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Traffic Service Position System No. 1 Recent Developments:

An Overview

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This paper presents an overview of the Traffic Service Position System No. 1 in terms of the objectives and design philosophy of the new features that have been continuously added to the system since its initial introduction into service in the Bell System. It also serves as an introduction to the detailed technical papers that follow.

I. INTRODUCTION

Almost all of the telephones in the United States can be used to dial toll calls directly over the Direct Distance Dialing network. Nevertheless, approximately 15 percent of the total number of toll messages are placed with the assistance of toll operators. These toll calls include person-to-person, collect, credit card, hotel-originated calls, calls from coin stations, operator-dialed calls, and certain international calls. On an average business day, more than 13.1 million calls are placed through operators, and, in addition, there are over 5.2 million operator contacts for assistance and originating number identification. At year-end 1978, about 60,000 operators were employed to give this service.

1.1 Capabilities of initial design[1]

The Traffic Service Position System No. 1 (TSPS No. 1) was introduced into the field in January, 1969 (in Morristown, New Jersey) as an operator service system that could be used in conjunction with almost all Bell System local and toll switching systems to allow customers to dial their own operator-assisted calls and to relieve the operator of many tedious tasks required by cord switchboards. The basic objective of the initial system design was to automate routine

functions so that the operator could concentrate on communicating with customers, using human judgment, and establishing calls. The features of the early installations were designed to handle basic functions for coin and non-coin calls, such as automatic call timing and recording, recording of originating directory number, and recording and transmission of customer-dialed numbers. Since TSPS employs stored program control, it was intended that additional features would be added to automate an ever-increasing number of functions as advances in technology made these technically and economically viable. Typical calls not included in the initial design were conference calls, mobile and marine calls, inward to operator calls, and special handling of hotel and motel calls.

TSPS No. 1 provides each operator with a cordless, electronic console which, through indicating lamps and pushbuttons, establishes an operator-machine interface for use in automation of routine functions. TSPS No. 1 increases the number of calls an operator can handle and also quickly makes auxiliary information available which may be needed to serve the telephone customers better.

Customers benefit from these features. Because number recording and timing calculations are performed by the computer-like system, the delay of manual operation is eliminated and calls go through faster. Calls are also billed more accurately. On coin calls, initial and overtime charge calculations are instantly available.

Operating companies benefit because they can provide operator assistance more efficiently. They can, therefore, handle increased traffic levels with the same number of operators. Furthermore, they are able to manage the work force more effectively because of the improved administrative features and to have the added flexibility to locate Operator Office Groups at convenient locations.

Operators benefit by a more attractive working environment, an equitable distribution of calls to their positions, and the satisfaction of serving their customers better.

From 1969 through 1977, five additional issues of generic programs have expanded the feature content in TSPS No. 1. There are now about 135 systems in the continental United States. Over 80 percent of Bell System customers and a large number of customers served by other companies are now served by TSPS. It is estimated that, within the next three years, the Bell System coverage will exceed 90 percent, providing almost universal availability.

1.2 Additions to capability

Since, as shown in Fig. 1, TSPS utilizes stored program control, new features have been continuously and easily introduced into the system.

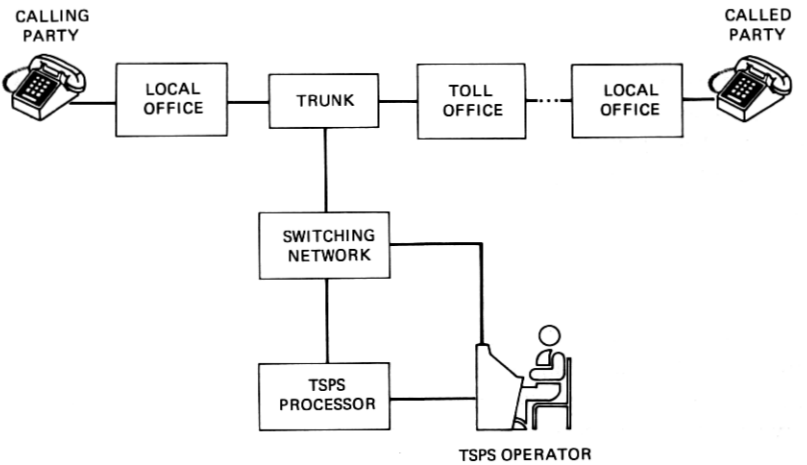

Fig. 1—Basic TSPS No. 1.

1.2.1 Hotel/motel

One of these features is the automation of hotel/motel billing. When a guest at a hotel or motel has made toll calls during his or her stay, the guest must pay the charges for these calls when checking out. These charges are now automatically computed (including taxes) for each call by TSPS. Within a few seconds, the charges are printed on a dedicated teletypewriter on the hotel/motel premises. If the hotel/motel does not have enough toll calling to justify a dedicated teletypewriter, the charges are printed at a telephone company billing center where a clerk telephones the hotel/motel and gives the charges orally—within a few minutes.

Other businesses such as convention centers, marinas, and brokerage houses may also employ this time and charge information feature to allocate telephone charges to their customers.

1.2.2 International call handling

Another of these features is the partial automation of international call handling. When a customer who is not served by an office equipped to handle International Direct Distance Dialing (IDDD) calls wishes to place an international call, he or she simply dials 0 and gives the desired international number to the TSPS operator. The operator then indicates to TSPS via key action on the console that this call is an international call and then enters the number. For a station-to-station call, the TSPS operator releases from the call, and the system automatically forwards the call to a gateway switching office, which then sends the call overseas via satellite or cable. If the call is made on a credit

card, a collect, or a person-to-person basis, the TSPS operator processes the rest of the call in the same manner as a domestic call.

In the case where a customer is served by local offices having IDDD capabilities, the customer who dials a 011 prefix followed by the country code digit and the national number will have his or her call forwarded by TSPS without the assistance of an operator. If the customer dials a 01 prefix followed by the country code and the national number, or if the customer dials 010 only, the TSPS operator will be connected to assist the customer.

1.2.3 Others

In addition, a number of other features such as time and charge quotations for non-coin (non-hotel) calls, recording of charges for directory assistance calls, and maintenance and administration improvements have been introduced into the system.

1.3 Hardware improvements

1.3.1 Semiconductor memory

The original TSPS design utilized piggyback twistor memory based on magnetic storage elements for program and call store. Advances in technology have made it possible to replace the piggyback twistor memory with a semiconductor memory resulting in major reductions in cost, space, and energy consumption.

II. MOST RECENT NEEDS

2.1 Extension to sparsely populated areas

Densely populated areas that generate a large amount of operator-assisted traffic easily justify the capital expenditures for a TSPS, but in a sparsely populated area, the toll switching center is small, and relatively few operators are needed. Savings in operating costs are not sufficient to balance the traffic-insensitive cost of the TSPS central processor. Nevertheless, the improvements provided by TSPS are extremely desirable in these sparsely populated areas. Not only can service be improved, but the difficulties of maintaining a sufficient number of operators, day and night, in small isolated teams could be eliminated.

2.1.1 Remote Trunk Arrangement[2]

To economically provide the benefits of TSPS to the sparsely populated areas, the Remote Trunk Arrangement (RTA), as shown in Fig. 2, has been developed to bring TSPS service from a distant TSPS to one of these locations.

The RTA equipment is located at a toll office in the rural area, with a concentrator network providing the talking path between the incom-

ing trunks and the TSPS operator. Data links (called peripheral control links, PCLS) connect the RTA equipment with the centrally located base TSPS processor which retains the control, logic, records, and centralized access to operators. The operator traffic from one or more RTAS is added to the traffic of a centrally located base TSPS to generate the load necessary to utilize a TSPS economically.

An improved electronic operator console (the 100C) combining training and service features has been designed to be used for both local and remote applications. This configuration is designated Position Subsystem (PSS) No. 2. The distance from the farthest RTA through the TSPS processor to the farthest Operator Office Group can total as much as 1000 miles, so that one TSPS can handle the traffic from a large geographical area.

2.1.2 Design aspects[3-5]

The articles in this issue covering the RTA design aspects include overall description, operational characteristics, transmission considerations, and hardware and software implementation.

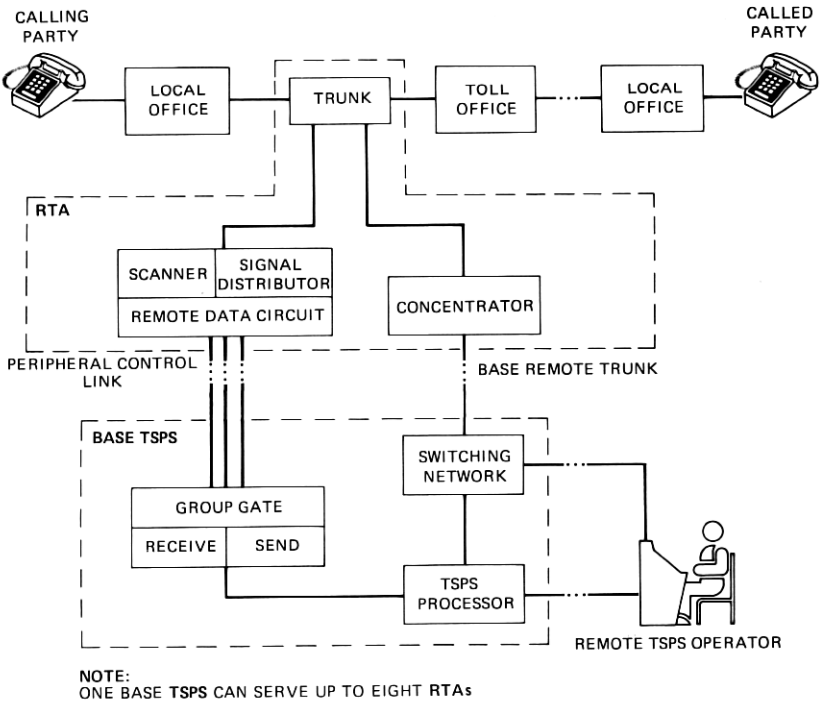

Fig. 2—Remote Trunk Arrangement.

2.2 Relieving operators of routine coin toll call functions

As advances were made in technology, it became increasingly apparent that routine coin toll call functions, such as charge quoting and coin collection, could be fully automated. Confirmation of the technical and economic viability of this approach was obtained via in-depth systems engineering studies supported by test results on laboratory feasibility models.

2.2.1 Automated Coin Toll Service

To further the benefits of TSPS, the Automated Coin Toll Service (ACTS), shown in Fig. 3, has been developed to provide TSPS with the ability to process station paid coin calls automatically, including initial period notification, overtime charge notification, and quotations on time and charges for non-coin originated calls. For communicating with the customer, additional equipment was provided with TSPS which could store digitally encoded speech segments, concatenate these speech segments into sentences, and monitor the coin deposits.

Stored program was added not only to control the new equipment in performing the coin service tasks but also for interfacing the new equipment with the existing TSPS.

2.2.2 Human factor studies[6]

The complex nature of the customer-machine interface in ACTS prompted the implementation of a three-month human factors trial in Chicago, Illinois. The trial was designed to provide ACTS-like service using TSPS operators plus a skeletonized prototype of the ACTS equipment.

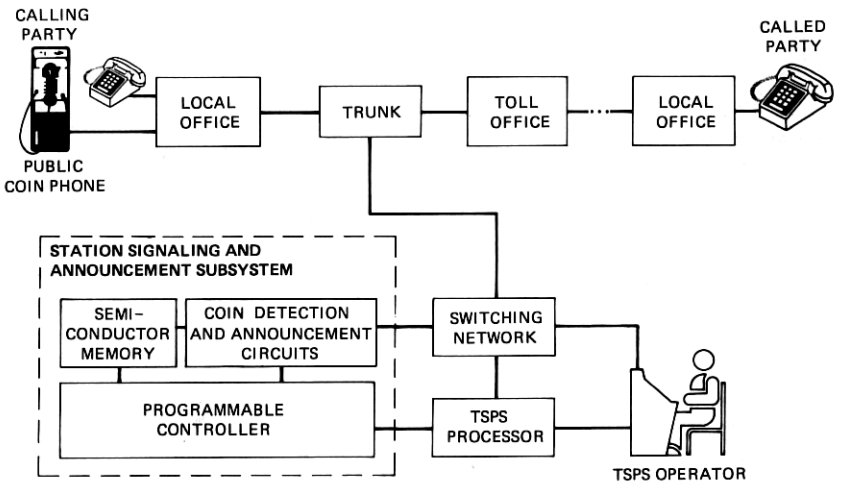

Fig. 3—Automated Coin Toll Service.

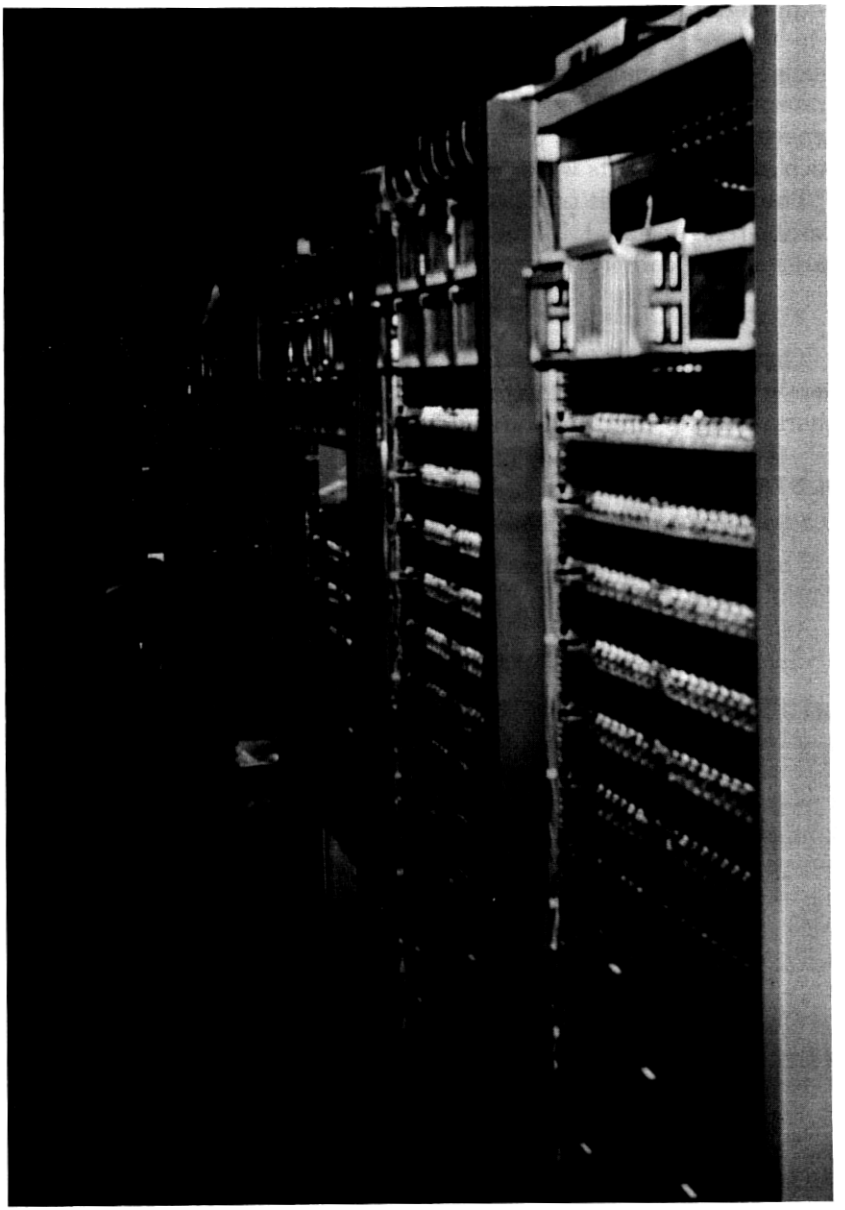

Fig. 4—Remote Trunk Arrangement in Utica, New York.

The TSPS operators were instructed to respond only to dial signals from customers and transmit the initial period length and call charges computed by TSPS to an auxiliary minicomputer via a teletypewriter. The minicomputer in turn sent instructions to the prototype ACTS

equipment to fabricate sentences (initial time interval and call charges) which were transmitted directly to the customer. The coin deposits made by customers in response to the announcements were then transmitted by the TSPS operator to the minicomputer via the teletypewriter. Subsequent prompting announcements and the timing of such announcements were controlled by the minicomputer.

The results of this trial established the basic human factors design parameters essential to the development of a system that would satisfactorily complete coin toll calls without operator assistance.

2.2.3 Design aspects

The articles in this issue covering the ACTS design aspects include details of the human factors trial, system description, operational characteristics, and hardware and software implementation.

III. STATUS

3.1 Remote Trunk Arrangement

The first RTA system was placed in service in Syracuse-Utica, New York, in May, 1976. The RTA equipment in Utica is shown in Fig. 4.

As of year-end 1978, 120 RTAs and 60 PSS No. 2s are in service, with about 20 more RTAs and 10 PSS No. 2s in various stages of installation.

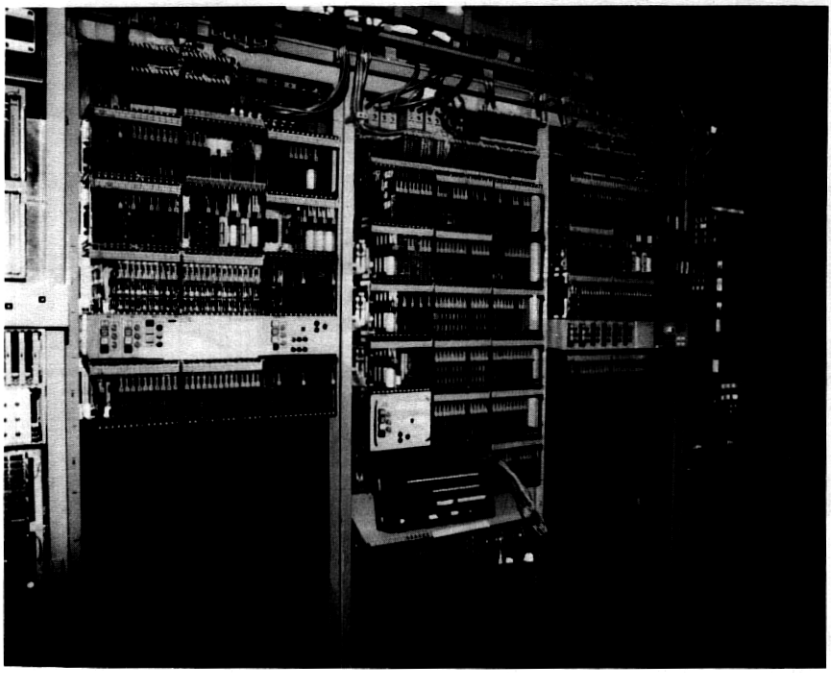

Fig. 5—Automated Coin Toll Service in Phoenix, Arizona.

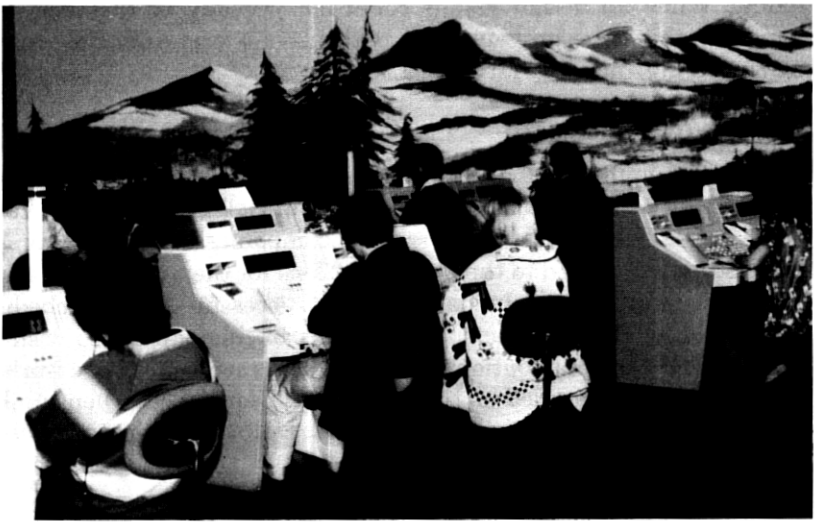

Fig. 6—An Operator Office Group in Phoenix, Arizona.

3.2 Automated Coin Toll Service

The first ACTS system was placed in service in Phoenix, Arizona, in November, 1977. The ACTS equipment in Phoenix is shown in Fig. 5.

As of year-end 1978, 3 ACTS were in service, with about 20 more in various stages of installation. By 1981, it is estimated that ACTS will be installed in all TSPS sites that have significant coin traffic, and that most of the coin paid calls in the Bell System will be handled by the ACTS equipment.

An Operator Office Group located in the suburbs of Phoenix is shown in Fig. 6.

IV. PERFORMANCE

Performance data from the RTA, PSS No. 2, and ACTS sites indicate that all design objectives have been achieved.

V. FUTURE TRENDS[13]

There are plans to exploit the stored program concept further by augmenting the operational software programs to utilize the basic ACTS equipment for handling credit card, collect, and third-number calling without operator intervention.

VI. SUMMARY

This paper has presented a general background for RTA and ACTS additions to TSPS No. 1 as an introduction to the technical papers that

follow. While all design details could not possibly be included, the papers in this issue provide a comprehensive overview of the greatly enhanced utilization of TSPS No. 1.

VII. ACKNOWLEDGMENTS

The development of these projects required the participation of hundreds of people in many organizations in Bell Laboratories, Western Electric, AT&T, and the operating companies. All the authors of this issue are indebted to these organizations for their cooperation and the team effort that culminated in the successful and on-schedule completion of these projects. The authors of this paper also wish to acknowledge the contributions of all the team members whose work is summarized here, as well as those of W. A. Depp, A. E. Spencer, Jr., M. A. Townsend, F. S. Vigilante; and J. C. Dalby, coordinating editor.

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