BASIC CALL PROCESSING
SOFTWARE SUBSYSTEM DESCRIPTION
NO. 3 ELECTRONIC SWITCHING SYSTEM

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1. GENERAL

1.01 This section provides a functional description of the software required to perform basic call processing functions in the No. 3 Electronic Switching System (ESS). The areas discussed include:

- Major storage areas
- Distribution of call processing tasks
- Major network connections
- Originating functions
- Terminating functions
- Ringing tasks and answer supervision

- Outgoing functions
- Disconnect functions
- Error handling.

1.02 Whenever this section is reissued, the reason(s) for reissue will be listed in this paragraph.

1.03 Part 8 contains a glossary of terms, abbreviations, and definitions necessary for comprehension of the information contained in this document.

1.04 The following sections may be helpful in understanding call processing.

SECTION	TITLE
233-151-105	Call Processing Overview Software Subsystem Description (SSD), No. 3 ESS
233-151-115	Operator Functions SSD, No. 3 ESS
233-151-120	Call Charging SSD, No. 3 ESS
233-151-125	Input Processing and Scanning SSD, No. 3 ESS
233-151-135	Custom Calling SSD, No.3 ESS
233-151-140	Network Path Hunt SSD, No. 3 ESS
233-151-145	Digit Processing SSD, No. 3 ESS
233-151-150	Translations SSD, No. 3 ESS
233-151-155	Peripheral Input-Output Control SSD, No. 3 ESS

1.05 Information contained in this section will aid in accessing the software listings which contain detailed program functions and coded software instructions for performing call processing functions. Table A contains the acronyms, names, and program listing numbers of each program referenced in this document.

2. CALL PROCESSING MEMORY AREAS AND TASK DISTRIBUTION

MEMORY AREAS

2.01 The call processing software uses allocated blocks of storage to retain data associated with a call. Some of the major storage areas are described in the following paragraphs.

A. Transient Call Record

2.02 A transient call record (TCR) is a 16-word block of writable main storage assigned to a call in the transient state. This area of storage contains control information, terminal path information, and receiving and sending data applicable to a call. The information contained in the TCR and the format of the TCR constantly change as different call processing functions are performed for the call. Therefore, a format of the TCR is not provided in this document, but formats of the TCR as it appears for the different functions are available in the program listings containing the software to perform the functions. The use of the TCR areas for a particular function is provided by the SSD describing that function.

B. Terminal Memory Records

2.03 The terminal memory record (TMR) is a 4-word block of writable main storage assigned to each junctor. See Fig. 1 for a format of a stable TMR and for the transient TMR. For stable calls, the TMR of the junctor specifies the scan point number (SPN) of the talking parties and provides timing control. If the terminal has no SPN (conference circuit, tone circuit, announcement circuit), the terminal equipment number (TEN) is placed in the TMR. For transient calls, the TMR also specifies the TCR assigned to the call as well as the SPNs of the connected circuits. For idle junctors, the TMR serves no function.

C. Originating Register

2.04 Each scan point in the six receiver scan rows has an associated originating register (OR) to be used in digit receiving. The originating register is one word and provides a link between the receiver scan point and the TCR for the call. It contains the TCR number, an area to accumulate the pulse count for a digit dialed, and a receiver code. The receiver code is used to indicate to

TABLE A

PROGRAM IDENTIFICATION

PROGRAM NAMES	PROGRAM TITLES	PROGRAM NUMBERS
COIN	Coin Clean-Up Routine	PR-3H150
CTRACR	Resident Portion of the Call Trace Program	PR-3H005
CUSTER	Customer Error Program	PR-3H151
CUSTOM	Custom Calling Programs	PR-3H152
DIGPRO	10-Millisecond Interrupt Program-Digit Receiving and Sending	PR-3H153
DISCON	Disconnect Progress Marks	PR-3H154
DNTRP	Digit Interpretation Progress Marks	PR-3H155
EMERG	911 Service Program	PR-3H156
EQPSEL	Equipment Selection Subroutines	PR-3H157
FALTCR	Call Failure Program	PR-3H158
FASTTK	Fast Trunk Scanning Program	PR-3H159
INPUT	Input Monitor Program	PR-3H160
LCLCHG	Local Charging-Coin and Message Register	PR-3H161
LNORIG	Line Originating Program	PR-3H162
MCSUB	Maintenance Subroutines	PR-3H251
NTCONN	No-Test Trace Connection Program	PR-3H163
OPER	Operator Calls Program	PR-3H164
OUTCAL	Outgoing Call Program	PR-3H165
PATHNT	Network Path Hunt, Busy and Idle	PR-3H166
PCAT	Catalog of Peripheral Control Sequences	PR-3H167
POINT	Peripheral Order Interpreter	PR-3H168
POPS	Peripheral Operation Subroutines	PR-3H169
PURC	Peripheral Controller Fault Recovery	PR-3H254
RING	Ring and Answer-Completion of Intraoffice Calls	PR-3H172
SCANS	Base Level Scanning Program	PR-3H173
TCRSCN	Base Level TCR Scan	PR-3H174
TERM	Completion of Incoming and Intraoffice Calls	PR-3H175
TKORIG	Trunk Origination Program	PR-3H176
TKPROC	Trunk/Junctor/Service Circuit Input Processing	PR-3H177
TREWAY	Three-Way Calling	PR-3H184
TSVSUB	Maintenance Subroutines for Replicated Circuits and Lines	PR-3H258
XSL3DG	Three-Digit Translation Program	PR-3H181

TABLE A (Cont)

PROGRAM IDENTIFICATION

PROGRAM NAMES	PROGRAM TITLES	PROGRAM NUMBERS
XSL4DG	Four-Digit Translation Program	PR-3H182
XSLSPN	Scan Point Number Translation	PR-3H179
XSLSUB	Basic Translation Subroutines	PR-3H180

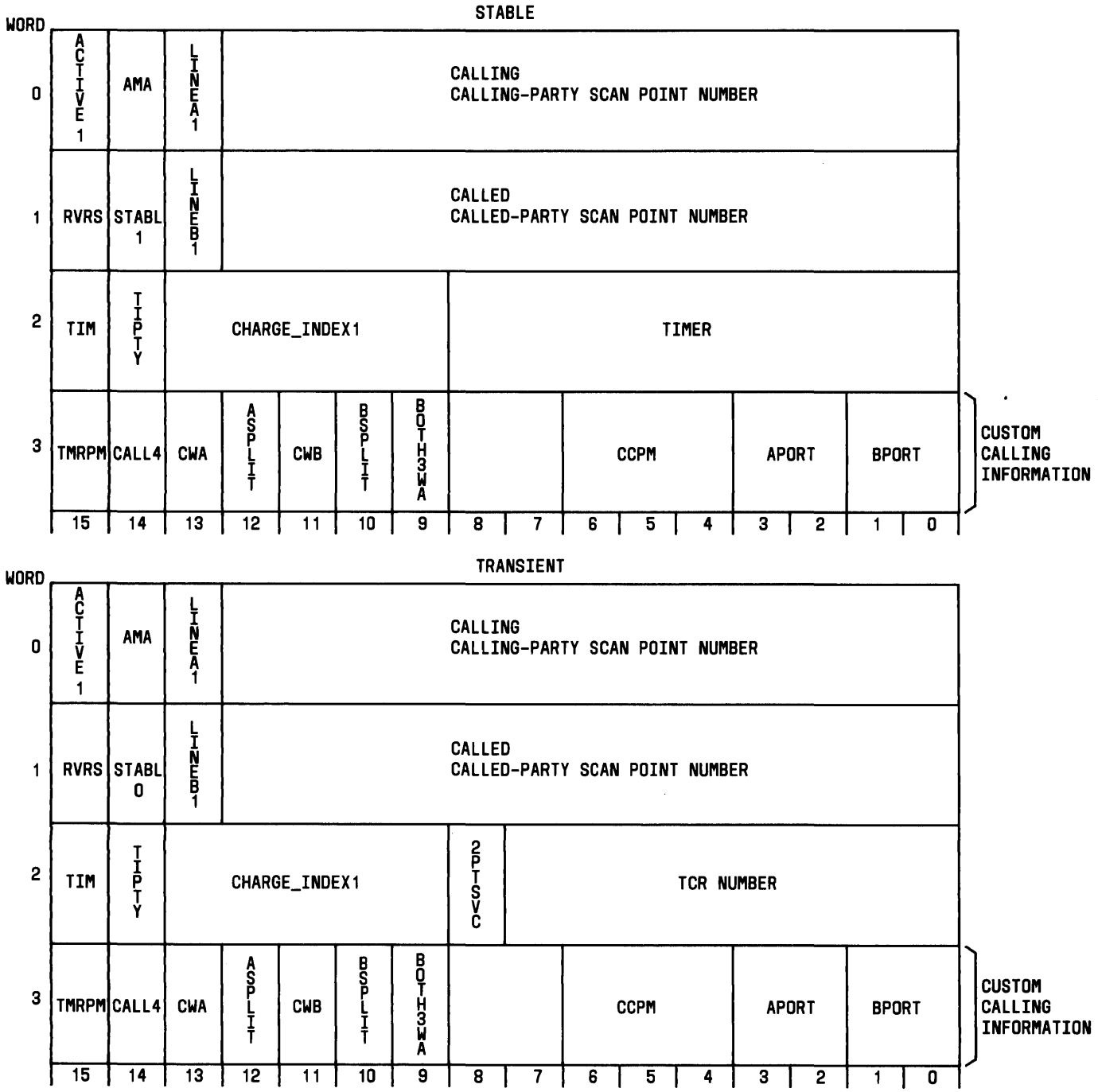


Fig. 1—Stable and Transient TMRs

which digit receiving and sending routine of digit processing (DIGPRO) control should be given during the next 10-millisecond interrupt.

D. Hoppers

2.05 Hoppers are dedicated areas of writable memory into which entries with a fixed format are made. Scanning routines make an entry into the appropriate hopper for each detected scan point state change. These entries are used by subsequent software routines to process the inputs. The following three hoppers are used by scanning and input processing software.

(a) The line originating hopper for line originations.

(b) The trunk/junctor/service circuit input hopper for scan point state changes from trunks, junctors, miscellaneous scan points, and service circuits scanned at base level as well as operator trunk originations found at interrupt level.

(c) The interrupt hopper for immediate start and operator trunk scan point state changes and for stop dial and start signal detection.

2.06 In addition, a hopper for dial pulse receiving trunk is utilized. Every active, incoming dial pulse trunk is assigned an entry in the hopper while the trunk is in the receiving state. The hopper 2-word entry is used like an originating register for counting pulses received from a dial pulse trunk.

E. Circuit Status Table

2.07 A circuit status table is provided in writable memory which consists of 2-word entries corresponding to each scanner row associated with circuits. One word contains the last look bits which indicate the states of the circuits in a scanner row during the previous scan. The second word consists of ignore bits which designate the circuit-scanner row bits that are to be ignored during a particular scan. These bits are examined and manipulated during the processing of calls.

F. Line Status Bits

2.08 Two bits of memory are also required to store the status of each line. The bits are organized into consecutive words corresponding to a scanner row. The bits are updated to indicate the line is (1) idle, (2) maintenance busy, (3) normal busy, or (4) in the permanent signal state.

DISTRIBUTION OF CALL PROCESSING TASKS

2.09 The base level loop (Fig. 2) is a major software loop of nontime critical programs which includes all functions not performed during interrupts of the base level loop. It includes most call processing programs and those maintenance tasks which can be deferred. Some call processing functions, however, are performed during timed interrupts of the base level loop. Timed interrupts (Fig. 3) are hardware-initiated every 10 ms for a period of time necessary to perform frequently required functions such as sending and receiving digits, the scanning of immediate start trunks and operator trunks, and most peripheral control functions.

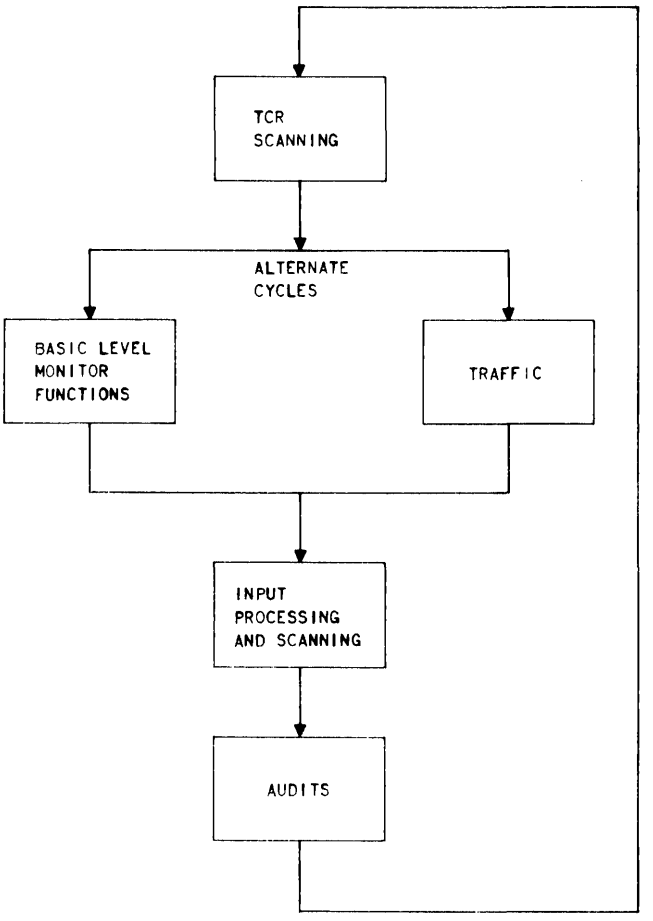


Fig. 2—Base Level Loop

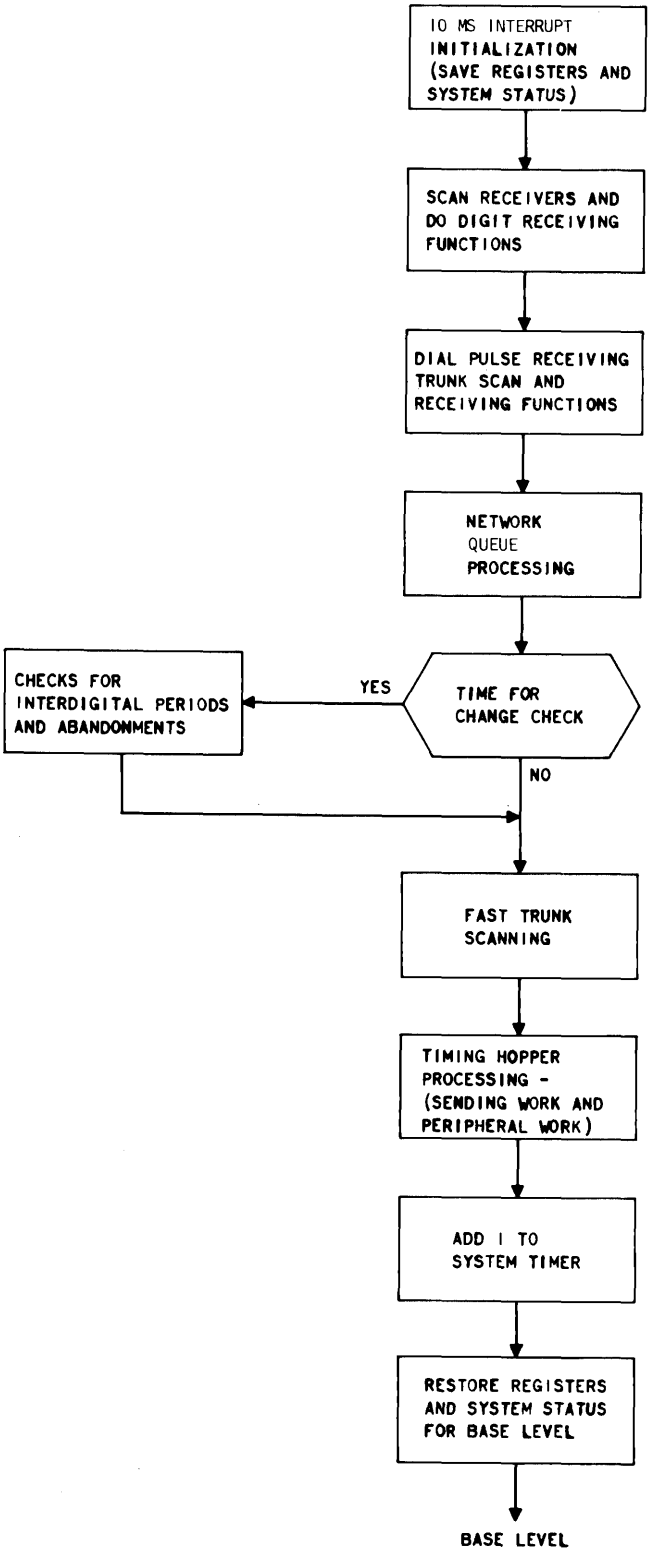


Fig. 3—Timed Interrupts

2.10 Figure 4 depicts the base level loop and the timed 10-ms interrupt from the system point of view, indicating the major call processing functions performed and the memory areas used in performing the functions. Several (not necessarily consecutive) base level loops are required to complete the call processing functions for a call. Similarly, call processing functions are performed for many calls during one base level loop.

2.11 The ***base level progress mark*** in the TCR is a number that indicates via a program transfer table the application software routine to be given control for the next step in processing a call. The base level progress mark must be present in an active TCR. Using the progress mark, the base level TCR scanning program (TCRSCN) controls much of the processing of calls. The TCRSCN program is normally considered to be first in the base level loop. Control is passed to TCRSCN by the audit routines which are the last programs executed in the loop. TCRSCN calculates the time since the last TCR scan (the time spent in the previous base level loop) by subtracting the start time of the last TCR scan from the present start time. Both times are stored in the application temporary store definition (ATSD) for later use.

2.12 The TCRSCN program then sequentially examines all of the TCRs for transient calls. When the TCR is active, TCRSCN decrements the timer word of the TCR by the time elapsed since the last scan. When the timer becomes less than zero, TCRSCN invokes the routine associated with the base level progress mark in the TCR. Otherwise, the reduced value of the timer is stored in the TCR timer word, and the base level action (BACTION) bit in the TCR is checked. When the BACTION bit is one (indicating base level action is needed for the call), TCRSCN also invokes the routine associated with the base level progress mark.

2.13 The TCRSCN program uses the value of the base level progress mark in the TCR to index into the base level progress mark branch table to transfer control to the proper routine. The base level progress mark routine performs the call processing function(s) (such as coin functions, terminating call functions, digit interpretation, outgoing call functions, disconnect, error handling, etc) needed for the call at that time and returns to TCRSCN. TCRSCN then processes the next TCR.

2.14 When progress mark values are not within the allowed range, the call is failed by the call failure program (FALTCR). An error message is printed by the TTY; all active paths and circuits are idled for the call, and the TCR is cleared.

2.15 The base level progress mark routine GOTORA (Go To Return Address) resides in TCRSCN and is a special progress mark which causes a branch to the address stored in the TCR words RAD0 and RAD1. It is normally used after a real-time break for transferring control to the next function to be performed.

2.16 The PWAIT_(peripheral action wait) progress mark routine also resides in TCRSCN. The routine is entered after a software call for a peripheral action sequence (PACT). When entry is made because of a TCR time-out, control is given directly to the peripheral error routine (PEER) in the peripheral operations (POPS) program or, if requested, (PERTN bit in TCR = 1) control is passed to the address stored in the RAD0 and RAD1 words of the TCR. When the peripheral sequence did not time out (that is, the BACTION bit = 1), control is passed to the address stored in RAD0 and RAD1.

2.17 The TCRSCN program also keeps a count of idle TCRs while processing each TCR. To preserve time and to protect the system from overloading, TCRSCN indicates to the input monitor (INPUT) that service of line originations should be skipped for this loop when only ten or less TCRs remain idle. Overloading might hamper the processing of inputs from immediate start and operator trunks which require immediate processing. When there are five or less idle TCRs found, service of trunks, junctors, and service circuits scanned at base level (the slow scan list) is also inhibited.

2.18 When a task is such that it causes the call to wait for its completion (digit reception, network connections, etc), the call is said to take a "real time break." This permits other calls to use the valuable processor time. When the task completes, the call will be given control again as described in paragraph 2.12.

2.19 Several procedures are used to provide real-time breaks for a TCR or to wait for a task to be finished. The transient call record wait subroutine (TCRWAIT) in TCRSCN may be called. It stores the address of the instruction following the call of the subroutine in the return address area of the TCR and sets the base level progress mark to GOTORA. It also sets the timer in the TCR for the time to be waited. Control is given back to TCRSCN or the input monitor for the processing of other calls. When the timer times out or the BACTION bit is set, indicating the call is ready for more processing, TCRSCN (usually one or more base level loops later) transfers control to the address stored in the TCR so that processing of the call can continue. In some cases, instead of the GOTORA progress mark, another base level progress mark is specified by the calling program and the associated base level progress mark routine is invoked by TCRSCN or the input monitor.

2.20 A call to the PACT macro to initiate peripheral work may result in a real-time break. Real-time breaks to wait for peripheral action are initiated by placing the TCR number and the time to be waited in the timing hopper. The timing hopper monitor program (TMON) processes each hopper entry during a 10-ms interrupt when the timer times out. It passes the TCR number to the appropriate routine for processing. In addition, the queuing of network controller orders in the network queues is performed to provide the time needed by the controllers between orders.

IDENTIFICATION OF MAJOR CALL PROCESSING FUNCTIONS

2.21 For the purpose of this document, major functions performed to complete a call may be identified as (a) originating functions, (b) terminating functions, (c) outgoing functions, and (d) disconnect functions. Because originating functions are covered in detail in Section 233-151-125, only a general overview of these functions appears in this section. There are four general call types: (a) intraoffice calls, (b) outgoing calls, (c) incoming calls, and (d) tandem calls. Figure 5 depicts the major functional areas required for completion of each general call type.

NETWORK CONNECTIONS

2.22 Network connections required to complete a call vary depending on the type of call. Figure 6 depicts the connections for a typical intraoffice call, Fig. 7 shows outgoing call connections, Fig. 8 multifrequency (MF) incoming call connections, and Fig. 9 dial pulse incoming call connections.

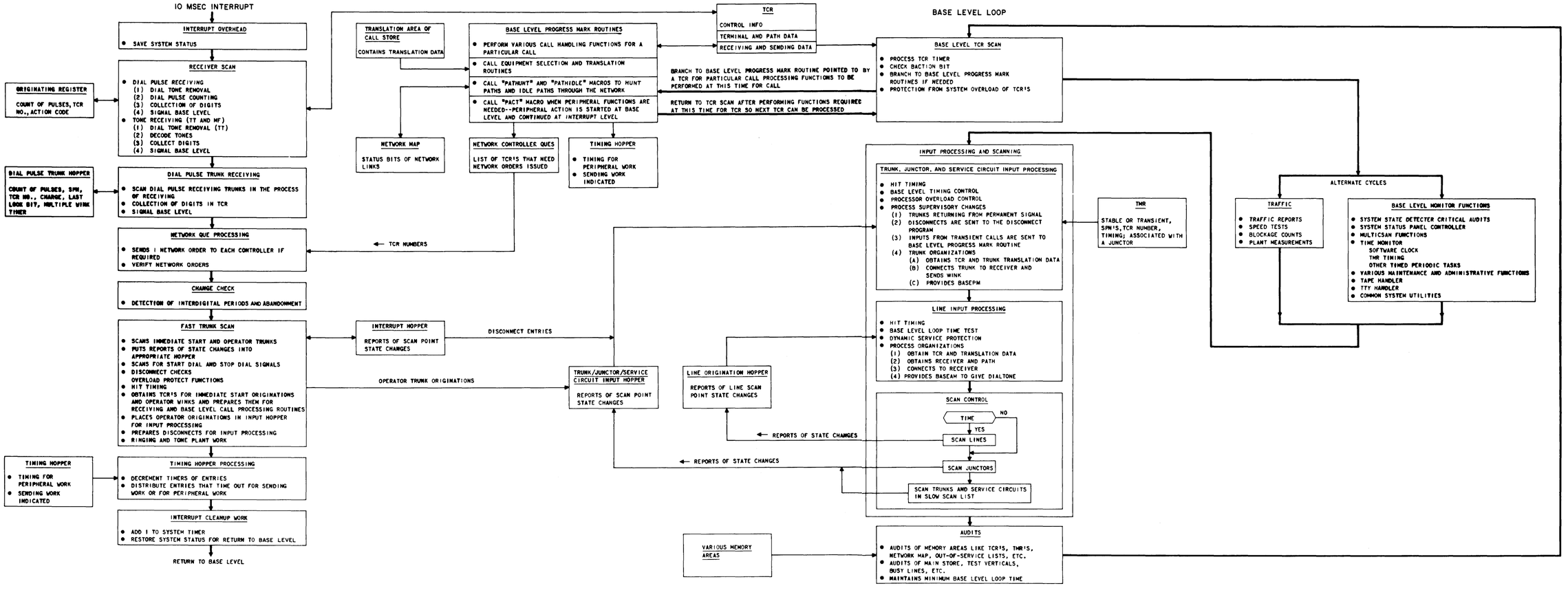


Fig. 4—Call Processing (System Viewpoint) With Associated Memory Areas

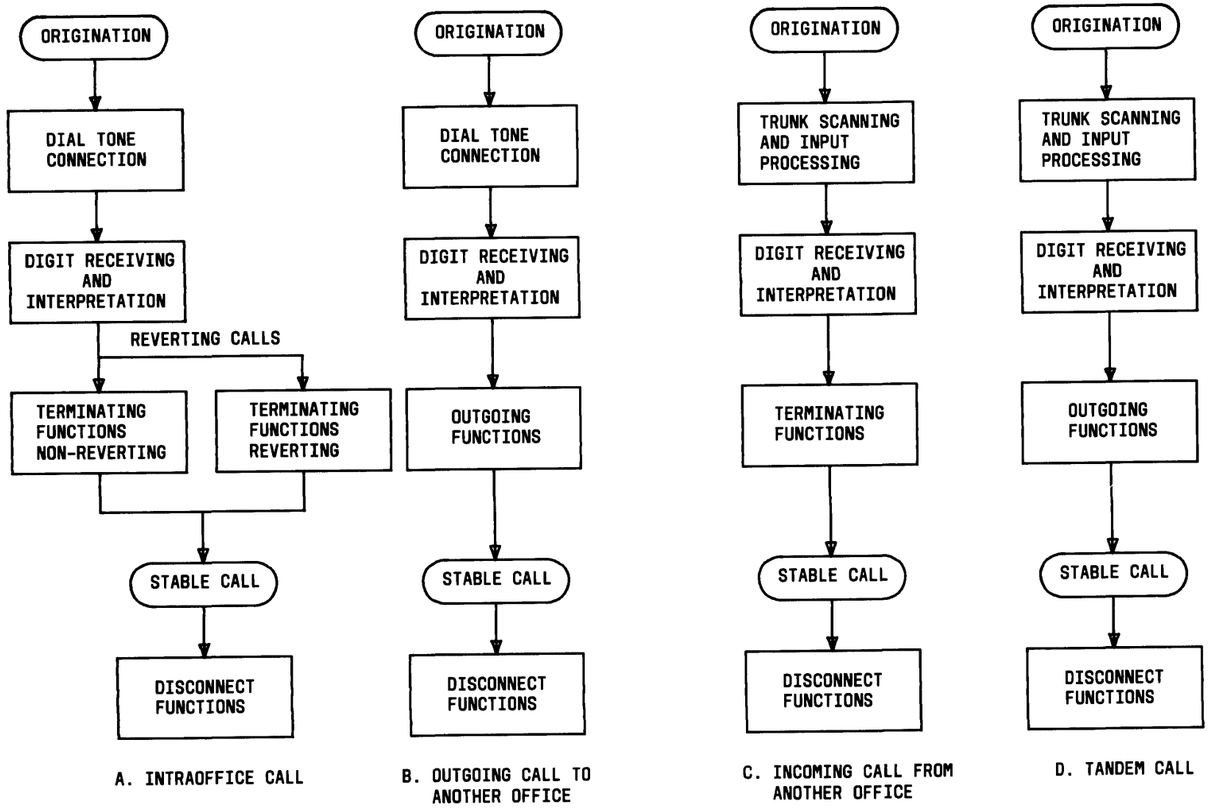


Fig. 5—Intraoffice, Outgoing, Incoming, and Tandem Call Functions

Hunting, reserving, or idling of network paths is performed by the program PATHNT which is accessed via use of the PATHUNT and PATHIDLE macros. These functions are described in detail in Section 233-151-140. Peripheral order processing routines are accessed through the PACT macro to make the connections and operate the periphery. Peripheral control functions are described in Section 233-151-155.

3. ORIGINATING FUNCTIONS

TRUNK ORIGINATIONS

3.01 Trunk originations are detected as off-hooks at the scan point (supervisory ferrod) for the trunk. ***Immediate-start trunks*** (from step-by-step offices) are scanned by the fast trunk scanning program (FASTTK) during 10-ms interrupts. When an origination is detected from an immediate-start trunk, FASTTK selects a TCR for the call and prepares the dial pulse receiving trunk hopper entry for digit reception since that type of trunk may begin to send dial pulse digits immediately. FASTTK also supplies the BIOFF base level progress mark and sets the BACTION bit in the TCR so that the BIOFF routine in the trunk originations program (TKORIG) is given control of the call during the next base level loop. All TMRs are first scanned to verify that the trunk is not already involved in a stable call. Valid originations continue to the data acquisition routine (GET_DATA) in program TKORIG.

3.02 ***Common control trunks*** are scanned during base level by the scanning program (SCANS), and ***operator trunks*** are scanned during interrupt level by FASTTK. When an origination is detected, the input is reported to the input monitor (INPUT) by an entry in the trunk/junctor/service circuit input hopper. Hit timing is performed and TKORIG is called to process the origination. (See Section 233-151-125 for more details on input processing and scanning.) TKORIG

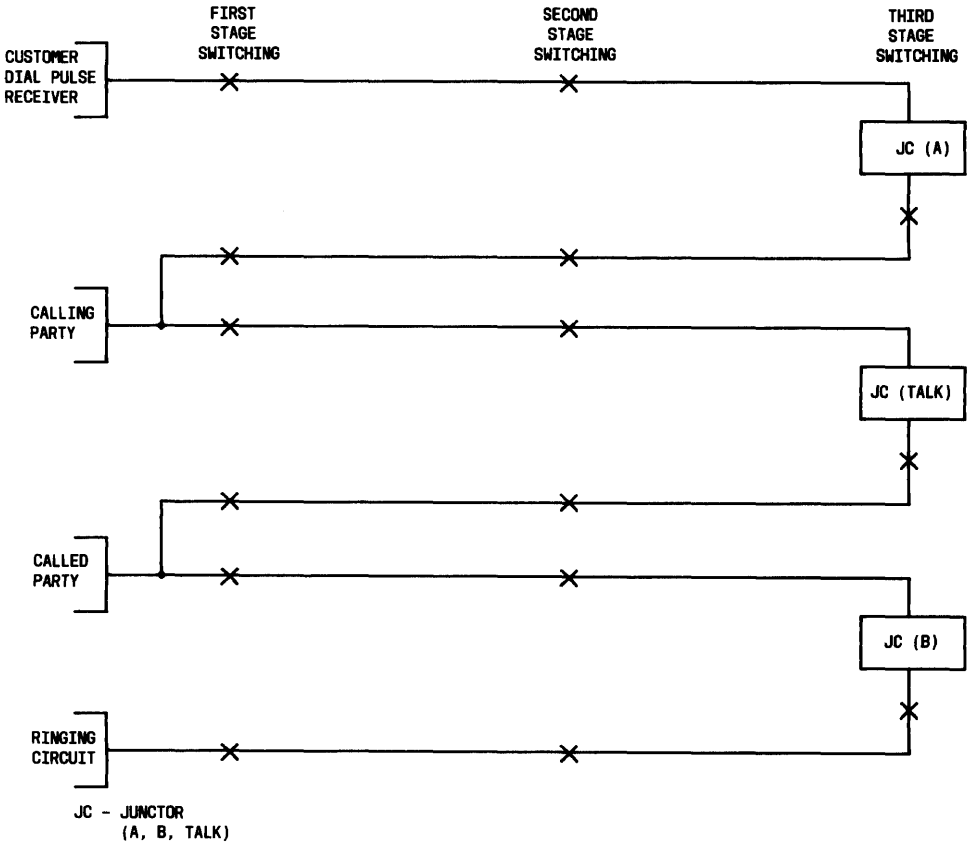


Fig. 6—Typical Intraoffice Call Connections

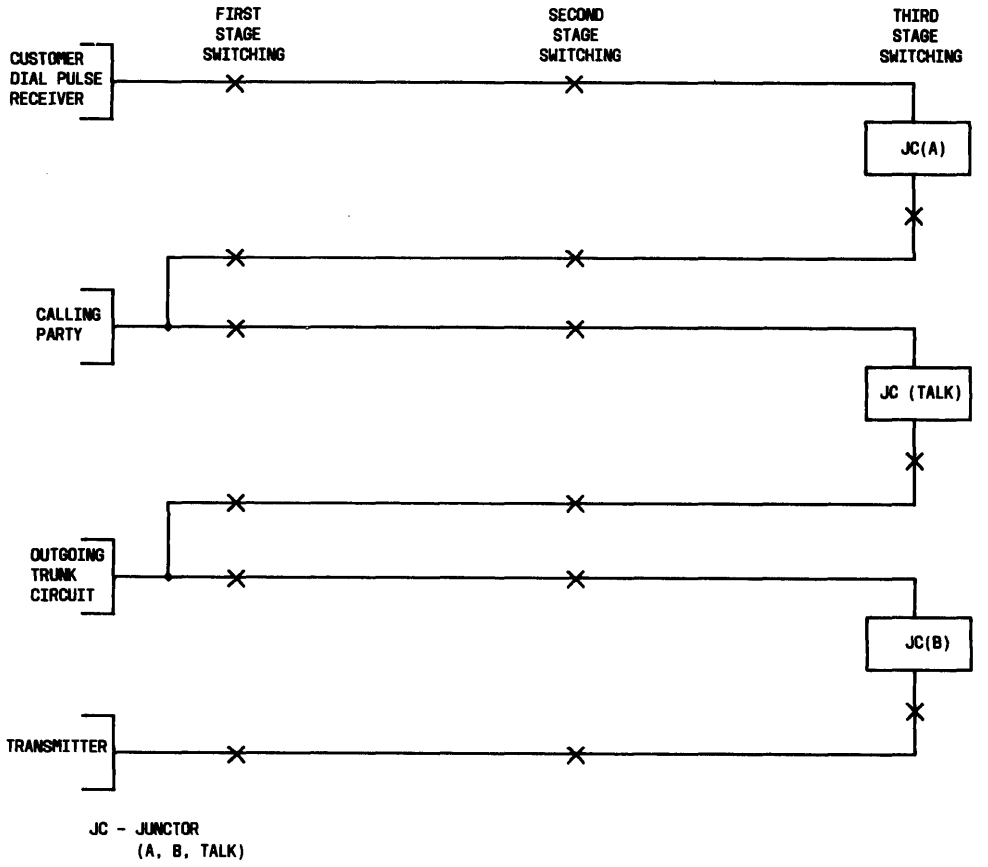


Fig. 7—Typical Outgoing Call Connections

first selects a TCR for the call since one has not already been selected. The ignore bit for that trunk in the circuit status table in memory is set to 1 so that any dial pulses which might follow will not be considered originations. The common control trunk originations then are passed to the GET_DATA routine as were immediate start trunk originations.

3.03 The GET_DATA routine in TKORIG must then acquire the trunk group translation data for the trunk and analyze it. The DATCKT subroutine in the equipment selection program (EQPSEL) is called to obtain the trunk group data (Fig. 10) using the scan point number (SPN) of the trunk. DATCKT returns the terminal equipment number (TEN), circuit type code, distribute triplet address, address of the group data block, and a return code. TKORIG then stores needed information in the TCR. The BUSYCKT subroutine in EQPSEL is called to set the selection bit of the trunk in memory to indicate it is busy so that a 2-way trunk will not also be selected for an outgoing call.

3.04 The status and type of trunk are examined. The following four cases are tested.

(1) A 2-way immediate start trunk experiencing "glare" (that is, an incoming origination on a trunk already seized for an outgoing call). This case is processed normally because the outgoing call program (OUTCAL) detects the glare condition and selects another trunk, thus allowing the incoming origination to continue on that trunk.

(2) A common control 2-way trunk experiencing glare. The origination is terminated.

(3) A 2-way trunk locked out of service in the outgoing direction. Normal origination processing continues.

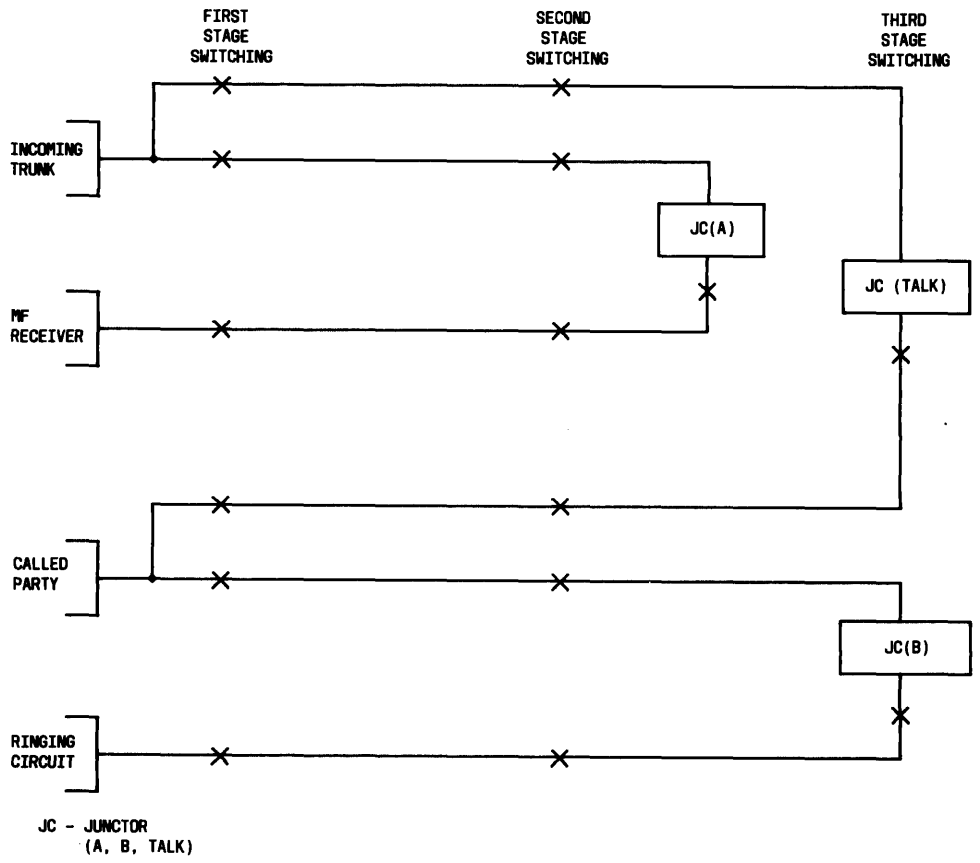


Fig. 8—MF Incoming Call Connections

(4) Origination from outgoing only trunk. If a 911 trunk, timed reorder is given under the control of the program EMERG. Otherwise, the trunk is placed in the high and wet state; the TCR is cleared; and the origination is terminated.

3.05 Immediate start trunks have already started to receive digits during 10-ms interrupts. Dial pulses are received at the trunk scan point. For other dial pulse receiving trunks, peripheral action is initiated to send the wink signal as a start dial signal to the other office (ie, a signal indicating this office is ready to receive digits.)

3.06 Multifrequency (MF) trunks must have an MF receiver for digit receiving. The GET_CKT subroutine in OUTCAL is called to select a receiver. A path is then hunted by the program PATHNT from the trunk to the receiver. When all receivers are busy or no path is available, the receiver (if selected) is idled and the TCR is cleared, but the origination is left in the trunk/junctor/service circuit input hopper to be processed later.

3.07 Traffic measurements for receiver attachment delay are taken after success in selecting a receiver and path. Then the peripheral sequence to connect the receiver and to send the wink or dial signal is begun. The sequence also initializes the originating register associated with the receiver for digit receiving.

3.08 Peripheral errors are analyzed by the peripheral error routine in POPS. Continuity failures result in an entry being made in the error analysis buffer, idling of the path and receiver, and a second attempt being made to select another receiver and path. Reorder is given for false cross and ground errors and also on failed second attempts to select a receiver and path.

3.09 The next function to be performed for all incoming calls is ***digit receiving and***

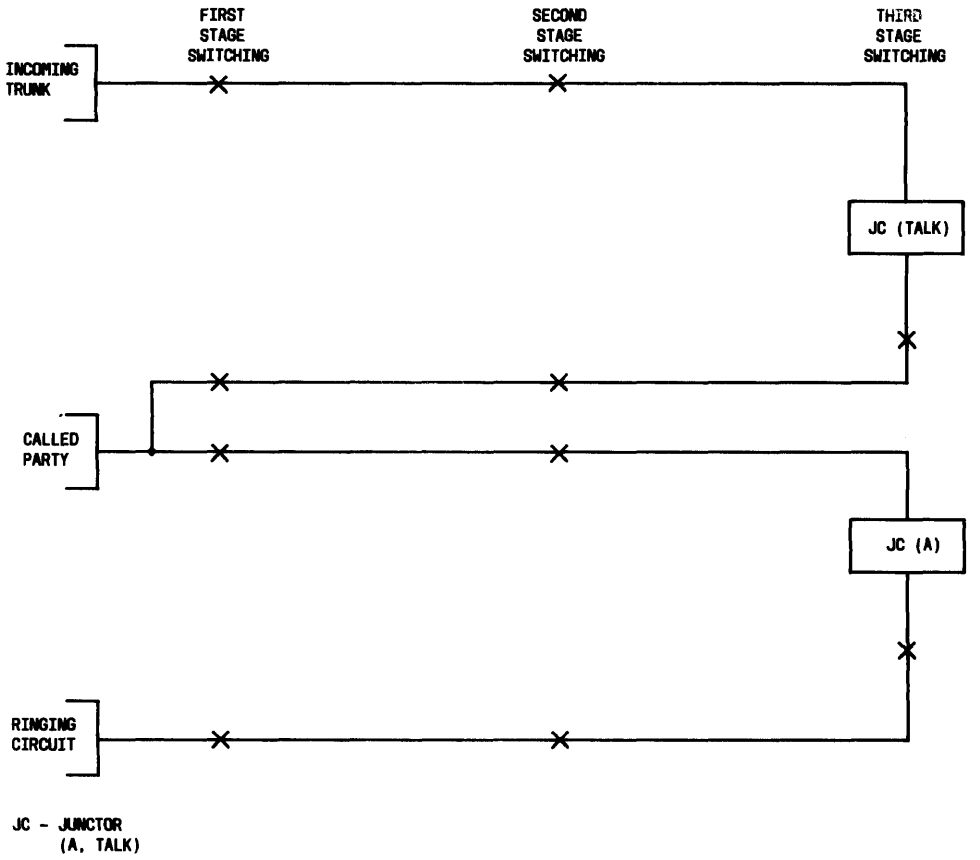


Fig. 9—Dial Pulse Incoming Call Connections

interpretation. (Receiving has already begun for immediate start trunks.) Digit processing is described in more detail in Section 233-151-145. At base level, TKORIG maintains control. The incoming digit translation code obtained from the trunk group data indicates the number of digits expected from the other office. TKORIG examines the code and sets the signal digit in the TCR equal to the number of digits to be received before further digit interpretation is needed at base level. Digit interpretation (Section 233-151-145) is performed until the call is identified as terminating (Part 4) or outgoing (tandem) (Part 5). When a TCR times out while waiting for digits (ie, not enough digits were dialed, thus a partial dial condition exists), the call is given reorder by the customer error program (CUSTER) if an immediate-start trunk or permanent signal if other trunk type (7.17).

LINE ORIGINATIONS

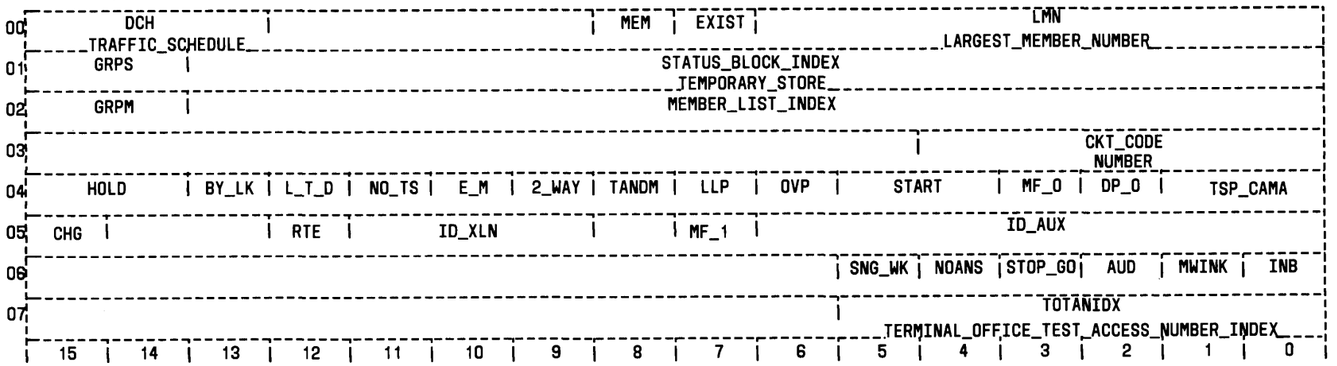
3.10 The subscriber going off-hook saturates the line scan point which is detected by the base level scanning program, SCANS. SCANS interrogates all line scan points at base level and reports originations by placing the line scan point number into the line origination hopper.

3.11 During a subsequent base level loop, after all trunk and junctor requests for service have been processed, the input monitor program (INPUT) processes the service request entry for the line in the line origination hopper. INPUT passes valid originations to LNORIG, the line originations program, which performs the following functions.

(a) Orders the line to be rescanned to eliminate momentary hits.

(b) Selects and initializes an idle TCR for the origination.

(c) Obtains an originating translation (via XSLSPN) to obtain line translation data (Fig. 11)



LMN — LARGEST MEMBER NUMBER
EXIST — THE GROUP EXISTS
MEM — GROUP HAS AT LEAST ONE WORKING MEMBER

DCH — TRAFFIC SCHEDULE
STATUS_BLOCK_INDEX
GRPS — HIGH 2 BITS OF THE GROUP NUMBER
MEMBER_LIST_INDEX
GRPM — HIGH 2 BITS OF THE GROUP NUMBER
CKT_CODE — NUMBER

TSP_CAMA
- 00 = REGULAR TRUNK GROUP
- 01 = CAMA TRUNK GROUP
- 10 = TSP TRUNK GROUP
- 11 = TSPS TRUNK GROUP

OP_O — 1 = DIAL PULSE OUTPULSING
MF_O — 1 = MF OUTPULSING
START
- 00 = IMMEDIATE START
- 01 = DELAYED DIAL
- 10 = WINK START - WAIT 350 MSEC. FOR END OF WINK
- 11 = WINK START - WAIT 1000 MSEC. FOR END OF WINK

OVP — 1 = OVERLAP OUTPULSING PERMITED
LLP — 1 = LONG LOOP PULSING REQUIRED
TANDM — = 1 TANDEMING ALLOWED OVER THIS TRUNK GROUP
2_WAY
- 1 = 2-WAY TRUNK
- 0 = 1-WAY TRUNK

E_M
- 1 = E & M TRUNK
- 0 = LOOP TRUNK

NO_TS — 1 = NO-TEST TRUNK
L_T_D — 1 = TRUNK FROM OR TO LOCAL TEST DESK
BY_LK — 1 = TRUNK FROM STEP-BY-STEP OFFICE
HOLD
- 00 = REGULAR TRUNK GROUP
- 01 = JOINT HOLD (RECORDING COMPL. OPERATOR)
- 10 = SERVICE HOLD (TOLL SWITCH TSP(S), OR NO TEST)
- 11 = CUSTOMER HOLD (NON-OPERATOR INTERCEPT TRUNKS)

ID_AUX — AUXILIARY INFORMATION REQUIRED FOR INITIAL DIGIT TRANSLATION.
MF_I — 1 = MF INPULSING EXPECTED FROM FAR OFFICE
ID_XLN — INCOMING DIGIT TRANSLATION CODE WHICH DIRECTS THE INITIAL TRANSLATION AS FOLLOWS:
- 000 = TRUNK IS 1 WAY OUTGOING
- 001 = USE 4 DIGIT TRANSLATION ON 1ST FOUR DIGITS RECEIVED
- 010 = IGNORE FIRST DIGIT AND USE 4 DIGIT TRANSLATION ON NEXT FOUR DIGITS
- 011 = USE 1 DIGIT TRANSLATION ON 1ST DIGIT RECEIVED
- 100 = USE 3 DIGIT TRANSLATION ON 1ST THREE DIGITS RECEIVED.
- 101 = FORM 4 DIGIT NUMBER FROM MOST SIGNIFICANT (1000'S) DIGIT PROVIDED BY 'IDAUX' AND 3 RECEIVED DIGITS. THEN USE 4 DIGIT TRANSLATION

RTE — REMOTE TEST EQUIPMENT
- 0 = DEDICATED FACILITIES ARE PROVIDED FOR LOCAL TEST DESK
- 1 = NON-DEDICATED FACILITIES ARE PROVIDED. REMOTE TEST EQUIPMENT FACILITIES ARE PROVIDED. AUTOCONNECT PROCEDURES ARE USED.

CHG — 1 = CALLS TO GROUP ARE TO BE CHARGED (INCOMING CALLS ONLY)
INB — 1 = MF INBAND SIGNALING
MWINK — 1 = MULTI-WINK SIGNALING
AUD — 1 = RETURN AUDIBLE (OUTGOING TO 23 INTERCEPT SYSTEM)
STOP_GO — 1 = INTERRUPTION OF PULSING IS PERMITTED ON OUTGOING TRUNKS
NOANS — 1 = ANSWER SUPERVISION IS NOT EXPECTED ON OUTGOING TRUNKS
SNG_WK
- 0 = NOT A 911 TRUNK - USE INB FOR FLTBLK OF SIGNALING.
- 1 = SINGLE WINK (PRESENTLY USED ONLY BY 911 SERVICE FOR RING BACK)

TOTANIDX — TERMINAL OFFICE TEST ACCESS NUMBER INDEX
- 0 = AUTO PROGRAM TEST NOT AVAILABLE
- 1-63 = TEST ACCESS INDEXES

Fig. 10—Trunk Group Data

containing such information as the type of receiver, the type of line, etc.

(d) Routes manual line and hot line originations to the proper call processing routines.

(e) Selects an appropriate type of receiver.

(f) Obtains a path to the receiver via the path hunting program PATHNT which also returns the TMR address associated with the junctor in the path. The TMR contains the necessary TCR information.

(g) Issues a peripheral action order to set up a network connection from the subscriber line to the idle receiver (including false cross and ground, power cross, and party tests if required).

The peripheral action macro call also results in the initialization of the originating register(s) associated with the receiver scan point(s) for digit receiving and the placing of the dial tone progress mark into the TCR.

3.12 After the peripheral orders to connect an originating customer to a receiver are completed, the dial tone progress mark routine (DIALTON) in the digit interpretation program (DNTRP) receives control. A test is made for stuck cutoff contacts which are reported in the error analysis buffer. Originating translation is redone for tip parties on a 2-party line to obtain correct information. A check is also made for denied originations, which are given permanent signal treatment and the connections and circuits are idled. When the origination is allowed, the TCR is readied for digit receiving. The distribute order is issued for dial tone to be given to the customer by the receiver. A real-time break to wait for reception of the first digit is taken. (Digits are received by the program DIGPRO during 10-ms interrupts.) As digits are received, the program DNTRP at base level interprets the digits until the call can be determined as a terminating (Part 4) or an outgoing call (Part 5). The call is then routed to appropriate call processing routines.

4. TERMINATING FUNCTIONS

TERMINATING TASK DISTRIBUTION

4.01 The program TERM performs call completing functions for all calls terminating to lines in the No. 3 ESS office. This includes both intraoffice and incoming trunk calls. The basic functions performed are:

- Determining the terminal equipment number of the called line
- Determining special treatment, ie, PBX directory number, series completion number, vacant code, intercept number, test line, etc
- Determining if the called number is a free line
- Selecting a talking path
- Selecting a ringing circuit to ring the called line
- Selecting a ringing path from the ringing circuit to the called line
- Making several tests on the calling line such as coin presence tests for coin lines and tip party tests on 2-party lines
- Determining type of ringing to apply to the called line and initiating ringing.

4.02 Upon entry, TERM determines whether a partial dial condition exists, in which case the call is given partial dial treatment by CUSTER. Otherwise, the originating register (if used) is idled; a test is made for valid service conditions; and the appropriate traffic counter is incremented. TERM then calls the translation subroutine 4DIGIT in the program XSL4DG for a 4-digit translation to obtain the terminal equipment number (TEN) for the line being called. There are several possible results of the translation which are indicated to TERM by a return code (Fig. 12) and are discussed next. Letters are used as keys to the flowchart.

4.03 An error return code (A) indicates a software error. The calling line is given error treatment by the announcement routine (ANTON) in CUSTER. When the return code indicates the called number is an ***unassigned number*** (B), the call is routed according to the route index via program DNTRP to a blank number intercept announcement administered by routine ANTON in CUSTER. Similarly, when the called number is ***denied terminating service*** (C), the call is routed to ANTON in CUSTER. TERM prepares

the digit storage area in the TCR for an outgoing call when a ***special routing return code*** (D) is received and the call is given to the program OUTCAL for processing.

4.04 When a ***private branch exchange (PBX)*** or a ***multiline hunt group*** (E)is indicated, the PBX group data (Fig. 13) is obtained for the TCR. Depending on information in the group data, an idle line is hunted (as shown in Fig.14) and the terminal equipment number of the line is place in the TCR for processing the call in the normal manner. When all lines in the group are busy, busy tone is given to the calling party through a tone circuit via routine ANTON in CUSTER.

4.05 When the called number has the ***series completion*** (F) feature (Fig. 12) (that is, when the dialed number is busy, an attempt will be made to complete the call to the next number in the series, etc), 4DIGIT returns the terminal equipment number of the called line and the next directory number in the series. A counter is maintained to permit a maximum of 16 series completion numbers. When a line is busy, the next number in the series is chosen and the next, etc, until an idle line is found. When all lines are busy, the customer is given busy tone. The same software is used to complete the calls as is used for POTS (plain old telephone service) calls.

4.06 When the return code indicates the called line has a ***key scan point*** (G), the scan point is interrogated. When the scan point is set, the calling line is given busy tone; otherwise, the call is processed like a POTS call. When a call has both a key scan point and ***series completion*** (H), the series completion counter is initialized and the scan point is interrogated. When the scan point is set, the dialed line is considered busy and series completion processing is begun.

CALLS TO IDLE LINES

4.07 When the return code indicates the dialed number is an ***assigned number*** (I), the terminal equipment number of the called line is placed in the TCR and processing of the call continues. Custom calling feature tests are made on the calling line, and a busy test is made for the called line. When the line is idle, TERM sets any auxiliary line circuit associated with the BPARTY (ie, noise immunity line, sleeve lead). The BPARTY major class in the TCR is examined for a free line. When the APARTY is a line or trunk not required to charge on calls to free lines, the charge index in the TCR is set to indicate "free." Several tests must be made on the calling line when the called line is not a free line. A coin presence test is performed for a coin line. When no coin is present, a coin announcement is given by the ANTON routine. A tip party test is performed on 2-party lines and compared with the previous result. Errors cause failure of the call.

4.08 When a call is to be traced, control of the call is passed to program CTRACR for tracing functions and then is returned to TERM. A talk path from the calling party to the called party is next reserved for the call via program PATHNT (except for operator rering calls which already have a path). Calls from no test or local test desk trunks are passed to program NTCONN for processing.

4.09 The type of multiparty service available to customers is dependent on the type of ringing equipment installed in the No. 3 ESS. An office may be equipped to handle either ac-dc ringing or superimposed ringing. AC-DC ringing is used to provide 2-party full selective, 4-party semiselective, and 8-party coded service. Superimposed ringing is used to provide 2-party full selective, 4-party full selective, and 8-party semiselective service. Superimposed ringing is an office option; therefore, the office data word indicates its availability. The type of ringer required is determined, a ringing circuit is selected (via GET_CKT in OUTCAL), and a path from the ringing circuit to the called party is reserved (via PATHNT). A failure to obtain a ringing circuit or path results in a second attempt after a one-second delay.

4.10 The peripheral sequence is performed to disconnect the CDPR to APARTY path (if existing), to connect the APARTY to the talk junctor, and to connect the ringing circuit to the BPARTY. In addition, a power cross test on the BPARTY, false cross and ground tests on both parties, and a continuity test on the APARTY are performed. When a continuity or false cross and ground failure occurs, existing paths and equipment for the call are idled, and the APARTY is given reorder (via CUSTER). A power cross failure results in the BPARTY being set to the maintenance busy state and the APARTY being given permanent signal treatment (via CUSTER).

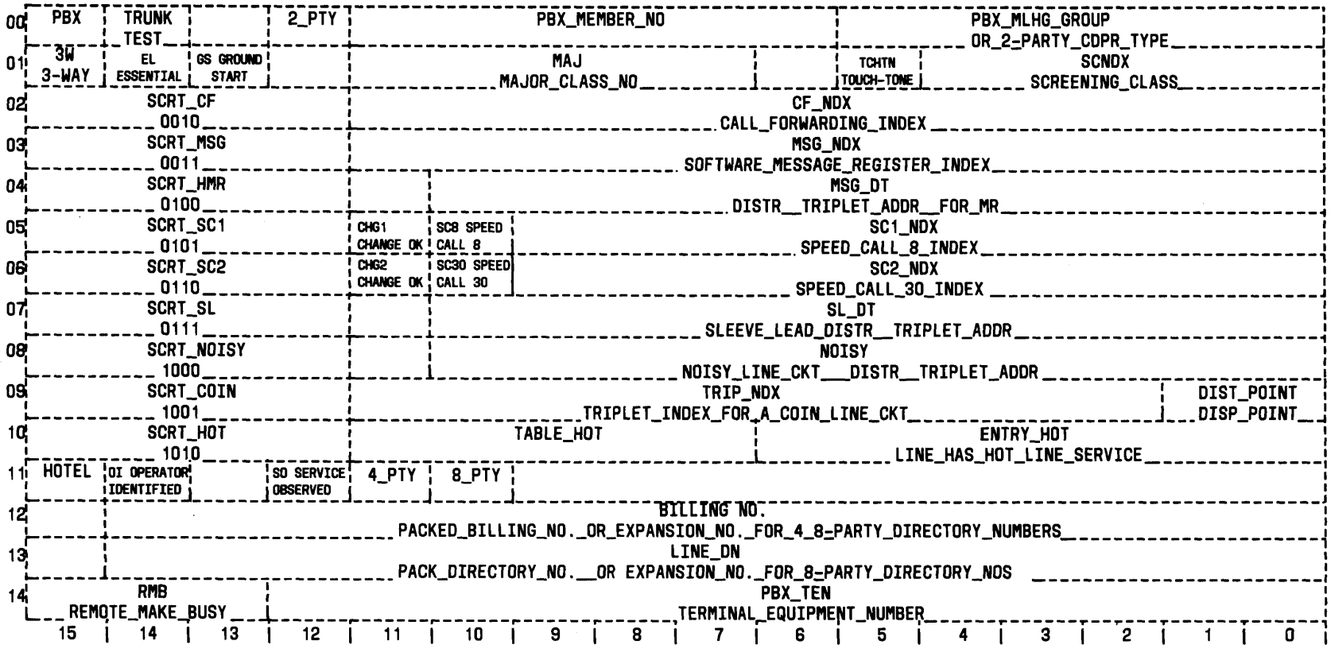


Fig. 11—Line Translation Data

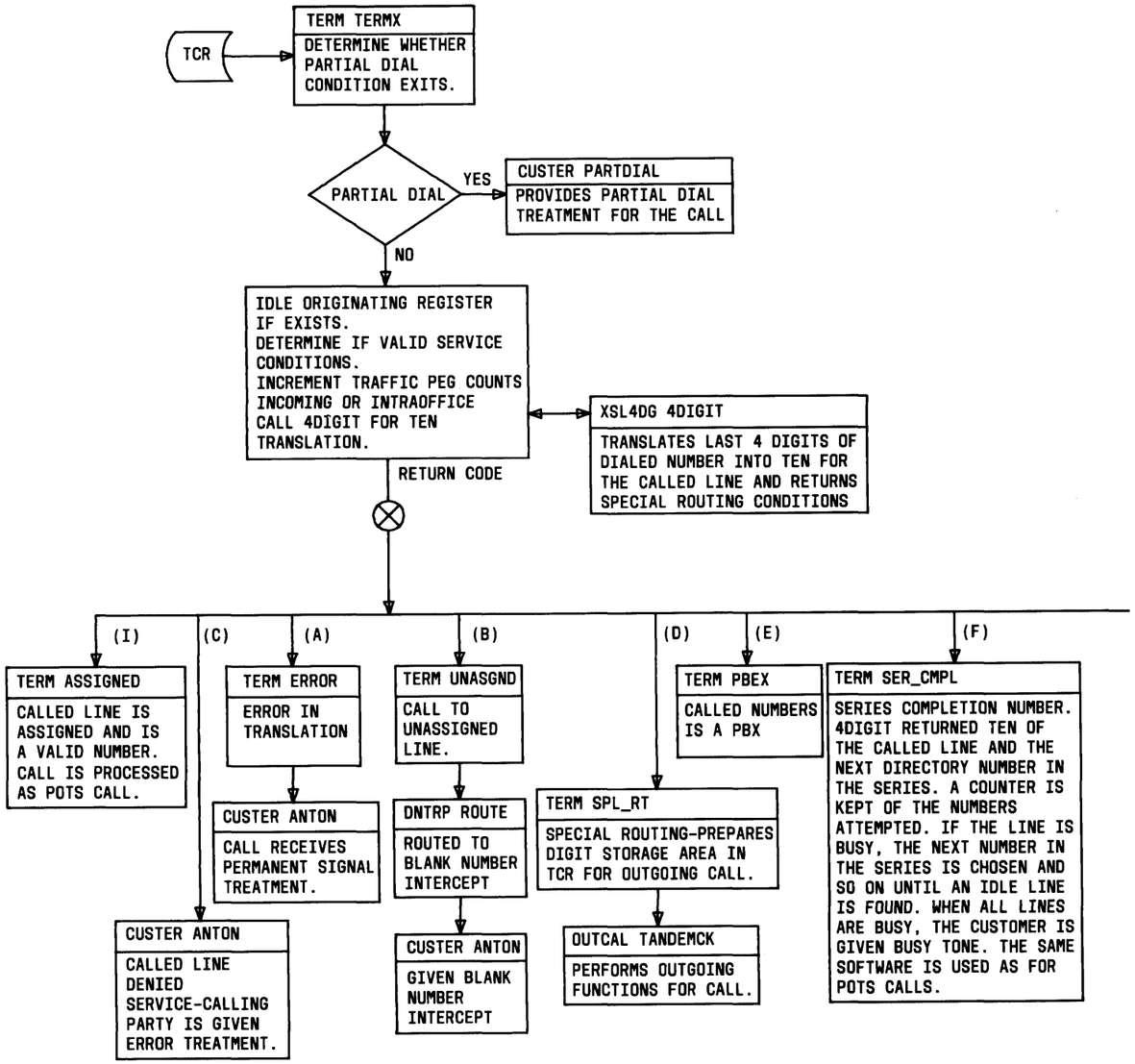


Fig. 12—Termination Processing Based on 40-Digit Translation (Sheet 1 of 2)

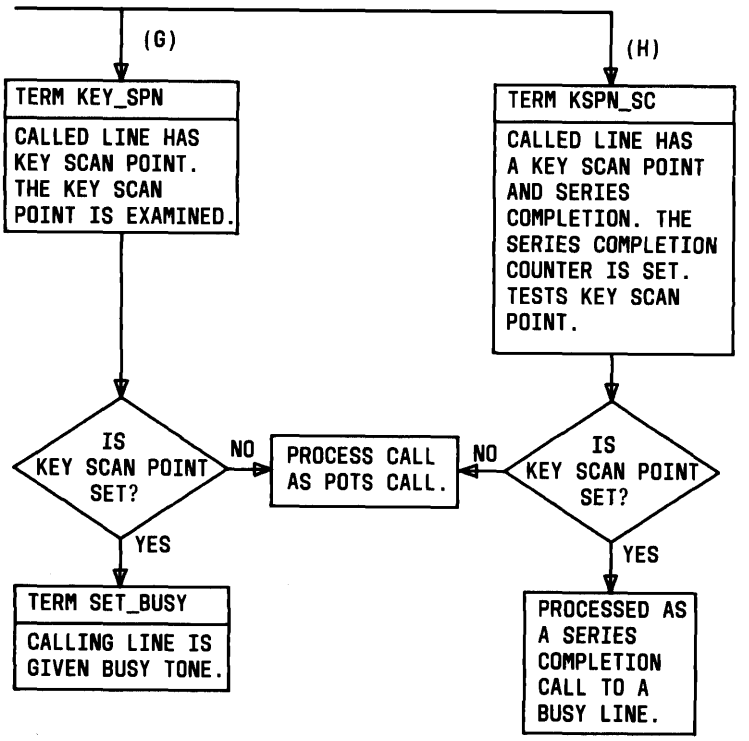


Fig. 12—Termination Processing Based on 40-Digit Translation (Sheet 2 of 2)

4.11 The pretrip test for immediate answer must be performed next. Immediate answer is an off-hook from the BPARTY after the ringer is connected but before ringing voltage is applied to the line. The following actions may be taken.

(a) When the BPARTY is a coin line, the APARTY is given reorder by CUSTER.

(b) When the BPARTY is a PBX line, a new line is selected for completion.

(c) When the BPARTY is neither a coin nor a PBX line, the talk path is set up by program RING as for other calls.

(d) When low leakage exists on a line, the error analysis buffer is loaded and the call is disconnected by routine TRNSDISC in DISCON.

After the pretrip test, the distribute order is sent to activate ringing. A continuity test is performed on the ringing circuit with a second attempt to select a ringing circuit and path being performed when a continuity failure is detected.

4.12 For operator rerings, the last look status bit for the ringing circuit is set to on-hook and the ignore bit is zeroed to enable supervision for answer from the BPARTY; the TCR timer is set for 4 seconds of ringing; and the base level progress mark is set to OPRING. The OPRING routine in program OPER controls ringing for operator rerings, while changes in supervision during ringing are processed by RING. See Section 233-151-115 for more information on operator functions.

4.13 When the APARTY is a line and ringing continuity is achieved, the talk junctor is set to the state to return audible ringing. The appropriate ringing state code is determined by TERM and is placed in the TCR for use by the RRING routine in program RING to control subsequent ringing. For a BPARTY which is multiparty line, the code is determined from the major class translation data for the line. The ringing timer (RTIMER) in the TCR is set to provide 2 minutes of ringing, and the TCR timer (TIMER) is set according to the ringing code to time the first ringing period. Supervision of the BPARTY

at the ringing circuit is enabled by setting the ignore bit for the circuit to zero and setting the last look bit to on-hook. Supervision of a trunk APARTY is enabled via appropriate manipulation of the status bits. The base level progress mark in the TCR is set for control to be given to RRING in program RING which controls ringing and supervision for answer (4.20 through 4.31).

CALLS TO BUSY LINES

4.14 When the called line is busy, several actions may be taken.

(a) When the APARTY is a no-test or local test desk trunk and the BPARTY is in the permanent signal state, the call is completed as if the line is idle.

(b) When the BPARTY is service busy and the APARTY is a no-test or local test desk trunk, the connection is made through a no-test connector by the NTCONN program.

(c) When the BPARTY is maintenance busy and the APARTY is a local test desk trunk, the call is completed via the standard connections as if the line is idle.

(d) Calls to plugged up lines (per BPARTY translation data) are routed to a trouble intercept operator through the routing routine in program DNTRP.

(e) When the BPARTY has call waiting functions (per the BPARTY translation data), control of the call is given to the call waiting custom calling routine in CUSTOM.

(f) When the BPARTY has the series completion feature, TERM obtains the next directory number in the series for completing the call, obtains a 4-digit translation to get the terminal equipment number of the line, and attempts to complete the call to that line in the normal manner. When all lines in the series are busy, the call is processed as described in (g).

(g) When a call to a busy line is nonreverting, the appropriate busy line traffic register is incremented. The calling party is given busy tone by the ANTON routine in program CUSTER.

(h) For reverting calls, see 4.15 through 4.20.

REVERTING CALLS

4.15 The call is a reverting attempt when the calling line is trying to reach another party on the same 2-party or multiparty line. Both customers have the same terminal equipment number which indicates the reverting attempt.

4.16 The reverting call is handled in one of the following ways depending upon the option selected by the telephone company:

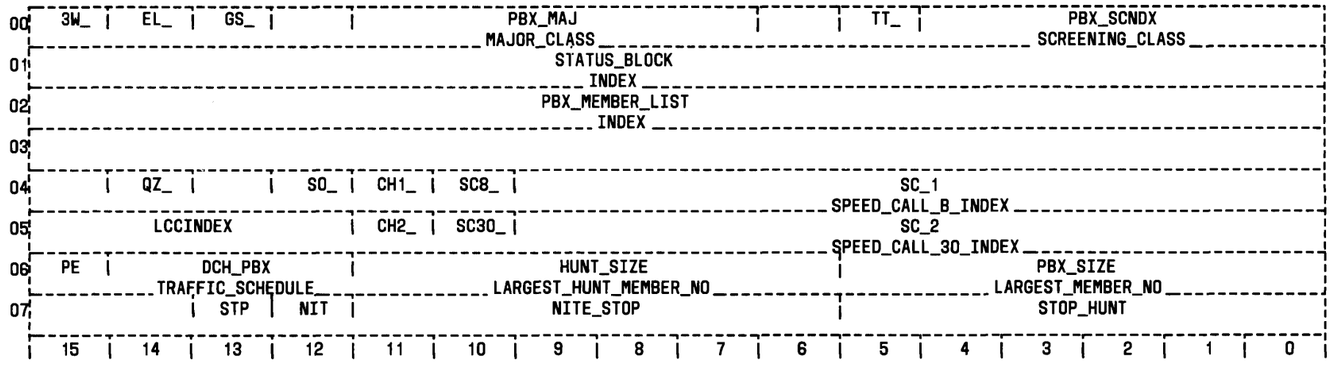
- 4-Party Full Selective and 8-Party Semiselective Ringing
- 2-Party Selective, 4-Party Semiselective, and Divided Code Ringing.

4-Party Full Selective and 8-Party Semiselective Ringing

4.17 When the office has superimposed ringing, (indicated in the office data word), the calling subscriber must dial a single digit (2 through 9) after dialing the called number to identify the calling line for ringing during the revertive ringing procedure. Superimposed ringing implies 4-party full-selective or 8-party semiselective ringing. To alert the calling party when the called party has answered, the calling party must be rung by its own ringing code and superimposed voltage; thus, the identification digit is required. Dial tone is returned to the calling party by the customer dial pulse receiver for the identification digit to be dialed. The signal digit in the TCR is set for one digit to be received, and the digit is received in the normal manner by DIGPRO during interrupt level. When the identification digit is invalid or is not dialed in the allotted time, the call is disconnected. Otherwise, the major class of the APARTY is determined via use of the digit dialed. The caller is given busy tone when the APARTY major class equals the BPARTY major class, indicating the calling party dialed his own number. Processing of calls using superimposed ringing is continued in the same manner as described in the following paragraphs.

2-Party Selective, 4-Party Semiselective, and Divided Code Ringing

4.18 A busy tone circuit and path are selected. The CDPR to APARTY path is disconnected, and the APARTY is connected to the busy tone



PBX_SCNDX	SCREENING CLASS
TT_	TOUCH TONE
PBX_MAJ	MAJOR CLASS
GS_	GROUND START LINE
EL_	ESSENTIAL LINE
3W_	3 WAY SERVICE
STATUS_BLOCK	INDEX
PBX_MEMBER_LIST	INDEX
BILLING_NO.	
SC_1	SPEED CALL 8 INDEX
SC8_	LINE HAS SPEED CALL 8 SERVICE
CH1_	MEMBERS PERMITTED TO CHANGE 8 CODE LIST
SO_	SERVICE OBSERVING
QZ_	QZ BILLING
SC_2_	SPEED CALL 30 INDEX
SC30_	LINE HAS SPEED CALL 30 SERVICE
CH2_	MEMBERS PERMITTED TO CHANGE 30 CODE LIST
LCCINDEX	LINE CLASS CODE INDEX (FOR PBX/MLHG ≡ INDEX < 16)
PBX_SIZE	LARGEST MEMBER NO.
HUNT_SIZE	LARGEST HUNT MEMBER NO.
DCH_PBX	TRAFFIC SCHEDULE
PE	PBX/MHLG EXISTS
STOP_HUNT	LAST MEMBER HUNTED WHEN STOP HUNT FEATURE IN EFFECT
NITE_STOP	LAST MEMBER HUNTED WHEN NIGHT SERVICE IN EFFECT
NIT	PBX/MHLG HAS NIGHT MAKE BUSY FEATURE
STP	PBX/MLHG HAS A STOP HUNT FEATURE

Fig. 13—PBX Group Data

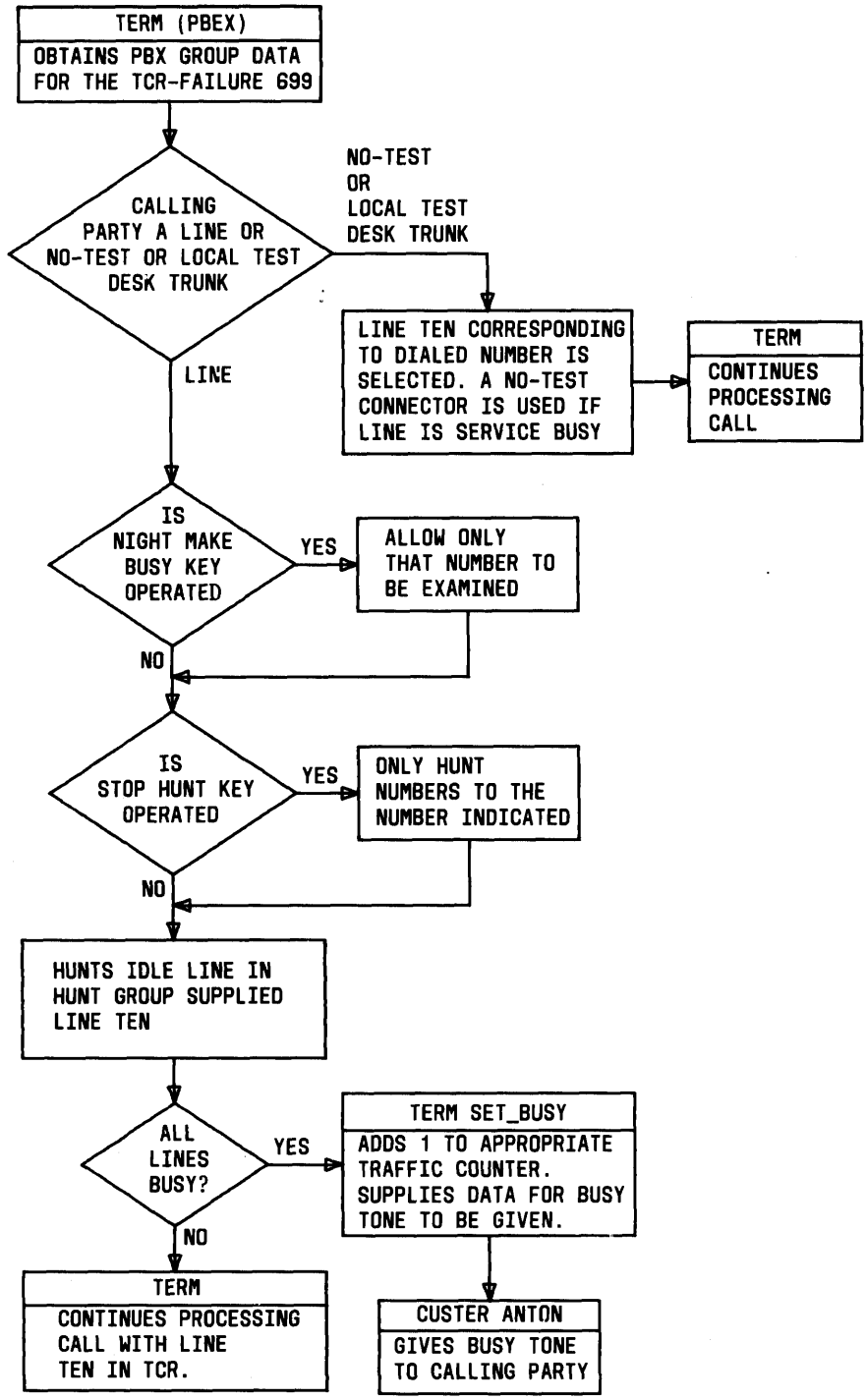


Fig. 14—PBX Call Completion

circuit as a signal for the APARTY to go on-hook for revertive ringing. When the APARTY does not go on-hook within the alotted time, the call is given partial dial treatment by program CUSTER. Busy tone is removed when the APARTY goes on-hook and the appropriate type of ringing circuit and path is obtained. The distribute order is sent to provide appropriate ringing to the APARTY. A continuity check is made on the ringer connection, and failures are reported by incrementing the appropriate traffic counter and are processed by the peripheral error routine in program POPS. Calls with failures are then disconnected by DISCON. Otherwise, the TCR timer (TIMER) is set to time the initial ringing period for reverting ringing of the APARTY. The ringing code of the BPARTY is determined from the BPARTY major class and is placed in the TCR. The ringing timer (RTIMER) in the TCR is set to permit 120 seconds of ringing. The ignore bit of the ringing circuit is cleared and the last look bit is set to indicate on-hook, since supervision of the line (both parties) is performed at the ringing circuit during ringing. (An off-hook from either party stops ringing.) The ringing bit, indicating that ringing is in progress, is set and the ringing base level progress mark (RRING) is placed in the TCR so that control of the call will be passed to program RING for ringing and answer supervision (4.20 through 4.31).

4.19 With 2-party lines, regular ringing is applied for the called customer; special revertive ringing is applied for the calling customer. With 4-party lines, reverting ringing is applied to the calling party and the ringing code of the called party is applied to the other side when the parties are on opposite sides of the line. However, when both customers are on the same side of the line, only the called ringing code is transmitted.

RINGING AND ANSWER SUPERVISION

A. Ringing

4.20 The program RING has control of a call terminating in the No. 3 ESS office from the time ringing is initiated in program TERM unil answer or abandonment of the call occurs. The RRING progress mark is placed in the TCR by TERM and the TCR timer is set to time the initial ringing period. Therefore, the routine RRING in RING is entered whenever the TCR timer times out or when a change in the APARTY or BPARTY status is detected by the input monitor program (INPUT).

4.21 Upon entry to RRING, a determination is made as to whether a ringing function or a supervisory function is needed. A ringing function is needed when the TCR timer times out and, therefore, a new ringing period is needed. For a ***nonreverting call,*** the RINGING bit in the TCR is examined to determine whether the previous period was an on or off ringing period. The distribute order is then sent to either turn ringing on or off depending on the previous period. The RINGING bit in the TCR is also updated to indicate the period to be sent. Then the ringing state code in the TCR is examined to determine the length of the period. The TCR timer is set to time the period accordingly.

4.22 The ringing timer (RTIMER) in the TCR is used to control the amount of time allowed for ringing before disconnecting the call. The program TERM initially set the timer for 120 seconds. The timer is decremented in RING. RING examines the timer to determine whether ringing has been given for 120 seconds. If not, the timer is decremented; the ringing state code is incremented for the next ringing state; the base level progress mark is set to RRING; and control is returned to TCRSCN for the processing of other calls.

4.23 When ringing has been given for 120 seconds (2 minutes), the ringing timer is reset to allow for an additional 3 minutes of ringing (a maximum total of 5 minutes). In addition, a test is made to determine whether all ringers of the type needed are busy. When all ringers are busy or after 5 minutes of ringing have been allowed, control is passed to TRNSDSKA in the program DISCON for disconnect of the call. The APARTY is given reorder. Otherwise, the timer is decremented; the ringing state code is updated; the RRING progress mark is placed in the TCR; and control is returned to TCRSCN for the processing of other calls.

4.24 When the call is a ***reverting call,*** the TCR is examined to determine whether the APARTY or BPARTY is to be rung or whether the period is to be a silent period. In addition, ac/dc or superimposed ringing is identified. The distribute order is set up and issued for the ringer. The ringing state code is used to determine the

appropriate period for the TCR timer and the timer is set accordingly.

4.25 The ringing timer in the TCR is examined and processed as described in 4.22 and 4.23. When more ringing is needed, the ringing state code is updated, the RRING progress mark is placed in the TCR, and control is returned to TCRSCN for the processing of other calls.

B. Answer Supervision

4.26 When entry is made to RING because of a supervisory change detected by the input monitor, control is passed to the supervisory routine SUPERV in RING. During ringing, an APARTY (a line) is supervised at the talk junctor. A trunk APARTY is supervised at the trunk supervisory scan point. The line BPARTY is supervised at the ringing circuit.

4.27 When the supervisory change is from the APARTY, an on-hook is expected. An off-hook is an error causing the call to be failed via the program FALTCR. An on-hook indicates an abandonment of the call by the APARTY. Station ringer test calls are sent to SRTOFHK in the program MCSUB for further processing. Otherwise, the appropriate traffic counter is incremented and the call is sent to the TRNSDISC routine in the program DISCON which turns off ringing, drops all connections, and clears the TMRs and TCR associated with the call. Control is then returned to the input monitor program (INPUT) for more input processing.

4.28 A supervisory report from the BPARTY is expected to be an off-hook or answer condition. An on-hook is an error causing the call to be failed by program FALTCR. Otherwise, a test is made for a reverting call. When reverting, the ringer is disconnected and a revertive talk path is established. Also, the ringing path and circuit are idled. If the call is not reverting, the ringer is disconnected and the talk path is completed to the BPARTY. The talk junctor is changed from the audible state to the talk state. The ringing path and circuit are idled.

4.29 A test is made on the line BPARTY for stuck cutoff contacts. Any errors are reported in the error analysis buffer, if available. The charge index in the TMR for the talk junctor is examined to determined whether the call is free or to be charged. If the call is to be charged, the charge (CHRG) bit in the TCR is set to one.

4.30 Supervision is then turned on for the call in the talk state. Trunks are supervised at the supervisory scan point of the trunk. Also, when a call is to be charged, the incoming trunk is set to the talk charge state. Lines are supervised at the talk junctor.

4.31 After supervision is enabled, the TMR is marked as stable and the TCR is cleared for all free calls, operator rerings, and trunk-to-trunk charged calls. Other charged calls are sent to the DLY_TIME routine in the program LCLCHG for charging. Charging functions are described in Section 233-151-120.

RINGING AND TONE PLANT CONTROL

4.32 The ringing and tone plant provides ringing, reorder tone, busy signal, and audible ringing to the appropriate circuits (ie, audible to the junctor). The fast trunk scan program (FASTTK), during 10-ms interrupts, performs timing functions and operates the interrupter relays for the ringing and tone plant. The tones are as follows:

TONE	IPM	ON PERIOD (MS)	OFF PERIOD (MS)
Audible Ring	10	2000	4000
Busy Signal	60	500	500
Reorder Signal	120	300	200

Three times in memory are used. The primary timer is incremented every two interrupts by 20 ms from 0 to 100 ms. When the timer reaches 100 ms, a check is made to determine whether the state of a relay should be changed. The intermediate timer with 100 ms units from 0 to 1000 ms is used to determine relay states for reorder tones and busy signals. The minor timer with units of 1000 ms from 0 to 5000 ms is used to determine the relay states for the audible ring signal.

4.33 FASTTK processes the timers, determines which ringing and tone plant is active, and sends the distribute orders to set the relay states as required. Every change in the interrupter relays requires a distribute order to initiate the change; therefore, timing is aligned in a way which minimizes the number of distribute orders necessary (Fig. 15). In addition, interrupter relays are tested frequently for proper operation. A scan point is provided for each set of interrupter relays and the scan point is saturated when all three relays are operated. Therefore, the scan point is interrogated when all three relays should be operated to test whether all three relays can operate. The scan point is examined when one relay of the set should be released to find stuck relays. Figure 15 also illustrates the timing of these tests. Relay failures are reported to the peripheral unit recovery program (PURC).

5. OUTGOING FUNCTIONS

5.01 All outgoing calls that require outpulsing (dial pulse or multifrequency) are processed by the progress mark routines and subroutines of the outgoing call program, OUTCAL. A call may enter OUTCAL in one of five ways.

(1) All digits have been dialed by the line. The digit interpretation program (DNTRP) has used the 3-digit translation routine to determine the call is outgoing and control is passed to the OGTST progress mark routine in OUTCAL via the TCR.

(2) Control is passed to the OGTOV progress mark routine in OUTCAL after only three digits have been received from a line, and OUTCAL provides outpulsing that overlaps the receiving of the remaining digits.

(3) An incoming trunk has pulsed all digits, and the trunk origination program (TKORIG) has determined that the call is a tandem call. Control is given to the OGTST progress mark routine in OUTCAL via the TCR.

(4) When a line dialed zero and the call is to be routed to a TSP(s) office, the operator trunk program (OPER) uses OUTCAL to provide Automatic Number Identification (ANI) outpulsing. Control is given to the TSPS_OP entry point after trunk selection in the operator program.

(5) TANDEMCK is the other entry point for 0+ and 1+ calls.

5.02 Partial dial conditions (a time-out of the timer in the TCR when digits are not received in the allotted time) detected while processing an outgoing call are passed to the partial dial routine in the customer error program (CUSTER) for termination. Abandonment of a call by the calling party is detected by the input monitor (INPUT), and control is passed to the progress mark routine indicated in the TCR. While outgoing functions are being performed and entry is made to OUTCAL, the appropriate traffic register is incremented to show the abandonment, and control of the call is given to the transient disconnect routine (TRNSDISC) in the disconnect program (DISCON).

5.03 The first function performed by the OGTST progress mark routine (entry for nonoverlap outpulsing calls) is to determine the type of entry in order to detect abandonments or partial dial conditions. The originating register used for receiving digits is idled if all digits have been received. Control of calls from coin lines is given to the coin program (COIN) for coin work and then returned to OUTCAL. A tip-ring reversal is made for toll diversions.

5.04 Overlap outpulsing calls enter OUTCAL at OGTOV and all other calls fall through to the OGTOV routine. Calls from coin lines and toll diversion calls are given a real-time break of a maximum of 20 seconds to receive any remaining digits since overlap outpulsing is not allowed for those calls.

5.05 From route index expansion information, charging treatment is determined for a call, and the proper charge index is stored in the TCR. An outgoing trunk is next selected via the GET_CKT subroutine in OUTCAL which, in turn, uses the trunk selection subroutine (TRKSEL) in the program EQPSEL to provide the address of the trunk group data block (Fig. 10) for the trunk selected. When all circuits in the group are out of service or there are no working members in the group, a TTY message is printed and the call is failed. When all trunks in a group are busy, the route index expansion information is examined for the possibility of alternate routing. When alternate routing is possible, another route index expansion is performed by a subroutine in the translation program XSL3DG using the alternate route index, and another attempt

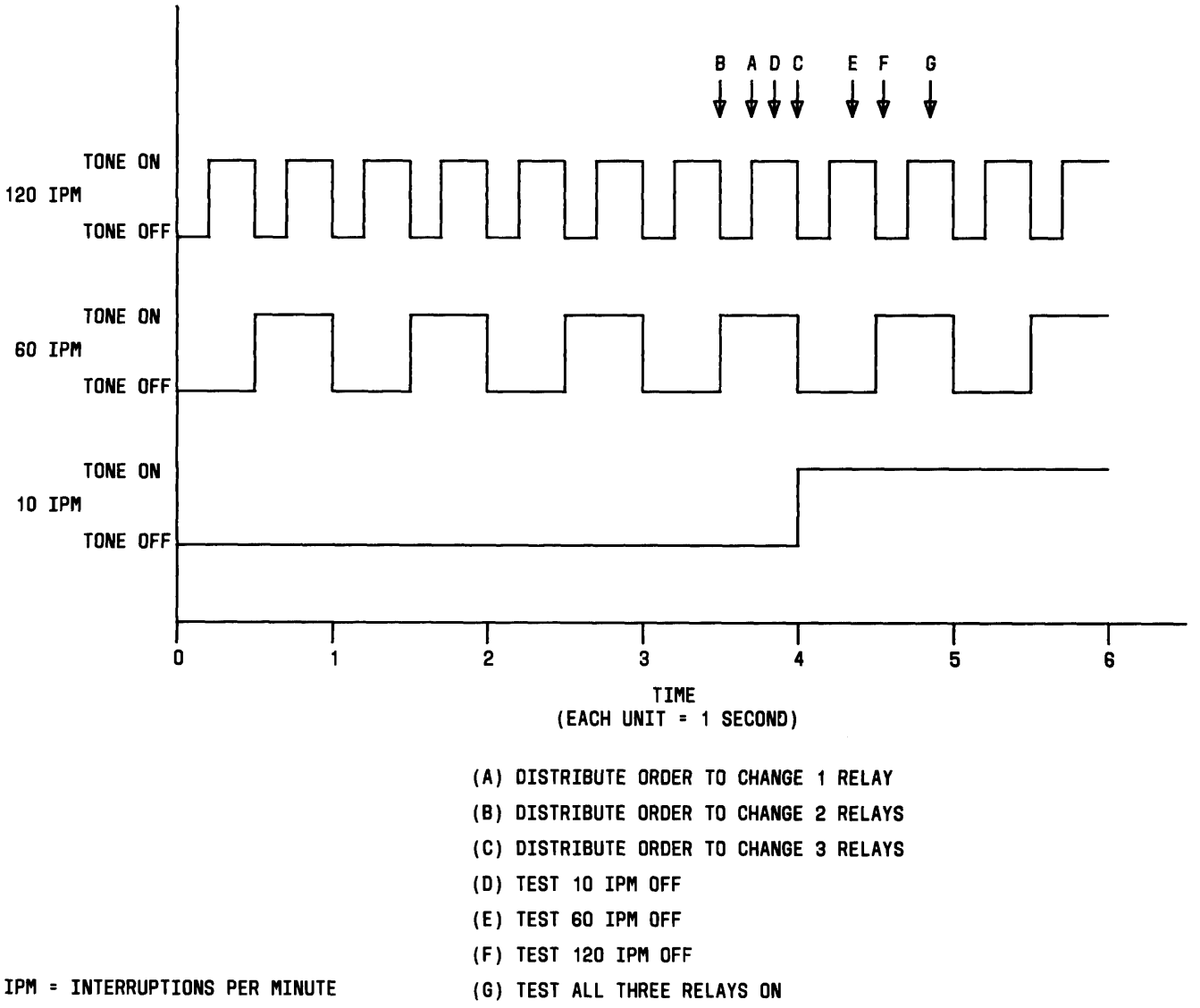


Fig. 15—Ringing and Tone Plant Timing

is made by OUTCAL to select a trunk and to complete the call. When alternate routing is impossible and the call is a nonoverlap call, the proper traffic counter is incremented and the call is disconnected via TRNSDISC in program DISCON with the calling party receiving reorder treatment. Calls using overlap outpulsing take real-time breaks to wait for digit reception, and then a second try is made to select a trunk and complete the call.

5.06 After a trunk is successfully selected, the trunk group data is accessed. All operator calls to a TSPS office requiring ANI outpulsing enter OUTCAL at this point. Calls to 911 emergency service trunks are passed to the program EMERG for processing. For all other calls, an attempt is made to reserve a talking path from the calling party to the trunk via the PATHNT program. A second attempt to complete the call by selecting another trunk and path is made if no path is available before disconnecting the call and giving the calling party reorder.

5.07 The appropriate type of transmitter (dial pulse or MF) is next selected for outpulsing by the GET_CKT subroutine in OUTCAL. (An exception is the E&M trunk which requires no transmitter for dial pulsing.) The PATHNT program

is again used to reserve a path from the trunk (called party) to the transmitter. When selection of a transmitter or transmitter path is not possible, a second attempt is made to select another trunk and complete the call after selected equipment and paths are idled.

5.08 Prefixing of up to three digits or deletion of up to seven digits or all digits in the digit storage area of the TCR may be needed before outpulsing begins. The route index expansion words are examined for prefixing and deletion information, and the digit storage area of the TCR is changed accordingly. In addition, leading 0 or 1 digits for 0+ or 1+ calls may be deleted. The outgoing digit counter (OUTDIGCT) in the TCR is set to point to the first digit to be outpulsed. At this point, the routine OCT in the resident call trace program (CTRACR) is accessed for tracing the outgoing call when required.

5.09 The appropriate start code is generated and stored in the last digit position in the digit storage area of the TCR for MF outpulsing calls. The start signal is transmitted to indicate to the other office when all digits have been outpulsed. Trunk group data is used in setting trunk type flags (ie, E&M, long loop, 2-way, etc) in the TCR. A party test (also used as a coin test for coin lines) is made for all calls originating from a 2-party line and for all nonfree coin calls. Calls using overlap outpulsing, however, wait until after digit reception before invoking the party test. The party test is made by placing the CDPR into the party test state and then scanning the CDPR.

5.10 An office (except step-by-step immediate start trunks) may require some amount of time (a few hundred milliseconds to several seconds depending on traffic load) to prepare for the reception of dialing signals on incoming trunks. Therefore, a start dial signal is sent from the called office when ready to accept signals, and digit sending can begin. There are two types of start dial signals — delay dial and wink. A delay dial signal is defined as an initial off-hook signal changing to an on-hook signal when pulsing receiving equipment is ready for digit reception. A wink signal is defined as a momentary on-hook/off-hook/on-hook signal (the off-hook being of a defined length). Detection of start dial signals is performed during timed interrupts by the program FASTTK. OUTCAL makes an entry in the interrupt hopper giving the scan point number of the trunk. FASTTK, during certain interrupt periods, performs a directed scan of the trunk scan point. When a start dial signal is detected, the appropriate bit is set in the interrupt hopper as an indication to OUTCAL that the signal has been received.

5.11 After the transmitter is physically idled, OUTCAL sends an order to connect the trunk to the transmitter. For nonoverlap outpulsed calls, the receiver and receiver path are idled and the calling party is connected to the talk junctor for supervision. For overlap outpulsing, the calling party remains connected to the receiver and supervision is done at the receiver. A continuity check is made on the trunk to transmitter path connection. An error results in the error being reported in the error analysis buffer, the idling of existing paths and selected equipment, and the selection of another trunk for a second attempt at completing the call.

5.12 The transmitter is set to the state for outpulsing. MF transmitters are tested for proper operation. A glare check is made on 2-way immediate-start trunks. Glare is the blocking of a call by seizure of a 2-way trunk from both ends simultaneously. To prevent glare conditions, a real-time break of 300 ms is taken after seizure is sent before continuing to process the call. When an origination is received during that time, a glare condition exists; therefore, another attempt to complete the call is made from the point of selecting another trunk after all selected paths and equipment are idled.

5.13 Verification of reception of a start signal is performed for all trunks except immediate-start trunks. The interrupt hopper entry for the trunk is examined for the start signal bit. Various timing tasks for real-time breaks are performed to await the signal when it has not yet been received. When a start signal is not received during the allotted time or all transmitters are busy, the call is disconnected and the calling party is given reorder. However, if glare is detected on a 2-way trunk during that period, a second attempt will be made to complete the call with another trunk.

5.14 When the start signal has been received (if expected), the interrupt hopper entry is cleared by OUTCAL and processing of the call continues. TSPS operator calls receive special processing from the ANI outpulsing routine because no called number outpulsing is required. The

routine retrieves the billing number for the calling party from translations and places it in the digit storage area of the TCR. A scan is made for the ANI start-pulsing signal (continuous off-hook). When the start signal is received, the information digit (used for billing) to be outpulsed before the billing number is determined and stored in the digit storage area of the TCR for outpulsing. The codes are:

0 = Automatically identified with service nonobserved

1 = Operator identification necessary with service nonobserved

2 = Identification failure with service nonobserved

3 = Automatically identified with service observed

4 = Operator identification necessary with service observed

5 = Identification failure with service observed

6 = Hotel/motel

The MF start code is stored after the last digit to be outpulsed and the signal digit is set to the appropriate value to indicate the position of the last digit (including start code) to be outpulsed. The TCR timer is set for outpulsing; the base level progress mark is supplied for return to OUTCAL after outpulsing is complete; and the MF keypulse sending function progress mark is supplied for interrupt use in sending. DIGPRO does all outpulsing functions during the timed interrupt. (See Section 233-151-145 for digit sending functions.)

5.15 For all other calls not requiring ANI outpulsing, a check is made to determine whether the first digit to be sent has been received yet and, if not, a real-time break is taken to wait for its reception. The appropriate sending function progress mark (DPSEND or MFKPSET) is supplied in the peripheral progress mark area of the TCR; the TCR timer is set according to the type of sending; and the base level progress mark is supplied so that control is returned to OUTCAL when outpulsing is complete. Control of sending functions, as already stated, resides in the program DIGPRO at interrupt level.

5.16 When sending is complete, OUTCAL regains control of the call and examines the group data to determine whether audible ringing must be returned to the calling party, and the TCR is set up accordingly. For overlap outpulsing calls, the 2-party or coin presence test must be performed at this time since it was skipped prior to outpulsing. The peripheral order is sent to disconnect the calling party-to-receiver path (if one exists), to disconnect the called party-to-transmitter path, and to complete the talk path connection. When audible is to be given by this office, the talk junctor is set to give audible to the calling party, and the talk path is not cut through from the trunk to the talk junctor at this time.

5.17 To complete the peripheral sequence, a check is made for peripheral errors (continuity); the transmitter is hardware idled, the transmitter and transmitter path are software idled; and the receiver and receiver path are software idled (if used). Supervision of a line is performed by the talk junctor while supervision of a trunk is done at the trunk ferrod (scan point).

5.18 When audible is being given by this office, a directed scan of the trunk is performed by OUTCAL each base level loop to detect answer. In addition, answer may be detected by the input monitor (INPUT) during the regular base level scan of trunks, in which case control is returned to OUTCAL. (If the calling party abandons the call, the call is disconnected.) The TCR timer is set for 90 seconds so that, while waiting for answer, OUTCAL performs a test every 90 seconds to determine whether all trunks in that group are busy. If all trunks are busy, the call is disconnected by TRNSDISC in DISCON and the calling party is given permanent signal treatment. Otherwise, OUTCAL continues to wait for answer. When the called party answers, the talk path is completed, and control of the call is passed to CHRG_TST in the program RING. The CHRG_TST routine determines charging treatment for the call. It also sets the junctors and trunks involved to the appropriate states for supervision of the call. The TMR is marked stable and the TCR is cleared.

5.19 When audible is not being provided by this office and the charge index is free or the trunk cannot return answer, the call is given to CHRG_TST in the program RING without waiting for answer. When audible is not being given by this office and a call does not have a free charge index, the TMR is made stable and trunk supervision is activated so that answer will be detected and

the TCR is cleared. When answer is detected by the input processing software, control is returned to OUTCAL at OGT ANSWER which selects and initializes a new TCR. The call is then passed to CHRG_TST in the program RING.

6. DISCONNECT FUNCTIONS

GENERAL

6.01 Disconnect functions are performed by the program DISCON at base level. Disconnect functions include the examination of supervisory reports to determine disconnect treatment, disconnect timing, and the idling of equipment and paths used for the call. DISCON may receive control because of a supervisory report detected by INPUT, via another call processing routine because of an abandoned call, or from TCRSCN when a TCR that is doing disconnect timing times out. The TMR address for stable calls is passed to DISCON (ie, a call that is in the talking state). DISCON selects and initializes a TCR for the call and changes the TMR to the transient state. For transient calls, the TRM address and TCR address are passed to DISCON.

TYPES

6.02 Early supervisory screening is performed for the call to determine the call type:

(1) Line to line

(a) Intraoffice

(b) Revertive

(2) Line to circuit

(a) Outgoing

(b) APARTY line to service hold trunk

(c) Joint hold

(d) Customer hold

(e) Line to service circuit

(3) Circuit to line

(a) Incoming

(b) BPARTY line to service hold trunk

(4) Circuit to circuit

(a) Tandem

(b) Trunk to service circuit

Supervision received by DISCON is classified as either primary or secondary. Primary supervision is the first supervision reported to DISCON. Secondary supervision is supervision received during disconnect timing.

A. Line to Line

6.03 Most calls involving a line require custom calling screening. A translation is performed on the party making the supervisory report to determine whether the customer has 3-way calling. When the line has the feature and is on-hook, a real-time break is taken to perform flash timing. A flash is an on-hook transition of more than 150 ms and less than 1.2 seconds followed by an off-hook to invoke the feature. When a flash has been received, DISCON sends the call to the program TREWAY for custom calling processing.

6.04 Otherwise, when custom calling is not invoked and primary supervision is from the BPARTY line, disconnect timing is begun and a 10-second real-time break is taken to wait for secondary supervision (an on-hook from the APARTY). If the BPARTY goes back off-hook before the end of 10 seconds, the call is returned to stable, the TMR is marked stable, and the TCR is cleared.

6.05 However, when a time-out in disconnect timing occurs or the APARTY goes on-hook, the call is terminated immediately. Reverting calls are always disconnected upon a primary supervision report. A call is terminated by idling the path and terminal hardware and restore verifying the line (done by the subroutine DISC in the program POPS). The call is passed to the coin cleanup progress mark in the program COIN for any necessary coin cleanup and software idling of the lines. Software idling refers to the updating of the status bits in temporary store to show an idle status as follows.

- For paths, the bits are in the network map.
- For lines, in the line status table.

- For trunks and circuits, in the circuit status table.

B. Outgoing Call

6.06 A primary supervision report from the BPARTY (or trunk) causes disconnect timing to be invoked in an outgoing call. However, an on-hook from the APARTY (line) causes the call to be terminated. (Flash timing is performed on the on-hook for a line with call waiting or three-way custom calling features.) An outgoing call is terminated by hardware idling the outgoing trunk. The outgoing trunk is given 750 ms of delay idle timing before the trunk is software idled. (To guard against glare conditions, special care is exercised in software idling bylink trunks.) The path is disconnected and idled. The APARTY line is idled by the coin cleanup routine in COIN.

C. Tandem Call (Trunk to Trunk)

6.07 A tandem call is from an incoming trunk to an outgoing trunk. There is no custom calling screening. Disconnect supervision on tandem calls is performd the same as that for ougoing calls.

D. Incoming Call (Trunk to Line)

6.08 A primary supervision report causes the BPARTY custom calling screening to be invoked. When primary supervision is an on-hook from the line BPARTY, the incoming trunk is placed in the talk free state to signal the distant office to begin disconnect timing. During disconnect timing, an off-hook from the BPARTY results in the call being returned to stable. (The TCR is cleared and the TMR is set to stable.) When the TCR times out or the incoming trunk goes on-hook at any time, the call is terminated immediately.

E. Customer Hold

6.09 A customer hold call is a call from a line to a service trunk, usually an Automatic Intercept Circuit (AIC) trunk. The call is not terminated until the customer line is on-hook regardless of trunk status (thus, customer hold). All primary supervision from the trunk is ignored. When the line goes on-hook, the call is terminated and idled as described in paragraph 6.06.

F. BPARTY Line and Service Hold Trunk

6.10 A call from a service hold trunk to a line (usually a toll switch or no-test trunk) receives service hold trunk disconnect timing, ie, the call is not terminated until the trunk is on-hook regardless of line status. A primary supervision report causes BPARTY custom call screening. When the primary report is a flash from the trunk, the trunk is considered on-hook and the last look bit in the circuit status table is set to on-hook, thus generating an off-hook to the input monitor. Trunk winks are passed to the operator program, OPER.

6.11 When the line flashes, the call is returned to stable. (When the line flashes and has the three-way calling feature, control is given to entry point ADDONJOB in program TREWAY for processing.) When the line goes on-hook, the call is given disconnect timing until the trunk goes on-hook. The call is terminated only when the trunk goes on-hook.

G. Joint Hold Call

6.12 A joint hold call is a call from a line to a recording completing trunk and is not terminated until both the line and trunk are on-hook. APARTY custom calling screening is done upon a primary supervision report. When primary supervision is a flash from the trunk, the call is returned to stable. Trunk winks are sent to OPER. When the trunk is on-hook, the call is given disconnect timing until the line goes on hook and vice versa. The call is then terminated when the other party goes on-hook.

H. APARTY Line and Service Hold Trunk

6.13 A call from a line to a service hold trunk [usually a TSP(s) trunk] is given service hold trunk disconnect timing as described in paragraphs 6.10 and 6.11. The calling and called parties in the TMR and TCR are reversed so that the calls can be treated the same.

I. Line to Service Circuit

6.14 A line to service circuit connection is usually from a line to a CDPR, TOUCH-TONE® receiver, or a ringing circuit. The call is in a transient state with a TCR. Only primary on-hook supervision is expected from the line indicating call abandonment which terminates the call (6.05).

There is no custom calling screening, no disconnect timing, and no circuit delay idle timing necessary.

J. Trunk to Service Circuit

6.15 A trunk to service circuit connection is usually to an MF receiver. There is no disconnect timing and no circuit delay idle timing required. The call is already transient and has a TCR. An on-hook from the trunk indicates call abandonment and terminates the call (paragraph 6.05).

K. Transient Call Disconnect Entries

6.16 The entry points IMTRDISC, TRNSDISC, and TRNSDSKA in DISCON are used to disconnect paths associated with transient calls. Transfer is made from the call processing routine directly to the proper entry. Calls with special audit codes in the TCR are handled by the FAILSUB subroutine in FALTCR program (7.01 through 7.02). Otherwise, the active paths are idled. The APARTY is scanned for off-hook. The call is sent to the coin cleanup routine in COIN if the APARTY is on-hook to perform coin cleanup functions (if needed) and software idling of the APARTY. When the APARTY is off-hook, the BPARTY is idled and the APARTY is given reorder treatment.

7. ERROR CHECKING, RECOVERY, AND TREATMENT FAILURE OF TCRs

7.01 Error checking in call processing routines is abundant. The fail transient call records program (FALTCR) is invoked to disconnect calls and to dispose of transient call records when errors are detected. A fail macro package is used for obtaining access to FALTCR. A fail data word is passed to FALTCR to provide information for the reason of failure and treatment the call is to receive.

7.02 FALTCR takes action to fail the call according to information stored in the data word. Only a TTY message (Fig. 16) indicating the reason for failure is printed, or a TTY message is given and failure information is stored in the TCR for further failure processing. In some situations, the calling program may have already printed a TTY message; therefore, FALTCR disposes of the TCR without printing a message. When further processing is required by FALTCR, the FAILURE base level progress mark is placed in the TCR. The appropriate traffic peg counter is incremented. If peripheral work was being performed when the failure occurred, the network queue and timing hopper entries are cleared. Active paths, as determined by the audit code in the TCR and service circuits, are hardware and software idled. Status bits for lines and trunks are set to the status indicated. Calls with special audit codes in the TCR are given the appropriate disconnect treatment as determined by the audit code. Figure 16 not only depicts the TTY error messages but also indicates the error conditions and programs which detect the errors.

RETRY PHILOSOPHY

7.03 Failures to obtain circuits and paths in many cases result in additional attempts to complete the call. Treatment varies depending on the type of call and failure and is described in the following paragraphs.

A. Terminating Calls

7.04 A terminating call is defined as a call to a line in the office. It may be either an intraoffice or an incoming trunk origination and, after translation of a sufficient number of digits, is directed to a line in the office. The system attempts to select a talking path, a ringing circuit, and a ringing path, in that order. Failure to obtain any facility results in the release of all previously selected facilities. One retry is attempted after a 1-second delay following the same order of selection as on the first trial. A second trial failure will result in the calling party being set to reorder tone.

B. Incoming Trunk Originations

7.05 Incoming trunk originations come from dial pulse trunks and MF trunks. Dial pulse trunks do not require a receiver for incoming dial pulses; therefore, no problem exists for dial pulse trunks. MF trunks require an MF receiver for incoming digits. If all receivers or all paths are busy, the request is left in the trunk/junctor/service circuit input hopper until such time as both a receiver and path are selected. Depending on the amount of traffic in the office, retries could be made as often as once every 100 milliseconds.

C. Recording Completing Trunk Calls

7.06 Failure to find an idle recording completing trunk results in returning reorder to the

1. OUTPUT MESSAGE FORMAT

tt RECOVRY PROG TBL DDD

TCR0 TCR1 TCR2 TCR3 TCR4 TCR5 TCR6 TCR7
TCR8 TCR9 TCRa TCRb TCRc TCRd TCRe TCRf

2. EXPLANATION OF VARIABLE FIELD

TCR0 = Contents of word 0 of the transient call record
TCR1 = Contents of word 1 of the transient call record
TCR2 = Contents of word 2 of the transient call record
TCR3 = Contents of word 3 of the transient call record
TCR4 = Contents of word 4 of the transient call record
TCR5 = Contents of word 5 of the transient call record
TCR6 = Contents of word 6 of the transient call record
TCR7 = Contents of word 7 of the transient call record
TCR8 = Contents of word 8 of the transient call record
TCR9 = Contents of word 9 of the transient call record
TCRa = Contents of word 10 of the transient call record
TCRb = Contents of word 11 of the transient call record
TCRc = Contents of word 12 of the transient call record
TCRd = Contents of word 13 of the transient call record
TCRe = Contents of word 14 of the transient call record
TCRf = Contents of word 15 of the transient call record
DDDD = One of the following decimal error codes

20 Cannot perform coin release function — invalid TEN or DTA

21 Bad terminal equipment number or line data translation

22 Bad information on coin control circuit or path selection error

60 Translation error

100 An attempt to use call forwarding or three-way calling deactivation routines

101 Attempt by subroutine CR_EXP to get address of call forwarding entry failed

102 Blank digits in active call forwarding entry

145 DISCON received bad supervision or call type

146 Call involving a special audit code was given to the transient disconnect routine

147 Trunk TEN bad — could not get supervisory scan point number

148 Supervisory report inconsistent

149 Invalid TMR address

150 Invalid TEN or SPN

185 Tip party originating translation resulted in error

186 3-DIGIT translation returned an error

187 Destination code from route index expansion exceeded the maximum possible

226 Could not software idle the talk path after a peripheral error when disconnecting a lowtone to 911 bureau path

227 Supervision reported to EMERG by the input monitor is not valid, either on-hook from a party that was on-hook or off-hook from a party that was already off-hook

Fig. 16—Error Message Information (Sheet 1 of 4)

228 Error in attempted high tone circuit selection to return high tone to 911 trunk

229 Could not get group and member number translation for 911 trunk SPN

265 A bylink trunk originated; however, it already had a trunk dial pulse receiver entry indicating that digit collection is in progress

266 An operator trunk winked; however, it already had a trunk dial pulse receiver entry indicating that wink collection is in progress

315 Unable to set talk junctor into a required state

316 The coin function area of the TCR indicates no function was set

317 Could not decode charge index, possible bad charge index or TMR address

318 The charge index expansion subroutine could not translate the charge index

395 Could not get trunk supervisory scan point number from the TEN via the subroutine GET_SSPN

396 TMR address is not valid — called line busy, no-test call

397 Could not get trunk TEN from SPN retrieved from the TMR

398 Could not close test vertical on no-test connection

415 Fatal error, bogus audit code, disallowed tandem, or translation failure

416 Winking operator trunk is untranslatable

445 One of the subroutines (GARI or RI_EXP) discovered an error. The most probable cause is an incorrect route index in 8 (TCR) bits 7-0

446 The RI_EXP subroutine was called for what was thought to be an outgoing route, and it was found to be intraoffice

447 A translation routine encountered an invalid scan point

448 Interrupt hopper was erroneously zeroed, or TCR was mutilated destroying the SPN, or the STSVR_ progress mark was not given control for an abnormally long period of time (4 seconds)

449 An all-busy check of the transmitter group failed

450 A progress mask was invoked by the input monitor when such an occurrence was considered impossible. Could be due to a bad ignore bit or an incorrect TMR to TCR link

451 A translation routine encountered an invalid scan point

452 The TRKSEL subroutine was given a bad group number

453 An unexpected time-out invoked a progress mark

485 An error was detected in the catalog data

486 TCR timed out while performing peripheral action

487 An error was detected in the TCR data

488 TCR caught performing more than one peripheral action

491 Network queue or timing hopper overflow

525 COINOPR subroutine could not translate a TEN

526 COINRLS subroutine could not translate a TEN

Fig. 16—Error Message Information (Sheet 2 of 4)

527 COINOPR subroutine failed distribute order

528 COINRLS subroutine failed distribute order

530 Coin line circuit failed

605 Ringing state code multilated

606 Supervisory report inconsistent

645 A distribute order to the station ringer test circuit failed

655 Base level progress mark = 0 or exceeds the current maximum

656 Input monitor report during a PACT

695 Distribute order failure

696 Could not get translation, possible bad B-party SPN for subroutine LNDATA

697 Tip party test failure

698 Could not get translation for trunk SPN from its TEN

699 PBX information bad, cannot get group data

700 Group data address or group data bad — could not get status block address

701 Error in 4DIGIT translation

735 The incoming digit translation code was either 0, 6, or 7

736 The 1DIGIT translation failed

737 The MF receiver ASVC (TCR) could not be idled by IDLESVC, probably due to a bad SPN

738 A party went off-hook on a stable call

739 Either a bad SPN was given to a translation routine, or 1 DIGIT failed

740 A service circuit (probably a ringer) originated

1000 Attempt to fail a TCR with an invalid TCR address in registers 12 and 13. The contents of the hold get area dumped instead of the TCR

3. PROGRAM REFERENCES

FIRST ERROR CODE	LAST ERROR CODE	PROGRAM
0	9	ALIT
10	19	AUDB
20	59	COIN
60	99	CUSTER
100	139	CUSTOM
140	144	CUT
145	184	DISCON
185	224	DNTRP
225	264	EMERG
265	304	FASTTK
305	314	INITA
315	354	LCLCHG
355	394	MCSUB
395	404	NTCONN

Fig. 16—Error Message Information (Sheet 3 of 4)

405	414	OFFTL
415	434	OPER
435	444	OTOTST
445	484	OUTCAL
485	524	POINT
525	564	POPS
565	604	PSUBS
605	644	RING
645	654	SRTH
655	694	TCRSCN
695	734	TERM
735	774	TKORIG
775	784	TSVSUB
1000	1023	FALTCR

Fig. 16—Error Message Information (Sheet 4 of 4)

calling customer. Having selected a trunk, an attempt is then made to select a talking path, a class-of-service tone circuit, and a path for class-of-service tone. Failure to find all of these results in idling any that had been selected. One retry is attempted after a 1-second delay beginning with trunk selection. Failure on the second trial to select a trunk or talking path results in returning reorder tone to the calling customer. Second trial failure to select a class-of-service tone circuit or path results in completing the call without the tone identifier. The operator then determines through conversation whether the calling line is coin or noncoin.

D. Tone and Announcement Circuit Connections

7.07 Failure to select both a tone or announcement circuit and a path results in idling a circuit which may have been selected and making a retry after a 1-second delay. Second trial failures result in returning reorder tone to the calling customer.

E. Coin Control Circuit Connections

7.08 A second trial is made for calls requiring coin control circuits if both a coin control circuit and associated path cannot be selected on the first trial. Because of the small number of coin control circuits, a delay of 2 seconds is employed before attempting a second trial. If there is a second trial failure, the call is allowed to continue to the next logical point as if the coin function had been successful.

F. Outgoing Trunk Calls

7.09 Outpulsing may be overlapped with the receiving of digits from the customer or it may be nonoverlapped for outgoing trunk calls. For the nonoverlapped case, failure to find an idle trunk after all routes are searched results in returning reorder tone to the calling customer. Failure to find any other circuit or path results in all associated circuits and paths being idled and one retry being attempted 1 second later from the beginning of trunk selection.

7.10 For overlap outpulsed calls, any selection failure results in idling all reserved circuits and paths, waiting for the end of digit reception, and attempting a second trial on a nonoverlap basis (unless an alternate route requiring nonoverlap outpulsing was encountered, in which case the subsequent nonoverlap attempt is considered to be a first attempt).

G. Dial Tone Starts

7.11 Dial tone requests require a customer dial pulse receiver and a connecting path. The request is left in the line origination hopper until the CDPR has been obtained. No count is made of the number of retries. If no path is available, then a new CDPR is selected (if one exists) and a new path is selected. If a path still does not exist, the line entry is removed from the line origination hopper for 3 seconds. After that time, another entry is made in the hopper and the procedure is repeated until dial tone is connected to the customer or an on-hook is detected.

CUSTOMER ERROR TREATMENT

7.12 The customer error program (CUSTER) contains several routines which process calls in special situations. Access to the routines is made from other call processing programs or via a destination code received from a route index expansion. CUSTER has routines to give announcement and special tones, to give reorder, to transfer calls, and to administer permanent signal and partial dial treatment.

A. Permanent Signal and Partial Dial Treatment

7.13 Permanent signal and partial dial treatment is used when the customer does not respond as expected when originating calls. Permanent signal treatment is given to a line or a trunk which fails to disconnect after the called or calling party has disconnected or, if originating a new call, fails to start transmitting digits within the allotted interval after receiving dial tone. Partial dial treatment is given when at least one digit has been received but the accepted number of digits is not then received in the allotted time. When a condition is detected requiring permanent signal or partial dial treatment, the software detecting the condition causes control of the call to be passed to the permanent signal/partial dial routine in the program CUSTER for processing.

7.14 Upon first entry to the permanent signal routine, a routine in the program DIGPRO is called to stop the digit reception function. In addition, any paths active for the call are idled and the status bits for the trunk or line are set

to indicate a busy condition (to prevent the call from receiving dial tone again). When the custom calling add-on feature or call forwarding feature is being used in a call, control of the call is given to the program TREWAY which may complete processing of the call or return to CUSTER.

7.15 A sequence of actions may then occur which, if the line or trunk does not go on-hook, concludes with the line or trunk being set to the high and wet state (monitored for an on-hook only). When the line or trunk goes on-hook (as detected by the input monitor) during any step of permanent signal/partial dial treatment, treatment is terminated and the call is disconnected by the program DISCON. When the line or trunk is already high and wet and an on-hook is detected, it is placed in the normal idle state by the input monitor.

7.16 The treatment given depends on the type of line or trunk involved. In addition, the operating company may determine the steps of treatment to be given via routing information in the translation data. The permanent signal routine in CUSTER directs the steps of treatment to be given via use of a special progress mark (MYPM) in the TCR to indicate the next step. The routine also supplies the appropriate route index for the treatment and routes the call by transferring control to ROUTE in the program DNTRP which then initiates a route index expansion and routes the call accordingly. For instance, when an announcement is to be given, control of the call is passed back to the program CUSTER at the ANTON entry point for announcement treatment. After the announcement times out, control is passed back to the permanent signal routine for scheduling of the next step.

7.17 As already stated, the permanent signal treatment steps are given according to party type. An incoming trunk from a step-by-step office (immediate-start trunk) receives 30 seconds of reorder tone (120 ipm). The trunk is then placed high and wet if reorder fails to get an on-hook signal. All other types of trunks receive no special treatment but are immediately set high and wet. A trunk is set to the high and wet state by the subroutine TRK_HAW in TSVSUB which prints a TTY message, increments the maintenance busy counter, and appropriately sets the selection and status bits. The TCR is then cleared.

7.18 When the party is a line (not a PBX or coin line), it can be given up to three steps of permanent signal treatment. The following sequence is provided:

(1) A permanent signal announcement (optional)

(2) One second of open interval

(3) Thirty seconds of receiver off-hook tone (optional)

(4) An operator (optional)

(5) Set high and wet and clear TCR.

Reorder may be substituted for (1), (3), or (4).

7.19 A PBX line can receive only one step of treatment. An announcement is suggested. One second of open interval is then given. When the line is still off-hook after the open interval, it is set high and wet and the TCR is cleared.

7.20 A coin line can receive only one step of treatment (an announcement is suggested). When the treatment fails or no treatment is given, the coin is returned (by the CLNUP routine in DISCON) before the line is set high and wet and the TCR is cleared.

7.21 The routine LINEPS in XSLSUB is used to set line status bits to the high and wet state. In the high and wet state, current is flowing in the loop and the lines are scanned for an on-hook every 100 ms. This can cause overheating of the line ferrods when there are several high and wet lines in the same switch pack. Therefore, when a line is made high and wet, it is placed on a 10-entry high and wet list for scanning every 100 ms for on-hook. However, every 10 minutes, the last entry on the list (if occupied) is removed from the list and the line is put into the high and dry state. (The ferrod is cut off by the next high and dry scan and does not have electrical or logical supervision.) Every 2 minutes, all ferrods of lines in the high and dry state are restored and scanned.

7.22 Partial dial treatment for a trunk is the same as permanent signal treatment. For a line, the first step may be a special partial dial announcement, but the remaining steps are the same as permanent signal treatment specified by the operating company.

B. Vacant Circuit Group Destination Code

7.23 In the following paragraphs, special destination code routines in CUSTER are described. A call is routed to the vacant circuit group destination code routine (NONE_) when the appropriate treatment for a situation has not been implemented in the office. In addition, the routine also receives control of some calls receiving announcement or tone treatment when a circuit or a path is not available. When the call is undergoing permanent signal treatment, control of the call is returned to the permanent signal routine. Otherwise, all paths are disconnected by program DISCON, and, if the party remains off-hook, the call is routed to the reorder routine.

C. Reorder

7.24 Reorder (120 ipm) is given to the calling party as a step in permanent signal treatment, as a substitute for a type of treatment which has not been implemented in a particular office, or as treatment for an error condition or network blockage which prevents a call from being completed. A junctor provides reorder; therefore, a half path from the party to a junctor must be obtained and the order to send reorder for 30 seconds is given. When a path cannot be found after two attempts or when reorder times out, the party is placed in the high and wet state unless the call is undergoing permanent signal treatment in which case the call is routed back to the permanent signal routine.

D. Call Transfer

7.25 The destination code routine CONVERT_ in CUSTER is used for the transfer of calls temporarily or permanently to another number other than the number dialed by the customer. A route index expansion is requested to obtain a pointer to a block of digits, and the digits in the TCR are replaced by the digits in the block.

E. Announcements and Tones

7.26 The ANTON destination code routine in CUSTER is used to give announcements and tones including normal busy tone (except reorder, dial tone, coin tones, and tones given by an operator). An announcement or a tone is given to inform a customer that the call cannot be completed or possibly as a part of permanent signal treatment. A proper announcement or tone circuit is selected and a talk path to the circuit is hunted. All tones are barge-in (that is, do not have to be at the beginning of the recording) and the path connection is made; therefore, the calling party hears the tone immediately.

7.27 Announcements are not barge-in; therefore, the calling party receives audible ringing from the talk junctor and the path to the circuit is not completed until the announcement is positioned at the beginning of the announcement. An off-hook from the scan point of an announcement circuit indicates the announcement is idle (at the beginning). Therefore, the TCR is set up for scanning the announcement circuit for an off-hook each base level loop for approximately one minute. The directed scan is performed by CUSTER. When an off-hook is not detected in the allotted time, the announcement is probably not operational so a trouble message is printed on the TTY and the call is sent to the program DISCON. DISCON disconnects the call and schedules reorder for the calling party if the party remains off-hook. When the calling party goes on-hook before the announcement is connected, disconnect timing is performed to eliminate hits, dial pulses, and flashes. Valid disconnects are sent to DISCON for processing. Otherwise, when an off-hook is detected from the announcement circuit (idle), the path to the circuit is completed and the customer begins to hear the announcement.

7.28 Both tones and announcements must be timed. At this point, local test desk calls are sent to the program MCLTD for processing, and calls with the add-on or call forwarding features are sent to the program TREWAY which determines the subsequent treatment of the call. Autoconnect calls are monitored separately in CUSTER.

7.29 The TCR timer is set to allow 30 seconds for some tones and 5 minutes for other tones. Announcements are given for 90 seconds. When the party does not go on-hook within the allotted time, control of the call is passed to the permanent signal routine to begin or continue permanent signal treatment. When an on-hook report from the party is detected by the input monitor, disconnect timing is performed by CUSTER to eliminate hits and flashes and all valid disconnects are passed to the program DISCON for processing.

7.30 When an announcement or tone is part of permanent signal treatment, the call is routed

back to the permanent signal routine when any of the following situations occur.

(a) An announcement or tone circuit cannot be selected.

(b) A path cannot be obtained to the circuit.

(c) An announcement is not operating correctly.

(d) An announcement or tone times out.

When the announcement or tone is given for any other reason, calls in situations (a), (b), or (c) are disconnected and routed to reorder. For situation (d), the call is routed to the permanent signal routine.

8. GLOSSARY

8.01 Terms, abbreviations, and definitions used frequently in this document follow.

APARTY—The calling party

BACTION Bit—Bit in TCR which is set to indicate base level action is needed

Base Level—Major software loop including all functions not done during interrupt level

Bit—The binary unit of information which is represented by one of two possible conditions, such as the digits 0 and 1, high potential or low potential, on or off

BPARTY—The called party

CDPR—Customer dial pulse receiver

Clear—To restore a storage device to the "Zero" state

Glare—Incoming call on a 2-way trunk already seized for an outgoing call

High and Wet—State in which the trunk or line is monitored for an on-hook only

High and Dry—State in which the trunk or line does not have electrical or logical supervision except every 2 minutes

Hoppers—Dedicated areas of writable memory into which entries with a fixed format are made

Hot Line—A line with direct access to a party for which no dialing must be done

Immediate Start Trunk—A trunk which does not wait for a signal before beginning to send dial pulses (usually from a step-by-step office)

Interoffice Call—A call switched between different central offices

Intraoffice Call—A call from one subscriber assigned to a central office to another subscriber within the same office

10-ms Interrupt—A hardware-initiated interrupt which interrupts the base level loop every 10 ms for a period of time necessary to perform frequently required functions

Junctor—A circuit associated with the switching network which provides a path for a call through the network

Line—Anything that connects to a network terminal that is not classified as a trunk or service circuit. Usually a pair of wires that serves to connect a customer telephone to a terminal on the network.

Macro—A sequence of operations called by an abbreviated notation

MF—Multifrequency

Nonoverlap Outpulsing—The outpulsing of digits after all digits have been received

Operator Trunk—One of five types of trunks (TSP, TSPS, toll switching, recording completing, operator office trunk)

Outpulsing—Generation of pulses to match the stored digit information and of the proper type to be used by the distant switching office

Overlap Outpulsing—The outpulsing of digits as received instead of waiting until all digits have been received before beginning to outpulse

POTS Call—Plain old telephone service

Plugged-up Line—A line which is busied for maintenance purposes

Program—A set of instructions assembled as one unit under a program name

Progress Marks—Areas in TCR which indicate next software routines to be executed for the call

Reverting Call—A call between two parties on the same line

Scan Point—Ferrod sensor used in scanners for supervisory purposes

Signal Digit—Area in the TCR to indicate the location of the digit to be received before base level is alerted for more base level action

Series Completion—Allows calls to be routed to any designated directory number within the same office code if the original number is busy

Set—To make a storage device equal to the "one" state

SPN—Scan point number

Stable Call—A call that is in the the talking state

Subroutine—A sequence of instructions which performs a well-defined function and is called by another section of instructions

Tandem—Trunk-to-trunk call

TCR—Transient call record (see 2.02)

TEN—Terminal equipment number

TMR—Terminal memory record

TT—TOUCH-TONE

TSPS—Traffic service position system

Word—A set of characters which occupies one location in storage and is treated by the system as a unit