

FEATURE DOCUMENT
AUTOMATIC MESSAGE ACCOUNTING RECORDING SYSTEM (AMARS)
FEATURE
NO. 3 ELECTRONIC SWITCHING SYSTEM

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INTRODUCTION

1. GENERAL INFORMATION

1.01 This section provides a description of the Automatic Message Accounting Recording System (AMARS) feature for the No. 3 Electronic Switching System (ESS). It also describes the operations performed by the No. 3 ESS in order to transmit all billing data to a remote Automatic Message Accounting Recording Center (AMARC) where it is assembled and recorded.

1.02 When this section is reissued, the reasons for reissue will be contained in this paragraph.

1.03 The AMARS feature is available with Issue 4 of the SO-2 generic program. The data interface circuit (SD-3H914), which provides the necessary data sets and connections between the No. 3 ESS and the 4-wire data link, is also available with this issue of the generic program.

2. DEFINITION

2.01 The Automatic Message Accounting Recording System (AMARS) feature is provided at a local central office and is used to generate and compile certain telephone call information associated with calls being originated through that office. The data is then temporarily stored for subsequent transmission to the Automatic Message Accounting Recording Center (AMARC) where all data for each telephone call is assembled into a data block and stored on magnetic tape for subsequent processing by the accounting center. The AMARS feature performs the same functions as the Local Automatic Message Accounting (LAMA) feature, used in many central offices, except that the data is recorded at the remote AMARC instead of by a local Automatic Message Accounting (AMA) tape recording machine.

2.02 Billing information for calls originating through the No. 3 ESS is compiled by the No. 3 ESS and stored in an Automatic Message Accounting (AMA) buffer to await transmission to the AMARC. When the AMARC is ready to receive data from this particular No. 3 ESS office, it polls the No. 3 ESS via a 4-wire data link. The No. 3 ESS then responds by retrieving a block of billing information from the AMA buffer and transmitting it to the AMARC via the same data link. The AMARC receives the billing information, assembles it into self-contained records, and stores it on

9-track magnetic tape at 1600 bits per inch (BPI). The process is repeated continually in order to prevent an AMA-buffer overflow.

2.03 Included in the types of billable calls which may be recorded by the AMARS feature are:

- OUTWATS—full business day and measured-rate
- Local measured-rate (bulk or detail billed), including calls made using Threeway Calling, call forwarding, and a combination of the two features
- Station paid (toll) including calls made using Threeway Calling feature
- Calls requiring complaint observing or service observing
- Directory assistance.

The AMARS feature is also capable of recording charges for all local calls in cases where Measured Service (MS) is in effect. This includes charges for calls made using the custom calling features such as Threeway Calling, call waiting, and call forwarding.

2.04 Call information for nonbillable calls may also be recorded. Call types in this category include:

- Coin station-prepay and dial-tone-first (DTF), including forwarded calls
- INWATS calls originating from within the No. 3 ESS service area; including originating INWATS calls made via Threeway Calling feature, calls forwarded to INWATS numbers, and a combination of the two situations
- Call forwarding activations and deactivations
- Calls made using call forwarding, call waiting, and Threeway Calling but charged on a flat rate basis
- Calls from lines involved in traffic sampling studies.

Provisions are also available to allow recording of call information for all locally originated calls for

purposes of studies such as Subscriber Line Usage (SLU), conference circuit usage, and other traffic studies. (SLU should not be confused with the Trunk and Line Usage (TLU) measurement available through TTY printouts. Refer to Section 233-020-020 for details concerning the TLU measurement.)

DESCRIPTION

3. USER OPERATION

3.01 Automatic message accounting is a means of recording accounting data on calls originating through the local class 5 office. The AMARS feature automatically identifies each individual and 2-party customer whenever a call to be recorded is placed. The calling directory number or billing number is recorded together with the called number and the answer and disconnect times. This recording process is performed remotely by the AMARC facility.

3.02 When AMARS is implemented into a No. 3 ESS office, single and 2-party customers can directly dial toll calls and measured-rate calls without an operator identification. In addition, the AMARS feature may be used for complaint observing on calls made from measured-rate lines, for billing verification of AMA calls made from service observed lines, for gathering data for subscriber line usage (SLU) studies, and it may be used to detail bill all measured-rate calls.

4. SYSTEM OPERATION

4.01 When used in conjunction with the AMARC, the AMA equipment in the No. 3 ESS central office provides an automatic recording service for toll, coin, and measured-rate calls.

4.02 During the normal progression of calls, the call processing programs determine which calls require AMA recording. The AMA program assembles the data to be recorded for these AMA related calls and prepares it for storage in the AMA buffer which resides in temporary storage. The AMA Buffer Management (ABM) program is responsible for controlling the flow of data into and out of the buffer. It also provides a timing check which insures that any data retrieved from the buffer for transmission to AMARC is valid and up-to-date. The Data Administration (DATADM) program controls the flow of data to and from the AMARC via the data link. A simplified block diagram of the AMARS feature is shown in Figure 1.

4.03 A triple-entry format is used in the No. 3 ESS to store AMA information in the AMA buffer. These entries consist of *initial*, *answer*, and *disconnect* entries which are made at appropriate stages in the progress of a call. Various other entries may be made from time to time as described in the following paragraphs.

4.04 During the processing of calls, AMA information is stored in a 2800-word (minimum) buffer in temporary storage. The data is placed in the AMA buffer by the base level program as it becomes available. When the DATADM program recognizes that a polling command has been received from AMARC, it causes the AMA data to be transferred out of the AMA buffer (also during base level) and initiates the transmission sequence. The DATADM interrupt level program then causes the AMA data to be transmitted to the AMARC. The AMARC assembles the triple entries into a single AMA magnetic tape entry. This entry conforms to the standards for AMA 9-track magnetic tape recording for single entry systems.

4.05 The primary data link, used for transmission of data to and from the AMARC, consists of a 202T data set at the AMARC, a 202T data set at the No. 3 ESS, and a dedicated 4-wire private line used to connect the two data sets. A TTY controller is used to provide an interface between the data set and the No. 3 ESS.

4.06 A backup data link is provided which assures AMA transmission if the primary link should fail. The backup data link consists of a 202T data set and a dedicated 4-wire private line which is identical to the primary data link.

4.07 The data sets are mounted in the miscellaneous frame (J3H001E-1) and interface with the No. 3 ESS through TTY controllers No. 2 and 3 located in the maintenance frame (J1C060A-1).

AMA ENTRY FORMATS

4.08 There are three basic AMA buffer entry formats used to record information for AMA related calls. They are the *initial*, *answer*, and *disconnect* entry formats. Other miscellaneous and statistical entries are also made which, along with the initial, answer, and disconnect entries, provide all the information required to perform AMA billing and to complete the necessary traffic studies.

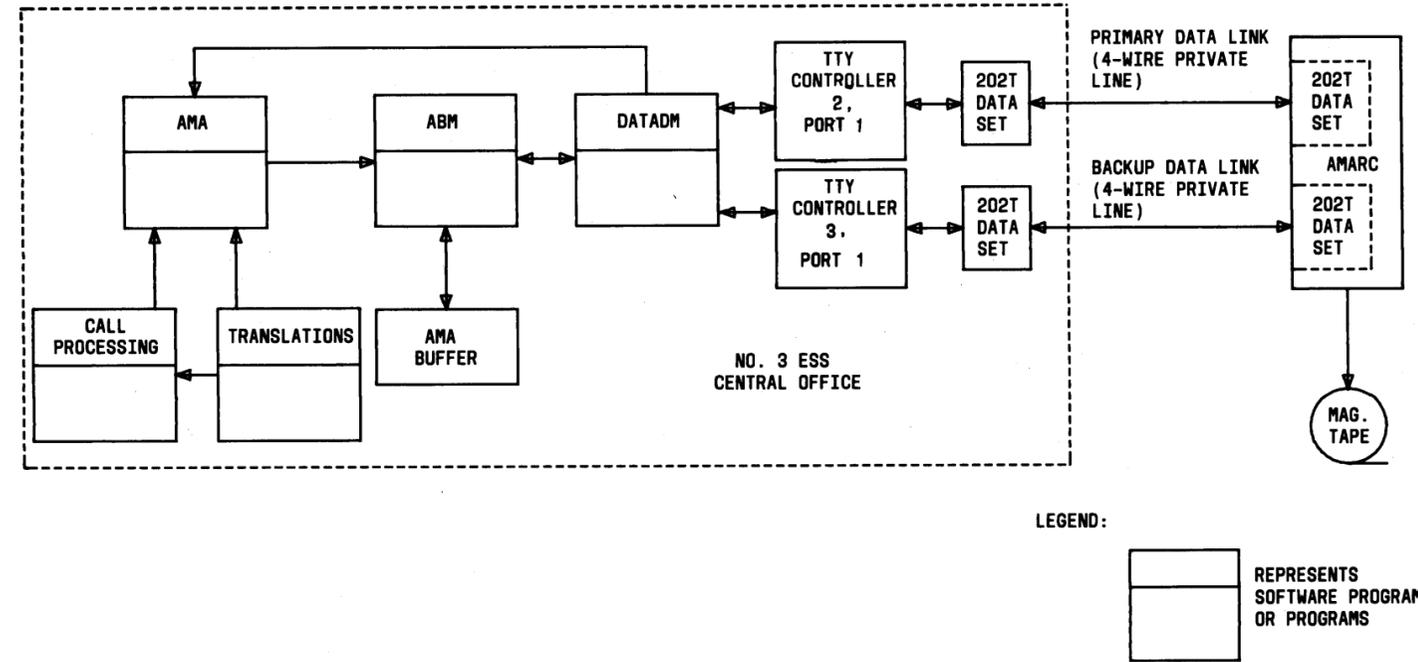


Fig. 1—Simplified Block Diagram of AMARS Feature

Initial Entry

4.09 When a customer originates a call attempt, the usual call processing is begun. A transient call record (TCR) is selected to monitor the progress of the call, and the customer's scan point number (SPN) is translated in order to identify the calling line. Dial tone is then returned to the customer and a customer dial pulse receiver (CDPR) is connected to the customer's line. When the first three dialed digits have been collected in the TCR, the 3-digit translation program examines them and furnishes a code index which, after further translation, leads to a charge index. This charge index, which indicates the need for AMA recording and identifies the type of call requiring AMA recording, is stored in the terminal memory record (TMR) for future use. The available charge indexes and their descriptions are shown in Table A.

4.10 When the called number has been completely dialed, the usual call processing is performed in order to locate the called party terminal and to hunt for a talk path. If the call requires AMA recording, the initial entry is made at this time.

4.11 The AMA program compiles information received from the call processing programs and from translations to assemble the initial entry. The information necessary for the initial entry consists of the AMA call type (see Table B), routing information, calling and called party telephone numbers, charging information, and record time stamp. Figure 2 shows the data layout required for the initial entry. The calling party Numbering Plan Area (NPA) codes are assigned abbreviated codes for AMA recording. The lowest valued NPA code which may originate through the particular No. 3 ESS office is assigned an abbreviated code value of 0, and the highest valued NPA code is assigned an abbreviated code value of 1. For domestic calls the called NPA must appear and the 11th and 12th digits are filled with noncheck dummy characters (NCDs). (The NCD character is represented by a binary 1011.)

4.12 The AMARS feature provides for recording a called party telephone number of up to 12 digits. The called party telephone number may be recorded in one of several ways depending on the type of call and the number of digits dialed. As shown in Figure 2, each digit of the called number [3 digits representing the NPA code, 3 digits representing the office code (NXX), and 4 digits

representing the thousands, hundreds, tens, and units digits] has an associated record-area within the initial entry. However, the digits recorded in the designated areas do not always represent the digits indicated. The NPA code may or may not be recorded, and in some cases it is recorded even though it was not dialed. In cases where the NPA code is not recorded, the associated record areas are filled with NCDs. Figure 3 shows the various ways used to record the called telephone number.

Answer Entry

4.13 When the called party answers, the No. 3 ESS maintains off-hook timing, and the AMA program causes the **answer** entry to be written into the AMA buffer. The data layout for the answer entry is shown in Figure 2.

Disconnect Entries

4.14 When the customer goes on-hook, the No. 3 ESS begins the normal disconnect process. At this time, the AMA program causes the **disconnect** entry to be loaded into the AMA buffer. Figure 2 shows the data format for the disconnect entries. If the customer goes on-hook before the called party answers, the abandon/attempt disconnect entry is made. If the called party goes on-hook and the calling party does **not** go on-hook within 10 seconds, the disconnect process will be performed. In this case, the timed release disconnect (TRD) entry is made. If the calling party goes on-hook within two seconds of answer recognition, the No. 3 ESS call processing programs begin the disconnect procedures. The AMA program causes the disconnect entry to be marked as a call of Minimum Recordable Duration (MRD) which is screened at the regional accounting office (RAO). If the called party goes on-hook within 2 seconds of answer recognition, a disconnect record marked as MRD is generated and the call processing programs wait 10 seconds to see if the called party goes off-hook again. If off-hook occurs, subsequent answer and disconnect entries are issued. If not, the connection is torn down when the calling party goes on-hook. An abandon/attempt disconnect entry is then made.

Miscellaneous and Statistical Entries

4.15 Several types of entries are grouped in this category which are used to control AMA

TABLE A
CHARGE INDEX DESCRIPTIONS

CHARGE INDEX	BINARY EQUIVALENT	DESCRIPTION
0	00000	Illegal
1	00001	Free
2	00010	WATS Band 0
3	00011	WATS Band 1
4	00100	WATS Band 2
5	00101	WATS Band 3
6	00110	WATS Band 4
7	00111	WATS Band 5
8	01000	WATS Band 6
9	01001	WATS Band 7
10	01010	WATS Band 8
11	01011	WATS Band 9
12	01100	Measured Service (MS)
13	01101	Internal Use
14	01110	Internal Use
15	01111	Station Paid (Toll)
16-31	1XXXX	Coin or Measured Rate (Assignable)— The low four bits (represented by XXXX) will appear in the initial entry as the Message Billing Index (MBI)

billing during trouble conditions and to provide statistics for traffic studies. These entries are as follows.

4.16 Call Forwarding Activations and Deactivations—This entry is made whenever a customer activates or deactivates the call forwarding feature. This entry includes a call forwarding indicator (indicating an activation or deactivation), calling and forward-to telephone numbers, IDDD, FM, SLU, service features indicators, and information bits A and B as shown in the initial entry. The calling number is recorded with an abbreviated NPA code as shown in the initial entry. The forward-to number is recorded as shown in Figure 4.

4.17 Stable Clear—No. 3 ESS may experience a stable clear condition in which the memory records for all stable calls (TMRs) are lost. If this condition should occur, all stable calls are terminated, the AMA buffer is cleared, and the single byte stable clear entry is written into the AMA buffer. Upon reception of this message, the AMARC cancels the billing records for all of the affected calls.

4.18 Nonstable Clear (NSC)—No. 3 ESS may experience a nonstable clear condition in which the memory records for all transient calls (TCRs) are lost. If this occurs, the billing records for all calls which have not reached the answer

TABLE B

AMA CALL TYPE DESCRIPTIONS

OCTAL CHARACTER	DESCRIPTION
105	Station Paid (Toll)
106	Local (Measured-Rate)
107	OUTWATS
113	Directory Assistance
127	Three-Way Call 2nd Link (Local)
130	Call Forwarded (Local)
131	Three-Way Call 2nd Link (Station Paid)
132	Call Forwarded (Station Paid)

state are terminated, the AMA buffer is cleared, and the single byte NSC entry is written into the AMA buffer. When AMARC receives this message, it terminates records for all calls which have only initial entries created, then marks all other calls in progress with an indication that an NSC has occurred. On subsequent entries from the No. 3 ESS, if a call which was in progress at the time of the NSC completes normally, it is billed normally. However, if the sequence of a call in progress (at the time of the NSC) is destroyed, the call is billed for the minimum charge.

4.19 Cancel—There may be situations where call records must be discarded because of inadequate AMA buffer space in which to store an entire record. Normally, this condition exists only in situations when both data links are not operable. There may also be situations when abnormal processing delays cause AMA records to be held in the AMA buffer too long (more than 9 minutes) thereby invalidating the data. In either of these cases, a single byte cancel message is written into the AMA buffer. Upon reception of the cancel message, the AMARC terminates (cancels) the billing records for all calls in progress. This procedure is designed to recover as much revenue as possible without overbilling any customers.

4.20 Junctor Change—The AMARC uses the junctor number to keep track of AMA

records for calls in progress. Some of the custom calling features for No. 3 ESS (ie, Threeway Calling) require that junctors be changed while the call is in progress. When this occurs, the junctor-change entry is written into the AMA buffer so that the AMARC can properly maintain the billing records. The junctor change entry contains conference circuit release and seizure indicators, old junctor number, new junctor number, and record time stamp.

4.21 Statistical and Status Message (SSM)—This message is a collection of traffic and other statistical information generated only upon a request from AMARC. This message may appear in any data block. Additionally, the statistics provided by this message are based on all the AMA data transmitted since the last SSM message was transmitted.

4.22 Further details, including the associated data layouts, for the miscellaneous and statistical entries may be found in Section 233-122-100.

Polling Commands and Responses

4.23 Data is transmitted from the No. 3 ESS only in response to a polling command received from the AMARC. When a polling command is received, the No. 3 ESS responds by retrieving the requested data, arranging it in a block format, attaching additional signaling data and transmitting it to the AMARC. Transmission to **and from** the No. 3 ESS occurs one byte (eight bits) at a time beginning with the least significant bit. Just prior to transmission, a start bit is added before the least significant bit of each byte and two stop bits are added following the most significant bit of each byte.

4.24 Several types of polling commands are sent from AMARC requesting different types of data to be transmitted from the No. 3 ESS. The various polling commands and their responses are as follows.

4.25 Initialize (INIT)—This command is used when initiating communication on the primary or backup data link or when switching from the primary to the backup data link. The No. 3 ESS responds to the INIT command with a terminal identification (TID) message which identifies the particular No. 3 ESS office to the AMARC for data link security purposes. This assures the AMARC that it is communicating with the correct

		AMA CALL TYPE				
		I D D D	FM	SLU	INFO BITS B	JUNCTOR NO.
		TRUNK GROUP			MEMBER NO.	
CALLING NUMBER (BCD)	ABBREVIATED NPA CODE		N	X	X	
	TH		H	T	U	
CALLED NUMBER (BCD)	N		P	A	N	
	X		X	TH	H	
	T		U	11 DIGIT	12 DIGIT	
	INFO BITS A		SERVICE FEATURES	MBI TENS	MBI UNITS	
		RECORD TIME STAMP				

ANSWER CHARACTER		
		JUNCTOR NUMBER
		RECORD TIME STAMP

B. ANSWER ENTRY

DISCONNECT CHARACTER*		
		JUNCTOR NUMBER
		RECORD TIME STAMP

* DISCONNECT = OCTAL 50
DISCONNECT (ABANDON/ATTEMPT)
= OCTAL 134
DISCONNECT (TIMED RELEASE DISCONNECT)
= OCTAL 147

C. DISCONNECT ENTRY

LEGEND:

- INFO BITS B - 00 = REGULAR CALL
01 = TEST CALL
10 = ONI
11 = COMPLAINT OBSERVED
- SLU - 1 = SUBSCRIBER LINE USAGE
- IDDD - 1 = IDDD, 0 = DOMESTIC
- FM - 1 = FLAT RATE (WATS FULL BUSINESS DAY)
0 = MEASURED RATE
- CALLING NO. - 1 BCD ABBREVIATED NPA CODE,
7 BCD NXX - TH, H,T,U
- CALLED NO. - 12 BCD DIGITS REPRESENTING NPA - NXX - TH, H,T,U
DIGITS 11 AND 12 RESERVED FOR FUTURE USE
- MBI - MESSAGE BILLING INDEX - 2 BCD DIGITS REPRESENTING
TENS AND UNITS
- SERVICE FEATURES - 0001 = PREPAY COIN, 0010 = HOTEL/MOTEL
0011 = PICTUREPHONE, 0100 = DTF COIN
- INFO BITS A - 1010 = NOT SERVICE OBSERVED NOR TRAFFIC SAMPLED
0001 = SERVICE OBSERVED
0010 = TRAFFIC SAMPLED - CHARGE
0011 = SERVICE OBSERVED AND TRAFFIC SAMPLED - CHARGE
0100 = TRAFFIC SAMPLED - NO CHARGE
0101 = SERVICE OBSERVED AND TRAFFIC SAMPLED - NO CHARGE
0110 = SERVICE OBSERVED NOT TRAFFIC SAMPLED - NO CHARGE
0111 = NOT SERVICE OBSERVED NOT TRAFFIC SAMPLED - NO CHARGE

A. INITIAL ENTRY

Fig. 2—AMA Call Records

N	P	A	N
X	X	TH.	HUND.
TENS	UNITS	11*	12*

*DIGITS 11 AND 12 RESERVED FOR FUTURE USE

A. AMA INITIAL ENTRY RECORD AREA FOR CALLED PARTY TELEPHONE NUMBER

*	*	*	0
*	*	*	*
*	*	*	*

B. DIAL 0 (OPERATOR)

*	*	*	4
1	1	*	*
*	*	*	*

B. FOUR DIGITS DIALED - ONE DELETED (USED WHEN SERVICE CODES MUST BE PREFIXED - I.E. 1-411)

*	*	*	9
1	1	*	*
*	*	*	*

C. THREE DIGITS DIALED (I.E. 911)

*	*	*	7
8	4	9	1
9	5	*	*

D. EIGHT DIGITS DIALED - ONE DELETED (I.E. 1-784-9195)

*	*	*	8
6	5	4	2
6	0	*	*

E. SEVEN DIGITS DIALED (I.E. 865-4260)

9	1	9	4
5	8	8	7
2	6	*	*

F. ELEVEN DIGITS DIALED - ONE DELETED (I.E. 1-919-458-8726)

5	0	3	6
1	7	6	0
7	7	*	*

G. TEN DIGITS DIALED - (I.E. 503-617-6077)

N	P	A†	X
X	X	X	X
X	X	*	*

† LOCAL NPA DUMMIED IN X = DIGIT OR NCD

H. TEST CALL (AS MANY DIGITS AS REQUIRED)

N	P	A†	4
5	3	4	9
2	1	*	*

†LOCAL NPA DUMMIED IN

I. SEVEN DIGIT WATS NUMBER DIALED (453-4921)

6	1	4	6
2	3	3	8
2	5	*	*

J. TEN DIGITS WATS NUMBER DIALED (I.E. 614-623-3825)

*THIS RECORD-AREA IS FILLED WITH A NONCHECK DUMMY CHARACTER (NCD)

Fig. 3—Called Telephone Number Portion of AMA Initial Entry for Various Types of AMA Related Calls

N	P	A	N
X	X	TH.	HUND.
TENS	UNITS	11*	12*

*DIGITS 11 AND 12 RESERVED FOR FUTURE USE

A. RECORD-AREA FOR FORWARD-TO NUMBER IN CALL FORWARDING ACTIVATION OR DEACTIVATION ENTRY

N	P	A†	7
2	4	2	5
6	0	*	*

†LOCAL NPA DUMMIED IN

*THIS AREA FILLED WITH NONCHECK DUMMY CHARACTER (NCD)

2	0	1	9
3	3	6	5
2	9	*	*

B. SEVEN DIGIT FORWARD-TO NUMBER RECORDED (I.E. 724-2560)

C. TEN DIGIT FORWARD-TO NUMBER RECORDED (I.E. 201-933-6529)

Fig. 4—Forward-To Number Recording for Call Forwarding Activations and Deactivations

No. 3 ESS office. The 6-digit Western Electric Company base and control number given to each No. 3 ESS office will be a part of the TID message. The AMARC uses this 6-digit number to identify the particular No. 3 ESS office. Two bytes representing an end-of-block (EOB) word and two bytes representing a cyclic redundancy check (CRC) sum word are also a part of the TID message. The EOB bytes indicate the end of the data block. The AMARC computes a CRC, based on the data it has received, and compares it to the CRC transmitted from the No. 3 ESS. If the two CRC totals coincide, the AMARC is assured that the received data block is accurate. The INIT and TID data formats are described in more detail in Section 233-122-100.

4.26 Transmit (T)—This command is transmitted to request the No. 3 ESS to transmit a new block of AMA data. If the No. 3 ESS has no data in the AMA buffer, it responds by transmitting a “no data” message. This message consists of

the two EOB bytes and two CRC bytes. The two CRC bytes will be all zeros since there is no data from which to compute a CRC.

4.27 If the AMA buffer has data to be transmitted, the No. 3 ESS responds with a “data block” (DBLK) message. This message consists of the data block type, a block sequence number, the AMA data, a block time stamp, two EOB characters, and two CRC characters.

4.28 The block sequence number is a BCD number in the range of 00-99 (decimal) which is incremented by 1 each time a new data block is transmitted. This allows the AMARC to anticipate the sequence number for the incoming data blocks. A trouble is indicated if the sequence number received does not agree with the expected sequence number. In this case, the AMARC automatically cancels the billing records for all calls in progress for that No. 3 ESS office.

4.29 The block time stamp (rounded to the nearest 40 ms) is derived from the same 16-bit counter that provides the record time stamp for the initial, answer, and disconnect AMA buffer entries. The counter is incremented every 10 ms, and therefore recycles every 10 minutes 55 seconds (approximately). The AMARC subtracts the record time stamp (made as a part of each AMA buffer entry) from the block time stamp (made when the data block is transmitted to the AMARC). This represents the processing delay time incurred within the No. 3 ESS (including the AMA buffer holding time). The processing delay time is then subtracted from AMARCs current real time to provide the real-time record to be recorded for each initial, answer, and disconnect entry.

4.30 *Retransmit (RT)*—This command is received by the No. 3 ESS whenever the AMARC has detected a CRC failure or a data link error condition. It is also received after a data link switch has occurred. The No. 3 ESS responds by retransmitting the most recently transmitted data block with an updated block time stamp.

4.31 The T and RT commands received from AMARC and the data block and no-data message transmitted to AMARC are described in more detail in Section 233-122-100.

4.32 *Generate Tracer Statistics (GTS)*—This command is used to request current statistical counts to be generated for intersystem integrity checks. Upon reception of this command, the No. 3 ESS immediately returns an acknowledge (ACK) message. At the same time, the No. 3 ESS assembles the requested statistical data in the form of the Statistical and Status Message and writes it into the AMA buffer. The SSM data is then returned to the AMARC in a data block upon reception of a later T command. The GTS message is described in more detail in Section 233-122-100.

4.33 *Test (TST)*—This optional message may be received by the No. 3 ESS whenever no billing data has been transmitted within a time period of 1 hour or as the result of a TTY request. The message initiates a series of tests designed to analyze the integrity of the No. 3 ESS/AMARC interface. Tests are performed to verify that the No. 3 ESS and the AMARC are not locked in a particular mode and to detect any data link errors. A CRC is then calculated, based on the pattern received, and returned, along with the bit pattern,

to the AMARC. The AMARC, by examination of the bit pattern and the CRC, can then determine if any failure occurred and in which direction it occurred. If the received CRC does not agree with the received data, the error occurred during transmission from the No. 3 ESS to AMARC. If the CRC agrees with the received data, but the received data is not identical to the data previously transmitted, the error occurred during transmission from the AMARC to the No. 3 ESS. Any test failure initiates a TTY printout (at the AMARC) describing the failure. This test sequence is further described in Section 233-122-100.

4.34 Figure 5 provides a flowchart showing the functional operations provided by the AMARS feature.

Signaling and Data Transmission

4.35 The No. 3 ESS transmits data to the AMARC only after receiving a polling command. The command is decoded and the appropriate response is provided as previously described. During the normal exchange of data, the AMARC maintains certain checks and procedures in order to assure the validity and accuracy of the recorded billing information. If a transmission error is detected, the AMARC is responsible for taking the appropriate steps required to restore accurate transmission and to recover as much revenue as possible without over billing any customers. The following paragraphs describe the possible error conditions detected by AMARC and the procedures employed to restore accurate transmission.

4.36 *Remote Location Response (RLR) Timing*—When the AMARC transmits the first byte of a polling command, a timer is started in order to time the response of the No. 3 ESS. A transmission error is indicated if the first byte of the response is not received before this timer expires.

4.37 *CRC Error*—When the AMARC receives a data block, it computes a CRC based on the data block received (excluding the EOB bytes) and compares it to the CRC received as a part of the data block. An error is indicated if the two CRCs are not identical.

4.38 *Block Overflow*—The largest allowable data block from No. 3 ESS contains 68 bytes including the block type, sequence number, block

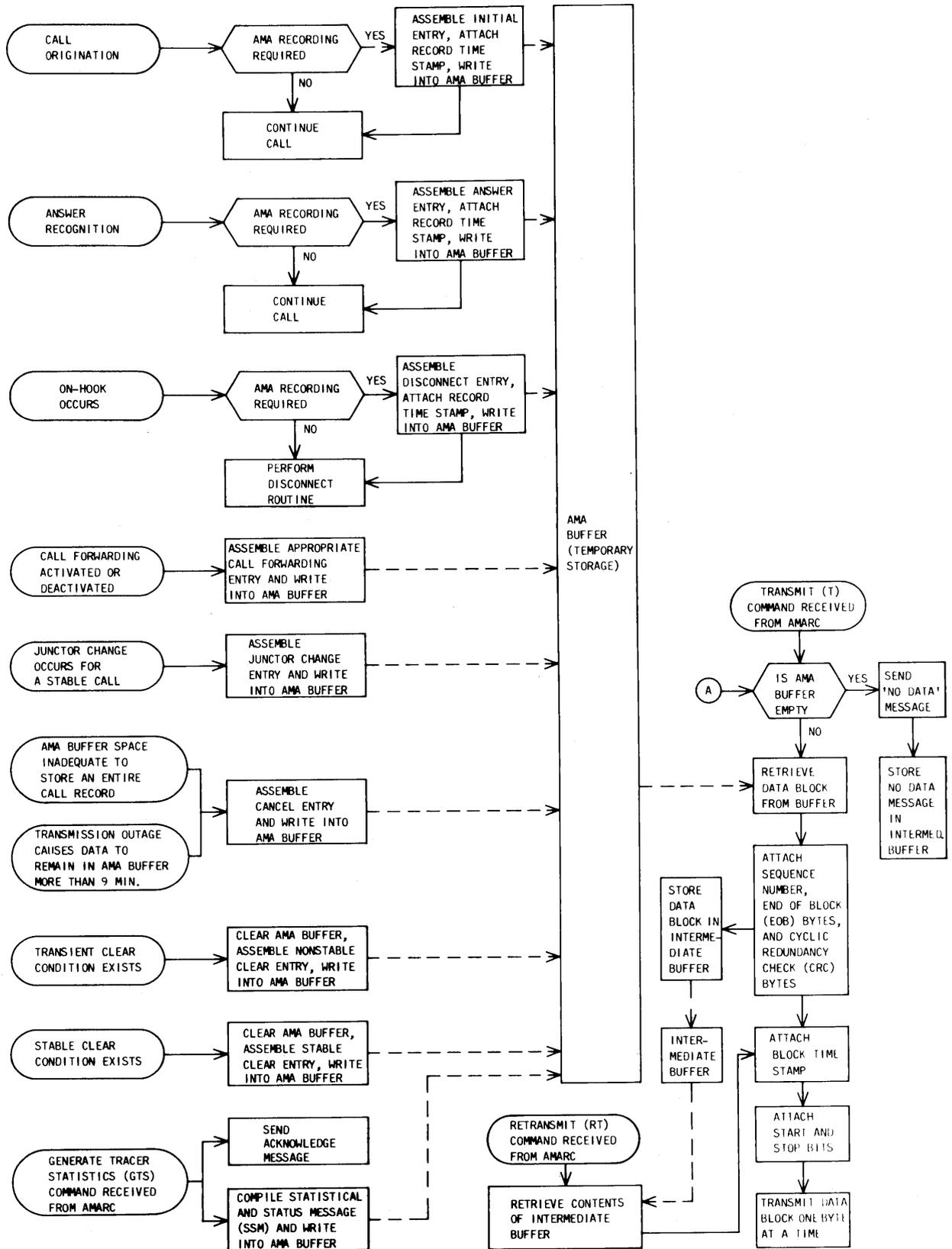


Fig. 5—Functional Flow Diagram of the AMARS Feature

time stamp, EOB and CRC bytes. If the EOB bytes are not detected following the 64th byte, a block overflow condition exists.

4.39 Block Time-Out—When AMARC receives the first byte of a data block, a timer is started. A block time-out condition exists if this timer expires before the EOB bytes are received.

4.40 Sequence Error—The AMARC continually anticipates the sequence number for the incoming data blocks. A sequence error exists when the sequence number of an incoming data block is not the one expected by the AMARC.

4.41 When the AMARC detects one of these error conditions on the primary data link, it usually issues RT commands in an attempt to acquire valid data. If valid data is not received within 3 seconds, the AMARC initiates a switch to the backup data link to assure accurate transmission of AMA data. Section 233-122-100 provides further descriptions of these error conditions and the operations performed to correct them.

CHARACTERISTICS

5. FEATURE ASSIGNMENT

5.01 The AMARS feature is provided on a per-system basis.

6. LIMITATIONS

6.01 The AMA clock at the No. 3 ESS recycles every 10 minutes 55 seconds. Therefore, if transmission failures should occur on both data links causing data to be held in the AMA buffer through one or more complete cycles of the AMA clock, it becomes impossible to determine the actual duration of calls in progress. In this case, the billing records for calls in progress must be cancelled as previously described. This cancellation occurs after the data has been stored approximately 9 minutes.

6.02 The AMARS feature can process a maximum of 8136 calls per hour. This should not present any problem since the largest No. 3 ESS can expect only about 11,000 busy hour calls which include originating calls (both AMA and non-AMA related) and terminating calls.

6.03 The AMARS feature cannot process billing information for calls originating from multiparty lines. Billing information for PBX lines may be processed only in cases where all stations within the PBX group are assigned the same billing number. Therefore, Centralized Automatic Message Accounting (CAMA) or Traffic Service Position System (TSPS) trunks must be provided to obtain the billing number for these types of lines.

7. INTERACTIONS

7.01 Software message registers are not provided in offices equipped with the AMARS feature. The AMARS feature operates independently of all other features and does not affect the operation of other features. However, some features require special procedures and/or assignments to assure proper AMA recording.

Custom Calling Features Considerations

7.02 The AMARS feature is capable of recording call information for calls made using the Custom Calling features. This information may be used for billing (ie, OUTWATS, Measured-Service) or for traffic studies (ie, SLU). Special considerations are required in order to record call information for these types of calls. These considerations are described in the following paragraphs.

7.03 Call Waiting—The Call Waiting feature provides an arrangement by which a short alerting tone is applied to a busy station whenever another call to that station is attempted. Upon hearing this tone, the customer may flash in order to place the original call on hold and to establish a connection with the third party. The call waiting customer may then alternate between the remaining two parties by flashing. AMA recording is performed normally for each call. Figure 6 shows the actions taken by the customer and the AMARS feature for a call waiting call. Refer to Section 233-190-107 for more details on the Call Waiting feature.

7.04 Threeway Calling—A customer subscribing to the Threeway Calling feature can establish a 3-way connection without operator assistance. When a 2-party connection has been established (regardless of which party originated the connection), the party subscribing to the Threeway Calling feature may flash in order to put the other party on hold and to obtain dial tone. When dial tone is received, the customer may then dial the telephone

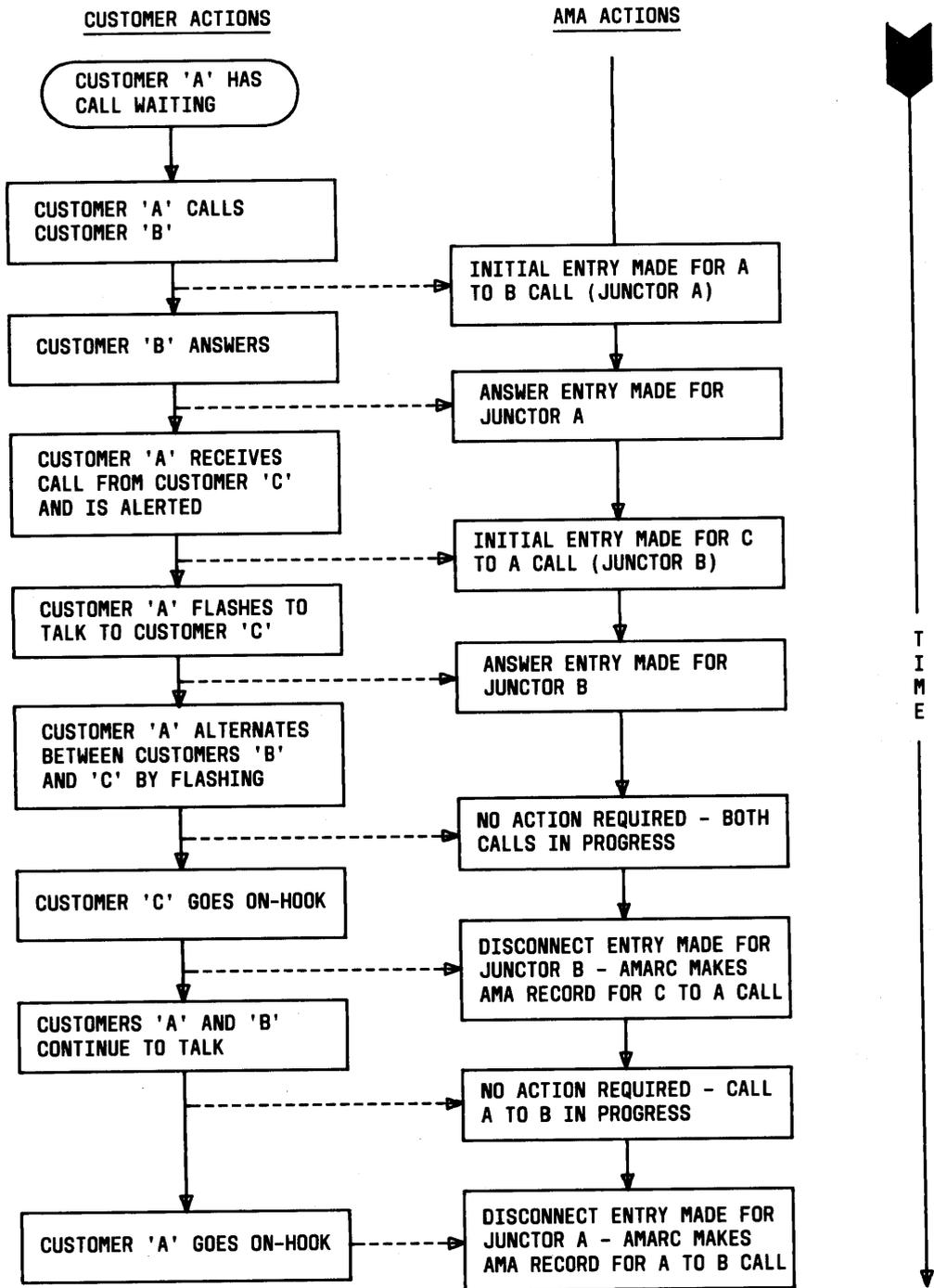


Fig. 6—AMA Operations Required for Call Waiting Feature

number of the third party. The customer may then flash again to establish the 3-way connection. Normal AMA billing records are made on the original 2-party call and on the added connection. The initial entry for the added-on call has an AMA call type of 127 or 131 (see Table B). Junctor change entries are also made in order to maintain records of conference trunk usage. Figure 7 shows the operations required to provide AMA records for Threeway Calling applications. Refer to Section 233-190-138 for further details on Threeway Calling.

7.05 Call Forwarding—The call forwarding feature allows the customer to forward all incoming calls to another station. The customer activates the feature by dialing a special access code and the forward-to number. When an incoming call is forwarded, the standard initial entry is made for the calling party. Another initial entry is made listing the called station as the calling number and the forward-to station as the called number. This initial entry has an AMA call type of 130 or 132 (see Table B). A call forwarding entry is made when the customer activates and deactivates the feature. Figure 8 shows the operations performed by the AMARS feature in order to provide AMA recording for calls utilizing the Call Forwarding feature. Refer to Section 233-190-105 for more details concerning the Call Forwarding feature.

7.06 OUTWATS—For OUTWATS calls, the No. 3 ESS automatically supplies the OUTWATS billing number required for AMA recording. This billing number consists of a 3-digit numerical code and a 4-digit number in the form of 0/1XY-XXXX. The first digit of the code (0 or 1) indicates whether the customer has full business day (0) or measured-rate (1) service. The second digit (X) is reserved for assignment by the operating company. (Usually a different digit is assigned to each state for identification purposes.) The third digit (Y) designates the service area or band subscribed to by the customer. (Digits 1 through 5 represent interstate calls and digits 0, 7, 8, and 9 are available for assignment by the operating companies for intrastate calls. Digit 6 is reserved for future interstate application.) The remaining four digits (XXXX) represent the specific billing number for the line. This is an arbitrary assignment; however, no 4-digit number should be duplicated within a given band in a given NPA. Refer to Section 233-190-142 for further details concerning the OUTWATS feature.

Special Studies

7.07 The AMARS feature has provisions for recording call data for lines involved in special studies. For these types of calls, the No. 3 ESS generates detailed billing information, activates the appropriate special studies flags (AMA indicators), and stores the data in the AMA buffer to await transmission to AMARC. The four types of special studies allowable within the No. 3 ESS are described in the following paragraphs.

7.08 Complaint Observing is an arrangement by which detailed billing may be provided, upon customer request, for local measured-rate calls. No. 3 ESS offices utilizing the AMARS feature may provide this service in one of two ways. At the No. 3 ESS, a special studies (SS) indicator in the line's originating translations may be set which causes the Information Bits B in the AMA initial entry to indicate the need for complaint observing (see Figure 2). Complaint observing may also be provided by entering the customer's line in a 400-entry table resident in the AMARC. This table is scanned before assembling the No. 3 ESS call records.

7.09 Service Observing is a study of a sample of an office's lines (typically 50 to 100 lines) performed by Service Observing operators who monitor the quality of telephone service. AMA records for service observed lines are checked for billing accuracy. Service observing may be specified by setting a service observing (SO) bit in the line's originating translations. All subsequent AMA calls from the line have a service observed indication provided by Information Bits A within the AMA initial entry (see Figure 2).

7.10 Traffic Sampling is a study used primarily for coin lines to obtain data for division of revenue. All AMA records produced for traffic sampled lines contain complete toll-like billing details which the operating telephone company (OTC) accounting center collects and compiles in the appropriate manner. Traffic sampling is specified by setting the SS bit in the lines originating translations. Subsequent calls from the line have detailed billing records with Information Bits A (in the initial entry) indicating that the line is traffic sampled.

7.11 Subscriber Line Usage is a long term study of a sample of an office's lines (typically

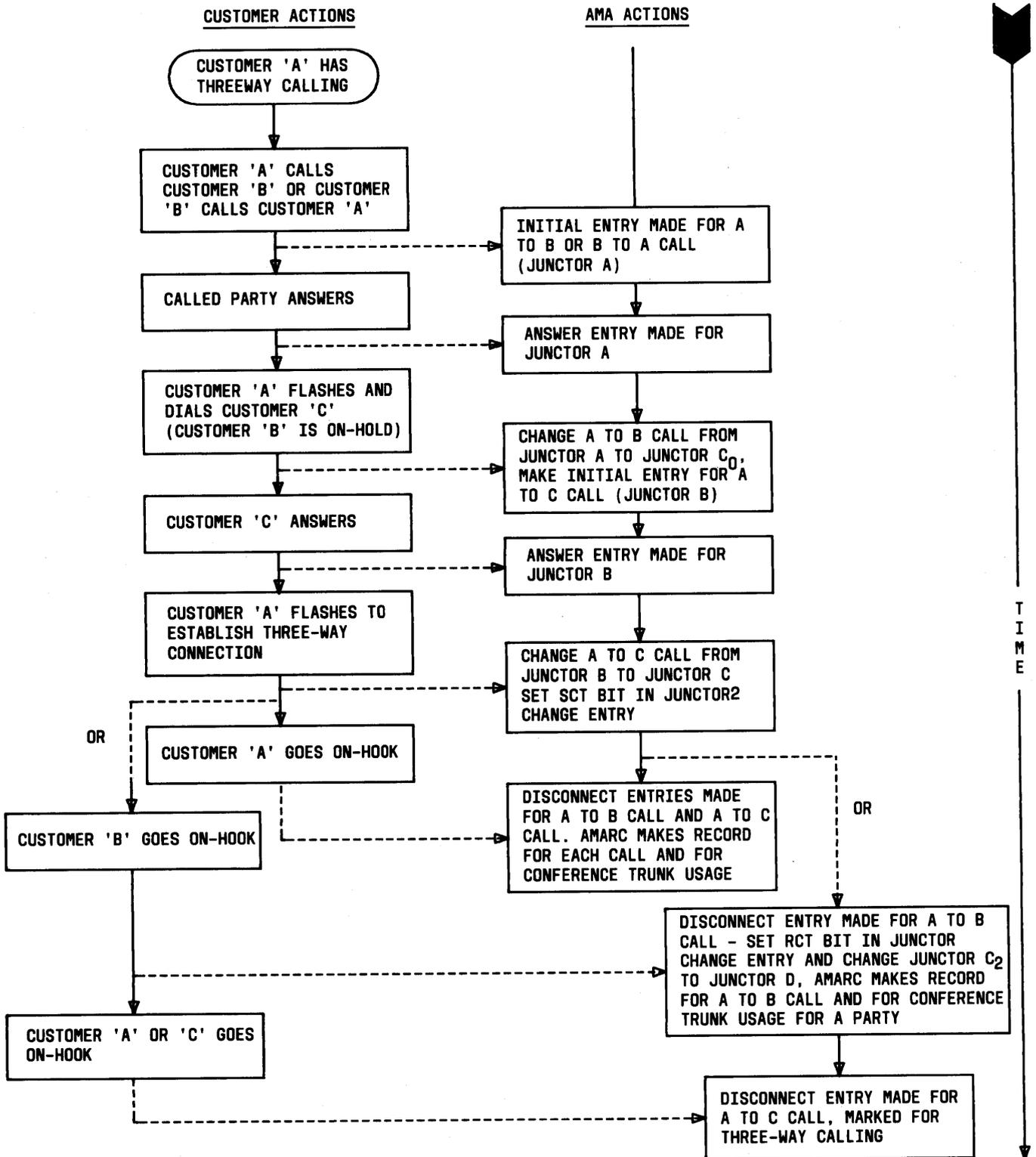


Fig. 7—AMA Operations Required for Threeway Calling Feature

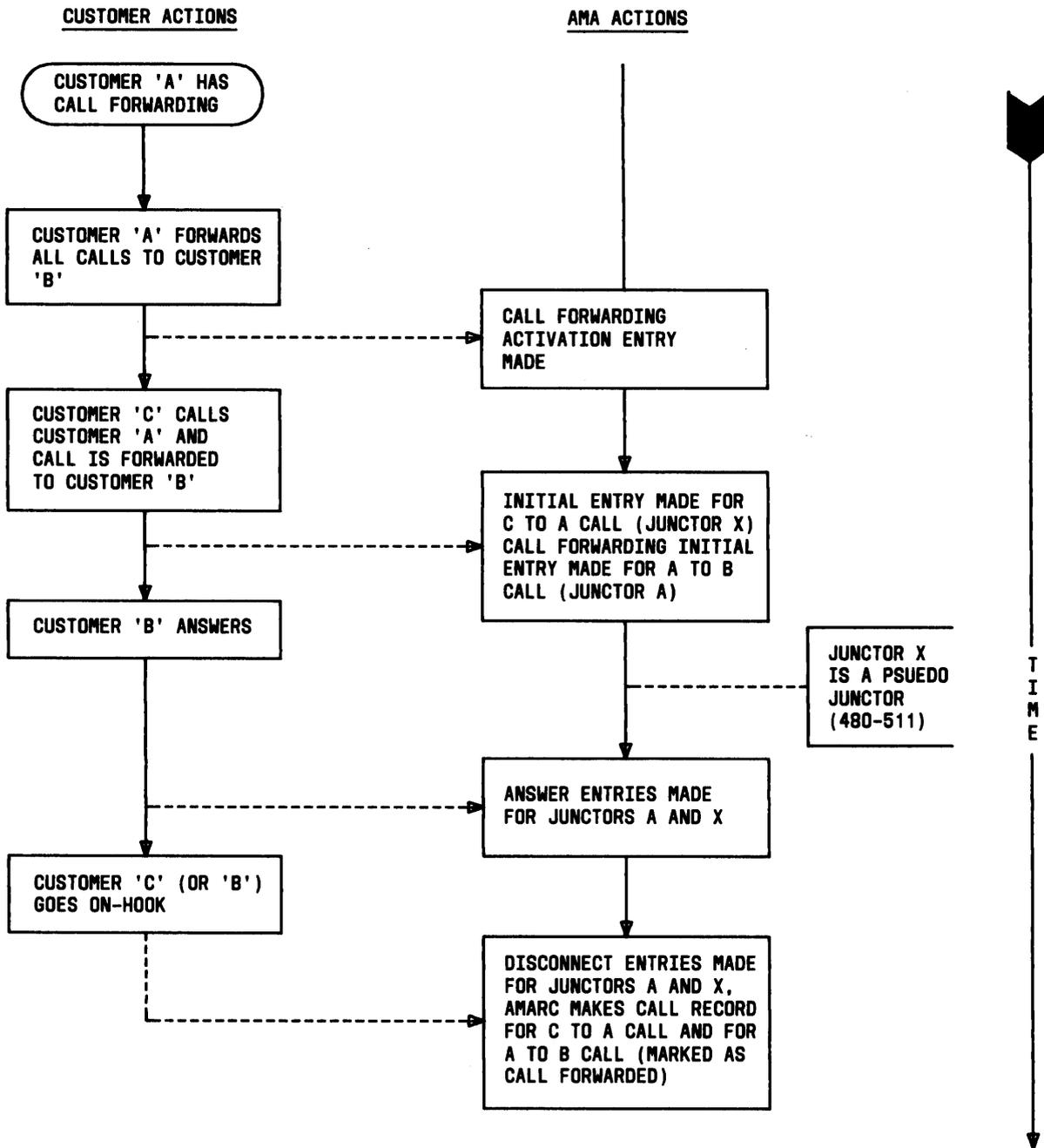


Fig. 8—AMA Operations Required for Call Forwarding Feature

100 lines). The study provides an OTC with data that may be used to obtain point-to-point calling habits of flat rate subscribers, to assist in the preparation of USP tariffs, or to monitor the effects of such tariffs. AMA records produced for calls from SLU lines contain complete toll-like billing details. The SLU study may be specified by setting the SS bit in a line's originating translations.

Subsequent flat-rate calls from the line are recorded in a toll-like manner with the SLU indicator set in the AMA initial entry (see Figure 2). This indicator identifies the SLU study.

7.12 The OTC may elect to perform any or all of the special studies. The service observing study has a dedicated bit (SO) in the originating

translations and may therefore be specified independently of the other three studies. The complaint observing, traffic sampling, and SLU studies share the same bit (SS) in the originating translations. However, the office options word has three bits (CMPOBS, TRF, and SLU identifying complaint observing, traffic sampling, and subscriber line usage, respectively) used to specify the study, or studies, currently being performed within the No. 3 ESS office.

7.13 If two or all of the studies are to be employed concurrently (excluding service observing), the generic program may not be able to determine which study is desired when a line's SS bit is set. Therefore, the AMA initial entry *may* provide flags which indicate a call's involvement in other studies in addition to the desired study. In these cases, it is the responsibility of the accounting center to scrutinize the call records to determine which study is desired. Table C lists the AMA flags set for each possible combination of special studies, and identifies each case in which an AMA record is generated.

8. RESTRICTION CAPABILITY

8.01 The No. 3 ESS translations provide all the necessary flexibility required for the various charging arrangements. (Refer to DATA ASSIGNMENTS AND RECORDS for a description of the translations.)

INCORPORATION INTO SYSTEM

9. COST FACTORS

9.01 The AMA buffer, located in the temporary storage area, must contain at least 2800 words. In offices without the AMARS feature, software message registers are provided on a per-line basis. To implement the AMARS feature in an existing No. 3 ESS, these software message register words are used to construct the AMA buffer.

9.02 The AMA, ABM, and DATADM programs are provided as a part of Issue 4 of the SO-2 generic program.

9.03 The translation area of program store requires one bit to be set in the office option word for each of the following AMA related indicators:

- AMA

- SLU (required only if it is desired to perform the SLU study)
- Traffic sampling (required only if the traffic sampling study is to be performed)
- Complaint observing (required only if complaint observing is to be performed).

9.04 Besides the availability of an AMARC, the hardware required for the AMARS feature includes the following items:

Primary Data Link

- Two 202T data sets (one at the AMARC)
- One dedicated 4-wire private line
- Port 1 of TTY controller number 2.

Backup Data Link

- Two 202T data sets (one at the AMARC)
- One dedicated 4-wire private line
- Port 1 of TTY controller number 3.

10. DATA ASSIGNMENTS AND RECORDS

10.01 Each line requiring individual AMA recording (such as complaint observing, traffic sampling, subscriber line usage, WATS billing number, etc) must be properly assigned. This assignment must be made through the use of recent change messages or, in the case of an initial installation, an office data administration (ODA) run.

10.02 Each line must be assigned the proper screening class in order to point to the appropriate charge index (see Table A) and route index.

10.03 The translation organization required to provide AMA recording is shown in Figure 9. The recent change messages associated with these translations are as follows:

RC:LINE	This message is used to specify a line class code, rate area, bill-to number, WATS billing number, service observing indicator, special
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studies (SLU, complaint observing, or traffic sampling) indicator, terminal equipment number and scan point number for a particular line.

Refer to the Input Message Manual (IM-3H300) for further details on these recent change messages.

10.04 For the initial ODA run, the following forms must be completed and sent to the WEC0 Regional Data Center.

RC:LCC This format is used to input the line class index, the line class code, the rate area, originating and terminating major classes, screening class and the party number.

- **Form ESS 3105-1 Multiline Hunting Group Table** is used to assign PBX lines to a group and to assign the rate area, line class code, and the billing number for the group.

RC:CHI This message is used to input the charge index which identifies a call as a coin or measured-rate call.

- **Form ESS 3107 Supplementary Information Table** is used to assign a billing number to a line or to a member within a multiline hunt group.

RC:OFFICE This format is used to specify AMA recording for the No. 3 ESS office and to specify complaint observing, traffic sampling and/or SLU for the particular office.

- **Form ESS 3300 Three-and Six-Digit Translation Table** is the starting point for establishing routing and charging treatment for all 3- and 6-digit NXX and NPA codes. This form provides a sequential listing of all dialable codes and provides the initial code reduction when all codes of similar treatment are assigned into code groups.

RC:SCR Used to input screening class, screening table, route index, and charge index identities.

- **Form ESS 3301 Rate and Route Table** is used to construct the screening tables by providing the proper charge and route indexes for each screening class.

RC:MTL Used to specify line class code, rate area, bill-to number, terminal equipment number, and service observing and/or special studies for a particular line within a multiline hunt group (for PBX). Information pertinent to other features is also specified by this message.

- **Form ESS 3306 Line Class Code Table** is used to relate various combinations of line class code, rate area, and party number to the originating and terminating major class combinations.

RC:MLHG Used to specify line class code, rate area, bill-to number, and group number for a multiline hunt group. Information pertinent to other features is also specified by this message.

- **Form ESS 3500 General Information Table** is used to assign TTY controllers for use with the AMARC data links.

RC:TTY Used to assign TTY controllers for the AMARC data links

Refer to TG-3 for further details concerning the completion of these forms. It should be noted that the service observing (SO) and special studies (SS) indicators cannot be set via the ODA run. They must be set using the RC:LINE recent change message.

RC:TWOPTY Used to specify line class code, rate area, TEN, party number, and service observing, and/or special studies for a 2-party line.

10.05 If an ODA run is made to incorporate the AMARS feature, the resulting output forms should be retained as a part of the office records. Records for trouble reports and maintenance should be kept in accordance with local procedures.

TABLE C

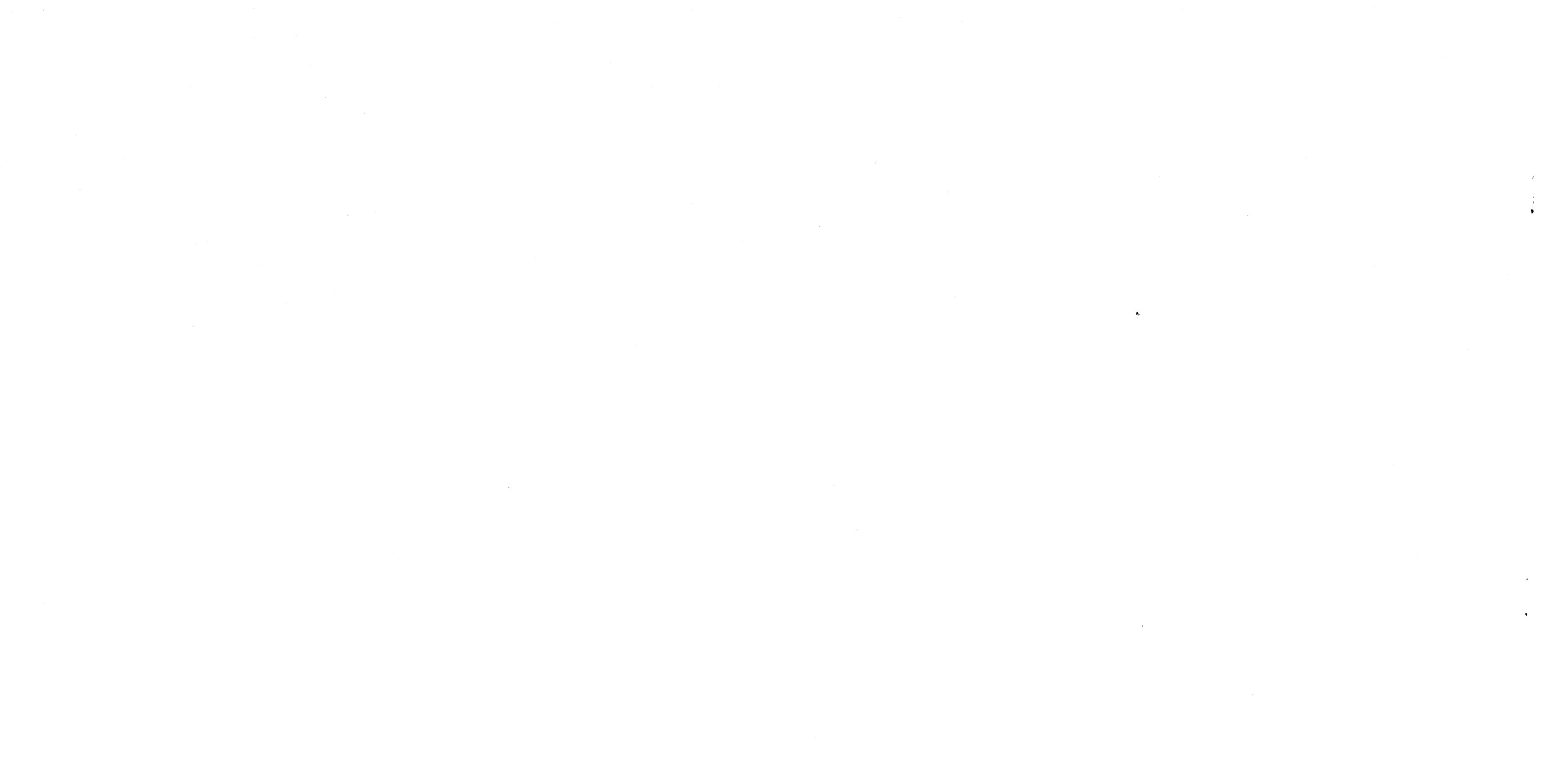
AMA FLAGS AND RECORDS FOR VARIOUS COMBINATIONS OF SPECIAL STUDIES

LEGEND:

- CO — Complaint Observing
- COIN 411 — Coin line calls to directory assistance
- COIN 800 — Coin line call to toll free 800 number
- FREE — Free call
- FREE 411 — Free call to directory assistance
- FREE 800 — Free call to 800 number
- IND — Irregular number of digits dialed (some number other than 7, 8, 10, 11—, eg, 611, 1611, 0—)
- MU — Message Unit call
- NR — No Record made
- RNF — Recorded but No Flags set
- SLU — Subscriber Line Usage
- SO — Service Observing
- TS — Traffic Sampling

STUDIES EMPLOYED				AMA FLAGS AND RECORDS FOR VARIOUS CALL TYPES									
SO	SLU	CO	TS	COIN	COIN IND	COIN 411	COIN 800	MU*	FREE	FREE IND	FREE 411	FREE 800	
					NR	NR	RNF	RNF	NR	NR	RNF	RNF	
			✓	TS	NR	NR	TS	TS	TS	NR	TS	TS	
		✓			NR	NR	RNF	CO	NR	NR	CO	RNF	
		✓	✓	TS	NR	NR	TS	CO,TS	TS	NR	CO,TS	TS	
	✓				NR	NR	RNF	SLU	SLU	NR	SLU	SLU	
	✓		✓	TS	NR	NR	TS	SLU,TS	SLU,TS	NR	SLU,TS	SLU,TS	
	✓	✓			NR	NR	RNF	SLU,CO	SLU	NR	SLU,CO	SLU	
	✓	✓	✓	TS	NR	NR	TS	SLU, CO,TS	SLU,TS	NR	SLU, CO,TS	SLU,TS	
✓					NR	NR	SO	SO	NR	NR	SO	SO	
✓			✓	TS,SO	NR	NR	TS,SO	SO,TS	SO,TS	NR	SO,TS	SO,TS	
✓		✓			NR	NR	SO	SO,CO	NR	NR	SO,CO	SO	
✓		✓	✓	TS,SO	NR	NR	TS,SO	CO, SO,TS	SO,TS	NR	CO, SO,TS	SO,TS	
✓	✓				NR	NR	SO	SO,SLU	SO,SLU	NR	SO,SLU	SO,SL	
✓	✓		✓	TS,SO	NR	NR	TS,SO	SLU SO,TS	SLU, SO,TS	NR	SLU SO,TS	SLU, SO,TS	
✓	✓	✓			NR	NR	SO	SLU, SO,CO	SO,SLU	NR	SLU, SO,CO	SLU,SO	
✓	✓	✓	✓	TS,SO	NR	NR	TS,SO	SLU,TS CO,SO	SLU, SO,TS	NR	SLU,TS CO,SO	SLU, SO,TS	

*IND, 411, and 800 type calls are never recorded on a message unit basis.



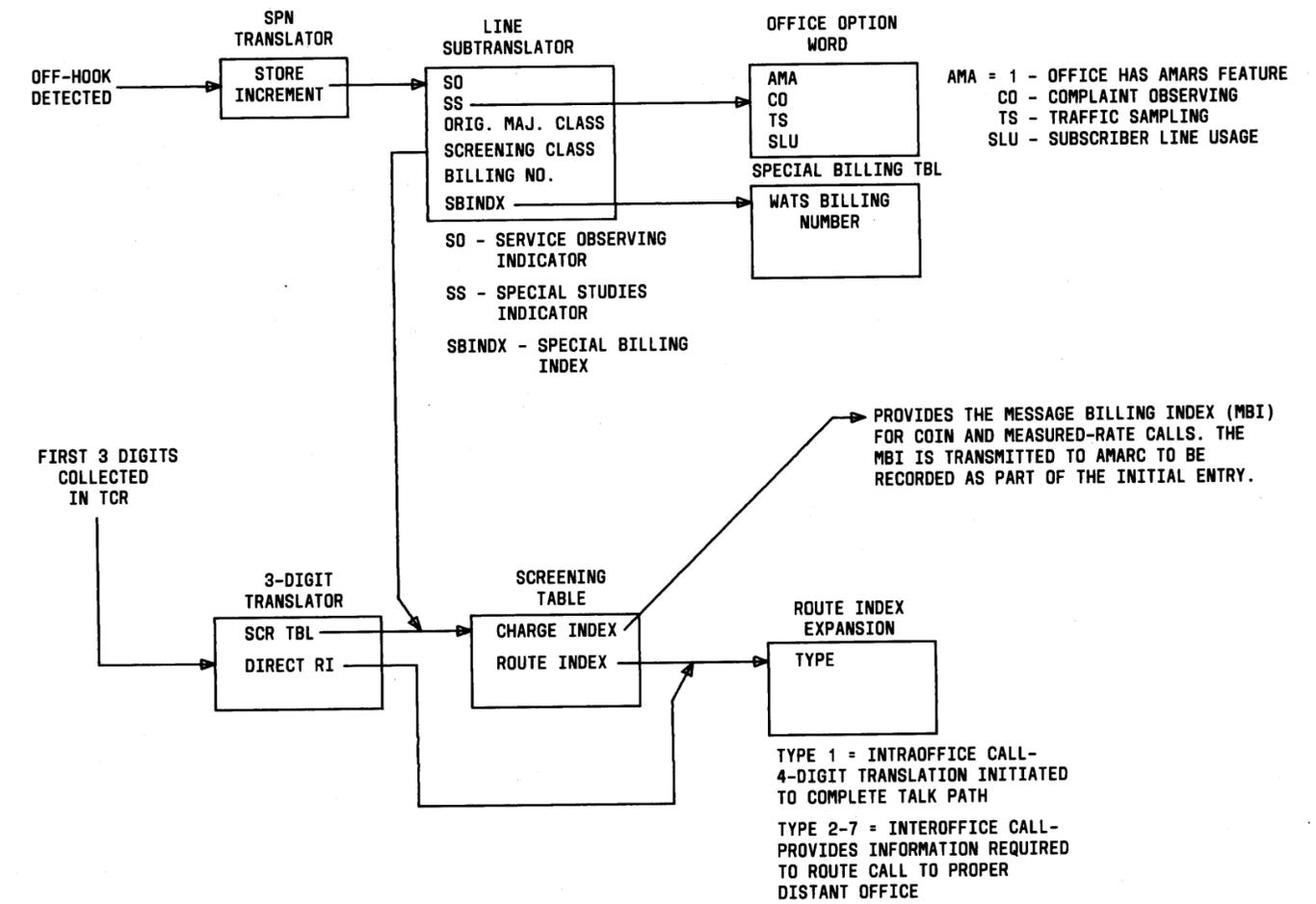


Fig. 9—Translation Layout for AMARS Feature



11. HARDWARE RESTRICTIONS

11.01 When the AMARS feature is implemented, TTY controllers 2 and 3 must be dedicated to the AMARS feature as shown in Figure 1. No other hardware restrictions exist for this feature.

12. INSTALLATION/ADDITION/DELETION

12.01 The procedures for providing the AMARS feature consist of installing the required hardware and organizing the software through the use of recent change messages or the ODA run as previously described. More detail concerning these procedures can be found in the Installation Engineering Handbook 269.

13. TESTING

13.01 The TST message may be automatically transmitted by the AMARC on a scheduled basis to verify the integrity of the data link. Additionally, the following verification messages may be used to verify that the feature is properly assigned.

- **VER:CHI** is used to verify charge index assignments.
- **VER:DIG** is used to verify the 3- and 6-digit translations which eventually lead to the charge index and route index.
- **VER:GRP** is used to verify assignment of group and member data for a PBX/MLHG.
- **VER:LCC** is used to verify the line class code assignments.
- **VER:LINE** is used to verify line information.
- **VER:MTL** is used to verify the assignment of PBX/MLHG lines.
- **VER:OE** is used to verify customer line originating translations.
- **VER:OFFICE** is used to verify the office options and the terminal identification.
- **VER:SCR** is used to verify the screening table entries.

- **VER:TWOPTY** is used to verify originating translations associated with 2-party lines.

14. OTHER PLANNING TOPICS

14.01 Care should be taken to insure that a minimum of 2800 words are available for use as the AMA buffer and that adequate space is available in the miscellaneous frame for the required data sets.

14.02 Since multiparty lines and individual PBX stations cannot be automatically identified, calls originated by these types of customers cannot be processed via the AMARS feature. Therefore, arrangements must be made to have these types of calls handled via CAMA with Operator Number Identification or via TSPS.

ADMINISTRATION**15. MEASUREMENTS**

15.01 All the necessary plant and traffic measurements associated with the AMARS feature are automatically generated by the No. 3 ESS. The AMARC initiates the generation of this data by transmitting the GTS message to the particular No. 3 ESS office. The No. 3 ESS responds by generating the data and loading it into the AMA buffer to be transmitted to the AMARC as the result of a subsequent T command. The measurement data is transmitted in the form of the SSM message. The SSM message is described in more detail in Section 233-122-100. The GTS message is scheduled at the AMARC normally on an hourly basis.

16. CHARGING

16.01 All charging information is transmitted to the AMARC where it is recorded on AMA tape. The details of this procedure are described in the SYSTEM OPERATION portion of this section.

SUPPLEMENTARY INFORMATION**17. GLOSSARY**

17.01 The following list identifies terms and abbreviations used in this document which may not be familiar to the reader.

- BCD - Binary Coded Decimal

SECTION 233-190-204

- BPI - Bits per inch
- CDPR - Customer Dial Pulse Receiver
- CRC - Cyclic Redundancy Check sum attached to data blocks or test command prior to transmission.
- EOB - End of Block indicators attached to the end of a data block or test command prior to transmission to AMARC.
- Junctor - Supervision circuits at No. 3 ESS whose numbers are used at the AMARC to keep track of calls in progress.
- MRD - Minimum Recordable Duration—The shortest call duration for which the AMARS feature can provide a complete call record.
- MS—Measured Service—A pricing plan by which all customers are billed according to usage for local and toll calls.
- NCD - Noncheck Dummy character—used to fill empty character spaces for certain AMA entries.
- ODA Run - Office Data Administration run —The mechanism by which translation information may be assembled for a No. 3 ESS office. Information from the ESS input forms is inputted into the regional ODA computer, assembled and sent back to the No. 3 ESS.
- OTC—Operating Telephone Company
- OUTWATS - Outward Wide Area Telecommunication Service
- RC Messages - Recent Change Messages—Mechanism for making changes to information stored in the program store via TTY input messages.
- SLU - Subscriber Line Usage
- SPN - Scan Point Number
- TCR - Transient Call Record—A block of temporary storage used to store information relating to calls not in a stable (talking) state.

- TID - Terminal Identification
- TMR - Terminal Memory Record—A block of temporary storage used to store information relating to calls in a stable state.
- TRD - Timed Release Disconnect—The procedure used to delay the disconnect routine for a maximum of 10 seconds when the called party goes on-hook and the calling party remains off-hook.
- TTY - Teletypewriter

18. REFERENCES

18.01 The following documents may be referred to for additional information related to the AMARS feature:

- Section 201-900-101 — No. 1 AMARC Description
- Section 233-020-020 — (Formerly DFMP, Division H, Section 11h)
- Section 233-190-107 — Call Waiting Feature No. 3 ESS
- Section 233-190-138 — Threeway Calling Feature No. 3 ESS
- Section 233-190-105 — Call Forwarding Feature No. 3 ESS
- Section 233-190-142 — Outward Wide Area Telecommunication Service (OUTWATS) - No. 3 ESS
- Section 233-190-013 — Service Observing Arrangements No. 3 ESS
- Section 233-190-101 — Charging Arrangements No. 3 ESS
- Section 233-190-108 — Coin Charging No. 3 ESS
- Section 233-190-109—Centralized Automatic Message Accounting Including Special Toll Billing No. 3 ESS
- Section 233-190-112 — Basic Coin Service No. 3 ESS

- Section 233-190-123 — Message Registers No. 3 ESS
- Section 233-190-126 — Multiparty Service No. 3 ESS
- Section 233-190-131 — Dial-Tone-First Coin No. 3 ESS
- Section 233-190-139 — Toll Diversion and Toll Restriction No. 3 ESS
- Section 233-122-100—Automatic Message Accounting Recording Center Data Link Description of Theory and Operation—No. 3 ESS
- Section 233-154-130 — Recent Change Users Guide
- Section 233-190-149—Interface With Traffic Service Position System (TSPS) No. 3 ESS
- Section 592-031-100 — 202T Data Set Transmitter-Receiver Description and Operation
- Section 592-031-150 — Data Set 202T Transmitter-Receiver Supplementary Information
- Section 592-031-180—Data Set 202T Summarizing Specification Data Systems
- Translation Guide TG-3
- Sections 233-060-XXX—Network Design Practices
- IM-3H300 — Input Message Manual No. 3 ESS
- OM-3H300 — Output Message Manual No. 3 ESS
- PA-3H300 — Office Data Tables Layout Specification No. 3 ESS
- CD and SD-3H914 — Data Interface Circuit
- PR-3H186-02 — AMA Buffer Management (ABM) Program
- PR-3H187-02 — Automatic Message Accounting (AMA) Program
- PR-3H262-02—Data Administration (DATADM) Program