SWITCHING SYSTEMS MANAGEMENT

NO. 5 CROSSBAR (2-WIRE)

OPERATIONAL FEATURES

LOCAL AUTOMATIC MESSAGE ACCOUNTING—COMPUTERIZED (LAMA-C)

NOTICE

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CONTENTS   PAGE

1. GENERAL

1.01   Local Automatic Message Accounting—Computerized (LAMA-C) is a method for obtaining detailed billing information of customer-dialed calls directly from the marker and trunks.

1.02   Whenever this section is reissued, the reason will be listed in this paragraph.

1.03   LAMA-C utilizes a high-speed computer to replace the equipment normally required for recording calls by paper tape. The LAMA-C equipment, which collects, analyzes, and assembles call details, is located at the central office (CO). Assembled calls are recorded and forwarded by data link to the No. 1 Automatic Message Accounting Recording Center (AMARC). The AMARC automatically records call details on magnetic tape.

1.04   Figure 1 shows a block diagram of a typical LAMA-C installation. (This diagram does not show the Automatic Number Identification (ANI), the Automatic Identified Outward Dialing (AIOD), or the Remote Message Register (RMR) features.) The system uses two Digital Equipment Corporation (DEC) computer complexes, each containing its associated peripheral equipment, one as the active recorder and the other as a full-time standby system. Each system includes a control circuit which provides system control and determines which processor is on-line and a distribute and scanner (DAS) circuit which serves as the interface between the computers and the No. 5 crossbar office.

1.05   Each computer subsystem tracks the progress of all calls, from the initial completing marker usage until either abandonment or disconnect occurs. Pertinent data for billing purposes is obtained by scanning the markers for *initial entry* information and the associated trunk circuits for *answer and disconnect*. The active or on-line processor then assembles the call information into single-entry format, and the completed call records are forwarded through dedicated voice-grade data links to the AMARC for centralized recording on 1600 bits per inch (BPI) industry compatible, 9-track magnetic tape.

1.06   Reliability to protect against a single data link failure is achieved by providing a dialed backup data link for use in the event of a dedicated data link failure.

1.07   The system is arranged to provide ANI, an interface to AIOD equipment, and message register operation with multiple registrations for multiunit calls for motel/hotel determination of guest billing. Interface circuits are required for these features which can no longer be provided electromechanically due to the removal of the AMA message register options. The system does not provide a Centralized Automatic Message Accounting (CAMA) function for tributary offices.

2. SYSTEM OPERATION

A. General

2.01   The general flow of call information is shown in Figure 2. The processor complex scans the markers and trunks several times a second in search of new information. When it is determined that the completing marker is setting a connection to any trunk arranged to handle recordable calls, the call details are read into the processor. The trunk involved is identified by the trunk link frame, trunk block, and trunk select present in the marker at that time. The trunk location information is translated into the address of the core memory location assigned as a *trunk register* for this trunk. The called number received from the marker scanning process is stored in this trunk register at this time.

2.02   The line equipment location obtained from the marker is translated to a calling (or

billing) number by the use of the line translation table as shown in Figure 2. The billing number is then stored in the trunk register portion of the core memory.

2.03 The line translation table also provides the billing class of the calling line. The billing class and the called area and office code are combined with miscellaneous other information to determine the type of call and the Message Billing Index (MBI). These are stored in the trunk register also. The initial entry information is now complete.

2.04 When the trunk scanning function recognizes that a call has been answered, the time at which the event occurred is stored in the trunk register. There is a fixed correspondence between the scan point representing called party answer on a given trunk and the memory address for the trunk register of the trunk; therefore, no translation is required when the time of a called party supervisory change is entered into the trunk register.

2.05 When calling party disconnects, the trunk scanning function detects the event and records the time in the trunk register. All the information required for billing the call is now complete. After the trunk is released, the call record is formatted and transmitted to AMARC. Fig. 2 shows a typical call record format. (See Bell System Practices Section 218-798-102.)

2.06 The customer is considered to have answered if the call off-hook supervisory signal persists at least 2 seconds. The charging interval ends when the calling party disconnects. The system includes all timing adjustments required internally for delays, clock granularity, etc, so that the accounting center does not have to make any further adjustments.

B.   Duplicated Processor Operation

2.07 The LAMA-C System includes two independent computer complexes interconnected to operate as a duplicated system. The computers function independently, each detecting and tracking a call by identical call processing algorithms until the call terminates. At that time the active computer assembles and stores the call record for forwarding to the AMARC. The two computers remain in their respective active and standby states until some maintenance or trouble condition occurs to change these states.

2.08 The computers are interconnected through the control and console circuit for system control and through the processor communications channel for intersystem communications. The control and console circuit maintains and displays the status of each system. The control panel containing this display also contains provisions for manually changing the status of each computer, eg, from standby to active.

2.09 Each of the two systems maintains the time of day for recording answer and disconnect times and other miscellaneous purposes. This time is checked and reset, if required, in both systems from a time signal received hourly from AMARC specifically for this purpose. Time verification and resetting is not required internally at the LAMA-C office.

2.10 After the call details have been assembled into the correct call record format, a block of call recording data containing a minimum of two and a maximum of four call records is assembled for transmittal to the AMARC through data link for recording.

C.   Data Link Communication With AMARC

2.11 All normal communication between LAMA-C and AMARC will be conducted over dedicated data link facilities. Arrangements are provided for a maximum of four dedicated data links. A dialed backup data link is provided to allow AMARC to gain access to LAMA-C through the Direct Distance Dialing (DDD) facilities in the event of a dedicated data link failure.

2.12 All unassigned disk memory is used for temporarily storing call records during any interruptions in data link transmission. This disk capacity provides for a minimum of 1000 call records which is equivalent to the average call carrying capacity of one data link for six minutes during the average busy hour.

2.13 Each data link facility connects to both computer systems as shown in Figure 3. Only the active system will be operating with these facilities. The control and console circuit monitors the status of both systems and maintains the connection between the active system and the data link facilities.

2.14 The data links operate in an asynchronous mode with a data block transmitted from LAMA-C only in response to a polling message from AMARC. After transmitting a data block, LAMA-C will wait for a new polling message from AMARC before sending a new data block. In the event AMARC detects an error within a data block, it will request retransmission of that data block. If LAMA-C does not have call record data to send in response to a request for new data (polling message), a *no data* message will be transmitted indicating this condition.

D. IN And OUT (I/O) Communications

2.15 Two system I/O terminals are always provided; up to four optional terminals may also be provided. Locations for the optional terminals are usually the Master Test Frame (MTF) and the Main Distributing Frame (MDF). Normally the MTF location would be used for testing and maintenance functions and the MDF location would be used for entering recent change data. (See the Bell System Practices, Section 218-798-305, for recent changes, formats, and procedures.)

2.16 Input commands and requests can be entered only from dedicated terminals (except the system terminal, from which any command or request may be inputted). Acknowledgments to these commands and requests are returned only to the terminal from which the input was entered.

2.17 The release of working equipment to Western Electric for wiring and testing during heavy load hours should be carefully studied. Depending on equipment loading, it may be necessary to schedule this work during light load hours.

3. FEATURES

A. Remote Message Register (RMR)

3.01 When a call originates that requires the RMR feature, the processor identifies this line from the billing class in the line translation data base. The combination of this billing class and MBI associated with the code dialed allows the processor to determine the initial and overtime intervals and the number of register operations required for each interval. There is no provision for varying the number of register operations with the time of day. There is no remote scoring for

calls from RMR lines to either 411 or 555-1212 local directory assistance.

B. Automatic Number Identification (ANI)

3.02 Two interface circuits (program controlled transverter circuits) are required per marker group to provide the control between the transverter connector and DAS circuit when ANI is required. These interface circuits appear as ANI tranverters to the transverter connector and can each serve call requests from senders independently and simultaneously.

3.03 When a call originates that requires the use of the ANI feature, the completing marker will select a trunk that will be identified to the processor as a non-AMA trunk. In this case the trunk is not scanned and no further processing of the call will take place. However, since the sender requires the identity of the calling line, it will request this translation via the transverter connector. The transverter connector will select one of the two interface circuits and complete a connection between this circuit and the sender. The sender will ground leads corresponding to the calling line equipment number. The processor will use this number to interrogate the line translation data base and obtain the calling customer's billing number. This number is returned to the sender; and after determining that the number was correctly registered in the sender, a release is initiated.

C. Automatic Identification Outward Dialing (AIOD)

3.04 Two PBX-AIOD buffer control and connector circuits are required to function between LAMA-C and the AIOD translator. These interface circuits appear as ANI outpulsers to the AIOD translator.

3.05 When a call originates that requires the use of the AIOD feature, the LAMA-C System will process this call normally until the processor interrogates the line translation data base to obtain the billing class and directory number. If the line is identified as an AIOD customer's line, the processor will seize an idle interface circuit. In the meantime, the processor will obtain the identity of the particular AIOD translator to which the PBX trunk was assigned. A 4-digit trunk number corresponding to the PBX trunk over which the call was originated is then transmitted to the appropriate AIOD translator. After the AIOD

translator receives the PBX station number from the station identification circuit, this number is returned to the processor which will then store it in the system trunk register corresponding to the trunk circuit selected by the marker. The LAMA-C System will then continue normal call processing.

3.06 The LAMA-C System can apply either message rate or flat rate billing class treatment to an AIOD call on a per-AIOD line basis, but not on a per-AIOD station basis.

3.07 The LAMA-C System is not arranged to block (reorder) calls in the event of AIOD failures (that is, any failure by LAMA-C to obtain the identity of the calling PBX station). When LAMA-C is unable to obtain the identity of the PBX station, the call will be billed to the Listed Directory Number (LDN) or a special trouble number contained in the line translation data base.

3.08 In those cases where AIOD calls are routed to a remote location for recording via the ANI feature, LAMA-C is arranged to handle AIOD failures in one of two ways:

(a) The LDN or special trouble number will be returned to the sender or

(b) The call will proceed as an identification failure and an operator (CAMA operator) will be called to identify the calling station.

3.09 Where special routing is not involved, the addition of LAMA-C eliminates the need for the AIOD class identity in the line link. This identity is contained in the line translation data base. Also, LAMA-C provides for flexible AIOD line assignments. The restriction of AIOD lines to three vertical files within a vertical group and of ring party lines only in the vertical group no longer applies.

D. Centralized Recording Of Billing Data

3.10 LAMA-C offers the features associated with centralized magnetic tape recording. These include the elimination of paper tape, message register processing, and call record assembly, since LAMA-C records are in single entry format.

E. Change To Customer Billing Class

3.11 The customer's billing treatment is maintained by LAMA-C on a *per line* basis within the line translation data base. Since the line link frame class of service is no longer used for billing treatment purposes, it is not necesssary to change the customer's line link frame location to change the billing class. However, where different trunk routings are required by different billing classes, it will be necessary to move the customer's line location. For example, toll calls from 4-party customers must be routed to CAMA on an operator-identified basis whereas 2- and one-party customers will be billed via the LAMA-C System. Also, if it is necessary to distinguish flat rate and message rate customers to the "0" operator, distinct routing classes will need to be maintained.

3.12 The equipment number to directory number translation cross-connection work in the AMA translators is no longer required. This translation is provided by LAMA-C on a *per line* basis within the LAMA-C line translation data base.

F. Data For Traffic Study

3.13 Refer to the Traffic Facilities Practices, Division D, Section 8, and the Bell System Practices, Sections 218-798-302, -303, and -310. LAMA-C is arranged to provide a printout of various network measurements as call process counts. (See Table A.)

3.14 Table A lists the following:

(a) The counts provided from LAMA-C by categories.

(b) The type of operation for each count.

(c) The counts that relate to traffic operations.

(d) The counts recorded by both computers, regardless of their status.

3.15 LAMA-C is not arranged for prescheduling of the traffic busy hour. An automatic daily printout will occur at 1 AM on both system terminals. On demand, printouts may be requested manually by a message at one of the system terminals located in the office. The measurements are cumulative. To obtain the measurements for an hour, the printout must be requested at the

beginning and the end of the hour and the readings subtracted. A printout will be provided immediately upon request.

Traffic Sampling

3.16 Traffic sampling is a feature that permits AMA records to be made on certain types of calls. The information obtained by sampling may be used as a basis for allocating revenue within and beyond certain geographical areas or as required by common control switching arrangement (CCSA) networks.

3.17 Prior to LAMA-C, traffic sampling was available on a customer group basis (class of service) or on a trunk group basis. In offices arranged for LAMA-C, traffic sampling will be done only on a trunk group basis.

3.18 When traffic sampling is to be applied to a trunk group, it is necessary to invoke the condition via a recent change (see Bell System Practices Section 218-798-305, Recent Changes and Recent Change Tests, Formats, and Procedures) for each trunk, entering a trunk class of service (TRK CS) 03, which indicates traffic sampling. The trunk must also be arranged for trunk scanning.

3.19 The percentage of sampling is controlled by setting the number of trunks in the trunk group to a sampling trunk class. The accounting center should specify the percentage of trunks to be used for this purpose.

G. Observing Facilities

3.20 Service and complaint types of observing facilities are provided in No. 5 crossbar LAMA-C offices.

Service Observing

3.21 Service observing is used to determine the grade of service customers are receiving. Calls are observed by an observer at a central observing station. Observed calls recorded by LAMA-C are indicated within the respective call record.

Complaint Service Observing

3.22 If a customer complains that his local service bill is incorrect, Commercial may place his telephone number on complaint observing to verify the bill for the next month. Commercial sends a form to Network Maintenance listing the telephone numbers they want complaint observed. Network Maintenance inputs this information via a recent change message at a system terminal. The processor marks these calls as complaint observed. A detailed record is made for each observed charge call originated at the customer line.

H. Electromechanical Equipment Not Required

Electromechanical Recording Equipment

3.23 During the installation of LAMA-C, Western Electric Installation will run a Line Translation Table data base generation program. The program is generated by using the processor to interrogate the AMA translators and number group circuits via a computer line verification access unit. After the line translation data base is loaded, the conventional electromechanical AMA equipment normally required for calls recorded on paper tape is no longer needed. Existing AMA translators, call identity indexers, transverters, recorders, and perforators may be removed.

3.24 Once an office is equipped with LAMA-C, the equipment associated with message registers is no longer needed. This includes message registers, the power supply for register operation, and message register test equipment.

3.25 If it is necessary for LAMA-C to provide the calling party line equipment to calling party number translation for any feature associated with ANI, such as Traffic Service Position (TSP) or Traffic Service Position System (TSPS), the transverter connectors *must not* be removed. To provide ANI with LAMA-C, program-controlled transverters are installed. These circuits are the interface between the existing AMA transverter connector and the LAMA-C distributor and scanner. Options in the markers and senders required for ANI should also be retained.

3.26 Floor space requirements for LAMA-C equipment range from 150 to 200 square feet. Sender holding times are lower since they are not required to perform the AMA function. Also, sender holding times will be reduced since the sender is no longer required for initial entries on IAO calls. Less expensive trunks and senders

are required since the AMA and message register options are not needed.

4. TESTING AND MAINTENANCE

A. General

4.01 Testing and maintenance arrangements for the LAMA-C System are provided in two basic categories:

(a) Arrangements for testing the interface circuits between the computer system and the associated No. 5 crossbar circuits are provided either from the No. 5 crossbar master test frame or from the LAMA-C System I/O terminals.

(b) Diagnostic programs are provided for fault isolation and can be run when a computer system is in the *maintenance busy state only.*

4.02 The LAMA-C System is also arranged to provide detailed error message reports via the system terminals when an error is detected during call processing. These error reports are designed to isolate troubles to a particular part of call processing and/or a hardware unit.

B. Test Features

4.03 All LAMA-C tests are described in the Bell System Practices.

Marker Tests

4.04 Arrangements are provided for a printout of the marker scan point status when a marker test is originated at the master test frame. This test is under control of a new key located on the master test frame. (See Bell System Practices Section 218-122-531.)

Trunk Tests

4.05 Lamps are provided at the master test frame to monitor the status of the trunk circuit calling and called supervision as detected by the processor. These lamps are lighted in response to a trunk test call. A printout of the marker scan point status may also be obtained during this test by simply operating a key at the master test frame. (See Bell System Practices Sections 218-247-501, 218-271-501, and 218-264-501.)

Line/Trunk Trap

4.06 This feature allows the contents of the software trunk register to be printed on the system I/O terminal after the associated trunk circuit releases. This printout occurs in response to a command placing the line or trunk on trap for maintenance observation. The printout will only be received when the call is via a recordable trunk (trunk register assigned in software to a trunk).

LAMA-C—AMARC Data Link Interface Tests

4.07 All data link maintenance is under control of AMARC. However, LAMA-C provides testing arrangements for testing the LAMA-C data link interface to isolate troubles between the computer complex and transmission facilities. (See Bell System Practices Sections 592-028-300 and 592-031-000.)

RMR Tests

4.08 These tests are performed from the system I/O terminal. They permit remote register scoring for trouble tests between the LAMA-C System and the remote register location.

ANI Tests

4.09 Arrangements are provided to test the ANI interface circuit (program-controlled transverter) from the master test frame by the same method used previously to test ANI transverters.

4.10 One difference is that a TTY terminal trouble printout rather than a trouble recorder card will be provided since the transverters are removed and LAMA-C is not arranged to interconnect with the trouble recorder. A new feature has been added for testing the overall time-out function of the interface circuit. (See Bell System Practices Section 218-798-502.)

AIOD Tests

4.11 These tests are provided from the system I/O terminal. The same basic tests are retained—that is, the short and long loop tests. Trouble records are printed on the system I/O terminal. (See Bell System Practices Section 218-798-501.)

C. Diagnostic Program

4.12 The diagnostic programs reside on cassette tape and are run only when the processor is in the ***maintenance busy*** state. Diagnostic programs are available for testing the distribute and scanner frame and all scan and distribute units in addition to the control and transfer frame.

Computer System Tests

4.13 Diagnostic programs are provided by the vendor for these tests. These programs are normally run under control of the vendor maintenance personnel. The error manual (Bell System Practices) provides guidelines for determining when vendor maintenance personnel should be called.

On-Line Trunk Audits

4.14 The system is arranged to perform audits of the supervisory elements of each trunk circuit during each trunk circuit usage. The audits verify the following:

(a) Only one trunk is assigned to a trunk register.

(b) A particular trunk is assigned to a particular trunk register.

(c) Out-of-service, repeat test, or trunk traps set in a particular trunk register are assigned to a particular trunk.

In addition, arrangements are provided for detecting trunk circuit irregularities on a ***per trunk*** basis where threshold numbers of consecutive short duration and consecutive unanswered calls have occurred. These conditions are reported immediately on all terminals as exception reports. (See Bell System Practices Section 218-798-307.)

Acceptance Test Procedures

4.15 Test procedures designed to determine if the LAMA-C System is ready for service are available. These procedures include selected Bell System Practices and operational tests in addition to call-through tests for matching the originating call details with the corresponding call record recorded by AMARC. (See Bell System Practices Section 218-798-810.)

5. SYSTEM RELIABILITY

General

5.01 Several hardware design and programming features are provided to insure a high degree of system reliability and call billing integrity. They are as follows:

(a) Two independent computer systems are used.

(b) Each system uses memory parity.

(c) Periodic audits of data bases between the two systems are performed.

(d) A hardware timer monitors each system's program cycling to protect against the effects of program or other malfunctions.

(e) The LAMA-C No. 5 crossbar interface design prevents a single fault from disabling the system.

(f) All data derived from marker and trunk scanning are checked for validity.

(g) An orderly sequence of data link commands between AMARC and LAMA-C prevents loss of data during interruptions in data communications and during switches between dedicated and dialed backup data links.

(h) A Cyclic Redundancy Check (CRC) word computed by LAMA-C for each data block insures the integrity of the billing data.

(i) A dialed backup data link is provided for use in the event of failure of one of the dedicated data links. The connection and use of the backup data link are controlled by AMARC.

(j) The system has provision for storing at least 1000 call records to protect against temporary interruptions in data communications.

6. SYSTEM CAPACITIES AND CAPABILITY

A. Central Office Equipment Required

Trunk And Junctor Circuits

6.01 Any trunk or junctor circuit capable of supplying a seizure and answer indication for AMA recording may be equipped for LAMA-C.

Computers

6.02 The foundation of a LAMA-C system is its two computers or processors. The general functions of a processor are data processing and operating input/output devices under control of a stored program.

6.03 The two processors operate in duplex configuration; ie, at any time one will be on active status, the other on standby status. Both processors collect call details, only the active processor assembles and forwards the call records to the AMARC. The standby processor is ready to take over the functions of the active processor if it should become nonoperational.

Control And Transfer Frame

6.04 The control and transfer frame contains the control and console circuit which interconnects the two processors and allows them to operate in duplex configuration. One of the main functions of this circuit is controlling the switchover of active status from one processor to the other.

6.05 The data sets for the data links are mounted on the console and transfer frame and are interconnected to the transmission facilites via the control and console circuit.

Distributor And Scanner Frame

6.06 The Distributor and Scanner (*DAS*) frame acts as an interface between the processor and the completing markers and LAMA-C trunks. Each DAS frame is equipped with various distribute and scan units which are monitored by both processors to detect changes in the state of markers and trunks. Scan units permit the central office to communicate with the LAMA-C system. Information is obtained from the equipment and trunks in the central office via scan points. Distribute units permit the flow of information from the LAMA-C system to equipment in the central office. For example, the scoring of remote message registers is achieved via distribute points.

Computer Line Verification Access Unit

6.07 The Computer Line Verification Access (CLVA) circuit is used primarily to verify cross-connections in the number group and line link frame prior to making recent changes in the line translation data base. For example, CLVA tests are made before a new subscriber station is put into service. When an office is converted to LAMA-C, the existing line verification test circuit can be removed as the CLVA performs all of its functions.

Teletypewriter Terminals (I/O)

6.08 At least one system terminal is provided for each processor. Arrangements are provided for up to four optional terminals.

6.09 The teletypewriters are used primarily for three purposes: to enter new information into the system, to perform maintenance procedures on the system, and to monitor system operation.

B. System Serving Capacities

6.10 The LAMA-C System is equipped with a maximum of five DAS frames and four dedicated data links, plus one dial backup data link. See Part 8 of this section and Traffic Facilities Practices Division D, Section 8J(5) for traffic sensitive No. 5 XBR equipment.

6.11 The LAMA-C System can accommodate an office having a maximum of 16 completing markers in two marker groups or 12 completing markers in a single marker group. The equipment arrangement provides for later rearrangement of a 2-marker group installation into two separate LAMA-C systems if required by growth.

6.12 The LAMA-C System can accommodate an office with a maximum of 3972 trunks.

6.13 The system will provide billing information for a maximum of 288 remote message register (hotel/motel) lines.

6.14 The system can forward 32,000 to 45,000 busy hour recorded call records to AMARC

over the maximum of four dedicated data links. This range depends upon the mixture of recorded toll and detail versus bulk billed message rate calls. It should be noted that a call record does not necessarily imply that the call was answered. In many cases call records are recorded for incomplete calls. For example, all unanswered toll calls during a Network Completion Study (NCS), all recorded statistical local directory assistance calls, and all unanswered observed calls are included in this category. Since these call records contribute to the system load, they must be considered in evaluating the system capacity. See Traffic Facilities Practices Division D, Section 8J(5) for the determination of traffic sensitivity.

6.15 The system can utilize a maximum of 31 office indexes (compressed office codes) and 64 billing classes. The 64 billing classes are assigned billing class numbers per Table C. The billing class indication replaces part of the class-of-service information associated with the line link frame cross-connection. Of the 64 possible billing classes, 41 are presently defined as follows:

- *16 Flat Rate*

    These flat rate classes are assigned to any one of 16 different flat rate dialing areas. Each flat rate dialing area includes a maximum of five Numbering Plan Areas (NPAs) [one Home Numbering Plan Area (HNPA) and four Foreign Numbering Plan Areas (FNPA)].

- *8 Message Rate*

    These messsage rate classes are assigned to any one of four different message rate dialing areas. These classes also determine if the customer is bulk or detail billed. Fifteen Message Billing Indexes (MBIs) are available to indicate the particular message rate charge treatment for each code dialed within any message rate area. Each message rate dialing area includes a maximum of five NPAs (one HNPA and four FNPAs). All message rate class calls are timed and recorded as timed entries. Arrangements are also provided for (a) message rate treatment [either bulk billed or detail billed] for service to certain selected office codes and (b) flat rate treatment to others, within a given message rate area. A customer may also be detail billed on the basis of the MBI assigned to the dialed code.

- *4 Coin Zone*

    Each coin zone dialing area includes a maximum of five NPAs (one HNPA and four FNPAs). This billing class is generally used for the division of revenue purposes only.

- *8 Remote Message Register*

    These classes are assigned to permit remote message register operation within any message rate area (4 bulk billed and 4 detail billed). Provisions are also included for specifying the number of registrations for the initial and overtime periods and the period length in one-minute increments up to a maximum of ten minutes for each MBI.

- *2 Wide Area Telecommunications Service (WATS)*

    These billing classes are assigned to WATS lines per the following:

    (a) Nonmeasured and Recorded

    (b) Measured and Recorded (full business day)

    Each of these billing classes can be associated with 8 bands of WATS areas.

- *1 Data Teletypewriter Exchange Service (DTWX)*

- *1 Unassigned*

- *1 Noncharged Nonbilled Station*

6.16 The system can accommodate ANI and AIOD in two marker groups.

7. SYSTEM SOFTWARE

A. Memory

7.01 Three types of memory are used in LAMA-C:

(a) Core memory is used as a storage media for part of the generic program and part of the data base.

(b) Disk memory is used to store a fresh copy of all generic programs which are core

resident and disk resident generic programs which are swapped into core for execution. Part of the data base is also stored in disk.

(c) Cassette tapes are used as backup storage for all programs and data. Cassette tapes are also used to store programs which are not coresident in the computer with the LAMA-C generic programs. (Table B shows the cassette tapes used with the LAMA-C system. See Bell System Practices Section 218-798-309 for information on generating, storing and handling backup program cassette tapes.)

B. LAMA-C System Generic Program

Operating System Program

7.02 This program is the heart of the system and provides monitoring and scheduling of other programs, clock and timing functions, and the capability to function with all system peripheral and I/O devices.

Call Processing

7.03 This program collects billing data by scanning markers and trunks, assembles a call record from this data into a single entry format, and transmits the call record to AMARC. (See Fig. 2.)

Recent Change

7.04 This program is disk resident and is used for changing customer charge treatment, customer additions, removals or changes, and office parameter data base changes.

Miscellaneous Disk Resident Programs

7.05 Some miscellaneous disk resident programs are provided that are not used during normal call processing sequences. These include the following:

- Midnight call processing

- Data base and table audits

- Maintenance and test programs

C. Installation Program

7.06 This program is maintained and used by Western Electric installation for initial system test and data base generation. After data base generation, the telephone company uses the recent change programs for all necessary data base changes. (See Bell System Practices Section 218-798-XXX.)

D. Diagnostic Program

7.07 This program is used for hardware validation at installation and for maintenance fault detection and isolation after the system is in service. It resides on cassette tape and is run only when a processor is in the maintenance busy state. It is used for testing the DAS frame and all scan and distribute units in addition to the control and transfer frame.

7.08 Diagnostic programs are provided from the vendor for computer system tests. These programs are normally run under the control of vendor maintenance personnel. (See Bell System Practices Section 218-798-306.)

E. Data Base

7.09 The system data base is composed of the following (see Part 8 of this section):

- **Office Parameter Data Base (Data Base 1)**

  This software resides in core memory and includes the necessary tables and recording feature indications to enable the operating program to retrieve the data pertaining to the No. 5 crossbar office and the customer's charge treatment to complete the billing process.

- **Line Translation Data Base (Data Base 2)**

  This software resides on disk and includes the per line equipment number to directory number translation and charge treatment data.

- **Fixed Data Base**

  The data base is always required and consists of various program table directories and pointers.

8. FORMS, CODES, AND ASSIGNMENTS

8.01 The programs developed and maintained by Bell Laboratories and used in the Digital Equipment Corporation, PDP 11/40 Computers for LAMA-C, requires that *certain information unique to a particular office be inputted into the data base prior to the turnup of a working system and maintained during the life of the LAMA-C System.* Western Electric will manually input this into the system per the direction of the operating telephone company.

8.02 The unique information required to establish a data base for a particular office is as follows:

(a) To determine DAS equipment required, the following must be known:

    (1) Quantity of completing markers in each marker group.

    (2) Quantity of LAMA-C trunks in each marker group.

    (3) Quantity of RMR lines in each marker group.

    (4) Need for AIOD and quantity of trunks.

    (5) Need for ANI.

(b) To determine the core memory requirements, the following must be known:

    (1) Quantity of translators and type (MR, FR, and CZ).

    (2) Quantity of 160 terminal trunk line frames (TLFs) with TB 0 to 5.

    (3) Quantity of 160 terminal TLFs with TB 6 to 9.

    (4) Quantity of 200 terminal TLFs with TB 6 to 9.

    (5) Quantity of AIOD trunks.

    (6) Quantity of groups of 16 RMR lines.

(c) To determine the disk memory requirements, the following must be known:

    (1) Quantity of vertical groups.

    (2) Quantity of vertical groups with 2-party lines.

    (3) Quantity of line link frames (LLFs).

8.03 The following telephone company changes in a LAMA-C office will require associated changes in the LAMA-C data base:

(a) *Trunk Changes*

    (1) Changing TB, TG, X-CONN on TLF.

    (2) Changing trunk class.

    (3) Adding, deleting, or moving trunks on TLF.

    (4) Changing scan point assignments.

(b) *Line Changes*

    (1) Adding, deleting, or moving a subscriber on LLF.

    (2) Changing subscriber billing class.

    (3) Changing subscriber billing number.

    (4) Changing subscriber service (orig only, term only, or both).

    (5) Putting a subscriber on complaint observing (or taking subscriber off).

    (6) Changing hotel/motel lines only.

    (All of the above except [4] [orig or term only does not apply], plus adding, deleting, or changing remote message register assignment.)

(c) *Number Group Changes*

    (1) Adding, deleting, or changing number group start lead assignments.

    (2) Adding or deleting a split number group.

(d) *Billing and Numbering Plan Changes*

(1) Adding or deleting an NPA or office code to the list of permissible subscriber billing numbers.

(2) Adding or deleting an NPA to the billing area (that area which at least some subscribers can reach on a nontoll basis).

(3) Changing the rate (for message rate) or the treatment (for toll and coin zone) for any office code in any NPA in the billing area.

(4) Assigning a new MBI or deleting an old one.

(5) Requesting all MR calls with a particular MBI to be detail billed (or removing the request).

(6) Changing the initial or the overtime period for a particular MBI on calls associated with remote message registers.

(7) Changing the number of the initial or the overtime period units for a particular MBI on calls associated with remote message registers.

8.04 *The data information which changes due to machine growth jobs, code rearrangement, central office index (COI) assignments, etc, are normally conveyed to the appropriate party through the network administrator.*

8.05 To acquire the necessary information to complete the data tables, the responsible persons will consult the accounting personnel, Network Design and equipment engineers, Western Electric drawings, and AMA recording information work sheets.

9. SUPPLEMENTARY REFERENCES

Bell System Practices (No. 5 Crossbar Offices Arranged for LAMA-C)

SECTION	TITLE
218-122-531	Marker to DAS Lead Verification
218-264-501	Trunk Tests, Outgoing Announcement
218-271-501	Trunk Tests, Outgoing
218-247-501	Trunk Tests, Intraoffice
218-798-000	Alphabetical Index
218-798-302	Miscellaneous Operational Procedures
218-798-303	Input Message Formats and Procedures
218-798-305	Automatically Identified Outward Dialing (AIOD), Recent Changes, Recent Change Tests
218-798-306	Diagnostic Tasks
218-798-309	Backup Cassette Tapes
218-798-310	Call Process Plant and Traffic Counts
218-798-501	Messages, AIOD Testing
218-798-502	Program Controlled Transverter (PCTV) Tests for ANI, Tests Using MTF
592-028-300	Data Sets, Maintenance—202S
592-031-000	Data Sets, Maintenance—202T
958-312-100	General Descriptive Information

Traffic Facilities Practices

Division D, Section 8-j(5), No. 5 Crossbar LAMA-C.
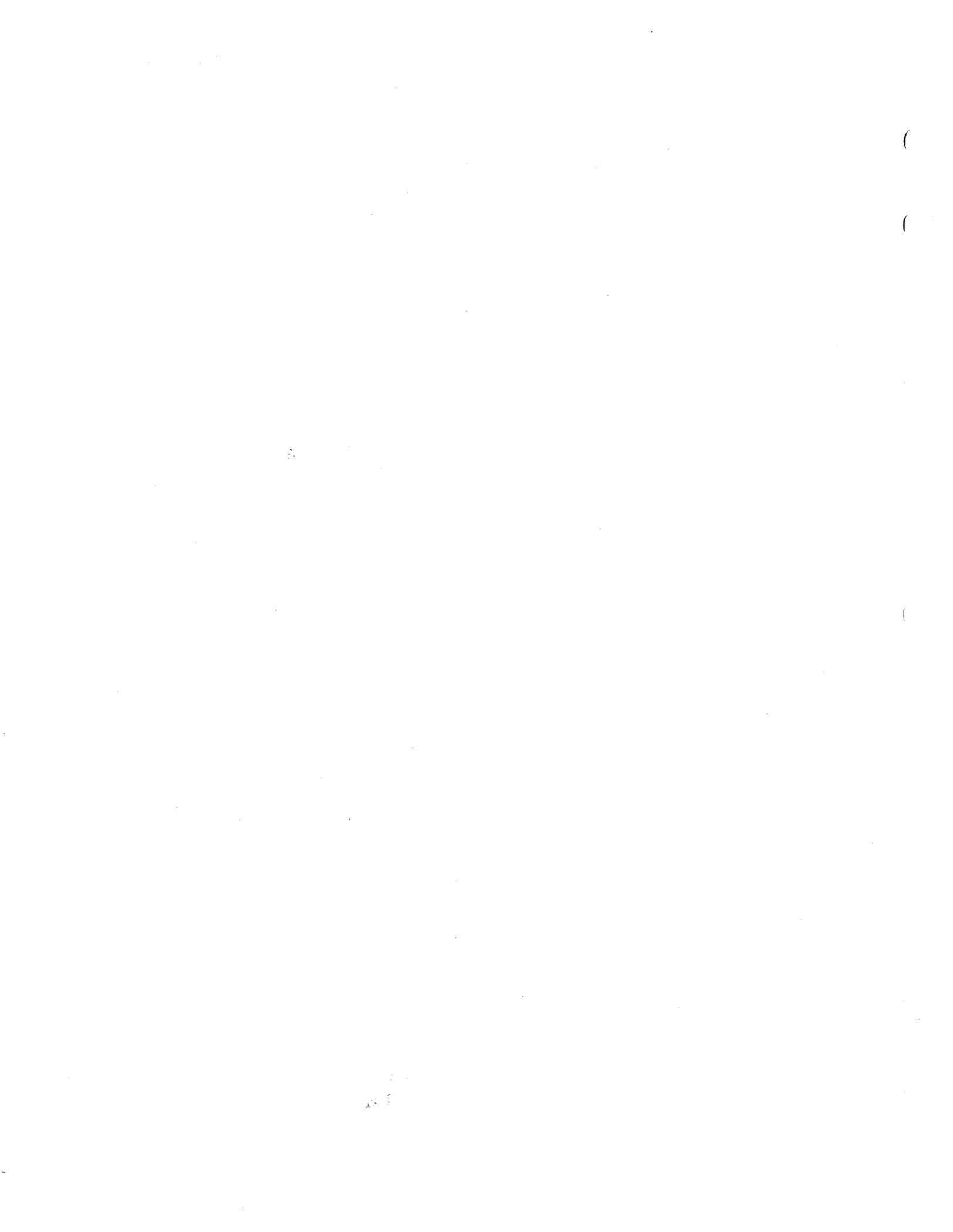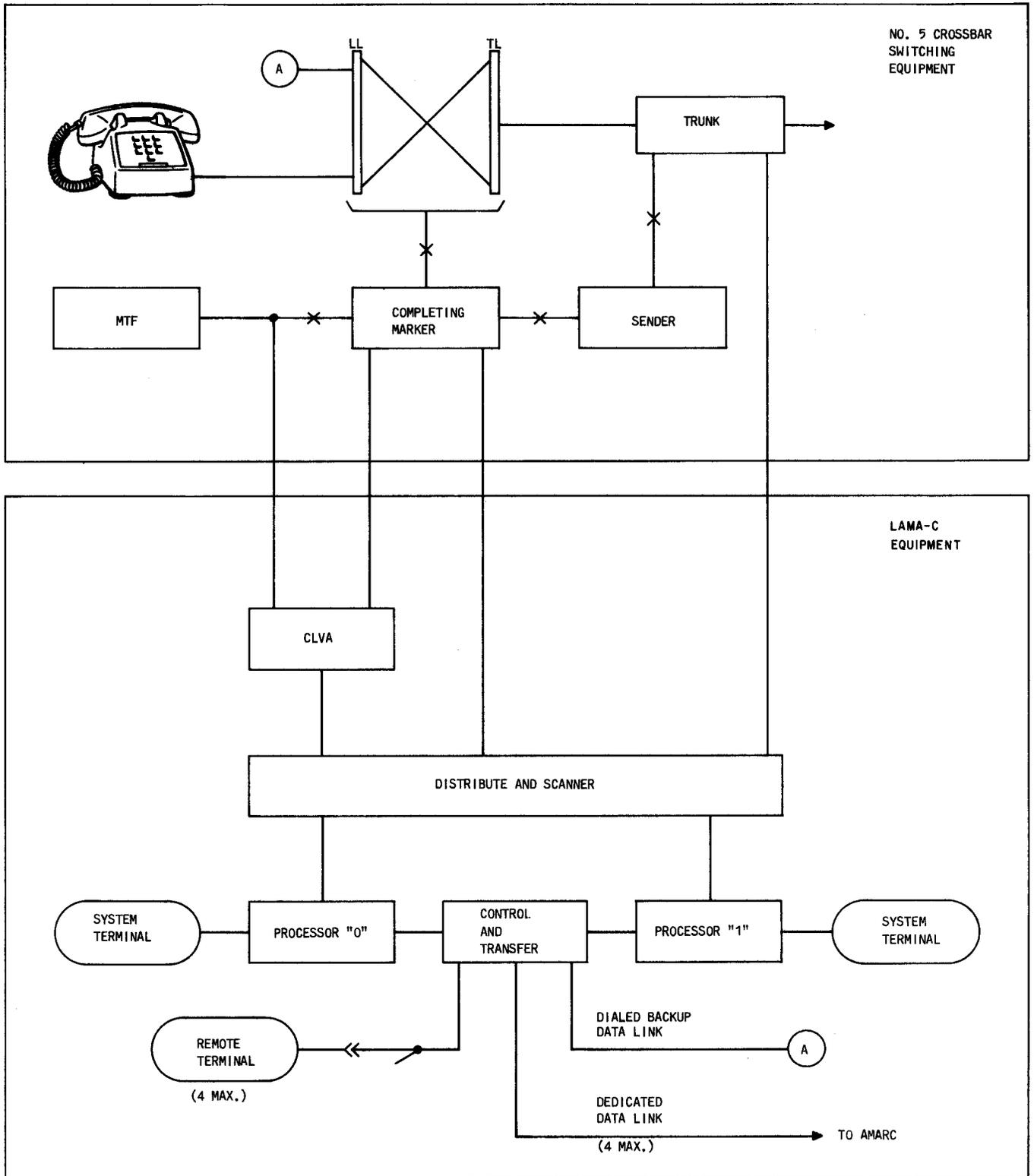
Fig. 1—LAMA-C Block Diagram

SAMPLE CALL FORMAT

V010000n20331188683934020362053516343333066614Y504n060514
TC A2   A3   B2   C   D   G J M N   Q
                                         Y

DATA GROUP	DESCRIPTION
(V)	START OF ENTRY CHARACTER
TC	TYPE CALL, (TOLL, DTWX, CCSA, WATS, MR....ETC)
A2	1ST & 2ND INFORMATION DIGITS, SERVICE FEATURES, (COIN. PICTUREPHONE®, DATAPHONE®, RMR.)
A3	CONNECT TIME
B2	CALLING NUMBER
C	MIDNIGHTS PASSED AND DISCONNECT TIME
D	CALLED NUMBER
G	MESSAGE BILLING INDEX (RATE TREATMENT)
J *	CALLING NPA
(Y)	ENTRY EXTENDER CHARACTER (ADDITIONAL INFORMATION)
M	OPTIONAL INFORMATION
N	OVERSEAS NUMBER EXPANDER
Q	TRUNK NETWORK NUMBER (TRUNK SCANNER NUMBER, ROW, AND BIT)
n	NONCHECK DUMMY

Fig. 2—LAMA-C Call Record

LL   TL

PROCESSOR (0)	202S DATA SET
	202T DATA SET

INCOMING TRUNK CKT

DIAL BACKUP
DATA LINK
FACILITY

AMARC

PROCESSOR (1)	202S DATA SET
	202T DATA SET

PRIMARY
DATA LINK
FACILITY
PRIVATE LINE

COMPUTER COMPLEX

CONTROL AND CONSOLE CIRCUIT

NO. 5 CROSSBAR SWITCHING
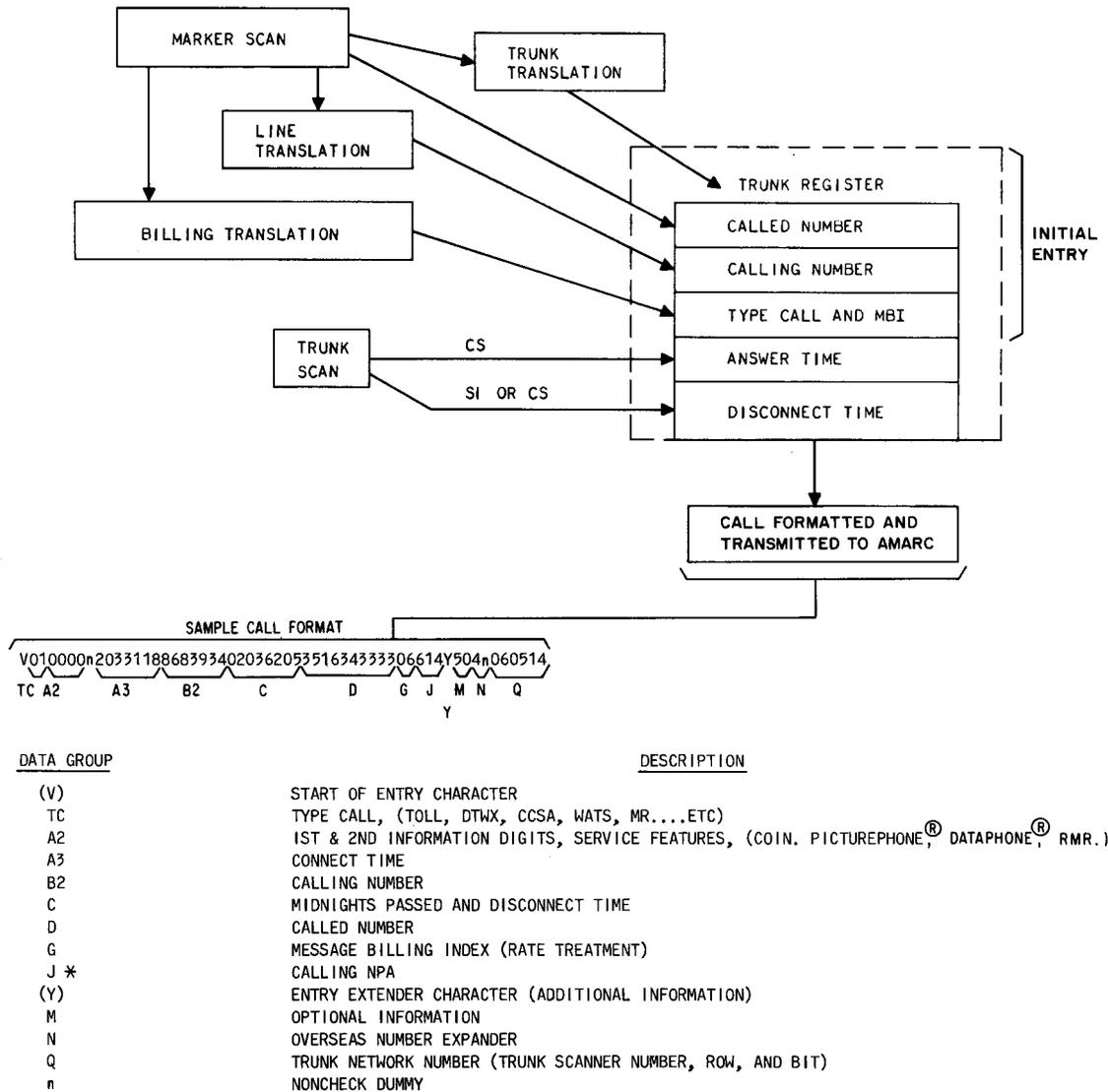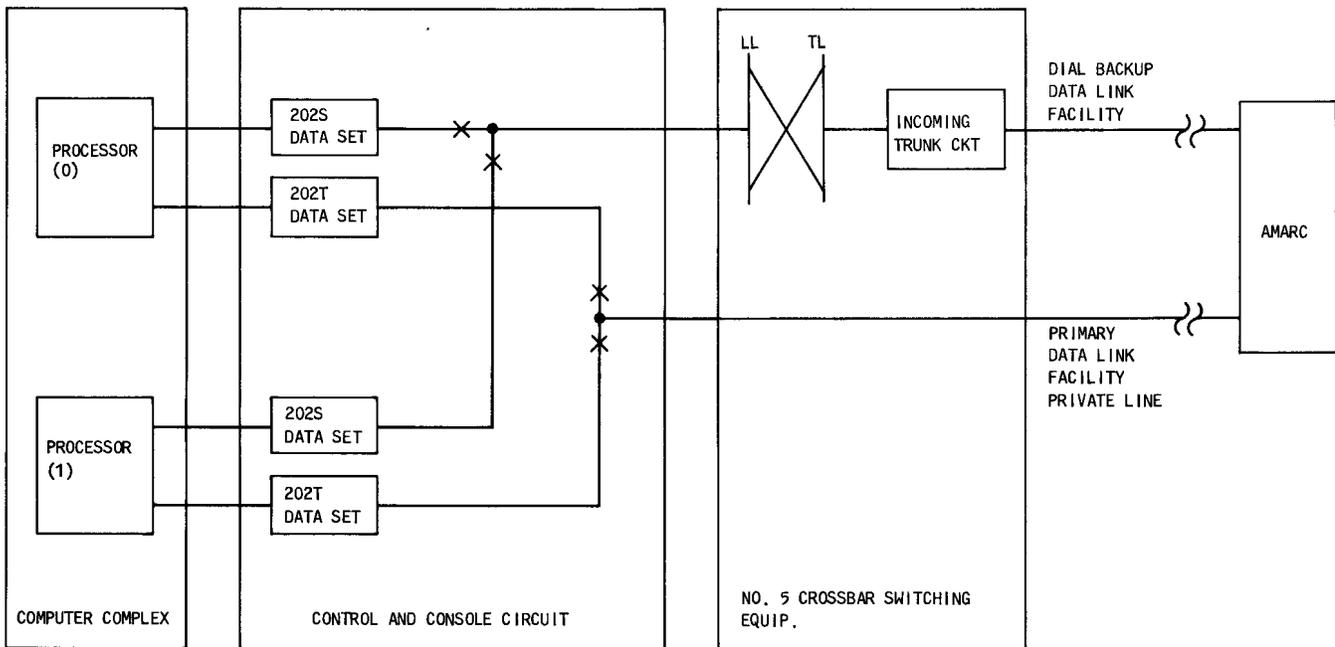EQUIP.

NOTE:
FIG. SHOWS ONE PRIMARY AND ONE BACKUP DATA LINK, A MAXIMUM
OF FOUR PRIMARY AND ONE BACKUP DATA LINKS MAY BE PROVIDED.

Fig. 3—LAMA-C AMARC Data Link Interface

TABLE A

LAMA-C COUNTS

CATEGORY	REGISTER DEFINITION	OPERATION COUNTED	COUNTS THAT RELATE TO TRAFFIC OPERATION	COUNTED BY BOTH COMPUTERS
Call Counts	Total recordable attempts	Counts total recordable attempts of all types		X
	Toll recordable attempts	Counts toll recordable attempts	X	X
	Nontoll recordable attempts	Counts nontoll recordable attempts	X	X
	Total ANI attempts	Counts total ANI attempts	X	X
	Total AIOD recordable attempts	Counts total AIOD recordable attempts	X	X
	Total call records formatted	Counts total call records of all types formatted for recording	X	
	Nontoll call records formatted	Counts nontoll call records formatted for recording	X	
	ANI failures	Counts the number of times LAMA-C fails to properly process an ANI attempt		X
	AIOD failures	Counts the number of times LAMA-C fails to properly process an AIOD attempt		X
	Call records by types of calls (1 register per type of call)	Counts the total call records formatted for each of the following types of calls:	X	
		Toll calls (direct-dialed station paid, IDDD station paid, coin zone, information, PICTUREPHONE® and DATAPHONE®		
		Data Teletypewriter Exchange (DTWX)		
		Common Control Switch Arrangement (CCSA)		
		Wide Area Telephone Service (WATS)		
		MR (Timed, bulk-billed)		
		Observed		
		MR (Untimed detailed-billed)		
		WATS-AFR (Automatic Flexible Route)		
		Local directory assistance		
		Usage Sensitive Rate Plan (USRP)		
	Total data blocks formatted	Counts the number of times the formatter marks a data block full	X	
	Total data blocks lost	Counts the number of data blocks lost due to storage capacity being full	X	
	Identification failures	Counts the number of times a telephone number is not identified		X

TABLE A (Cont)

LAMA-C COUNTS

CATEGORY	REGISTER DEFINITION	OPERATION COUNTED	COUNTS THAT RELATE TO TRAFFIC OPERATION	COUNTED BY BOTH COMPUTERS
Marker Counts	Originating calls (1 register per marker)	Counts the total calls handled by each marker. Includes both recordable and nonrecordable attempts		X
	Trunk register initial entries (1 register per marker)	Counts the number of initial entries placed in the trunk register by each marker		X
	Initial entries with no trunk seizure	Counts the number of initial entries placed in the trunk register and a seizure is not received from the associated trunk		X
	Trunk seizures with no initial entries	Counts the number of times a trunk is seized with no initial entries in its trunk register		X
Data Link Counts	Data blocks transmitted (1 register per data link)	Counts the number of data blocks transmitted by each data link		
	Transmits received from AMARC (1 register per data link)	Counts the transmits received from AMARC for each data link		
	Retransmits received from AMARC (1 register per data link)	Counts the retransmits received from AMARC for each data link	X	
System Counts	Background task no work	Counts the number of times no work is found in the background tasks	X	X
	Foreground task overflow	Counts the number of times foreground tasks are not completed during the allotted cycle time	X	X

TABLE B

LAMA-C CASSETTE TAPES

	TITLE	DESCRIPTION
1	Generic Program Tape	Contains all LAMA-C programs.
2	Data Tape 1*	Contains the entire data base except line translation.
3	Data Tape 2*	Contains line translation data only. One Data Tape 2 can hold translations for about 20,000 lines. Thus more than one Data Tape 2 (2A, 2B, etc) will be required in a large office.
4	Recent Change Tape	Contains a record of day-to-day line translation changes which do not appear on Data Tape 2. Periodically new Data Base 2 tapes will be generated. At these times a new recent change tape is started.
5	LAMA-C Diagnostic Tape	Contains diagnostic programs which are not normally resident in the computer.
6	Line Translator Table Generation Tape	Contains an installer program which is used for initial generation of the line translation data.
7	Data Compiler Tape	Contains an installer program which is used for compiling the data base.
8	DEC Diagnostic Tape	Contains diagnostic programs for DEC supplied hardware. These are normally used by the DEC field service people only.

*The Generic Program Tape, Data Tape 1, and Data Tape 2 are used to reconstruct a working system after a failure. This is necessary only if both computers are not operating. If one computer is operating, the second computer can obtain a data base from the working computer.

TABLE C

BILLING CLASS NUMBERS

NUMBER	DESCRIPTION
0	Unassigned line
1	Message rate bulk billed 0
2	Message rate bulk billed 1
3	Message rate bulk billed 2
4	Message rate bulk billed 3
5	Message rate detail billed 0
6	Message rate detail billed 1
7	Message rate detail billed 2
8	Message rate detail billed 3
9	Flat rate 0
10	Flat rate 1
11	Flat rate 2
12	Flat rate 3
13	Flat rate 4
14	Flat rate 5
15	Flat rate 6
16	Flat rate 7
17	Flat rate 8
18	Flat rate 9
19	Flat rate 10
20	Flat rate 11
21	Flat rate 12
22	Flat rate 13
23	Flat rate 14
24	Flat rate 15
25	Coin zone 0
26	Coin zone 1
27	Coin zone 2
28	Coin zone 3
29	WATS, (full business day)
30	WATS, measured
31	Not assigned
32	Not assigned
33	RMR, message rate bulk billed 0
34	RMR, message rate bulk billed 1
35	RMR, message rate bulk billed 2
36	RMR, message rate bulk billed 3
37	RMR, message rate detail billed 0
38	RMR, message rate detail billed 1
39	RMR, message rate detail billed 2
40	RMR, message rate detail billed 3
41	Dial TWX
42	Noncharged, nonbilled
43—63	Not assigned