# CUSTOMER TOLL DIALING

## CONTENTS



## 1. GENERAL

1.01 This section is intended to provide REA borrowers, consulting engineers, contractors and other interested parties with technical information for use in the design and construction of REA borrowers' telephone systems. It discusses in particular customer toll dialing of originating traffic, including field of application, equipment requirements and economic studies of its feasibility.

1.02 This section replaces Section 157, Issue No. 3, dated March 1963, and the addenda thereto. The revision includes new developments since 1963, such as the installation of automatic number identification (ANI) equipment at tributary offices and new toll settlement agreements.

1.03 Customer toll dialing, or Direct Distance Dialing (DDD), is a method for toll users to dial their own calls to points beyond their local or extended service area. Its primary purpose is to improve service and to reduce operator and manual toll position requirements.

1.04 DDD uses the same trunks, toll dial switching facilities and signaling arrangements that are provided for operator toll dialing, but requires additional equipment for recording and timing messages for billing purposes. It also requires an access code, access trunks and toll switching facilities capable of routing and completing calls in response to dial pulses from the customer's telephone. These pulses represent a toll access code, the area code, office code and local number of the desired telephone. The recording, timing and switching equipment used by independent telephone companies is generally known as an Automatic Toll Ticketing (ATT) system.

1.05 The local and toll dial switching facilities normally installed in REA borrowers' systems provide for the completion of incoming calls dialed by toll users in distant cities and, therefore, are not discussed in this section.

1.06 The recording and timing facilities needed for DDD usually are separate and distinct from the local and toll dial equipment. The local equipment may be provided by one manufacturer and the ATT equipment by another. However, the introduction of DDD usually requires some changes or additions to the local dial offices and to the toll dial equipment at the toll center through which connection is made to the national toll network.

1.07 DDD can be limited to paid station-to-station calls, or it can include person-to-person, collect and special instruction (PPCS) calls. Coin station users cannot dial toll calls with the equipment now available to REA borrowers and arrangements must be made for preventing their access to the DDD equipment.

1.08 Customer toll dialing for tributary office subscribers can be provided by a toll ticketing system at the toll center, or an ATT installation at the tributary office may be used.

1.09 All arrangements for ATT by an REA borrower should be discussed with the connecting company responsible for toll service in the area and agreement reached on all required changes including the toll settlement.

1.10 This material is written on the assumption that step-by-step type of equipment is used in the borrower's office, but the same principles apply to common control systems. In the latter case, it is necessary to arrange the local system so that calls will be routed to the ticketers in response to the access code and that subsequent digits will reach the ATT equipment.

1.11 Familiarity with the following sections of the Telephone Engineering and Construction Manual will be found useful in understanding this section:

Section 156 - "Nationwide Toll Dialing"
Section 218 - "Plant Annual Cost Data for System Design Purposes"
Section 225 - "Bell System Traffic Agreement"
Section 327 - "Application Guide for the Preparation of Part III - Specifications of Detailed Requirements for Direct Distance Dialing Equipment"
Section 328 - "Application Guide for the Preparation of Part III - Specifications of Automatic Number Identification Equipment"
Section 500 - "Telephone Traffic"
Section 511 - "Telephone Traffic - Dial Equipment for Toll Centers"
Section 512 - "Telephone Traffic - Manual Toll Board Equipment"

## 2. APPLICATION IN REA BORROWERS' SYSTEMS

2.1 The installation of ATT equipment is generally desirable in toll centers. When toll growth necessitates relief for a manual toll board, it is advisable at least to consider DDD. The ATT equipment at the toll center or toll point usually provides DDD service to the tributary offices.

2.2 If a toll ticketing system is installed at the toll center or toll point, certain changes and additions are required. Following are the items encountered most frequently:

2.21 An access code is required for reaching the toll ticketing equipment. The preferred access code is the digit "1" although it is open to the objection that line slap on open wire lines may cause a large number of false seizures of the access trunks. Another digit or a two-digit code may be used where necessary. If a single digit other than "1" is selected, consideration should be given to future requirements for additional local or EAS codes.

2.22 A group of access trunks from each tributary is required to reach the ticketing equipment at the toll center. Where a Bell System operating company operates the toll center, a separate one-way trunk group is provided from the tributary to the toll center. Where an independent company operates the toll center, dual function trunks may be used which carry all of the toll traffic. This may avoid adding trunks due to splitting the toll group, but new, more costly trunk circuits are needed. Agreement on compensation for new trunks or new trunk circuits must be reached with the connecting company involved.

2.23 Blocking access of coin telephones to the toll ticketing is necessary where a Bell ticketing system is to be used. With operator identification of the calling number, the coin tone identifying plan used in manual service is not feasible in a Bell ticketing system. Blocking coin station access is relatively simple where the linefinders in the local office are designed for blocking calls to certain codes dialed in the associated first selector on an individual line basis or by linefinder levels. If this arrangement has not been provided, an existing linefinder group may be modified to provide this feature or a new linefinder group may be installed to meet this requirement. Costs and the probable need for the additional linefinder group are the determining factors.

2.24 Where equipment of an Independent manufacturer is installed at the toll center, it may include provisions for denying DDD service to coin stations (by coin tone identification when the operator asks for the calling number), and no special blocking arrangements may be needed at the tributary.

2.25 Where a connecting company provides the toll ticketing equipment at the toll center, an REA borrower operating a tributary office may provide for automatic calling number identification at the tributary. This requires special trunks and equipment for identifying the calling line. This arrangement is possible whether the connecting company is Bell or Independent, but the exact equipment

arrangements will vary depending upon what method is used to transmit the calling number to the toll center. This type of arrangement is often called ANI and further details are contained in REA TE & CM-328, "Application Guide for the Preparation of Part III - Specifications of Automatic Number Identification Equipment."

2.3 The installation of ATT equipment at a tributary presents several problems not encountered at a toll center.

2.31 Access to the toll network in accordance with the General Toll Switching Plan usually involves new intertoll trunk groups and routing changes since a toll office that handles originating traffic must have direct access to the national toll network. This may be through a toll center (Class 4 office) if only one tributary is involved. However, if the ATT system handles traffic for two or more offices, the access to the toll system should be through a control switching point (Class 3 or higher) to meet service objectives.

2.32 Facilities will be needed at a toll center or at a switching point for dial access to the toll network.

2.33 ATT at a tributary requires automatic calling line or number identification. Operator identification is available only at toll centers since manual toll positions must be provided.

2.4 In any proposed installation of ATT equipment, it is essential that provision of facilities, operation, and settlement arrangements be discussed and agreement reached in advance with the connecting company.

2.5 Customer dialing of person-to-person, collect and special service (PPCS) calls is being introduced by some companies. It has the advantage of placing all but a small amount of residual traffic on the toll ticketing tape, permitting more uniform processing of toll bills. It has been accepted by the public where it has been tried and it reduces operator and toll position requirements, particularly in large offices.

2.6 Economic studies are required for all initial installations of ATT equipment.

3. REQUIREMENTS IN REA BORROWERS' SYSTEMS

3.1 For DDD the minimum information required for billing purposes consists of the calling party's number, the number called, the length of the conversation, the date and the time of day. In practice, these items are recorded on a tape, together with the number of the machine (recorder or ticketer) on which the call was handled. The office or office and area code of the called number indicates the place called. From these, together with the time-of-day and the date, the rate can be determined.

3.2 Closely associated with the recording and timing mechanism is the method for converting the call information recorded into an item for posting on the customer's bill. This is done by machines called printers or analyzers that convert the tape record into toll tickets or punched cards suitable for use by billing clerks or in business machines which print the final toll statements. The borrower may perform this function or the tapes may be sent to a business machine center for processing.

3.3 The toll tickets may be rated manually or the charges may be entered on the tape or card record by a machine, called a computer, which rates most of the messages, leaving only a few points infrequently called for manual rating. Computers are very costly and can be justified only for large volumes of toll traffic.

3.4 DDD requires toll trunk plant and dial switching equipment that offer a speed of service comparable to that on local calls. This is a change from toll service usually rendered by operators which involves delays due to "all circuits busy" on a somewhat higher proportion of calls. If trunk quantities are inadequate or the trunks poorly maintained, there is danger that customers will not make full use of the service and will place many of their calls through the operator. This, of course, defeats the whole purpose of customer toll dialing. Another consideration is that, with inadequate trunks, subscribers make many more attempts which tend to overload the entire system.

3.5 Access to operators is essential for handling toll calls which customers cannot dial, such as person-to-person, collect (with no PPCS) and those originating at coin telephones. Also, provision needs to be made for operators to furnish area codes and telephone numbers and to give assistance when customers encounter difficulty in dialing.

3.6 A group of toll trunk selectors is necessary to establish connections to different toll trunk groups. Rotary switches rather than selectors are used where all traffic is routed over one two-way trunk group. Toll trunk selectors or rotary switches are not necessary where all traffic is routed over one one-way trunk group.

3.7 Equipment must be provided for customers to reach the ATT system when the access code is dialed. In all cases toll users will dial the access code followed by the area code, if required, and the directory number of the called party.

3.8 Provision must be made for identifying the calling number. This may be done by suitable equipment (automatic line or number identification) or by connecting an operator who asks for the calling number and key pulses it into the ticketing equipment (operator identification).

3.9 Arrangements must be made for preventing coin telephones from completing calls through the ATT equipment.

4. EQUIPMENT ARRANGEMENTS

4.1 Figure 1 shows a typical switching diagram for DDD at a toll center serving a local office and a tributary. Calling number identification at the toll center and at the tributary is automatic.

4.2 Use of "dual function trunks" permits handling DDD and calls for the toll operator (plus incoming calls) over one group of trunks from the tributary. A separate group of trunks for DDD service could be provided and this is usual Bell System practice even though it increases the trunk requirements.

4.3 Customers dial "1" at the toll center and at the tributary to gain access to the toll ticketing equipment. They dial "0" to reach the toll board from either office. Dial "0" calls from the tributary are "timed," so that if no further digits are received the call is routed to the toll board.

4.4 In this illustration an "identifier" is provided in the local office at the toll center and at the tributary to identify the calling number (automatic number identification). Several types of equipment are available for automatic identification.

4.41 With the "circle digit" plan, the toll user dials a single digit immediately following the access code. This digit identifies which station on a party line originated the call. For uniform operation a circle digit also is assigned to individual lines. This method has been in successful use in the independent telephone industry for sometime and is recommended for REA borrowers where automatic identification is desired.

4.42 Some suppliers offer a special subscriber's instrument which generates signals that identify the calling station. This avoids the possibility of identifying the wrong party on a line and eliminates the necessity for "circle" digit, but is more costly to install and maintain. Two general types are available, one limited to two parties and the other capable of identifying any one of four stations.

4.43 In terminal-per-station offices an arbitrary "circle" digit (1 to 0) is assigned to indicate the calling station. The identifier converts this information into the calling subscriber's number. It is usually desirable to assign an equivalent number of each of the circle digits throughout the office for the benefit of the equipment. Where the equipment arrangement permits, it is more convenient to associate each circle digit with a ringing frequency on one side of the line. This would make special records unnecessary.

4.44 In terminal-per-line (TPL) offices, the circle digit usually corresponds to the last digit of the directory number. In some larger TPL offices, one or more connector groups may be provided for PBX (and individual line) service and these require special arrangements as the equipment must not use the circle digit as the last digit of the directory number in these groups.

4.45 The identifier supplied by some manufacturers will block calls from coin lines.

4.5 Operator identification of the calling number requires a signal on a manual switchboard position when the toll user completes dialing the called number. A "zip" tone may be used to show the operator is on the line or the operator may answer. In either case the toll user gives his own number, the operator key pulses the digits and they are stored in the toll ticketer. Several equipment arrangements are offered by different suppliers which vary considerably in features provided and in cost.

4.51 The plan used most generally in the smaller and medium sized toll offices is to modify several or all of the existing positions so that operators can handle identification calls along with other traffic. The equipment consists of a series of keys on the keyshelf with associated lamp signals. The operator answers by operating a key and disconnects by restoring it to normal or, if the key is nonlocking, disconnect may be automatic when the last digit is pulsed. In some systems, a special "release" key is provided. It is customary to provide a key set rather than a position dial. The space required for keys and key set may necessitate reducing the regular cord pairs on the position to five, but this should be ample under normal traffic conditions.

4.52 Key sets are provided with the customary correction key. Provision also is made for blocking calls where the toll user gives the called number in place of his own number. The operator usually has provision to force a release of the call so as to prevent its completion.

4.53 In the larger toll ticketing installations, where the volume of identification calls requires several operators in the busy hours, special cordless positions are usually provided for this purpose. These are normally supplemented by modifying a few regular positions for identification during light-load hours.

4.54 With operator identification different procedures are used in completing the connection during the identification interval. Some systems hold the entire called number until the operator finishes key pulsing. Some transmit part of the called number and wait for the operator to finish before sending the remainder. Other systems use one or the other of these methods depending on the called office code received.

4.55 Coin stations present a special problem with operator identification of the calling number. The preferred plan for preventing coin station users from dialing toll calls is to block them from reaching the access trunks. Equipment is available for doing this in the linefinders and first selectors on an individual line or on a group basis. If not already installed, this must be provided in tributary offices served from Bell System CAMA centers with operator identification. Where ATT equipment of Independent suppliers is used, the spurt of identifying tone used on manual toll boards is acceptable. Where the cost of adding the blocking feature to existing equipment is high, it may be more economical to add a linefinder group equipped with this feature to serve the coin stations (and other lines).

4.6 The "trunk selector" gives the ticketer access to outgoing toll trunks.

4.7 The "Toll Ticketer" (TT) includes all of the equipment needed for recording the necessary information to permit billing the calling telephone and for transmitting the dial pulses needed to complete the call. The main components and their arrangement are illustrated in Figure 2.

## 5. THE TOLL TICKETER

5.1 There is considerable difference among the various manufacturers of DDD equipment in the arrangement of the equipment and in the terms used, but basically all systems must perform the functions described below and illustrated in Figure 2.

5.2 The "recorder" or "ticketer" receives and stores the digits dialed by the customer (area code plus called number) following the access code and the party station (circle) digit when it is dialed. It also records the calling number which is furnished by an identifier or by an operator.

5.3 The register sender and translator receive the digits of the called number and transmit to the trunk selector and the outgoing trunk the digits needed to complete the connection. This may be more, fewer or different digits from those received. Cross connections in the translator control the digits transmitted. The translator and registers generally are needed for nationwide dialing.

5.4 In an ATT office where all ticketed traffic is routed over one group which terminates in a common control switching center, register senders and a translator at the ATT office are not essential. However, register senders are required, in any case, in most of the ticketing systems available from Independent suppliers. Besides their primary functions, register senders provide a regenerated pulse train, and tend to absorb excess dialing time on the intertoll train, while translators screen out nondialable calls.

5.5 Where an "identifier" or "detector" is provided to identify the calling number, the recorder receives the necessary digits from the identifier in the local office. With operator identification the recorder receives the digits from the operator. A group of trunks to the toll board is provided when operator identification is desired.

5.6 The "dater-timer" or "calendar" is called in to provide the date and time of day and in some systems supplies pulses showing the length of conversation in minutes.

5.7 The ticket tape may be perforated paper tape or a magnetic tape. In either case it has to be transcribed to a record which can be billed. This may be a punched card or a toll ticket similar to the one made out by toll operators.

5.8 The "computer" is a device for figuring the total charge on each message based on the calling and called points, the date, time of day and the elapsed time. It recognizes the reduced rates in effect evenings, nights, on Saturday and Sunday and on some holidays. Where it is not provided, the toll tickets are rated manually and where provided there will still be some tickets to places rarely called which have to be rated manually. The computation of the charge in some systems is made before the message is recorded on the tape and, therefore, is included in the tape record. In other systems the charge computation is made in the process of converting the tape record to a billing record. A computer may be used regardless of whether the final output is a printed ticket or a punched card.

6. METHOD OF OPERATION

6.1 To make a DDD call the customer dials the access code, area code, when needed, and called number. The area code is required to reach a foreign area. The area code may be omitted if the call stays in the home area (except in certain areas where it is the custom to dial it). Not infrequently ATT equipment will serve subscribers in two areas. Those subscribers in the other area must dial their home area code, but may omit the other foreign area code. A list of the places the customer can dial, together with the area code for each, is included in the telephone directory or in a special pamphlet supplied by the telephone company. If the called number is not known, the customer may reach the information operator at the called point by dialing the area code plus 555-1212.

6.2 The access code establishes the connection to the ticketer. The circle digit identifying the party line station is registered in the recorder or register sender. If the call originates in a terminal-per-station tributary with ATT in the toll center, the circle digit is registered in the trunk circuit at the tributary. Subsequent digits are registered in the recorder and the register sender.

6.3 The area code, if dialed, and called number (office code plus four numerals) are transferred from the register sender to the translator unit.

6.31 The routing is determined in the translator from the area code or from the area and office code alone. The digits required for selecting an outgoing trunk, as determined from the translator wiring, are transmitted by the register sender to the trunk selector, followed by the area code (if required), the office code and the four digits of the called number. The translator is capable of adding or deleting digits or of sending different digits from those received. It also determines the digits to be transmitted when all trunks on the first route are in use and an alternate route is to be tried.

6.32 The translator may also perform other functions, such as blocking calls for unauthorized codes (for instance, EAS calls), or determining the type of pulses to be transmitted, dial or multifrequency.

6.4 The calling number keyed by the operator or obtained by the identifier is registered in the recorder either directly or through the register sender depending on the make of the equipment.

6.5 Timing of the message begins when the called number answers and normally ends with the hang-up of the calling telephone. The elapsed time may be recorded by individual registrations every minute or by counting the elapsed time and registering the total on a tape or by registering the connect and disconnect times, depending on the make of the system. The dater-timer is used to show the date and time of day and in some systems also to record conversation time.

6.6 At the end of conversation as indicated by the disconnect of the calling party, the information stored in the recorder is transferred to the tape which shows only completed toll messages. In some systems, there is one tape per recorder. Uncompleted calls appear on the tape, but are eliminated when the tape is converted to a billing record.

6.7 Computers, where provided, compute the total charge on each message and add this item to the tape record, or in some systems, to the ticket or punched card developed from the tape. Where computers are not provided a toll ticket is prepared from the tape and rated manually or the tape may be sent to a business machine unit for processing.

6.8 In all DDD systems the tape record is converted to a ticket record, a punched card, or their equivalent, for billing purposes. In some systems, this conversion is done automatically at fixed intervals, and in others, the tapes are taken out of the ticketers at night or when a roll runs out and sent to the accounting office. Where the conversion is automatic, the information on the tape may be transmitted to a centralized accounting center in another location over a special trunk.

6.9 DDD systems of different manufacturers differ in method of operation and each manufacturer offers several optional arrangements, but basically, they all function substantially as described above. For any given installation, the options available need to be studied and a decision reached on what to put in the specification.

7. PPCS CALLS

7.01 Customer dialing of paid station-to-station toll calls has more than fulfilled expectations with respect to public acceptance and service improvement. Moreover, it seems to have resulted in some increase in toll business. Accordingly, consideration now is being given to extending the plan to Person-to-Person, Collect and Special Instruction calls, generally referred to as "PPCS."

7.02 PPCS calls will use the same toll ticketing and calling number identification equipment as provided for station-to-station traffic. However, provision must be made for operator assistance on each call.

7.03 Customers wishing to dial PPCS calls dial the access code, "zero," the circle digit, then the area code, if required, and the called number. An operator answers and the customer gives the name of the person desired, states the call is "collect" or gives other instructions. The operator proceeds from there as on any manually handled call, except that the called number is not dialed, no ticket is written, and when conversation begins, she operates a "start timing" key or dials a certain digit. The ticketer records all information needed for billing, including codes showing that the call was person-to-person, collect, or required special billing. The operator indicated these by operating appropriate class of service keys or by dialing certain digits.

7.04 Details of the method of operation and of the equipment provided by different suppliers vary widely and can be obtained from the literature furnished by the various manufacturers and in REA TE & CM-328, "Application Guide for the Preparation of Direct Distance Dialing Specifications."

7.05 "Zero" is used as the access code for PPCS calls and also for assistance calls and for the remaining operator handled toll traffic. If the "zero" is followed within about four seconds by an area or office code, the call is completed through the toll ticketing equipment. If no dialing follows the "zero," the call is routed to a regular toll and assistance position after a four-second relay.

7.06 The equipment for PPCS service is designed to signal an operator as soon as the called number has been dialed and in some systems to extend the call at once to the telephone dialed in the distant city. The switchboard position may be a specially equipped regular toll position, a cordless position designed primarily for operator identification or a position designed for both PPCS service and operator identification.

7.07 When cordless positions are provided and on some modified regular positions, a call is routed automatically to an idle position and in many installations both customer and operator hear a "zip" tone when the operator is connected. (If used in conjunction with operator identification, the zip tones are distinctive, for instance, two beeps for identification and three beeps for PPCS). If the customer does not speak promptly, the operator answers and requests the details of the call if necessary. When regular toll positions are used for PPCS service without keyshelf modification, jacks and lamp signals are provided which operators answer like any other signals. Start of conversation and class of service on such positions are indicated by dialing or key pulsing certain digits.

7.08 On cordless switchboards the position normally is released when the start timing key is operated, but the operator can hold the connection on the position. On cord boards the operator also may disconnect after starting conversation or may hold the connection. When a call is held on a position, the operator proceeds with other work as on any cord board.

7.09 Operators handle customer dialed person-to-person, collect and special instruction calls somewhat the same as they do ordinary toll calls, but most of the time needed to write the ticket, find the route, plug into a trunk and key pulse is saved. Several special features, such as the ability to handle "time and charge" or special billing calls, are available on some systems and these are described in the literature of the manufacturers and in REA TE & CM-328, "Application Guide for the Preparation of Direct Distance Dialing Specifications."

7.10 The switchboard positions in some systems are arranged for storing and displaying the called and calling numbers so that the operator can make a second attempt to complete a call without asking the customer what number he dialed.

7.11 When a PPCS call is not completed because a paths-busy or no-ringing signal condition is encountered or a second number is to be tried, the operator normally makes a second attempt at once by operating a key which releases the forward train and then key pulsing the number on the display plate or the new number. Where no number display is available, the operator asks for the number called. If the second attempt also is not completed, the operator usually asks the customer to call later. If he wishes to have further attempts made, the operator extends the call to a regular toll position or makes out a complete toll ticket and sends it to the toll board. There is no provision for the PPCS operator to handle delayed calls except when she is operating on a regular toll position.

7.12 Person-to-person and collect calls are indicated on the tape record by special codes which permit proper rating either by a computer or manually. On special instruction calls, a memorandum is prepared by the operator giving the information received from the customer, such as charge to third telephone, credit card or charge to special code. A code to identify such messages also is registered on the tape record. When the tape is converted to the billing records, the memo tickets are matched against the special instruction messages on the tape and billed manually. One supplier offers a plan that avoids the memo ticket.

## 8. CALCULATION OF SWITCH AND TRUNK QUANTITIES

8.1 To be acceptable to toll users DDD must be better than the service provided by operators. This means that trunks, toll ticketers and positions for operator identification must be provided in sufficient quantity so that calls dialed by customers will rarely be delayed. The following bases are suggested as the minimum busy hour requirements:

Access Trunks (CAMA Trunks) to Distant ATT Center - 1 Delay in 100 Attempts
Toll Ticketers - 1 Delay in 100 Attempts
Toll Trunks (Final Groups) - 3 Delays in 100 Attempts
Identifying Positions - 1 Position per 200 Messages
PPCS Positions - 70 Percent of Positions Required for Manual Operation (See REA TE & CM-512, "Telephone Traffic - Manual Toll Board Equipment")
Registers - 1 Delay in 1000 Attempts
Translators - 1 Delay Beyond 3 Seconds in 1000 Uses

8.2 The first step in the calculation of switch and trunk quantities is to decide on the method of operation, including access to ATT system, access to outgoing toll trunks, method of identifying calling number, etc.

8.3 The second step is to determine how many toll messages per day customers are likely to dial. The study should be made for the estimated toll messages on an average business day at a future period, such as five years from date.

8.4 In estimating the volume of traffic that customers will dial, it is advisable to begin with a forecast of the total toll originating messages from the area to be served by the ATT center. Such estimates generally are based on a five-year projection of the toll messages per station. Due regard, of course, should be given to any expected changes in EAS or in toll centering. An analysis of a few days' tickets during period of normal traffic is advisable to determine the percentage of messages that are dialable. This usually is limited to paid station-to-station messages, excluding those from coin stations. However, where PPCS calls are to be dialed, a separate count of these should be made. Theoretically, calls to manual offices or to other points which cannot be dialed should not be considered dialable, but with the progress being made toward universal dialing, it seems safe to ignore these in most cases in estimating the traffic volume to be dialed in five years.

8.5 Having prepared an estimate based on past trends in station growth and toll calling rate, a stimulation factor may be applied to the dialable station-to-station traffic. A figure of five percent may be used unless some other amount seems more appropriate for a particular situation. This includes some shift from person-to-person service. There has not been enough experience with PPCS to indicate that it also will stimulate toll traffic.

8.6 From the estimated number of dialable messages the required number of selectors, trunks and other equipment items may be calculated in the usual manner by developing the number of unit calls in the busy hour and applying the appropriate traffic tables of trunk capacities. It should be kept in mind that some elements of an ATT system, such as register senders, are in use only while the connection is being established while others, such as recorders, are held during the entire length of conversation. Separate holding times must be used in such cases to reflect the time each element is actually used in handling a message. Allowance also needs to be made for uncompleted calls which require just as much time as completed messages on common control elements, such as register senders, but much less time on recorders or trunk selectors. One translator will handle the DDD traffic in most REA borrowers' systems, but a second one may be provided to guard against total loss of DDD service due to failure of one translator.

9. ECONOMIC STUDIES

9.01 Before undertaking an economic study of an ATT installation, it is essential that agreement be reached with the connecting company responsible for toll service in the area on the overall method of operation and on the arrangement and ownership of toll trunks involved. Any questions about changes in payment for line haul or in the preparation of customers' toll statements also should be settled. Agreement also must be negotiated on the "B" settlement to be paid for PPCS calls where this service is offered.

9.02 In making a study of ATT at a toll center it is suggested that, in the first approach, automatic calling number identification be considered for all local offices. If this proves too costly to make the installation attractive, operator identification may be considered for the tributaries or for all traffic although it is less satisfactory. In the case of ATT at tributaries, automatic calling number identification must be used since there are no operators. Operator identification is not as satisfactory as automatic.

9.03 In an initial study of ATT it is suggested that only dialing of paid station-to-station traffic be considered. If this proves attractive, extension of the system to include PPCS may be considered on its own merits.

9.04 A computer that determines the charge on most messages is an optional arrangement, but it will generally be feasible only in the larger ATT installations or where it can serve a number of offices. For study purposes it is suggested that it be considered separately on its own merits rather than including it in the basic study of ATT.

9.05 To determine the reduction in manual toll positions and operators from the introduction of ATT at a toll center, it may be assumed that one position will be saved per 40 paid station-to-station DDD messages busy hour. With operator identification this will be offset to the extent of one position required per 200 messages busy hour. For study purposes it may be assumed that three less operators will be required for every position saved. There has not been experience on which to base corresponding figures for PPCS traffic, but for the present the savings may be estimated at 30 percent of the positions required to handle the same traffic manually.

9.06 The cost of ATT installations differs widely and it has not been possible to develop dependable unit cost data to be used for study purposes. For the present, therefore, it is suggested that for proposed ATT installations, information such as shown on attached Figure 3 be submitted to two or more suppliers with a request for an estimate of the total cost. Separate information is suggested for PPCS where this service is under consideration.

9.07 The "B" settlement paid for handling toll traffic is substantially affected by the introduction of ATT in a previously manual toll center. The amount per message is less on the ticketed traffic, but higher on the remaining manually handled calls. The net effect is a decrease in the total payment. The amount of the settlement per ticketed message varies with the amount of traffic handled. In making economic studies care needs to be taken to apply the correct schedule.

9.08 A borrower operating a tributary office served by a Bell System CAMA center receives a monthly payment per CAMA trunk in compensation for the cost of necessary changes at the tributary (A-4). This is over and above any other line haul payment and does not cover automatic calling number identification.

9.09 An ATT installation at a tributary usually requires changes in or additional interoffice trunks. When the borrower agrees to provide these, cost estimates are needed, together with estimates of any increase in line haul payments.

9.10 An ATT installation produces a billing record in the form of a punched tape, punched card or a printed ticket which differs substantially from the toll tickets normally written by operators. The method of converting the ATT record into a customer's toll statement, including the rating of messages, has to be decided and if the cost is substantially different from that for the existing procedure, it should be reflected in the economic study.

9.11 For study purposes the annual charges on the toll ticketing equipment may be estimated at 20 percent of the installed cost. This includes maintenance, depreciation, taxes, insurance and a return on investment. Annual charges on additional trunks may be based on experience with similar facilities already in service. (See REA TE & CM-218, "Plant Annual Cost Data for System Design Purposes.")

9.12 To estimate the effect on net revenues of a proposed ATT installation the economic study may be limited to the incremental costs and offsetting savings and the changes in settlement. A complete study of total toll operating costs and settlement payments with and without ATT equipment, while more accurate, is much more complicated and hardly necessary for the intended purpose.

9.13 Attached Figures 4, 5, 6, and 7 are examples of economic studies of ATT at a toll center and at a tributary office and for ANI at tributary offices. The cost savings and "B" settlement figures used are for the purpose of illustration only and cannot be taken as representative for any particular study. As stated earlier it is assumed that full agreement has been reached with the connecting company involved on the method of operation, trunking changes and ownership, "B" settlement, etc., before undertaking the study. In the great majority of cases it is expected that the settlement and other payments agreed upon between the Independent industry and the Bell System will be used, but it would be well to make sure of this when making an economic study. See REA TE & CM-225, "Bell System Traffic Agreement."

## 10. TRANSLATOR ASSIGNMENTS

10.1 The translator or route interpreter in DDD systems examines the area and office codes dialed by the customer and determines the digits to be transmitted by the sender. In order to provide the translator with a "memory," most translators have a cross-connect field. Unassigned codes may also have to be cross-connected in some systems in order to route calls for them to intercept.

10.2 The operation of a translator is described in REA TE & CM-327, "Application Guide for the Preparation of Part III - Specifications of Detailed Requirements for Direct Distance Dialing Equipment." In brief the translator can delete, add or substitute other digits for those dialed by the customer and it provides for automatic alternate routing to an idle trunk in an alternate trunk group when all trunks on the first route are busy. The translator also may direct the sender to transmit multifrequency pulses after a trunk is seized which terminates in a common control toll switching center.

10.3 Provision needs to be made for the routing or interception of every three-digit code from "111" to "000." (The recorder or register sender blocks some codes). Also where there are two or more routes to or toward a foreign area, requiring six-digit translation, provision must be made for the routing of the three-digit office codes reached over each of these trunk groups.

10.4 Information on the distant offices to which DDD may be authorized and the routing to points not reached over direct trunks may be obtained from the connecting company responsible for toll routing in the area.

10.5 Most toll centers are equipped with step-by-step toll trunk selectors on the banks of which the different outgoing toll trunk groups appear. The assignments of groups to levels is completely arbitrary, but it is advisable to place the larger groups on the lower levels. These selectors are not needed where all traffic is routed over one trunk group terminating at a distant switching center.

10.6 Complete route information, including toll selector assignments, should be prepared well in advance of the cutover date and a copy given to the supplier in time to do the strapping at the factory where feasible. Assignments, of course, need to be checked before cutover to make sure that any routing changes have been cared for.

10.7 Figure 8 illustrates a typical toll trunking layout for which routing instructions would be as shown in the table. It is assumed that level assignments on the step-by-step toll trunk selectors are as follows:

| Level | Type | Office | Number of Trunks |
|---|---|---|---|
| 0 | Intercept | - | 3 |
| 9 | Tributary | E | 3 |
| 8 | Tributary | F | 4 |
| 7 | Toll Center | K | 4 |
| 6 | Toll Center | B | 4 |
| 5 | Toll Center | D | 5 |
| 4 | Tributary | G | 6 |
| 3 | Tributary | H | 6 |
| 2 | Sectional Center | C | 10 (a) |
| 1 | Sectional Center | C | 10 (a) |

(a) Arranged for level hunting or provided with rotary switches.

10.8 It is assumed that tributaries of the ATT toll center are arranged for receiving four digits on incoming toll calls.

10.9 Typical Routing Table

| Called Point | Area Code | Received Office | Digits Deleted | Digits Prefixed | No. of Digits Sent | Notes |
|---|---|---|---|---|---|---|
| E | - | 563 | 563 | 9 | 5 | |
| F | - | 564 | 564 | 8 | 5 | |
| G | - | 574 | 574 | 4 | 5 | |
| H | - | 572 | 572 | 3 | 5 | |
| C | - | 622 | - | 1 | 8 | |
| D | - | 428 | - | 5 | 8 | |
| D-Alt. | - | 428 | - | 1 | 8 | |
| I | - | 322 | - | 5 | 8 | (1) |
| B | 919* | 227 | 919 | 6 | 8 | |
| B-Alt. | 919* | 227 | - | 1 | 11 | |
| L | 919* | 224 | 919 | 6 | 8 | (1) |
| K | 919* | 724 | 919 | 7 | 8 | |
| K-Alt. | 919* | 724 | - | 1 | 11 | |
| J | 919* | 723 | 919 | 7 | 8 | (1) |
| Other Authorized 7-Digit Codes | | | - | 1 | 8 | (2) (4) |
| Other Authorized 10-Digit Codes | | | - | 1 | 11 | (3) (4) |

*Six-Digit Translation

Notes:

(1) The routing for the tributary is the same as for its toll center. Therefore, the alternate route will be tried if the direct group is busy and it is not necessary to show an alternate route for the tributary.

(2) Every office code in the home numbering area (703 is the example) to which DDD is authorized needs to be listed.

(3) Every foreign area to which DDD for any office is authorized needs to be listed.

(4) Calls received for the following are routed to intercepting, generally by deleting all digits and substituting the digit "0":

(a) Vacant or unauthorized office codes in the home numbering plan area.

(b) Vacant or unauthorized area codes.

It is not necessary to list the vacant or unauthorized codes. The translator usually is wired to route calls for such codes to intercepting.

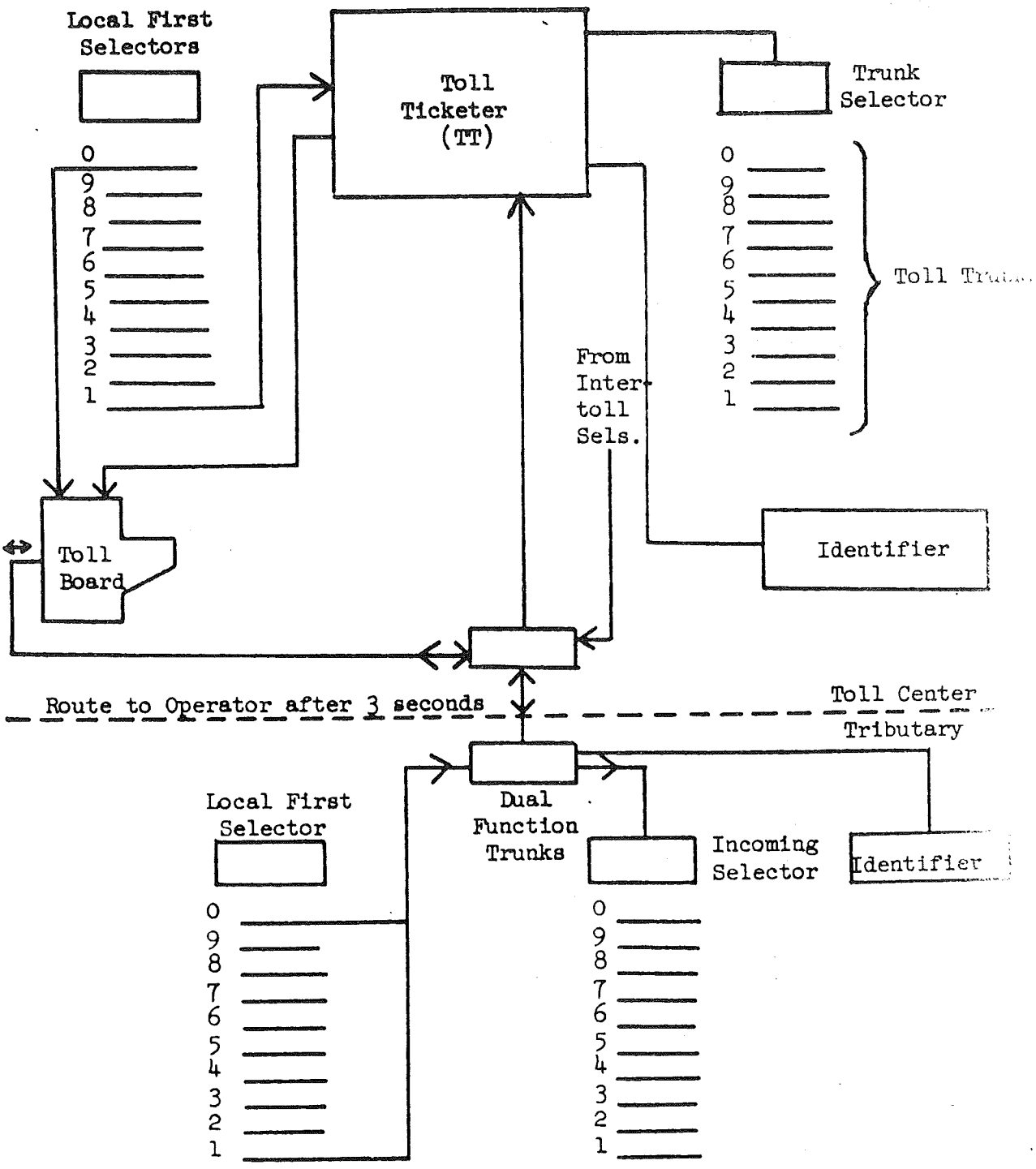



FIGURE 1

DDD - Typical Switching Diagram

Automatic Identification at Toll Center and Tributary

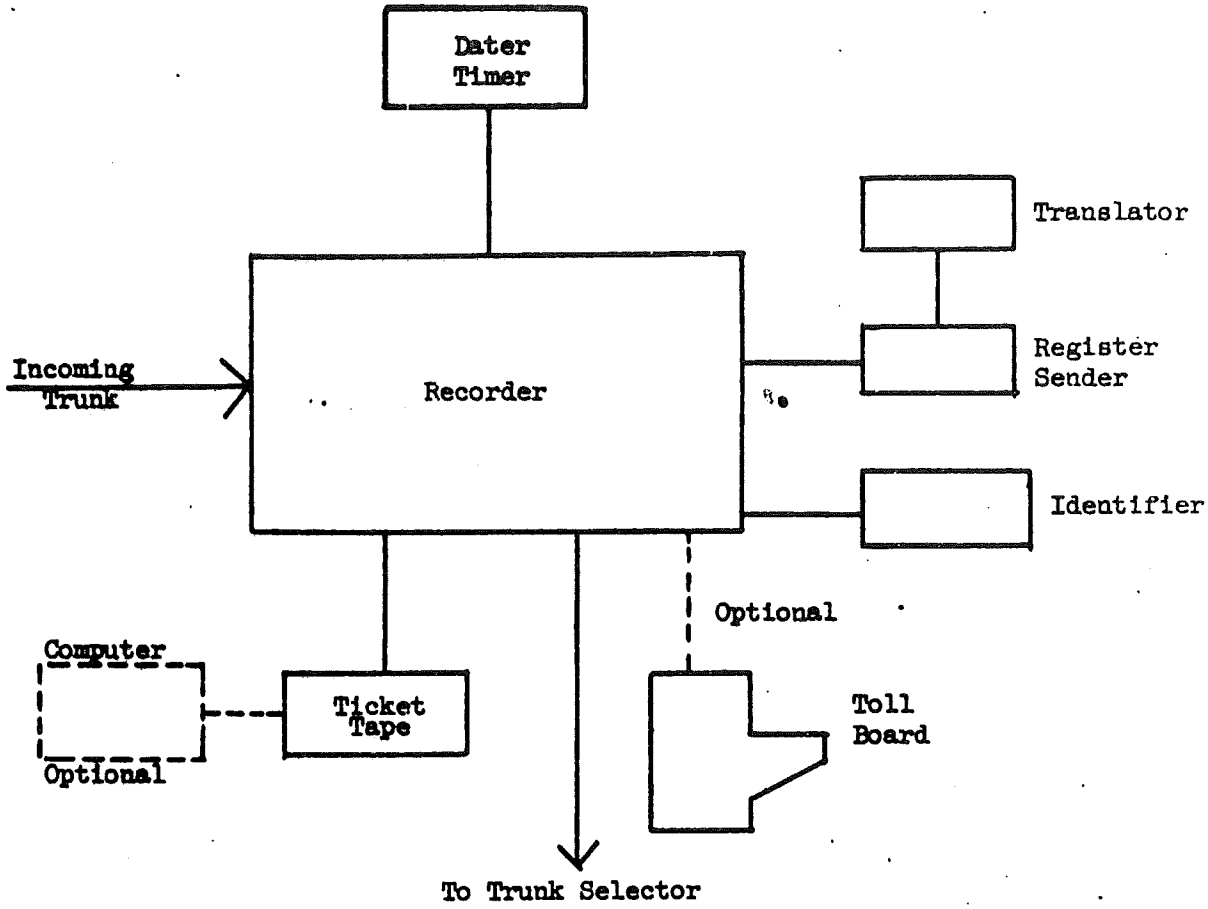



FIGURE 2

Toll Ticketer

Block (TT) in Figure 1

# PRELIMINARY INFORMATION FOR ECONOMIC STUDY OF AUTOMATIC TOLL TICKETING

1. Location of ATT Office _____

1.1 Estimated number of paid station-to-station messages, busy hour _____

| 1.2 Local Offices | TPS Connector Terminals | TPL Connector Terminals |
|---|---|---|
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |

(Automatic Calling Line Identification Assumed)

1.3 Requirements (State whether or not required)

1.31 Registers _____

1.32 Translator _____

1.4 Billing Record - Type

1.41 Printed Ticket _____

1.42 Punched Tape _____

1.5 Trunking diagram showing all toll trunk groups to which customers will have access.

FIGURE 3

# EXAMPLE OF ECONOMIC SELECTION STUDY OF AUTOMATIC TOLL TICKETING AT A TOLL CENTER

## 1. Basic Information

### 1.1 Present Time

| | | |
|---|---|---|
| 1.11 | Toll Messages per Day | 911 |
| 1.12 | Station-to-Station Paid | 765 |
| 1.13 | Residual | 146 |
| 1.14 | Percent of Station-to-Station Paid | 84% |
| 1.15 | Percent of Residual | 16% |
| 1.16 | ARPM Station-to-Station Paid | $ .75 |
| 1.17 | ARPM Residual | $ 1.45 |
| 1.18 | Total ARPM | $ .86 |

### 1.2 Five-Year Period (Five Percent Growth Compounded Annually)

| | | |
|---|---|---|
| 1.21 | Toll Messages Per Day (911 x 1.276) | 1162 |
| 1.22 | Station-to-Station Paid (.84 x 1162) | 976 |
| 1.23 | Residual (.16 x 1162) | 186 |
| 1.24 | Percent Dialable (Estimated) | |
| 1.241 | Of Station-to-Station Paid | 95% |
| 1.242 | Of Residual | 75% |
| 1.25 | Daily Calls Through ATT Without DDD Stimulation | |
| 1.251 | Station-to-Station Paid (.95 x 976) | 927 |
| 1.252 | PPCS (.75 x 186) | 140 |
| 1.26 | Daily Calls Through ATT With Five Percent DDD Stimulation | |
| 1.261 | Station-to-Station Paid (927 x 1.05) | 973 |
| 1.262 | PPCS (140 x 1.05) | 147 |
| 1.27 | ANI Information | |
| 1.271 | S-S ATT Messages | |
| 1.2711 | Exchange A | 19076 |
| 1.2712 | Exchange B | 4051 |
| 1.2713 | Exchange C | 2871 |
| 1.2714 | Exchange D | 760 |
| 1.272 | Number of Stations | |
| 1.2721 | Exchange C | 840 |
| 1.2722 | Exchange D | 220 |

FIGURE 4

2. Plan I - Handle All Calls at Manual Toll Board

2.1 Revenues

| | | |
|---|---|---|
| 2.11 | Daily Messages | 1,162 |
| 2.12 | Monthly Messages (1162 x 27.5) | 31,955 |
| 2.13 | B1 Settlement per Message (ARPM $.86) | $ .339 |
| 2.14 | B1 Settlement Monthly | $ 10,833 |
| 2.15 | B1 Settlement Annually ($10,833 x 12) | $ 129,996 |

3. Plan II - Automatic Toll Ticketing, Station-to-Station, Sent Paid Only

3.1 Toll Board Savings

| | | |
|---|---|---|
| 3.11 | Position Savings (Busy Hour Messages ÷ 40) (927 x .12 ÷ 40) | 2.78 |
| 3.12 | Savings in Traffic Expense ($10,000 x 3) | $ 30,000 |
| 3.13 | Savings in Annual Charges - Three Positions (.14 x $5,000 x 3) | $ 2,100 |

3.2 Annual Charges on ATT Equipment

| | | |
|---|---|---|
| 3.21 | Investment | $ 65,000 |
| 3.22 | Annual Charge Rate | 20% |
| 3.23 | Annual Charges | $ 13,000 |

3.3 Estimate of Settlement

3.31 B-2 Settlement

| | | |
|---|---|---|
| 3.311 | Daily Messages | 973 |
| 3.312 | Monthly Messages (973 x 27.5) | 26,758 |
| 3.313 | Per Message B-2 Settlement | $ .1175 |
| 3.314 | Yearly Messages (26,758 x 12) | 321,096 |
| 3.315 | Annual B-2 Settlement | $ 37,729 |

3.32 B-3 Settlement

| | | |
|---|---|---|
| 3.321 | Daily Messages (1162 - 927) | 235 |
| 3.322 | Monthly Messages (235 x 27.5) | 6,463 |
| 3.323 | Per Message B-3 Settlement (ARPM $1.45) | $ .545 |
| 3.324 | Yearly Messages (6,463 x 12) | 77,556 |
| 3.325 | Annual B-3 Settlement | $ 42,268 |

3.33 B-5 Settlement

| | | |
|---|---|---|
| 3.331 | B-5 Settlement-Exchange A (.0363 x 19076) | $692.46 |
| 3.332 | B-5 Settlement-Exchange B (.0697 x 4051) | 282.35 |
| 3.333 | B-5 Settlement-Exchange C (215+.13x340) | 259.20 |
| 3.334 | B-5 Settlement-Exchange D (125+.30x120) | 161.00 |
| 3.335 | Total B-6 Settlement - Monthly | 1395.01 |
| 3.336 | B-5 Total Annual B-5 (12 x 1395) | 16740.00 |

| | | |
|---|---|---|
| 3.34 | Total B Settlement | $ 96,737 |

4. Plan III - Automatic Toll Ticketing, Station-to-Station, PPCS

| | | |
|---|---|---|
| 4.1 | Toll Board Savings | |
| 4.11 | Position Savings (2.78 + 1.96) (See Items 6.22 and 6.34) | 4.74 |
| 4.12 | Savings in Traffic Expense (10,000 x 5) | $ 50,000 |
| 4.13 | Savings in Annual Charges - Five Positions (.14 x 5,000 x 5) | $ 3,500 |
| 4.2 | Annual Charges on ATT Equipment | |
| 4.21 | Investment | $ 70,000 |
| 4.22 | Annual Charge Rate | 20% |
| 4.23 | Annual Charges | $ 14,000 |
| 4.3 | Estimate of Settlement | |
| 4.31 | Annual B-2 Settlement (same as Item 3.315) | $ 37,729 |
| 4.32 | B-4 Settlement | |
| 4.321 | Daily Messages | 147 |
| 4.322 | Monthly Messages (147 x 27.5) | $ 4,043 |
| 4.323 | Per Message B-4 Settlement (ARPM $1.45) | .473 |
| 4.324 | Yearly Messages (4,043 x 12) | $ 48,516 |
| 4.325 | Annual B-4 Settlement | $ 22,948 |
| 4.33 | B-3 Settlement | |
| 4.331 | Daily Messages (.05 x 976) + (.25 x 186) | 95 |
| 4.332 | Monthly Messages (95 x 27.5) | $ 2,613 |
| 4.333 | Per Message B-3 Settlement (ARPM $1.45) | .545 |
| 4.334 | Yearly Messages (2613 x 12) | $ 31,356 |
| 4.335 | Annual B-3 Settlement | $ 17,089 |
| 4.4 | Annual B-5 Settlement (same as Item 3.336) | $ 16,740 |
| 4.5 | Total B Settlement | $ 94,506 |

5. Summary

| | PLAN I Manual | PLAN II S-S ATT | PLAN III PPCS |
|---|---|---|---|
| Settlement | $129,996 | $ 96,737 | $ 94,506 |
| Savings in Traffic Expense Due to ATT | - | 32,100 | 53,500 |
| Less Additional Expense Expenses of ATT | | (13,000) | (14,000) |
| Net Effect | $129,996 | $115,837 | $134,006 |

6. Toll Board Requirements Worksheet

6.1 PLAN I - Manual

6.11 Positions Required (1162 Daily Messages ÷ 125 = 9.3) 10

6.2 PLAN II - Station-to-Station

6.21 235 Daily Messages to Toll Board
6.22 Position Savings (See Item 3.11) = 2.78
6.23 Positions Required (9.3 - 2.78 = 6.52) 7

6.3 PLAN III - PPCS

6.31 Daily Messages to Toll Board (Not DDD)
Station-to-Station (.05 x 976) = 49
PPCS (.25 x 186) = 46
95

6.32 Daily PPCS (DDD) Messages to Toll Board 147
6.33 Positions Required (6.52 x .70) = 4.564 5
6.34 Positions Savings (6.52 - 4.564) 1.96

7. Computer Study

7.1 Assumptions

7.11 Computer will handle 90 percent of calls
7.12 Regular toll tickets cost $.004 to rate
7.13 Computer investment is $9,000
7.14 Computer annual charges are (.20 x $9,000) $ 1,800

7.2 Under Plan II (Station-to-Station Only)

7.21 Yearly DDD messages 321,096
7.22 90 percent 288,986
7.23 Costs in Manual Rating ($.004 x 288,986) $ 1,156

FIGURE 4
(Page 4)

7.3 Under Plan III (PPCS)

| | | |
|---|---|---|
| 7.31 | Yearly DDD messages (321,096 + 48,516) | 369,612 |
| 7.32 | 90 percent | 332,651 |
| 7.33 | Costs in Manual Rating ($.004 x 332,651) | $ 1,331 |

# EXAMPLE OF ECONOMIC STUDY OF AUTOMATIC TOLL TICKETING AT A TRIBUTARY OFFICE

1. Estimated Revenue

| | | | |
|---|---|---|---|
| 1.1 | Messages per Month and Year: | | |
| | 30 Per Busy Hour x 8 Busy Hours per Day | = | 240 per Day |
| | 240 Per Day x 27.5 Busy Days per Month | = | 6,600 per Month |
| | 240 Per Day x 330 Busy Days per Year | = | 79,200 per Year |
| 1.2 | "B2" Settlement - 6,600 Messages | | $ .1200 |
| 1.3 | "B5" Settlement | | .0596 |
| 1.4 | Total "B2 and B5" Settlement | | $ .1796 |
| 1.5 | "B" Settlement Annually (.1796 x 79,200) | | $ 14,224 |

2. Incremental Expenses and Annual Charges

| | | |
|---|---|---|
| 2.1 | Additional Billing Expense (79,200 x $3.50 ÷ 1,000) | $ 277 |
| 2.2 | ATT Plant Investment* - $28,000 | |
| 2.3 | ATT Annual Charges (20%) | $ 5,600 |
| 2.4 | Total Annual Charges and Expenses | $ 5,877 |

3. Summary

| | | |
|---|---|---|
| 3.1 | Estimated Additional Settlement per Year | $ 14,224 |
| 3.2 | Estimated Additional Annual Costs | $ 5,877 |
| 3.3 | Estimated Additional Net Settlement | $ 8,347 |

*Cost of installation and any necessary modifications should be included.

FIGURE 5

# EXAMPLE OF ECONOMIC STUDY OF AUTOMATIC NUMBERING IDENTIFICATION (CAMA) AT A MEDIUM SIZED TRIBUTARY OFFICE

1. Estimated Revenue

1.1 Messages per Month and Year:

| | | |
|---|---|---|
| 30 per Busy Hour x 8 Busy Hours per Day | = | 240 per Day |
| 240 per Day x 27.5 Busy Days per Month | = | 6,600 per Month |
| 240 per Day x 330 Busy Days per Year | = | 79,200 per Year |

| | | |
|---|---|---|
| 1.2 | B-5 Settlement (Part III) per Message (6600 Monthly) | $ .0596 |
| 1.3 | Annual B-5 Settlement (.0596 x 79,200) | $ 4720 |
| 1.4 | A-4 Settlement (8 Trunks x 5 x 12 Months) | $ 480 |
| 1.5 | Total Settlement Revenue ($4720 + 480) | $ 5200 |

2. Annual Charges on ANI Equipment

| | | |
|---|---|---|
| 2.1 | *Investment - Identifier | $ 9800 |
| 2.2 | Investment - Trunks (8 x $200) | 1600 |
| 2.3 | Total Investment | 11400 |
| 2.4 | Annual Charge Rate | 20% |
| 2.5 | Annual Charge | $ 2280 |

3. Summary

| | |
|---|---|
| Settlement | 5200 |
| Less Annual Charges for ANI | 2280 |
| Net Effect | $ 2920 |

*If special subscriber's instruments (see Item 4.42) are used, the installation and investment must be included in this amount.

FIGURE 6

# EXAMPLE OF ECONOMIC STUDY OF AUTOMATIC NUMBERING IDENTIFICATION (CAMA) AT A SMALL TRIBUTARY OFFICE

1. Estimated Revenue

1.1 B-5 Settlement

10 per Busy Hour x 8 Busy Hours per Day = 80 per Day
80 per Day x 27.5 Busy Days per Month = 2200 per Month

Therefore B-5 Part I Applies

550 Stations Equipped

| | | |
|---|---|---|
| B-5 Settlement | $215.00 Monthly | |
| plus $.13 x 50 | 6.50 | |
| Monthly B-5 Settlement | $221.50 | |
| Annual B-5 Settlement (12 x $221.50) | | $ 2,658 |
| 1.2 A-4 Settlement (5 trunks x $5.00 x 12) | | 300 |
| 1.3 Total Settlement Revenue | | $ 2,958 |

2. Annual Charges on ANI Equipment

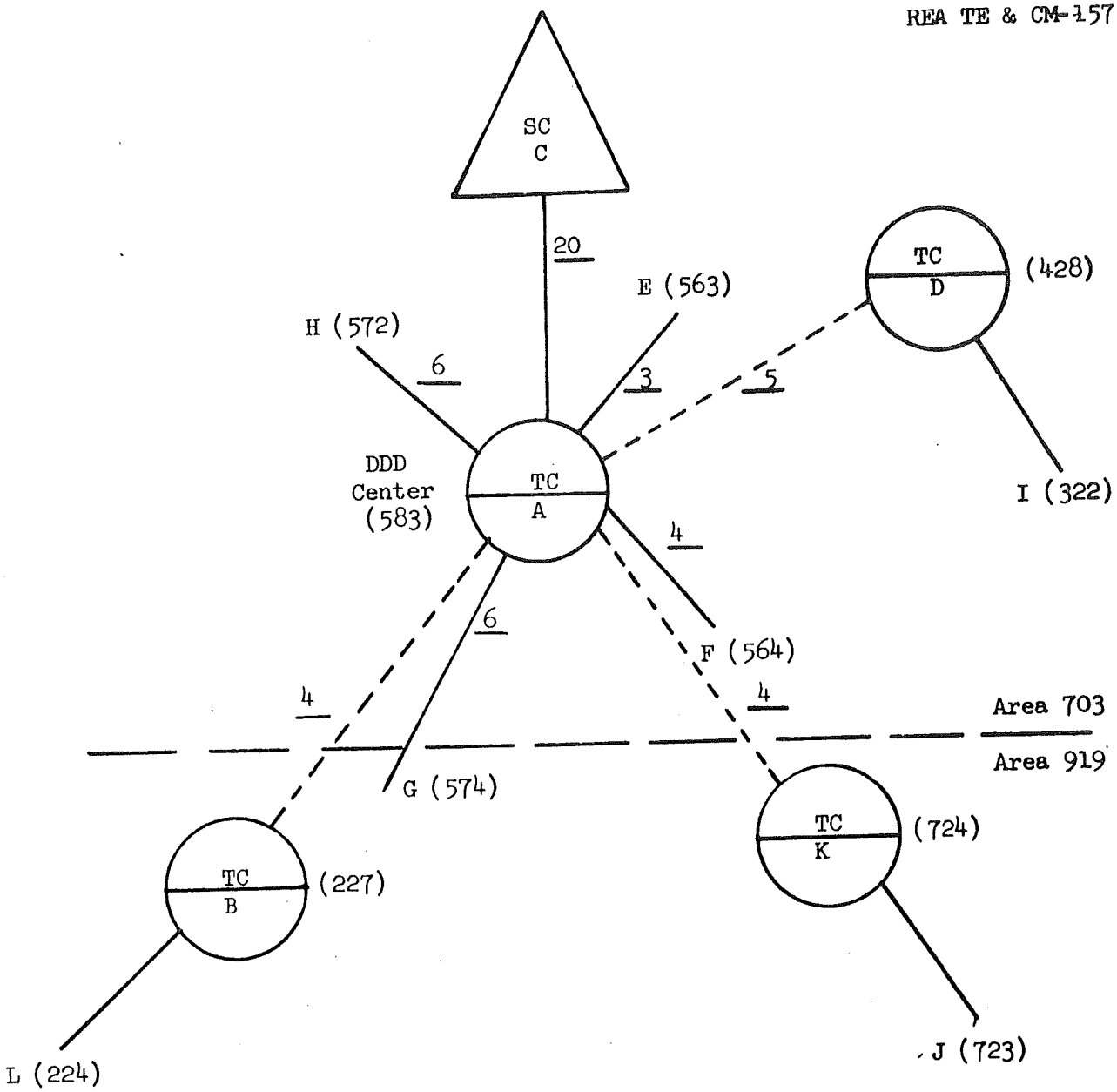
| | |
|---|---|
| 2.1 *Investment - Identifier | $ 5,600 |
| 2.2 Investment - Trunks (5 x $200) | 1,000 |
| 2.3 Total Investment | 6,600 |
| 2.4 Annual Charge Rate | 20% |
| 2.5 Annual Charge | $ 1,320 |

3. Summary

| | |
|---|---|
| Settlement | 2,958 |
| Less Annual Charges for ANI | 1,320 |
| Net Effect | $ 1,638 |

*If special subscriber's instruments (see Item 4.42) are used, the installation and investment must be included in this amount.

FIGURE 7




C - Sectional Center

A, B, D, K - Toll Centers

E, F, G, H, I, J, L - Dial Tributaries

( ) - Office Code

_____ - Number of Trunks

_____ - Final Group

- - - - - - High Usage Group

FIGURE 8

DDD Trunking Diagram