unit trunk circuits. However, because they are controlled over the data link, they differ significantly in design from base unit trunks. They have greater logic capability for sending coded flashing signals and for timing incoming flashing signals. They also have greatly augmented features for testing of the trunk units. With the use of integrated circuits and miniature relays, these complex trunks are similar in size to the functionally simpler TSPS trunks. Potential distortion of the relative timing between consecutive orders during periods of data link congestion necessitated the design of remote trunks with a unique feature. All remote trunks have the ability to generate from one to five winks from a single command. Winks of precise time duration are needed for coin station control using multiwink signaling.

As described earlier, the PCL has also been designed to function with new operator position equipment. The new 100C console contains the necessary electronics to decode information transmitted from the signal distributor, to light or extinguish the appropriate lamps, and to remember the state of all the lamps on the position. The position electronics also detects operator keying actions and provides data to the PCL scanner in appropriate form. Only a few pairs of wires are necessary to connect a position console to the PCL. Thus, the addition of positions to a position subsystem is a relatively simple matter.

The RTA/PSS No. 2 fault recognition and diagnostic programs make use of three maintenance circuits controlled by the PCL. The maintenance buffers are used to set and reset circuit states for reconfiguration and testing purposes. A Diagnostic Controller Circuit is activated over the PCL and used to execute sequences of RTA/PSS No. 2 diagnostic tests stored within its read only memory (ROM). Failing test results are reported back to the base via the PCL and formated for TTY output to the craft. The third maintenance circuit under PCL control is the Test and Display Circuit. This circuit provides the craftsforce at the remote site with a manual interface for control of trunk and position transmission test equipment. It also provides a status display of PCL and controlled circuit equipment.

2.3 Peripheral control link configurations

The RTA/PSS No. 2 system design provides for up to 15 peripheral control links to a base TSPS. There is a maximum of 8 RTA subsystems per TSPS and a maximum of 8 operator groups per TSPS.

The RTA and PSS No. 2 subsystems were each designed to operate when located at a 1000-mile maximum distance from the TSPS base unit. However, for proper transmission of voice and tones, a 1000-mile limit is applied to the sum of the farthest RTA distance to the base plus the farthest PSS No. 2 distance to the base. In other words, if a PSS No. 2 is located in a town 400 miles from the TSPS base and it is the farthest remote group, then the RTA subsystems served by the same TSPS base would have to be within a 600-mile radius of the TSPS base.

2.4 Hardware technology employed for RTA/PSS No. 2

The RTA/PSS No. 2 control circuitry design was one of the early Bell System applications of the Transistor-Transistor-Logic (TTL) integrated circuit technology. The Position and Trunk Control frame, at the remote end of the PCL, also consists of scanning circuitry using opto-isolators and diagnostic circuitry using instructions stored on existing state-of-the-art read-only-memory (ROM) devices.

The 100C positions provided with PSS No. 2 were the first large volume application of the 7-segment light-emitting diode (LED) numeric display. This new display technology was also made available for retrofit into the 100B position provided with PSS No. 1.

The RTA/PSS No. 2 features greatly extended the transmission range of TSPS. To permit such great distances between operators and customers and still maintain good voice quality required the simultaneous development of three key pieces of equipment: the Unified Telephone Circuit (4251 B network), the 1P precision hybrid, and a new three-way/four-wire bridging repeater. Each of these is discussed in Ref. 3.

The Logic Analyzer for Maintenance Planning (LAMP) was used extensively for the generation of circuit-board test-vector information provided to Western Electric. Results were also used to modify board designs to improve test access.

A minicomputer-controlled fault insertion system was developed to automate the large and repetitive task of physical fault insertion for Trouble Locating Manual (TLM) diagnostic data generation. This new system also made available timely feedback to the diagnostic designers about potential problems with diagnostic coverage and resolution.

III. RTA SUPPORTING FEATURES

The addition of the RTA feature, expansion of the geographical area served by a TSPS, and the necessity for handling special operator service traffic, affected several TSPS design parameters and required the addition of several new features. For example, with RTA, the maximum number of states and Numbering Plan Areas (NPAS) served by TSPS were increased from three to eight. In addition, the maximum number of toll switching offices with unique routing patterns serving a TSPS complex was increased from three to eight. When advancing a call to the toll network, TSPS must sometimes change the dialed or keyed digits according to a set of code conversion rules. These rules had to be changed to permit the advancement of incoming, inward, and INWATS calls through TSPS or RTA toll offices located in more than one NPA.

As mentioned in Section I, as TSPS service is extended to a wider area and TSPS capabilities are broadened to handle a wider range of call types, cordboard operations which remain solely to handle Special

Operator Services Traffic (SOST) become less and less efficient. This creates an impetus to handle more of the SOST traffic on TSPS, with the ultimate aim of eliminating the cordboard operation. Among the SOST items that were handled on cordboards, but can now be handled by TSPS, are: inward traffic and postpay coin service. In addition, small central offices connecting to TSPS require compatible trunk equipment. Multiwink coin signaling, an economically attractive method to provide coin signaling to these small offices, was also provided in TSPS/RTA.

3.1 Inward

Inward calls occur when an operator at the originating end of a call requires the assistance of an operator at the terminating end (called the inward operator) so that the latter may perform certain functions that the former cannot.

Examples of inward calls and the functions traditionally performed by the inward operator are:

(*i*) Verification—the inward operator verifies that a line is busy.

(*ii*) Calling hard to reach numbers—the inward operator tries another route for the call where previous attempts have been unsuccessful.

(*iii*) Call-back to coin stations—the call rating, computing, and recording functions are performed by the inward operator.

(*iv*) Call back (to a noncoin station) with time and charges (T&C)—the inward operator performs call rating, computing, and recording functions, and gives the T&C quote to the called party (who *originally* initiated the call).

(*v*) Call back to hotel—the inward operator performs call rating, computing and recording functions, including identification of the hotel guest, and provides the quote of charges to the hotel.

The inward feature allows a TSPS operator to act as the inward operator on an inward call. Figure 5 shows how inward calls are routed to a TSPS operator acting as the inward operator. To reach an inward operator, the originating operator, whether at a cordboard or at a TSPS position, would key forward (NPA)+(TTC)+OC, where NPA+TTC is the routine code to the Terminating Toll Center (obtained from a routing guide as a function of the NPA+NXX portion of the number to be reached by the inward operator). The numbers in parentheses (i.e., (NPA)+(TTC)) are not always present, their presence or absence being determined by the route of the call. The abbreviation OC, which stands for Operator Code, is a 3- to 5-digit number which specifies the nature of the service required from the inward operator. The Operator Codes used, together with their associated call types, are shown in Table I.

The Terminating Toll Center (TTC) recognizes inward traffic from the operator code which it receives, i.e., the OC keyed by the originating operator. Once it recognizes an inward call, the TTC will seize an inward

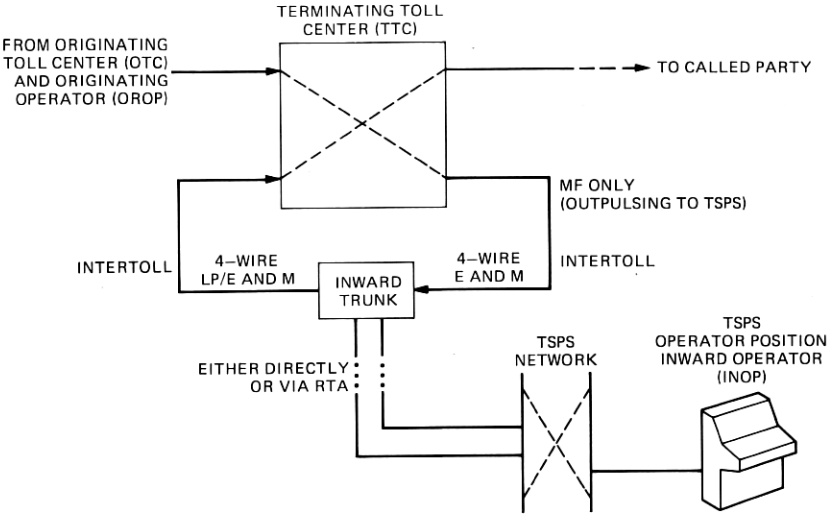

Fig. 5—Routing of inward calls to TSPS INOP and to the called party.

Table I—Operator codes and associated inward call types [originating operator keys (NPA)+(TTC)+Operator Code (OC)]

Operator Code	Inward Call Type
121	General inward, hard-to-reach, verification
1150(1)*	Collect or call-back to coin
1155(1)*	Time & charges (T&C) call back
1156(1)*	Hotel call back

* Additional 1 is local practice option.

trunk to the TSPS serving its toll traffic, and will outpulse the OC to that TSPS. From the OC, the TSPS determines the initial display to be given to the inward operator. The actions taken by the TSPS operator upon arrival of an inward call at the console will depend upon the nature of the inward call.

Inward trunks can be installed at RTAs as well as at a base unit. In either case, as shown in Fig 5, the inward trunk connects on its incoming side to a toll office outgoing trunk, and on its outgoing side to a toll office incoming trunk. The facilities on both sides of the inward trunk are classified as intertoll facilities for transmission purposes. Both base TSPS and RTA inward trunks are four-wire and are used with a three-way, four-wire bridging repeater. E&M signaling is used on the incoming side. The outgoing side can be arranged for either loop or E&M signaling.

Inward trunks may be organized in one trunk group for every toll office serving the TSPS complex (base unit and RTAS). A single trunk group carrying all inward traffic routed to the TSPS or RTA through a given toll office will optimize the trunk efficiency. Alternatively, having separate trunk groups for each toll office serving the TSPS complex optimizes the grade of transmission on inward calls. Most desirable is the centralization of inward trunks at the highest class toll switch (usually the one serving the base unit) in the TSPS/RTA complex. This provides both good trunk efficiency and the ability to meet or exceed transmission performance objectives.

3.2 Postpay coin service

In postpay coin operation, the coin stations do not have coin collect and return functions. Once a coin is deposited, it is not retrievable. Therefore, collect and return signals are ineffective and are not used in postpay coin operation. Thus the trunks carrying this traffic from local offices to cordboards are simpler than those used in prepay coin operation.

Since the operator cannot return coins on a postpay coin call, a deposit for the initial period is not requested until:

(*i*) The called party answers and

(*ii*) It is determined that the correct called number has been reached.

For collection of overtime charges, there is no difference between postpay and prepay coin operation except that incorrect or questionable deposits cannot be returned.

Any of three methods may be used to bring postpay coin traffic into TSPS from a local office. Under normal conditions (no ANI failure), the first two methods result in automatic identification of postpay coin calls. The third method requires operator intervention to recognize such calls. The three methods are as follows:

(i) Dedicated Postpay Coin Trunks—The only calls routed to TSPS on such trunks are postpay coin calls.

(ii) Combined Postpay Coin-Noncoin Trunks with ANI Screening Identification—This technique is used to identify the kind of call when the local office has ANI. The technique consists of searching the coin band tables in TSPS for the received ANI number to determine whether or not that number corresponds to a coin station.

(iii) Combined Postpay Coin-Noncoin Trunks with Service Tone Identification—For such trunks, the TSPS operator can identify postpay coin calls by the presence of a service tone generated by the local office. The tone is heard shortly after the zip tone when the call is first brought the position. Absence of the service tone signifies a noncoin call.

3.3 Multiwink coin signaling

The Bell System Coin Service Improvement Committee recommended that multiwink signaling coin control be made available to provide additional coin control signals. With TSPS-RTA, BR trunk connections to coin control circuits can be eliminated with multiwink signaling, and multiwink is more economically provided than inband coin control for certain local offices.

The multiwink signaling format employs a series of one to five supervisory on-hook winks from TSPS to the local office outgoing trunks. The signals and their use are shown in Table II.

IV. ADDITIONAL TSPS FEATURES ON THE RTA GENERIC

In parallel with the RTA development, other service and maintenance features were developed. These features were made available with RTA. This section briefly describes those additional features.

4.1 Selective call screening

TSPS is required to provide for selective screening of incoming traffic that was previously handled by cord switchboards. The ability of TSPS to screen calls from various incoming trunks enables the telephone companies to offer institutions and businesses (e.g., hospitals, military installations, press and media, prisons, and university dormitories) the option of restricting the type of charging permitted for toll calls originating over some or all of their lines. Some hospitals, for example, do not want to expend the administrative effort required to collect telephone charges for toll calls from hospital patients. Hospitals could receive this kind of service from cord switchboard operators since the trunk appearance on the cordboard was labeled as hospital and the operator responded accordingly. Given the new ability for TSPS to restrict the kinds of charges allowed, the use of coinless public telephones is also made possible. Coinless public telephones can only be used to place credit card, collect, and bill-to-third-number calls. Coin-

Table II—Multiwink signaling system

Number of On-Hook Winks	Function
1	Operator release
2	Operator attached
3	Coin collect
4	Coin return
5	Ringback

less public telephones are especially attractive to operating companies in places such as major transportation centers to reduce the number of expensive coin stations.

Another feature provided with screening is the charge quotation feature. It allows businesses (such as law firms) to get voice or automatic quotation of telephone charges on calls by account numbers similar to the TSPS hotel/motel feature.

TSPS performs the following basic functions in handling a screened call:

(*i*) TSPS determines if the line is a screened line. This is done with information present in the trunk software register indicating the trunk group as screened or by the presence of that line number in screening line number tables.

(*ii*) If the line is screened, TSPS identifies what type of screening is applicable. A table, called the screening type table, indicates the specific combinations of restrictions allowable. Each line number in the screening line number table has an index to the applicable combination of restrictions in the screening type table.

(*iii*) TSPS also validates the operator's actions. Since the screening restrictions are in memory, the acceptability of the class of billing entered by the operator is checked. If the operator enters an unacceptable class of charge, the system informs the operator by flashing the appropriate key/lamp. The operator then interacts with the customer in an effort to obtain acceptable billing.

(*iv*) Once an acceptable class of charge is entered, a unique mark is placed on the Automatic Message Accounting (AMA) tape indicating that the call was a screened call.

Any of three methods may be used to bring screened traffic into TSPS from a local office:

(*i*) Mixed traffic (combined screen/nonscreen).
(*ii*) Dedicated screened traffic.
(*iii*) ANI 7 information-digit-identified screened traffic.

In the mixed traffic case, traffic with screening conditions and traffic without screening conditions will originate over the same trunks. A search is conducted using the calling digits provided by Automatic Number Identification equipment (ANI) to determine if a screening condition exists on that particular line. If the calling number is not in the search tables, it is assumed that the line does not have a screening condition on it. If an ANI failure occurs, Operator Number Identified (ONI) digits are used for the search.

In the dedicated traffic case, a trunk group is dedicated to screened traffic. If local offices without ANI require screening, dedicated trunks must be used to deter fraud. If the trunk belongs to the dedicated screening trunk group, the calling number obtained by the operator is checked against the screening line number tables, as in the mixed traffic case, to determine the specific restrictions.

In the case of calls from an electronic local office, an ANI 7 information digit is supplied for screened calls. The ANI information digit is denoted I in the following ANI sequence:

KP-I-7D-ST, where 7D is the 7-digit calling number.

If the ANI information digit or any part of the ANI sequence is destroyed or not received at TSPS, ONI digits are obtained and a search conducted as in the mixed traffic case. Given good ANI, the calling number is then checked against the line number table to determine the specific restrictions.

4.2 More stores/bus (MORSTR)

More stores/bus (MORSTR) is an all-software feature which expands the Stored Program Control (SPC) No. 1A store maintenance structure to cover all expected piggyback twistor/semiconductor memory configurations. It removes the memory capacity limitation imposed by the previous maintenance software (20 stores/bus).

The maximum capacity of the SPC memory was limited by the maintenance software and by processor addressability. It was estimated that the larger TSPS systems with a combination piggyback twistor (PBT) and semiconductor memory stores would exceed the memory capacity limitation imposed by the maintenance software (20 stores/bus) upon advance to subsequent generics. The MORSTR feature was developed to provide maintenance capabilities for a maximum of 24 stores/bus. The SPC store maintenance software with MORSTR can support the various PBT/semiconductor memory combinations up to a limit imposed by the processor with the restriction that no more than 18 of the maximum 24 stores can be of the PBT type.

V. RTA CHARACTERISTICS REQUIRING SPECIAL DEVELOPMENT EMPHASIS

5.1 Necessity for more stringent transmission requirements

The original TSPS base system served by the Position Subsystem (PSS) No. 1 presented a transmission environment confined and simplified by the T1 carrier. The T1 carrier transmission limit meant that remote PSS No. 1 locations were relatively close to the toll office. With the introduction of RTA and PSS No. 2, a complex set of transmission considerations arose due to the large range of subsystem site locations allowed by the peripheral control link design. The TSPS transmission plan was revised to provide engineering and maintenance documentation for TSPS in the new RTA/PSS No. 2 environment.

5.2 Maintenance of unattended remote offices

The design intent for the RTA/PSS No. 2 feature is to provide for the primary maintenance of RTA and PSS No. 2 subsystems by a craftsforce situated at the base TSPS location. Upon identification of a fault in the remote equipment, remote site personnel would then be dispatched to replace or repair the faulty equipment. This requirement to provide base-located maintenance control reflects the general trend to more centralized maintenance in the Bell System.

Maintenance software design for the RTA/PSS No. 2 feature was strongly influenced by this trend. It was complicated by the need to provide also for those operating company situations in which more direct maintenance control was to be exercised by craftspeople situated at the remote locations.

The normal maintenance strategy associated with such items as teletypewriter interactions and visual status displays takes on an added dimension of difficulty when complicated by the introduction of multiple distant equipment sites.

More detail about the maintenance strategy chosen is provided in a subsequent article in Ref. 1.

5.3 Rapid RTA / PSS No. 2 installation buildup

The RTA and PSS No. 2 features are very attractive to operating telephone company planners because of the much increased flexibility for operator team location, the economic and service gains achieved with the replacement of small toll office cordboards, and the ability to prove in new TSPS base offices for cities of moderate size. The early demand was high, and the resulting pressures on Western Electric to supply that market were evident in the final stages of development and deployment.

Due to the efforts of many departments involved with manufacture, testing, documentation, installation, and support at the Western Electric, Columbus works and the regional offices, that heavy initial demand was satisfied. One year after the initial RTA and PSS No. 2 cutover at Utica, New York, on May 16, 1976, a dozen peripheral control links were in service and nearly one hundred had been shipped to the field. By year-end 1978, 120 RTA subsystems and 60 PSS No. 2 groups had been placed into service.

VI. ACKNOWLEDGMENTS

Many of our colleagues have made substantial contributions to the development of the RTA. R. G. Crafton and A. N. Daudelin provided system engineering support and economic analysis. A. Friedes, E. E. Hanna, and S. Lederman provided many of the development requirements and worked to ensure that the requirements were thoroughly

implemented. D. J. Eigen provided design requirements for the selective call screening feature and contributed to the software design effort. G. E. Fowler tirelessly worked to develop call-processing software and later participated with A. W. Robinson and J. J. Serinese in the field test of RTA at Syracuse and Utica, New York.

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