NO. 2 ELECTRONIC SWITCHING SYSTEM
OPERATIONAL FEATURES
AUTOMATIC MESSAGE ACCOUNTING

CONTENTS PAGE

1. GENERAL

1.01 This section describes the operation of automatic message accounting (AMA) equipment and programs for the No. 2 Electronic Switching System (ESS).

1.02 When this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 This section contains information which makes AMA compatible with the EF-1 generic program and with Issue 4 and later of the LO-1 generic program. The differences between the information pertaining to these generic programs and information pertaining to LO-1, Issue 3.3 and earlier generics, are indicated where applicable.

2. DESCRIPTION

2.01 The purpose of AMA is to provide automatic billing service for toll calls, coin calls, and message rate calls originating from one- and 2-party and centrex customers in the No. 2 ESS office. The No. 2 ESS control complex collects AMA billing information for originating calls and records it on 9-track AMA magnetic tape (Fig. 1). The tape is periodically sent to a Bell System electronic data processing (EDP) center. Individual customer bills, which include the AMA data, are produced at the data processing center.

2.02 A No. 2 ESS may be operated as a local automatic message accounting (LAMA) office, or billable calls can all be forwarded to a centralized automatic message accounting (CAMA) office.

Note: Calls from message register lines which should be recorded on a local or remote message register cannot be handled by a CAMA trunk because answer supervision is not returned from a CAMA office. Such calls can be routed over CAMA only if they are not to be pegged. In addition, calls from coin lines cannot be handled over CAMA.

2.03 No. 2 ESS can also function as a LAMA office with calls requiring operator number identification (4- and 8-party customers) being routed to a CAMA office, manual switchboard, or Traffic Service Position System (TSPS) location.

2.04 This section deals only with the LAMA function in a No. 2 ESS. It includes a description of the AMA equipment required to

perform this function, operational procedures, and data entry descriptions.

2.05 Two complete AMA units are contained in a single-bay frame (Fig. 2). The units are designated 0 and 1. The duplicated tape transports provide uninterrupted AMA capability while the magnetic tape is being changed for shipment to the EDP center. Each unit consists of a tape transport and associated electronic circuit logic. Tape transport 0 is located in the lower half of the frame, and tape transport 1 is located in the upper half of the frame. The AMA circuits associated with each transport are located in circuit packs at the top and bottom of the AMA frame. Each reel of tape will hold several days' billing information for a large No. 2 ESS office. Only one tape transport is actively recording billing information at any one time.

OPERATION

2.06 Each AMA unit is maintained in the active, standby, or out-of-service state. One AMA unit is in the active state, while the other is either in the standby or out-of-service state. The state of each AMA unit is controlled by the AMA program. The definition of each state is as follows:

- ***Active:*** The AMA unit is actively recording billing information for customer calls.

- ***Standby:*** The AMA unit is ready for service but not actively recording billing information. It is available for active service if a problem should develop with the active equipment or if it becomes necessary to change the tape on the active recorder.

- ***Out of Service:*** The AMA unit has been removed from service. An AMA unit can be placed in this state by the program due to a trouble condition. A unit can also be placed out of service by maintenance TTY request for the purpose of replacing a reel of tape or performing routine maintenance of the tape transports.

2.07 Lamps on each tape transport indicate the status of the AMA unit. In addition, a lamp is dedicated to the AMA unit in the system status area of the maintenance administration center (MAC) control and display panel. This lamp (red) lights whenever the off-line unit is not ready for service or the door is open on the active unit.

2.08 On a periodic schedule, usually every 24 hours, AMA operation is automatically transferred from the active to the standby tape transport. (A transfer label is recorded during an AMA unit transfer as scheduled in the call store traffic work table. The time and date of the transfer and an office identity code are included in the entry on both tapes.) At this time, the tape reel containing the recorded information for the previous period can be removed and a new reel of tape installed. Storage areas for reels of magnetic tape should be located away from ***magnetic fields caused by alternating or direct current sources.*** These sources include high current buses, rectifier units, electric motors, and relay banks. Tapes should be kept away from ***permanent magnets.*** Tapes should always be stored in their dustproof plastic canisters and positioned vertically in a storage bin. Storage bins equipped with partitions between each reel are recommended.

Caution: To prevent tape damage, extreme care and proper instructions must be observed when physically handling reels of AMA magnetic tape.

2.09 Recorded AMA tape must be properly labeled before being shipped to the accounting center.

2.10 The active AMA tape transport operates incrementally, stepping and recording each time data is received from the AMA buffer which is located in the No. 2 ESS call store (CS). This method of program and tape transport operation allows AMA billing information to be recorded without the necessity of storing a large amount of data in call store.

TAPE TRANSPORT

2.11 The incremental tape transport is used to record customer billing information. Recording is done in a 9-track format. The complete write-head assembly contains nine separate write heads positioned side by side which simultaneously write nine bits of data across the width of the magnetic tape. Tape characters are recorded at 200 characters per inch of magnetic tape. The operation of transferring a character onto tape is accomplished by the central processor commanding the transport to step, which causes the magnetic tape to be physically moved

under the write head. The data written onto the tape are transferred to the magnetic tape during the period that the tape is moving from its rest position to its next rest position.

2.12 Information written onto tape is placed there in a format compatible with the standards currently used in Bell System EDP centers. Actual data characters are written in blocks of approximately 500 characters, although the initial entry on a new tape and the final entry (tape identity) may have a block as small as 19 characters.

2.13 The billing information for any particular call is recorded onto tape in three entries. The first entry (initial entry) is placed onto tape when the customer has completed dialing. The second entry goes onto tape when the called party answers (answer entry), and the third entry is put onto tape at the termination of the call (disconnect entry). Since the three entries defining a single call could be widely separated by their physical location on tape, each entry is labeled with a call identity index (CII). The three entries for each call are later combined at the data processing center to obtain all the billing information and the elapsed time for each individual recorded call. This triple entry (or multientry) system of recording billing data is similar to that used in existing electromechanical systems. It is advantageous from the central office switching equipment standpoint since it does not require large amounts of data to be stored in temporary memory (call store) for all calls that are in progress. Instead, each phase of a call can be recorded onto magnetic tape as it takes place in the central office.

2.14 The AMA equipment, from a system concept, is considered a piece of peripheral equipment and therefore is addressed from the central processor by means of the peripheral buses which are shared by many other types of equipment. Communication in the reverse direction from the AMA equipment to the processor is accomplished by the use of scan points.

2.15 In the normal sequence of writing a data character onto tape, the 9-bit tape character is sent to the AMA equipment via the peripheral unit address bus. After the tape transport has recorded the information onto tape, the same nine bits that the recorder has written are displayed on nine scan points so the processor can verify that the data sent to the AMA equipment matches the data that have been recorded on the tape.

3. RECORDING ENTRIES

A. Multiple-Entry System

3.01 The No. 2 ESS AMA operates on the multiple-entry system of customer billing. This system is similar to most electromechanical AMA systems and is preferable for No. 2 ESS because it allows data to be recorded using a minimum of call store memory. The principal entries for this type of customer billing are the minute entry, the initial entry, the answer entry, and the disconnect entry.

Minute Entry

3.02 The minute entry is placed in the AMA buffer once every minute. Minute entries are recorded on the active AMA tape in the proper sequence and designate the time of day in hours and minutes (11:30, 11:31, etc.). The minute entry is derived from system data and timing information and uses 24-hour clock notations (i.e., 11 a.m. is recorded as 1100 hours; 11 p.m. is recorded as 2300 hours). Answer and disconnect entry times are computed at the data processing center by adding the answer/disconnect time (in seconds) to the preceding minute entry.

Initial Entry

3.03 After determining that a call requires AMA billing, the AMA program assembles the necessary information for an initial entry. The entry is packed into the 128-word (64 words for L0-1, Issue 3.3 and earlier) AMA buffer, located in call store. A number of retries are attempted if the buffer is full on the first attempt. If all retries fail and the active AMA is operating normally, a detail billed call (3.08) will be stopped, and the AMA buffer overflow register (BSM-30) will be scored. A message rate call (3.07) under this condition will be allowed to complete free of charge. When the initial entry for an AMA call has been placed in the buffer, a bit in the associated stable terminal memory record (TMR), located in call store, will be set to indicate that answer and disconnect entries are required.

3.04 An initial entry contains the following information:

(a) ***Entry Identifier:*** The entry identifier designates the call as a multientry type.

(b) ***Entry Code:*** The entry code identifies the call type (i.e., directory assistance, test call, WATS, centrex, etc.).

(c) ***Call Identity Index:*** As mentioned in 2.13, the call identity index identifies the particular call.

(d) ***Information Digits:*** The information digits indicate whether a call is AMA recorded for a traffic sample or service observed.

(e) ***Service Feature Digits:*** The service feature digits indicate that the AMA recorded call originated from a coin line, hotel-motel line with a message register, or a line with a specific custom calling feature.

(f) Calling Number.

3.05 In any No. 2 ESS installation, there are three basic initial entry AMA formats which are used to record calls. The first format type is used to record message rate calls, the second type to record any call requiring detailed billing, and the third type for detail billed message rate calls. In addition to the basic data recorded for each of these formats, the calling numbering plan area (NPA) may also be recorded for all calls. This is an office option and, along with the type of entry required for each office code or NPA from which routing of the call is determined, is entered into translations by the network administrator. Instructions for making these assignments are contained in the Translation Guide, TG-2H, Division 4, Preparation of Forms, and Division 5, General Office Translations.

3.06 All initial entries are basically similar, the main difference being the quantity of data required to fully define the call. The type of initial entry format to be recorded for each call is determined by the billing information associated in translations for the called NPA and/or office code (NNX). The following paragraphs define various initial entries including message rate, detail billed, and detail billed message rate calls.

Message Rate Calls

3.07 In the message rate entry, a message billing index (MBI) is used to identify one or more office codes which will receive the same billing in the form of message units. Since the called number is not recorded on the AMA tape, this type of entry can only be used when bulk billing for all message units is used.

Detail Billed Calls

3.08 If the called directory number and NPA are required to correctly bill a call, then the detail billed entry is required. In this format, the called NPA and called directory number are entered in place of a message billing index.

Detail Billed Message Rate Calls

3.09 The detail billed message rate entry is only used when specifically requested via a TTY request. There are three separate requests that may be entered into the system. Two of these requests are for coin and message rate lines marked "complaint observed," where customer dissatisfaction with service or billing treatment has been identified. The third request is for all message rate lines. These requests are as follows.

(a) ***Complaint Observed Coin Calls:*** Coin calls are not normally recorded on LAMA tape. However, when a complaint observed request is implemented, all coin calls from coin lines with a complaint observed indicator set in translations are detail billed.

(b) ***Complaint Observed Message Rate Calls:*** This request causes all message rate calls from message rate lines with the complaint observed indicator set in translations to be detail billed with the called NPA and directory number in addition to the message billing index. Only those message rate calls which would normally be recorded are entered on the tape.

(c) ***Detail Bill All Message Rate Calls:*** This request causes all normally recorded message rate call entries to include the called NPA and directory number in addition to the message billing index.

Most Economical Routing

3.10 Most economical routing (MER) is a routing arrangement whereby the switching machine selects the most economical route when a centrex extension dials a specified access code prior to dialing a toll call. MER calls are allowed to select various WATS bands, foreign exchange (FX) facilities, common control switching arrangement (CCSA) trunks, or the local exchange network. The use of WATS trunking provides complete billing detail including calling station identification. Since different rates are charged on different WATS bands, it is necessary to provide a WATS band indication, in addition to the calling station identification, on the AMA tape. When WATS is used in association with MER, the WATS band indication is furnished by the message billing index.

Directory Assistance

3.11 Offices having either the LO-1, Issue 4 or later, or EF-1 program may elect to enter directory assistance (411) calls on LAMA tape. These tape entries, when made, could be used for either billing or traffic study purposes. A dedicated entry code is defined for LAMA tape identification of directory assistance calls.

CCSA, Tie Trunk, And FX (MER)

3.12 CCSA, tie trunk, and FX (MER) entry types are normally considered traffic samples and are therefore not charged.

Answer Entry

3.13 The answer entry for an AMA billed call is recorded after a 700-millisecond charge delay following the reception of called party answer supervision. At this point, the billing time for the call is initiated. The entry contains the call identity index assigned to the call and the number of seconds since the last minute entry.

Disconnect Entry

3.14 The disconnect entry for an AMA billed call is recorded when the call is terminated. The billing time for an AMA call is the time lapse between associated answer and disconnect entries. A disconnect entry contains the call identity index assigned to the call and the number of seconds since the last minute entry.

Timed Disconnect Entry

3.15 A timed disconnect entry is placed on the AMA tape in the event that the calling line fails to disconnect within a specified interval after the called line disconnects. After the time-out period, the timed disconnect entry is recorded on the active AMA tape. This entry serves as the disconnect entry for the timed-out call. The entry includes a timed disconnect identifier code, the call identity index of the timed-out call, and the number of seconds since the last minute entry.

Change Entry

3.16 For the EF-1 generic program, the call identity index will remain unique to a call as long as the call is in progress (including custom calling feature calls). In the LO-1 generic program, the CII could change during a call if the call involves the call waiting, the 3-way calling, or the call forwarding feature. The change entry is used during the processing of a call whenever it is necessary for the system to change the junctor being used for the talking connection of a call. For example, this is the case when a third party served by the same office makes a call to a line with call waiting service and the line with call waiting service has been involved in either end of a billable call. All three parties are connected to a conference circuit causing the junctor that serves the billable portion of the calls to be changed and requiring a change in the call identity index.

B. Special Classes and Entries

Coin Line and Administrative Calls

3.17 AMA entries are required on some coin calls for division of revenue and for tax purposes. Coin calls follow the normal 3-entry pattern with additional information in the initial entry for coin identification. Certain administrative entries are required for purposes such as fraud prevention on information calls. The format for these calls follows the normal 3-entry pattern with appropriate identifier codes in the initial entry.

Call Forwarding

3.18 For LO-1 offices, call forwarding is not allowed on AMA recorded calls. This implies that any given call (regardless of the number of call forwards involved) never requires more than

one triple-entry record on AMA tape. This means that message rate lines where all calls are AMA recorded cannot be offered call forwarding.

3.19 For EF-1 offices, each leg of a call-forwarded call can be individually billed (up to a maximum of three billed legs per call). If B forwards a call to C and A calls B, A is billed for the A-to-B leg, and B is billed for the B-to-C leg. Each billed leg has an initial, answer, and disconnect entry. Thus, when C answers, it is necessary to make two answer entries, one for the A-to-B leg and one for the B-to-C leg. The same treatment applies for disconnect.

C. Determination of Capacity

3.20 The capacity of the automatic message accounting equipment in No. 2 ESS is dependent upon the number of calls to be recorded on the AMA tape, the type of initial entry required for each call, and the percent of the billable calls on which answer supervision will be received. Consult Traffic Facilities Practices, Division D, Section 12-g(3).

4. AMA CONTROL

4.01 Both the active and standby AMA units are under program control during normal operation. Manual control, however, can be exerted via maintenance TTY request over certain aspects of the AMA operation for various purposes. These purposes include loading and unloading AMA tape (refer to Bell System Practices, Section 232-112-301), changing the call store traffic work table AMA schedules (refer to Bell System Practices, Section 232-120-301), detail billing of bulk billed customers for complaint observing purposes (refer to the Input Message Manual, IM-2H200, for A RC L and M AM OBS TTY messages), and diagnostics or service removal via maintenance TTY request (refer to the Input Message Manual).

AMA CONTROL PANEL

4.02 The AMA control panel is used to manually operate both tape transports. The control panel is located in the center of the single-bay AMA frame between the two tape transports and provides manual pushbutton control of both tape transports. Manual control allows removal of old tape and loading of new tape during a tape-changing interval. In addition, various test jacks and alarm lamps are provided on the AMA control panel.

4.03 Manual controls on the panel provide for fast-forward, rewind, and stop operations.

5. ALARMS

5.01 The normal condition for the AMA frame is for one AMA unit to be active and recording calls and the other unit to be in standby and ready for service. A lamp, dedicated to the AMA in the system status area of the maintenance administration center control and display panel, lights whenever the AMA frame is not in the normal condition (2.06) or the door is open on the active AMA unit. Unless caused by TTY request, there should always be an office alarm and a TTY printout at the maintenance administration center when this lamp lights.

5.02 A blown fuse in either AMA unit causes a fuse alarm and an office alarm. The PWR OFF lamp on the AMA control panel and an aisle lamp light during a blown fuse condition.

5.03 A major recording failure in the active AMA results in an AMA transfer, AMA diagnostics on the failing unit, and a resulting TTY diagnostic printout.

5.04 If a transfer is not possible due to a failure to find a working AMA, the AMA program allows all calls dialed after this point to continue without AMA billing. The AMA buffer is closed to initial entries. Minute entries and answer and disconnect entries for calls now in progress (which have at least one entry in the buffer or on tape prior to the transfer attempt) are placed in the buffer until it is full. In addition, a working mode failure TTY message is generated which indicates that the program is unable to find a working AMA and that calls are now being allowed to continue without AMA billing. Both AMA units remain in the out-of-service state until one can be manually or automatically restored to enable the resumption of AMA recording.

5.05 When a system initialization at least as serious as a transient clear has occurred, the entire AMA control area is cleared. The AMA buffer is cleared, and the AMA bits contained in the terminal memory record are reset to prevent a disconnect entry on a call whose initial and answer

entries were in the buffer. All of these actions during a transient clear are taken to help eliminate any possibility of overcharging a call.

5.06 Once the AMA control area has been cleared, an AMA initialization message is printed, and the AMA trouble light is illuminated. When the system recovers, recording begins on AMA unit 0. (If AMA unit 0 is inoperative due to some condition such as power off, an attempt is made to switch to AMA unit 1.) The active AMA unit accepts the next entry loaded in the AMA buffer, as all previous entries have been discarded.

6. NETWORK LIMITATIONS WITH LAMA

6.01 In offices using the LO-1 program, the call identity index represents the number of the junctor used in the call. (As previously mentioned, if the junctor is changed during the progress of a call after the initial entry has been made, a special entry is made on the AMA tape indicating a change in the call identity index.) The call identity index may range in value from 0000 to 2999; this necessarily limits the number of junctors in the system to 3000. Due to this junctor restriction, if LAMA is provided, offices with LO-1 programs are limited to 11 line trunk networks (LTNs).

6.02 In offices using the EF-1 program, the call identity index remains unchanged; once selected, it is used for the duration of the call and, additionally, is not a limiting factor in the number of junctors in the system. Offices without centrex may have up to 15 line trunk networks, while offices with centrex are limited to 12 line trunk networks.

7. REFERENCES

7.01 The following references provide additional information concerning automatic message accounting.

(1) Translation Guide, TG-2H, Division 4, Preparation of Forms, and Division 5, General Office Translations

(2) Traffic Facilities Practices, Division D, Section 12-g(3), July 1973, Automatic Message Accounting

(3) Bell System Practices, Section 232-112-101, Issue 2, Automatic Message Accounting Description

(4) Bell System Practices, Section 232-112-301, Issue 2, Automatic Message Accounting, Tape Loading and Unloading Procedures

(5) Bell System Practices, Section 232-120-301, Issue 2, Traffic and Plant Measurements

(6) PD-2H113, Issue 3, Automatic Message Accounting Program

(7) PD-2H132, Issue 3, Automatic Message Accounting Maintenance Program

(8) Output Message Manual, OM-2H200

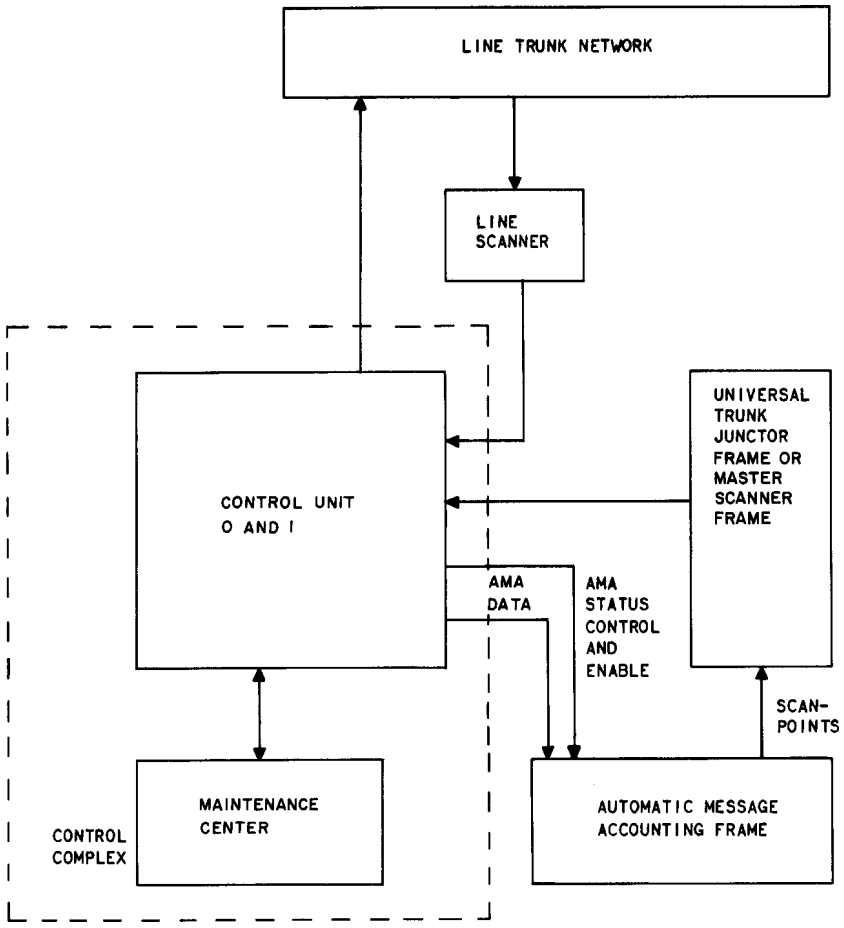

Fig. 1—Block Diagram—No. 2 ESS Automatic Message Accounting

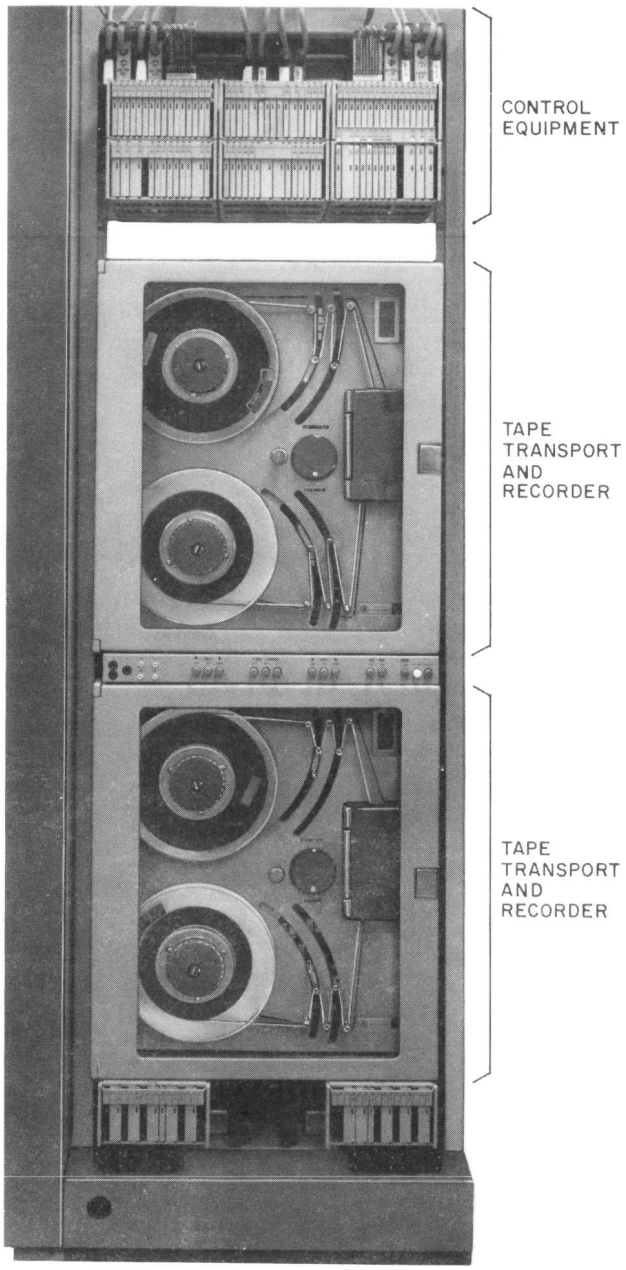

Fig. 2—No. 2 ESS AMA Frame