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No. 4 ESS:

Mass Announcement Capability

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We describe the mass announcement capability that has been introduced in No. 4 ESS beginning with the 4E5 generic. This capability allows various sponsors to provide services in which a large volume of callers can dial advertised numbers to listen to Public Announcement Service announcements, register their opinions via telephone calls, or participate in call-ins whereby randomly selected callers are connected to a celebrity for a live answer. Although these kinds of services are not new, they have usually been offered on a limited, individually engineered basis at high administrative cost to the telephone network. Mass announcement capability provides a general means to accommodate sponsor-provided announcement-related services which can be offered on a local, regional, or national basis.

I. INTRODUCTION

Public demand exists for expanded new uses of the telephone to provide information and entertainment. Hearing a recorded announcement over a telephone is increasing in popularity. Radio and television stations are encouraging public participation in telethons and call-ins. In the past, the scope of these kinds of services has been limited. More extensive services, such as a presidential call-in, have required special engineering at substantial cost. When the telephone company has not been consulted in advance, peaked traffic caused overloads and widespread congestion in the telephone network. The challenge of the Mass Announcement System (MAS) feature is to provide the mechanism so that sponsors can offer these kinds of announcement-related capabilities on a widespread basis to fulfill existing needs and yet to contribute

significant revenues for the Bell System. High capacity, flexibility, and network protection are key factors because the served area may be large or heavily populated, many different services may be provided simultaneously, and calling may be stimulated by media programming.

The MAS is a major part of the 4E5 generic development on the No. 4 ESS. The No. 4 ESS provides a means of recording announcements and the capability to connect a large volume of callers to these announcements. The high terminating capacity of the No. 4 ESS and its position in the Direct Distance Dialing (DDD) network make it a viable switching machine for providing MAS services. The technical architecture inherent in the No. 4 ESS time division/space division network provides an efficient mechanism for transmitting the announcements in a digital format.

The Mass Announcement System is an optional No. 4 ESS feature. No. 4 ESS offices equipped with MAS will be strategically deployed throughout the country so that sponsors can provide service on a local, regional, or national basis. Each of these offices will be designated as an MAS node and its associated calling region will be designated as an MAS island. National MAS coverage for initial service in 1980 is illustrated in Fig. 1.

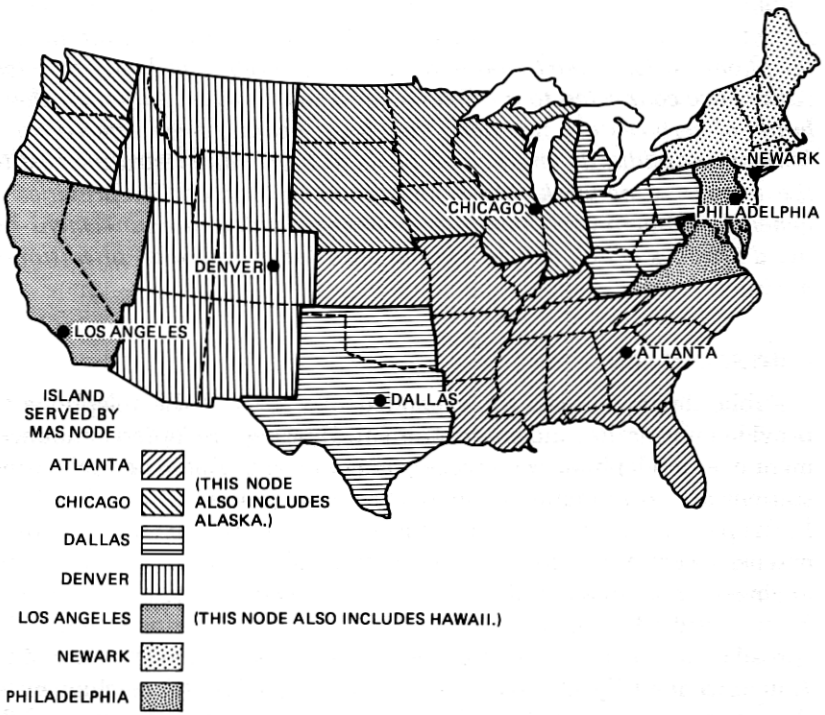

Fig. 1—Seven-node national service for 1980.

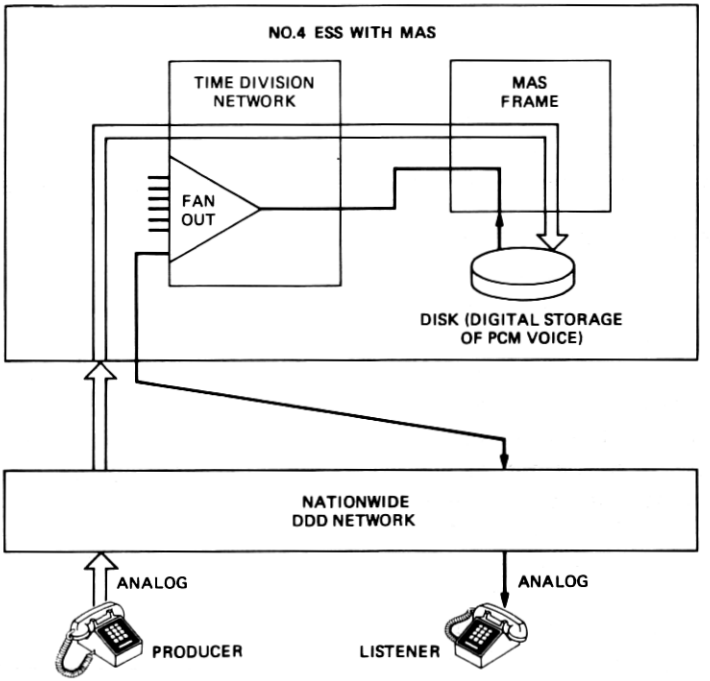

Fig. 2—Mass Announcement System digital recording.

II. MASS ANNOUNCEMENT FEATURE REQUIREMENTS

2.1 Definition of offered features

The MAS feature consists of a variety of announcement-related services in which a large volume of callers dial an advertised number and expect to hear a prerecorded announcement. The main types of service are as follows:

(*i*) Public Announcement Service (PAS)
(*ii*) counting of media stimulated calls
(*iii*) cut through [typically Media Stimulated Calling (MSC)].

2.1.1 Public announcement service

The PAS tends to be stable in nature with reasonably predictable calling patterns. Requests for weather or time are typical applications which have been carried on the network for many years. More recently new forms of PAS have emerged. Some examples are news, horoscope offerings, jokes, sports results, and other entertainment programs.

A No. 4 ESS with the MAS feature provides capability for sponsor-offered announcement recordings, quick updating, and the means for transmitting these announcements, as shown in Fig. 2. An MAS frame can provide a large number of varying length synchronous announcements which start over again every 15 s. A caller to an MAS announce-

ment is generally supplied with audible ringing until the announcement starts.

Public Announcement Service announcements may also be provided by an audio source other than the MAS frame. These are called barge-in announcements since callers are connected to these announcements at any point in the announcement cycle after hearing audible ringing.

2.1.2 Counting of media stimulated calls

Counting of media stimulated calls is a service in which a sponsor can stimulate callers through advertising to register their opinion by telephone on a topic of general interest. If the question posed on television, on radio, or in the print media has a yes or no answer, then two telephone numbers would be assigned to have corresponding significance. If a dozen candidates were nominated for "most valuable player," then it would be necessary to provide 12 telephone numbers. Callers hear an MAS announcement and the No. 4 ESS counts each call to the specified number. More than one No. 4 ESS office can participate in the same MSC counting application. The accumulated counts from all No. 4 ESS offices participating in the same application can be output to a sponsor's location in near real time, thus, allowing these MSC counting applications to be coordinated with radio or television programming.

2.1.3 Cut-through service

Cut-through service is another sponsor-offered MSC service which permits selective access to a telethon or call-in sponsor while the large majority of callers are diverted to a customized MAS announcement. The selectivity relates to one call per unit time which is forwarded to another DDD directory number to be given personal attention, perhaps by a politician or celebrity. Cut-through service can be offered in conjunction with an MSC call counting service as a means of soliciting additional information from a sample of the callers expressing their opinion.

2.2 Specification of No. 4 ESS system requirements

Key attributes of the MAS services are specified in the following sections in terms of minimum and maximum bounds.

2.2.1 Call terminations

The basic capacity of a No. 4 ESS office with a minimum MAS equipment configuration of one MAS frame and two dedicated time-slot interchange switching and permuting circuits (TSI SPCs) for simultaneous call termination is 896 per dedicated TSI SPC or 1792. Using 90 percent occupancy on the dedicated TSI SPCs, 7.5-s average wait time,

and a 30-s holding time per call, there could be approximately 150,000 calls per hour to one announcement or to a mix of MAS announcements available on the two MAS-dedicated TSI SPCs. To provide perspective, the busy hour call capacity of the No. 4 ESS is approximately 500,000. An additional 896 simultaneous call terminations can be handled with each additional MAS-dedicated TSI SPC, of which there is a maximum of 15. However, any one announcement can be available from a maximum of two MAS-dedicated TSI SPCs.

2.2.2 Announcement capacity

There can be from 1 to 8 MAS frames in a No. 4 ESS office. Each MAS frame can provide a maximum of 59 30-s MAS announcements. However, MAS announcement basic building blocks are in terms of 30-s sectors. These 59 sectors can be assigned as desired. If an announcement lasts less than 30 s, one must nevertheless devote a 30-s time sector to that purpose. Announcements can range from 30 s to 5 min in length. Ten 30-s sectors must be allocated to provide the necessary resources for a 5-min announcement.

Each MAS frame has capacity for a total of eighty 30-s sectors of audio. A maximum of 59 of these can contain active audio, that is, audio which is playing back to callers. The balance of these sectors can be used to store standby audio, which is not yet available to callers.

The number of barge-in announcements in a No. 4 ESS can vary from 0 to 24. Barge-in announcements can exist even though an office does not have an MAS frame.

2.2.3 Announcement characteristics

Much flexibility exists in defining each MAS announcement in the No. 4 ESS. The length of an MAS announcement can be from 30 to 300 s but must be a multiple of 30 s. A barge-in announcement can be from 5 s to 300 s long. Multiple plays, if specified, allow three options in which callers can hear the audio two or three times or repeatedly (for about $2\frac{1}{2}$ hours). Callers are automatically disconnected from hearing the announcement after the specified number of plays. The charge option, if specified, results in the No. 4 ESS returning answer supervision, thus, resulting in the caller being charged for calling the announcement. The forced audible ringing option ensures that the caller hears at least one cycle of audible ringing before the announcement audio starts.

Announcement audio can be rapidly updated via any one of several methods, most of which are external to the No. 4 ESS. A maximum of 28 MAS announcements per MAS frame can be simultaneously updated.

Announcements are available to the calling public according to start and stop time parameters for each announcement. These parameters

can be specified so that announcement audio is activated for playback to callers immediately and plays continuously. Or, these start or stop time parameters can specify scheduling up to 23 hr in advance.

An announcement application can have its audio in the standby state or in the active state or in both. However, an announcement application can have at most two audio copies or versions existing on the MAS disks—one in the active state and one in the standby state. Audio in the active state is playing back to callers. Audio in the standby state is scheduled to go active and thereby to replace the active copy, if it exists, at some specified start time.

Mass Announcement System announcements are synchronous and start from the beginning every 15 s. Thus, callers normally wait from 0 to 15 s to be connected to the beginning of audio, with an average waiting time of $7\frac{1}{2}$ s. This wait time may be increased for announcements defined with forced audible ringing.

2.2.4 Capabilities for counting media stimulated calls

Counting media stimulated calls is a service that involves one or more MAS announcements, as well as the pegging, collection, and output of counts of customer calls on a dialed number basis.

In a No. 4 ESS MAS node, there are 128 dialed number counters which can be used for up to 16 different MSC counting applications simultaneously. Up to 64 counts can be collected in connection with one MSC counting program. Number patterns such as 900-234-0001 through 900-234-0064 could be counted separately, yet, cause routing to a single announcement which might simply say, "Thank you for calling. Your opinion has been counted." On the other hand, there could be a separate announcement for each dialed number or any grouping of numbers.

For one MAS node, the MSC counting totals can be transmitted to a sponsor on a minute-by-minute basis via a dial-up connection which consists of a data terminal with a mating unit on the other end of a DDD connection. Alternatively, if multiple No. 4 ESSs are involved in the same MSC counting application, each No. 4 ESS reports results to a designated master No. 4 ESS, which can transmit the results to the service sponsor. Each such No. 4 ESS, which counts customer calls and sends these results to a master, is referred to as a slave. A given No. 4 ESS MAS office can perform slave, master, or both functions. A master function, however, can exist in a No. 4 ESS without MAS. However, that No. 4 ESS must have the 4E5 (or later) generic.

A master can have any number of slaves reporting to it. Figure 3 shows an MSC counting application involving callers in three MAS nodes. Slaves update master counts every 5 min via Common Channel Interoffice Signaling (CCIS) direct-signaling messages. In each No. 4

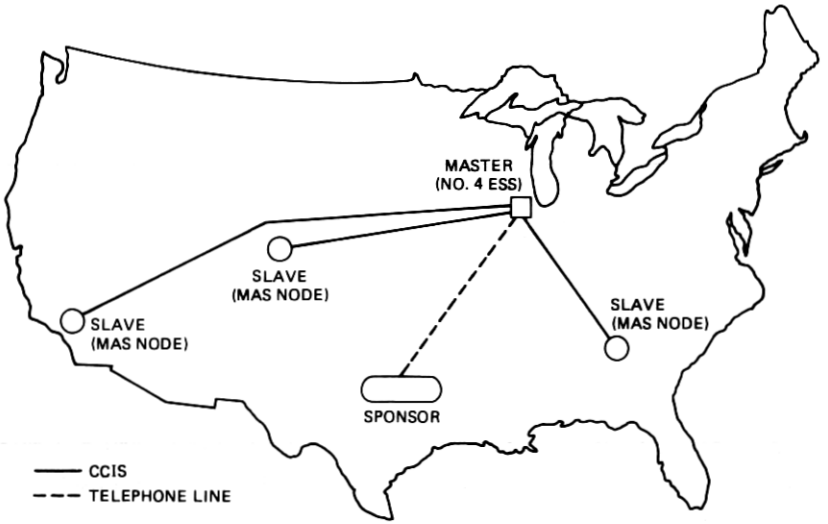

Fig. 3—Counting of media stimulated calls.

ESS office, there are 128 master counters which can be used for up to 64 different MSC counting applications simultaneously. A maximum of 64 master counters can be used for one master application.

A No. 4 ESS office can simultaneously support a maximum of five dial-up connections to sponsors who desire to receive minute-by-minute MSC counting results as counts are being tabulated. This number may be less if the office engineered number of dial-up ports is less. However, any number of master applications not exceeding the 64 limit can transmit to the same sponsor simultaneously over a single dial-up connection.

An MSC counting application can be scheduled according to specified start and stop times, or it can run continuously, or it can cycle on and off on a daily basis. An MSC count scheduling is independent of scheduling of the MAS announcement(s) associated with an MSC counting application.

Flexibility exists to set up a national MSC counting application in which calls are counted at the same hour relative to each time zone. For example, callers may be stimulated to call from 7 to 8 p.m. in their own time zone. The master can serve as a master and slave in its time zone so that calls coming from that time zone are counted only from 7 to 8 p.m., but counts from other nodes are accumulated until stop time has been reached in all slave nodes for this application.

2.2.5 Cut-through capabilities

A cut-through application can be applied to any 10-digit directory

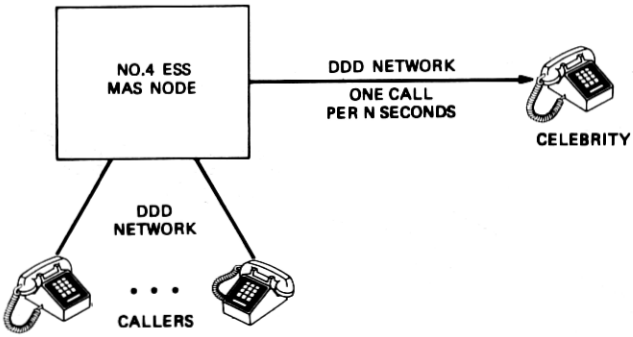

Fig. 4—Cut-through application.

number.* Up to 64 cut-through applications (shared with network management gap controls) can be applied simultaneously in any one No. 4 ESS.

In a cut-through application, one call is cut through to a prespecified DDD directory number roughly every N seconds as shown in Fig. 4. N is referred to as a call-gapping interval. The call-gapping interval for a given cut-through service can be selected from 16 different values ranging from 0 to 360 s.

Each cut-through application must have a different announcement associated with it. Conversely, any MAS announcement can have at most one cut-through application associated with it.

Similarly to counting of media stimulated calls, a cut-through application can be scheduled according to specified start and stop times, or it can run continuously, or it can cycle on and off on a daily basis. Cut-through scheduling is independent of scheduling of the MAS announcement associated with the cut-through application.

2.3 Specification of external interface requirements

Since MAS services may be local, regional, and national in scope, coordination of such things as dialable number, announcement capacity, announcement audio, and service schedules in all the No. 4 ESS MAS offices must be administered by one central source. An organization called the Operations Network Administration Center (ONAC) is responsible for administration of all MAS services. Two main support systems are used by ONAC personnel as shown in Fig. 5. One of these support systems is the MAS Support System (MSS), which is a computerized system minimizing manual administrative functions needed to

* Gap control, however, is a network management control described in Section 4.3.6 which can be applied on a 3-, 6-, 7-, or 10-digit basis.

define, schedule, and monitor MAS services in all the MAS nodes. The other of these support systems is the Announcement Distribution System (ADS) which accepts audio from the producer and then can simultaneously update all the No. 4 ESS MAS nodes which are to receive this audio. Although ONAC and both of these support systems are external to the No. 4 ESS, the No. 4 ESS must interface with them in a compatible manner.

In case a backup method is needed, all functions which ONAC performs must also be capable of being performed in a No. 4 ESS office to administer MAS services in that office. Another external audio update method called the direct producer update method is also needed as a backup in case ADS system failure occurs, or in case local applications may not be using ONAC.

2.4 Transmission plan

Since the overriding purpose of an announcement service is to deliver an audio product of high quality, considerable effort was placed on means to safeguard the fidelity of the ultimate product, voice playback. Three noteworthy opportunities to introduce impairments are readily identified. First a producer may transport an announcement by electronic means to a control location, such as the ADS. If this is a DDD connection, there is exposure to noise, loss, and possible echo in this transaction. The call must then be fed to one or more No. 4 ESS MAS nodes. Although dedicated trunks make possible tighter control of transmission variables, noise, for example, will be an additive

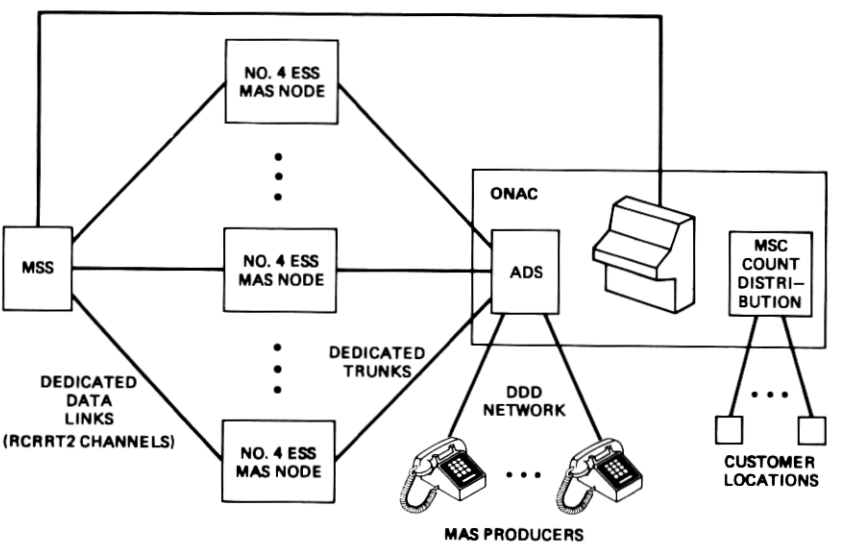

Fig. 5—No. 4 ESS/ONAC interfaces.

impairment. Finally, when digitized recording is played back over DDD, new hazards to fidelity must be anticipated. Since control between the ADS and the MAS node is most practical, special effort was placed on the parameters of this link. Here companding was applied in conjunction with the use of a pilot tone to permit positive checks on transmission level to be made during transmission. Loss of pilot tone would be a positive warning that a gap in the announcement had been experienced. At the MAS node, the pilot tone is filtered out, levels set and feedback provided to the source when repetition of the announcement is called for.

Transmission planning extended to the full network service, just as the signaling and switching planning did. It was necessary to evaluate peak power and average power effects when one popular announcement might be dominant over various facilities. The levels of ringing tone, busy tone, and the playback itself had to be established. Since the network is not homogeneous, simple universal answers were generally not to be found. Tentative answers were established, however, and means of adapting, if necessary, were investigated and identified. Both laboratory and field experiments were conducted. Limits previously found necessary to protect switching and signaling also found use in the transmission world. Thus, a total requirements package was constructed. Within its structure, means are established to allow large numbers of callers to have common access to versatile and customized telephone announcements.

III. NO. 4 ESS SYSTEM ARCHITECTURE FOR MAS

3.1 Mass Announcement System hardware complex

The minimum physical equipment configuration for a No. 4 ESS with MAS is illustrated in Fig. 6 and consists of the following components:

- *An MAS frame and two moving head disk units* record, store, and playback digitized voice announcements. (The maximum number of MAS frames is eight.)
- *A Peripheral Unit Control (PUC) frame* provides common operational and maintenance interfaces between the 1A Processor and the MAS frame. (One PUC frame can handle a maximum of two MAS frames.)
- *Two DS-120 links (two coaxial cable pairs)* connect an MAS frame to the No. 4 ESS network. Record, monitor, and playback channels are identified by their time-slot appearances on these links.
- *Two dedicated TSI SPCs* provide fanout of the announcement phases coming from the MAS frame. Any barge-in announcements and audible ringing are likewise fanned out by these dedicated TSI SPCs. Incoming MAS calls are terminated on these dedicated TSI SPCs. (The maximum number of dedicated TSI SPCs for MAS is 15.)

- *Two auxiliary audible ringing trunks from the ringing and tone plant* provide the ringing that callers hear before start of audio. (One of these is needed per dedicated TSI SPC.)
- *Connections from up to 24 barge-in announcement trunks* may also be optionally provided as shown in Fig. 6.
- *One or more automatic dial-up 1200-baud asynchronous channels* (not shown in Fig. 6) are required on the Input/Output Processor (IOP) frame. These dial-up channels are required for transmitting MSC counting results to a remote data terminal. (The maximum number of dial-up ports in a No. 4 ESS is six, but a maximum of five of these can be used for MSC count reporting to sponsors.)
- *An RCRRT2 (remote recent change) channel* (shown in Fig. 5) on the IOP frame is remoted to ONAC via a dedicated data link and allows ONAC personnel to enter and receive messages from a No. 4 ESS to define, control, and monitor MAS services.
- *A dedicated trunk subgroup* exists (shown in Fig. 5) between ONAC and the No. 4 ESS for recording announcements from ADS. This trunk subgroup must be uniquely identified with a special name in No. 4 ESS.

3.2 Utilization of dedicated TSI SPCs

The concept of a dedicated TSI SPC was introduced in the initial generic of the No. 4 ESS for the fanout of office announcements and tones. A dedicated TSI SPC is physically the same as a regular TSI SPC, except that its transmit and receive ports are looped with coaxial cables. A dedicated TSI SPC has dynamic fanout capability which enables all the callers connected to it to hear one announcement or any mix of announcements available on it according to current demand. This fanout capability of dedicated TSI SPCs avoids having to engineer terminations separately for each announcement service.

The MAS frame continually plays back active announcement phases into the network via the playback channels. Playback channels are "nailed up" from serving TSI SPCs to dedicated TSI SPCs as shown in Fig. 6. For reliability reasons, the two MAS submembers or units from the same MAS frame must be connected to different TSI frames. For further reliability reasons, the serving and dedicated TSI SPCs for each MAS submember or unit should be from the same TSI frame. Each dedicated TSI SPC fans out one audible ringing signal and a maximum of 104 announcement phases.

3.3 Mass Announcement System customer call strategy

Providing MAS announcements is a unique kind of function for a toll switching office. A large volume of customer calls is being terminated in, instead of being switched through, the No. 4 ESS. This large volume

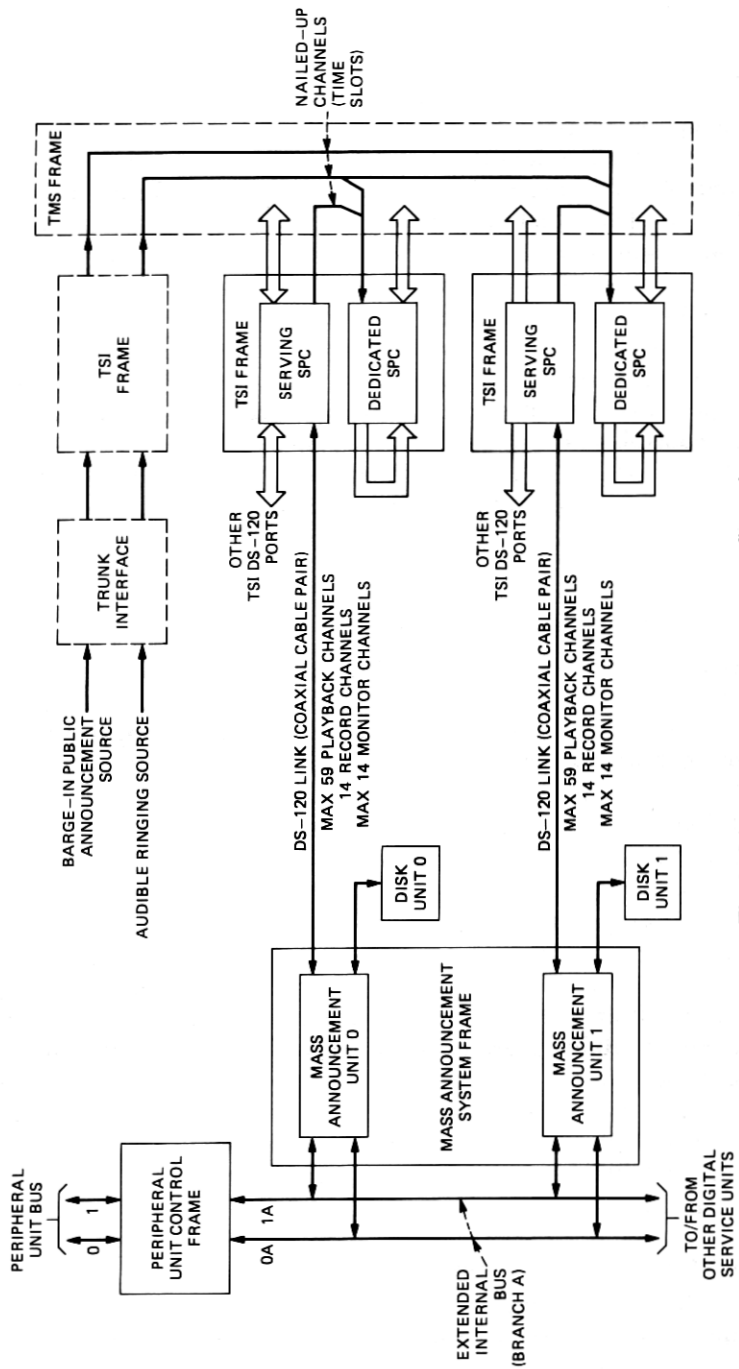

Fig. 6—Mass announcement system configuration.

of callers is being terminated on MAS-dedicated TSI SPCs within No. 4 ESS offices. Since any MAS announcement is available from two dedicated TSI SPCs, customer calls to that announcement are connected to the dedicated TSI SPC on which the next phase of the announcement occurs so that customer delay time is minimized. Customers hear audible ringing and announcement audio from the same dedicated TSI SPC.

An announcement start point in the MAS hardware is randomly selected at the time audio is first recorded. Thus, different announcements should phase at different times. This design was intended to spread simultaneous traffic load and the distribution of answer signals.

3.4 Announcement update strategy

Before any MAS announcement can be recorded initially, service provisioning data must have been input into the No. 4 ESS to define the announcement.

The No. 4 ESS MAS software is designed to accommodate two basic methods of recording MAS announcements from sources outside the No. 4 ESS MAS office. Both methods are software controlled and require no intervention by No. 4 ESS personnel during the recording process. These two methods are designated the ONAC/ADS update method and the direct producer update method. A manual update method also exists for recording MAS announcements from within the No. 4 ESS. A report is output to ONAC after each announcement is recorded in the No. 4 ESS, regardless of the method.

3.4.1 Operations Network Administration Center/Announcement Distribution System update method

The ONAC/ADS typically accepts an announcement directly from the producer and records multiple copies of it for distribution to the appropriate No. 4 ESS MAS offices. Recording calls are then automatically placed via dedicated transmission facilities to these No. 4 ESS MAS offices to transmit the announcement audio. The ONAC/ADS compresses the audio and superimposes a pilot tone to ensure the quality of the announcement audio during the recording process. After recording completes, a report is sent to ONAC to indicate a satisfactory update.

3.4.2 Direct producer update method

The direct producer update method provides a means for a producer to directly update MAS announcements to a No. 4 ESS MAS office. A producer can call a predesignated telephone number and record or update an MAS announcement. After successful completion of the recording process, the No. 4 ESS MAS software originates a callback to

the predesignated producer telephone number. When the producer answers the callback, the No. 4 ESS MAS office plays back the MAS announcement. A producer may accept the audio by listening to the entire callback sequence or the producer may reject the recorded announcement by hanging up any time during the playback.

3.4.3 Manual update method

Personnel within the No. 4 ESS MAS office can make an on-site recording from a 51A or 53A test position [in the Trunk Operations Center (TOC)]. An input message must first specify the announcement identity and several other announcement parameters. There is no automatic callback for update verification after the manual update method completes. The announcement is automatically marked verified.

IV. MASS ANNOUNCEMENT SYSTEM SOFTWARE ORGANIZATION

The MAS software package developed in the 4E5 generic of No. 4 ESS closely interfaces with the new MAS-related hardware to control PAS, counting of media stimulated calls, and cut through. This software package is organized and incorporated into most functional areas of the No. 4 ESS. This section describes the design objectives, characteristics, and main capabilities provided by each of the MAS software functional areas.

4.1 Mass Announcement System software design objectives

The overall design objectives for the MAS software were as follows:

(*i*) Compatibility with the existing No. 4 ESS system and environment was necessary. The development of all these new capabilities involved integrating a large and complex software package into an already large and complex software system where resources are becoming scarce.

(*ii*) Hierarchical, modular, and structured programming design was advocated. This has benefited understandability, development, and maintainability.

(*iii*) Reliability was paramount. Defensive checks abound to ensure integrity of the services being offered.

(*iv*) Audio preservation for an indefinite period of time even through office phases and other unusual system disturbances was required.

4.2 Mass Announcement System software characteristics

Mass Announcement System is the largest feature provided since the initial No. 4 ESS development. It is comprised of approximately 100,000 words of operational software and of approximately 50,000

words of maintenance software. Several new data structures have also been created. All of this software is closely tied together and is closely interfaced with the MAS hardware, thus, forming a complex but unified system.

The MAS software is basically organized into functional areas. It relies heavily on subroutines and is generally separated from other software. For example, new call processing code for new MAS related types of calls is packaged as new call processing programs. Existing call processing code, such as final handling treatment of unsuccessful calls, is in modified existing programs.

Mass Announcement System software has to handle various interesting cases. Most MAS functions take many time segments to complete but occur at infrequent intervals, at least relative to the number of calls that the No. 4 ESS handles. For example, an update call stimulates many bursts of MAS functions which could total several minutes duration, but there should *not* be a large number of such simultaneous update calls. Also, interfaces with the MAS hardware involve delays from the time an order is sent until the time MAS completes the function. In general, MAS functions are deferred when the No. 4 ESS system experiences overload.

Announcement data is distributed over several data bases. Translation data contain permanent service order information. Call store structures contain current status information. File store contains a backup of nontransient current announcement status information.

4.3 Mass Announcement System software functional areas

4.3.1 Announcement Handling

Announcement Handling plays a dominant role in providing MAS services. It is a new software functional area that controls MAS announcements and barge-in announcements from the time they are first defined until they are deleted from the No. 4 ESS. It is the primary operational interface with the MAS hardware (sending almost all the operational orders). Announcement Handling also interfaces with almost all other functional areas involved with the MAS feature.

The main functions of Announcement Handling include the following:

(*i*) administrative processing during recording updates and verification callbacks,

(*ii*) duplication processing for MAS announcements,

(*iii*) scheduling of PAS, MSC counting, and cut-through services,

(*iv*) providing call processing with announcement phasing information,

(*v*) maintaining MAS hardware status as it applies to MAS announcements,

(*vi*) providing manual support capabilities,

(*vii*) providing file store backup for nontransient announcement data.

To control and administer MAS announcements, Announcement Handling maintains a central source of current status and bookkeeping information for every MAS announcement in a No. 4 ESS. The primary data structures, which are all new to the No. 4 ESS, include the following:

(*i*) The MAS Announcement Status Table (MSTAT) is a per announcement call store data table. Each entry contains current announcement data (such as announcement state, duplication status, sector identities, and manual control information), as well as translations-like information which is recent changeable (such as announcement start and stop times and cut-through directory number).

(*ii*) The MAS Announcement Phasing Table (MAPT) is another per announcement call store data table. Each entry contains active announcement information used by Call Processing to handle MAS customer calls quickly.

(*iii*) The MAS sector busy/idle map is a call store structure containing current usage status of each of the 80 sectors available for announcement audio storage on each MAS frame in the office.

(*iv*) The MAS Announcement Register (MAR) is a four-word call store data table seized when needed from a pool of MARs. Announcement Handling functions, such as duplication, callback, and MAS order sending, use these registers in two-way linked lists to queue these internal processes (since they may take minutes of time to complete). This enables easy processing of these per announcement functions on a first-in, first-out basis.

In performing its functions, Announcement Handling controls the announcement audio cycle by processing an announcement through its various announcement states. These Announcement Handling functions are described in more detail in the following sections.

4.3.1.1 Recording interfaces. Checks are made to see if a recording call can be accepted. If so, sectors may need to be allocated in the MAS hardware before recording can begin. Announcement Handling selects which submember the announcement should be recorded on. If transmission check failure reports are received from the MAS hardware during an ONAC/ADS recording, Announcement Handling informs Call Processing as to whether or not the recording call should continue. For a given announcement, the first three such call attempts with transmission problems are aborted. The fourth such attempt is recorded in spite of transmission problems, but a report is issued so that manual actions can subsequently be taken to listen to the audio and either accept it or remove it. At completion of recording, several

Announcement Handling processes are started such as announcement duplication and verification callback for direct producer updates.

4.3.1.2 Direct producer callback interfaces. Direct producer callback requests are queued and, when appropriate, Announcement Handling requests Call Processing to initiate an outgoing call to the direct producer. There is an initial delay of about 10 s to allow the direct producer to hang up after recording completes. Thereafter, reattempts are initiated once a minute until the direct producer answers, for a total of four such attempts. For security reasons, a direct producer recording cannot be activated until verification completes.

4.3.1.3 Announcement duplication. When an MAS frame is duplex, announcement audio is recorded onto one MAS submember. Announcement Handling must send orders to the MAS hardware so that announcement audio can be duplicated within the mate submember. Several orders must be sent for each sector involved in a prescribed time order. Except for maintenance update, the MAS hardware can operationally duplicate only one sector at a time from each of the MAS submembers. An announcement duplication request is queued in Announcement Handling as soon as recording completes. The time needed to duplicate an announcement (not including time on the queue) is equal to the defined length of the announcement plus 15 s. Activation can precede duplication if start time occurs before duplication is initiated.

4.3.1.4 Scheduling of PAS announcements, MSC counting, and cut through. Announcements can be recorded and scheduled to start immediately or up to 23 hr in the future. For external recordings, start time must be previously entered via a recent change. (This recent change could specify that the announcement should start immediately. Start times are normally in terms of hours and minutes.) Manual recordings are initiated with an input message which specifies start time. When a recording begins, a start date is determined based on the current value of start time for that announcement. If the start time is less than an hour past the present time, it is assumed that the announcement should start immediately. When start time occurs, Announcement Handling begins the announcement activation process by sending orders to the MAS hardware. When this is accomplished, the announcement state changes from standby to active. This is a gradual process in the MAS hardware and is not complete until all phases of the announcement are playing back.

If there was a previously active version of the announcement when start time for the standby version occurs, an active/standby switch takes place. The standby version goes into activation and the previously active version goes into deactivation.

Announcement stop time scheduling is similar to start time scheduling. A stop date is determined when activation completes based on the current value of stop time for that announcement. When stop time occurs, Announcement Handling begins the announcement deactivation process by sending orders to the MAS hardware. Deactivation is also a gradual process. When deactivation completes, the audio for this version no longer exists.

Announcement Handling also schedules MSC counting and cut-through applications. Whenever start or stop times occur, the appropriate functional area program is invoked.

4.3.1.5 Announcement phase processing. Active announcements are phased in the MAS hardware so that the beginning of an announcement starts every 15 s. The total number of phases an announcement has is directly proportional to its length. The number of phases equals defined length (which must be a multiple of 30 s) divided by 15. The MAS submembers autonomously issue a playback phasing report when the beginning of a phase occurs. Phases occur on alternate units for a duplex system. Announcement Handling processes these phasing reports by marking a call store table with all the information Call Processing needs in order to determine quickly where to connect callers at any given time (which dedicated TSI SPC, port, channel, time of the phasing report, etc.).

4.3.1.6 Mass Announcement System hardware status change processing. Announcement Handling updates current announcement status to reflect the current state of the MAS hardware. The MAS hardware status changes and the corresponding actions which Announcement Handling takes are as follows:

(*i*) *Restoral with audio lost.* The MAS hardware initially restores the first MAS submember with audio lost. This same type of status change also occurs after a duplex MAS failure due to a fault in the MAS hardware. At this restoral time, Announcement Handling issues reports for any audio lost. Announcement Handling sends orders to the MAS hardware to redefine all announcements defined in the No. 4 ESS translations data base. When order sending completes, the MAS hardware is ready to accept recordings. All audio needs to be rerecorded.

(*ii*) *Restoral with audio saved.* This type of a restoral of a MAS submember takes place after a duplex failure of MAS which was caused by a fault in a connecting unit, such as a TSI or PUC. Announcement Handling determines at this time whether any audio was lost due to the duplex failure. Any audio which was previously simplex on the MAS submember still out-of-service is lost and an audio lost report is issued. Otherwise, all normal announcement activities on the restored submember resume. This announcement audio has survived the duplex

failure condition. Announcement phasing reports resume from the simplex MAS submember. Thus, MAS customer calls can resume. Recording and other actions can also now take place on this simplex MAS submember.

(*iii*) *Restoral to duplex.* The second MAS submember to be restored is brought into service via a process called Maintenance Update. In this process all audio and announcement definitions and assignments from the in-service MAS submember are copied to the out-of-service MAS submember. This process takes approximately 2 min. During this time all Announcement Handling activity (except the standby monitor function) is locked out. After this Maintenance Update process completes, all audio is duplex and normal announcement activities can resume on both MAS submembers.

(*iv*) *Removal causing simplex outage.* Two basic interfaces exist with Peripheral Maintenance. (*i*) A conditional removal is one resulting from a diagnostic or a manual request whereby the simplex removal is delayed until all announcement activity on this MAS submember completes so that audio will not be lost. Announcement Handling ensures that all recordings in progress on this MAS submember complete, that customer calls hear at least one play of the longest active announcement on this MAS submember, and that all simplex audio on this MAS submember is duplicated within the other MAS submember. (*ii*) For a forced removal, all activity on this MAS submember is aborted. This includes recording calls and direct producer callbacks. All simplex audio on this MAS submember is lost and corresponding audio lost reports are issued.

(*v*) *Removal causing duplex outage.* (Both MAS submembers fail simultaneously or the second MAS submember fails.) All announcement activities in progress at the time of the failure are aborted. No processes involving the MAS hardware can take place. Announcement status is left unchanged since audio loss is determined at restoral time.

4.3.1.7 Manual support capabilities. Manual intervention is not required to control MAS services except for defining the services, monitoring their current status, and resolving problem situations. Automatic reports are output regarding announcement situations which administrative personnel must be aware of. (The destination of these per announcement reports is assigned at the time an announcement is defined.) Manual announcement override capabilities are provided which are initiated via input messages. These capabilities can be exercised by either ONAC personnel or personnel in the No. 4 ESS. A list of these per announcement capabilities is as follows:

(*i*) Manual update can be done from a 51A or 53A test position.

(*ii*) Standby audio can be listened to from a 51A or 53A test position or from a dedicated trunk to ONAC.

(*iii*) Announcement audio, either standby or active, can be removed.

(*iv*) External updates can be inhibited (and then subsequently be allowed).

(*v*) Activation can be inhibited even though start time arrives.

(*vi*) Update received reports can be inhibited.

(*vii*) A standby announcement can be manually marked verified (for cases where a direct producer callback failure has occurred and the audio has been manually verified).

(*viii*) A standby announcement which has been recorded using the ONAC/ADS method in which the recording was accepted on the fourth attempt in spite of transmission check failures can have the transmission problem indication removed from its current status so that activation scheduling can take place.

(*ix*) Announcement status can be obtained.

(*x*) The number of busy disk sectors per MAS frame can be obtained.

4.3.1.8 File store backup of nontransient data. A Machine Updatable Data System (MUDS) exists to back-up nontransient MAS announcement data on disk. Every time a significant event happens to an announcement, a disk write request is made. Thus, integrity of important, translations-like information, such as cut-through numbers, is provided. This backup information is retrieved after phases in which call store has been cleared, after Audits have detected call store mutilation, and after recent change rollback situations.

The MUDS system also provides a lockout system so that only one process can be working on a given announcement at the same time. This prevents interfering situations.

4.3.2 Call Processing

Call Processing controls the new types of MAS calls, which are as follows:

(*i*) There are three types of audio recording calls for the various update methods available.

- the ONAC/ADS update method,
- direct producer update method, and
- manual update method using 51A or 53A test position. (Control is shared with trunk maintenance.)

(*ii*) Callback for direct producer recording.

(*iii*) Mass Announcement System customer call.

The traditional call register is the basic data structure used for all these MAS calls. Calls involving connections to a dedicated TSI use new data structures called Dedicated TSI Connection Registers (DTCRs).

Another function which Call Processing provides is PUC report

dispensing. These reports originate from the MAS frame and indicate significant announcement events which either Call Procssing or Announcement Handling must act on. Examples of these reports are recording transmission check failures, recording complete, and announcement phasing reports.

4.3.2.1 Call flow for ONAC/ADS update. Figure 7 shows a simplified event flow for the ONAC/ADS recording method. A more detailed system description for a typical ONAC/ADS update call is as follows:

(*i*) The ADS dials a directory number over the dedicated trunk to the No. 4 ESS. This director number is different for each announcement. At the particular No. 4 ESS, the received directory number is recognized as a request to update a particular MAS announcement. The

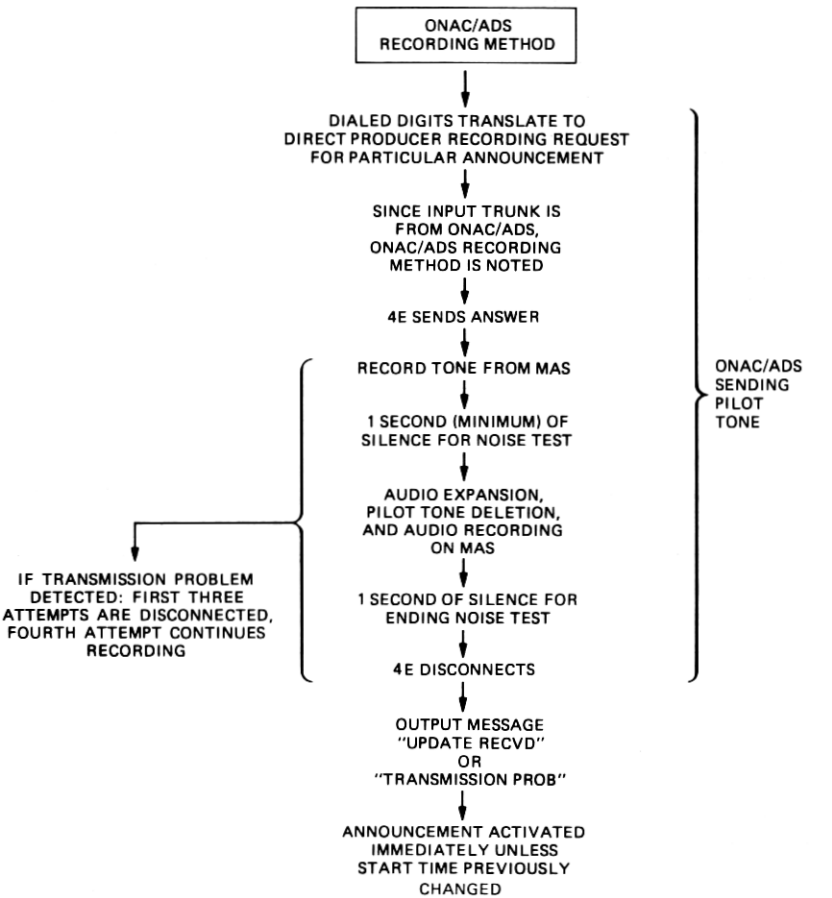

Fig. 7—Simplified event flow for ONAC/ADS recording method.

special identity of the incoming trunk distinguishes this recording call as an ONAC/ADS update call.

(*ii*) ADS starts sending a pilot tone after completing digit transmission. The No. 4 ESS sends an answer signal and hunts for a record port on the appropriate MAS submember. The MAS submember is instructed to begin recording (with transmission checks) after the connection to the record port is established.

(*iii*) The MAS submember autonomously performs the recording function. This includes measuring the pilot tone gain and filtering out the pilot tone, doing an initial noise check, sending the start record tone which alerts ADS to start transmitting announcement audio, expanding the audio material as it is recorded on the disk, monitoring the pilot tone for fading during audio transmission, performing a final noise check when the end of the last allocated disk sector is reached, and generating a recording complete report.

(*iv*) If a transmission check problem is detected at any time during the recording, the MAS submember issues a report. The recording call will be aborted unless this is the fourth consecutive update call attempt encountering a transmission problem for a particular announcement.

(*v*) When the recording completes, the record port is released and the call is disconnected by No. 4 ESS. Announcement audio for the given announcement now exists in the standby state. Announcement duplication and start time scheduling are automatically initiated by the No. 4 ESS.

4.3.2.2 Call flow for direct producer update. Figure 8 shows a simplified event flow for a direct producer update and subseqent callback. A more detailed system description for a typical direct producer update call is as follows:

(*i*) The producer dials a 7- or 10-digit recording update directory number, which is different for each announcement, and is routed to the No. 4 ESS. At the No. 4 ESS, the received directory number is recognized as a request to update a particular MAS announcement.

(*ii*) The call is then connected to a minimum of one cycle of audible ringing and the appropriate MAS submember is selected for the call. At the end of the ringing period there is approximately one-fourth s of silence. At the end of this silent period, answer supervision on non-CAMA (Centralized Automatic Message Accounting) trunks is returned and on CAMA trunks billing is initiated. Call progress tone is connected to the call for a minimum of one-half s while a record port is hunted and reserved.

(*iii*) The MAS submember is instructed to begin recording (without transmission checks). Call progress tone continues until the MAS submember is ready to start recording. The record port is then connected

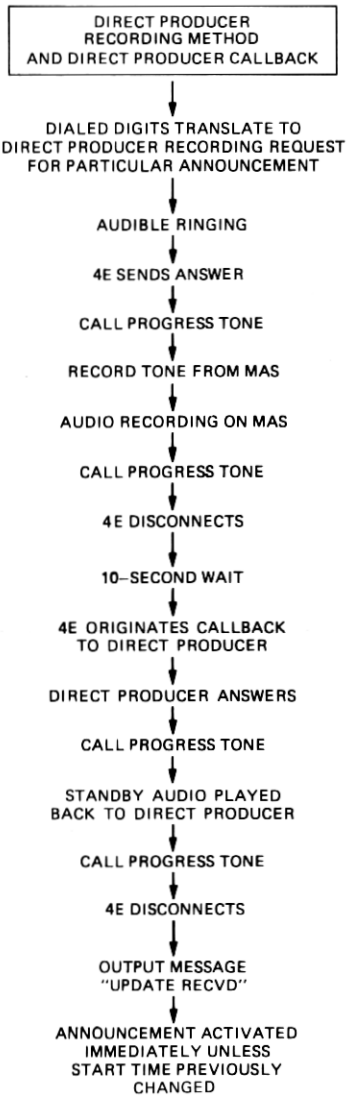

Fig. 8—Simplified event flow for direct producer update and callback.

and the producer hears approximately three-fourths s of record tone and can then begin input of audio material.

(*iv*) The producer must maintain the connection for the allotted announcement length, plus an additional 10 s. When the MAS submember reports that recording is complete (i.e., has reached the end of the last disk sector allocated for recording), the record port is released and

the call is connected to a final 10 s of progress tone, after which the call is disconnected. If the producer does not disconnect first (i.e., before the end of the call progress tone), the recording is successfully completed and announcement audio for the given announcement now exists in the standby state. Announcement duplication and scheduling of the direct producer callback are automatically initiated by No. 4 ESS.

4.3.2.3 Call flow for Manual Update. Figure 9 shows a simplified event flow for a manual recording. A more detailed system description for a typical manual update call is as follows:

(*i*) Within the No. 4 ESS an input message is entered to request a manual update for a particular announcement. The input message also specifies a start time, actual audio length (so that subsequent customer calls to hear the announcement can be removed from the announcement termination promptly), whether or not transmission checks are to be performed, and the identity of the 51*A* or 53*A* test position trunk to be used.

(*ii*) The person making the recording from the test position then hears one of two possible sets of tone sequences. If no transmission checks are specified (which is the normal manual case), the recording scenario follows that described for a direct producer update (after the digit reception process.) If transmission checks are specified, the recording scenario follows the ONAC/ADS update call flow. In this case, pilot tone and compressed audio are expected by the MAS submember.

(*iii*) When recording successfully completes, announcement audio for the specified announcement exists in the standby state. Announcement duplication and start time scheduling are automatically initiated by the No. 4 ESS.

4.3.2.4 Call Flow for direct producer callback. Figure 8 shows a simplified event flow for a direct producer update and callback. A more detailed system description for a typical direct producer callback is as follows:

(*i*) When appropriate, No. 4 ESS originates a call to the producer's callback number and waits for answer supervision to be returned. When steady (greater than 2 s with no switchhook transitions) answer supervision is received, the call is connected to call progress tone. A monitor port on the appropriate MAS submember is hunted and reserved.

(*ii*) The MAS submember is instructed to play back the announcement on the monitor port. At the beginning of the announcement playback, the call is switched from call progress tone to the monitor port to hear the announcement.

(*iii*) After one play of the announcement, the call is connected to a

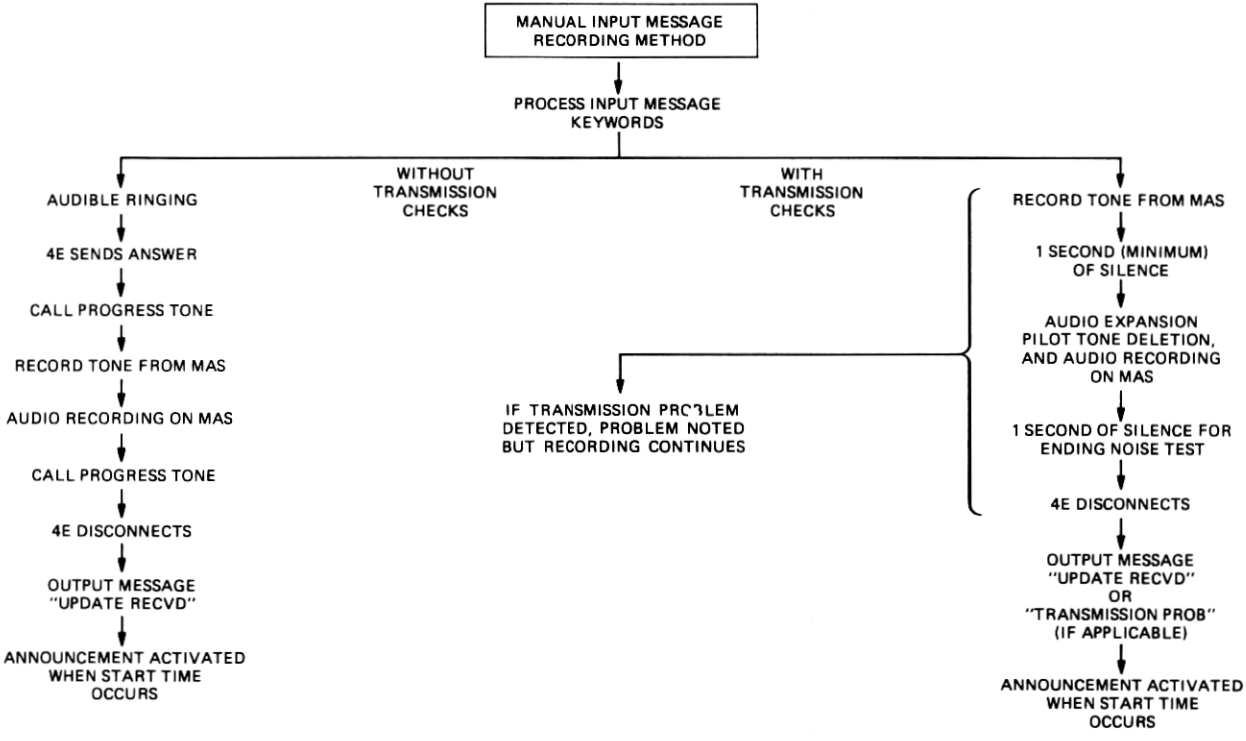

Fig. 9—Simplified event flow for manual recording method.

final 10 s of call progress tone and then disconnected. If the producer does not disconnect first (i.e., before the end of the final call progress tone), the audio update is considered to have been verified and will be scheduled for activation as soon as possible or at the start time given via recent changes.

4.3.2.5 Call Flow for MAS customer call. Figure 10 shows a simplified event flow for a MAS customer call. A more detailed system description of the call flow for a typical customer call to a MAS announcement is as follows:

(*i*) The customer dials a 7- or 10-digit announcement service director number and is routed to a No. 4 ESS MAS office. The No. 4 ESS recognizes the received number as a request to hear a particular MAS announcement. It also recognizes whether MSC counting is associated with the dialed number. Next, it determines whether cut-through service is in effect and, if so, whether the call should be cut through or connected to the announcement. When the dialed number is a MAS vacant code, or the requested announcement service is inactive, the call will be connected to an appropriate special MAS announcement. The preannouncement attempt count is incremented at this point.

(*ii*) The No. 4 ESS determines which dedicated TPI SPC the call should be connected to in order to minimize the time spent listening to audible ringing. When specified, the forced ringing option is taken into account. If all terminations are busy on the first choice dedicated TSI SPC, the call will be connected to the second choice dedicated TSI

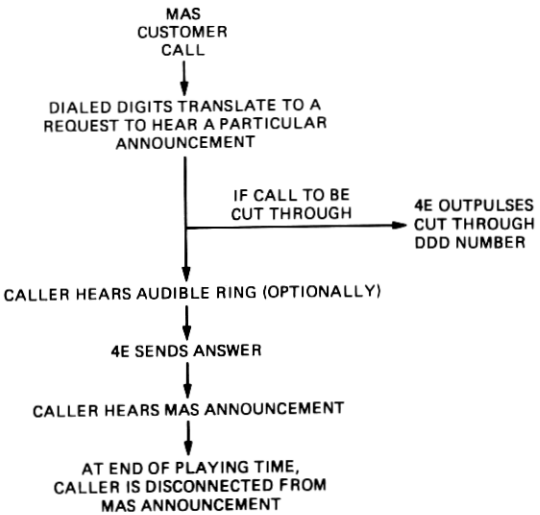

Fig. 10—Simplified event flow for MAS customer call.

SPC (for MAS announcements only) or else to busy tone if no announcement terminations are available. If the MAS equipment should be out-of-service so that no MAS announcement can be given, the call is connected to a no-circuit announcement from the office announcement machine. At the same time, a call is connected to a PAS-dedicated SPC, the appropriate announcement occupancy count is incremented; and the appropriate count in the geographic separations matrix is pegged. This is further explained in Section 4.3.7.

(*iii*) At the end of the audible ringing interval, the call is connected to the announcement via the same dedicated TSI SPC that provided the audible ringing. When the announcement connection is made, the appropriate announcement completion count is incremented. Answer supervision is then initiated (unless specified otherwise) or CAMA billing is initiated (if the incoming trunk is CAMA). If applicable, the MSC dialed number count is incremented after answer supervision is returned.

(*iv*) The customer can abandon at any point during the announcement. In the absence of early abandonment, the call is automatically removed from its MAS termination when the allocated playing time elapses (as determined from the announcement length and specified number of plays). The announcement occupancy is measured up to the point of abandon or forced termination.

4.3.3 Trunk Maintenance

Trunk Maintenance software provides a variety of capabilities. Many of the manual support capabilities were developed in the Trunk Maintenance area to interface with Announcement Handling and will be used by ONAC personnel. These functions are described in the Announcement Handling section and in the Audits and System Integrity section. Other Trunk Maintenance capabilities developed for MAS are as follows:

(*i*) Trunk Maintenance handles the MAS related trunks. It removes and restores the record and monitor trunks corresponding to removals and restorals of the associated MAS submember. Playback trunks are kept nailed up to the dedicated TSI SPC.

(*ii*) The Trunk Operations Center alerting software informs ONAC of duplex MAS failures and restorals.

(*iii*) Trunk Maintenance messages can be requested to include per call information on ineffective attempts for update calls and MAS customer calls. These are useful for resolving problems with unsuccessful update calls and MAS customer calls.

(*iv*) Trunk Maintenance shares control with Call Processing for manual recordings which use the 51A or 53A test position. The trunk maintenance calls for recording and listening to standby audio use the traditional trunk maintenance register (TMR) for per call data.

4.3.4 Peripheral maintenance software

The MAS and PUC frames are two new peripheral units for No. 4 ESS. The peripheral maintenance software functions provided for these new frames are as follows:

(*i*) Bootstrap capability during office phases 2 and higher configures these frames as appropriate to the escalation rate of phases and severity of the problem(s). Duplex configuration of MAS and PUC are preserved if possible.

(*ii*) Input message or Power Control Switch (PCS) functions are manual means which request removal, diagnosis, and restoral of PUC, MAS, and associated hardware units.

(*iii*) Master Control Center (MCC) panel and frame status monitor and display whether or not the PUC, MAS, and associated units are in service.

(*iv*) Diagnostics and routine exercise programs run automatically to ensure the sanity of the MAS and PUC hardware. Trouble location procedures and diagnostics can be requested manually in attempting to resolve problems.

(*v*) Fault recovery routines are executed when faults are detected for any of the PUC, MAS, or associated hardware units. These errors can be reported through *f*-level, interject level, or base level.

Because of the unique design of PUC and MAS frames that use microprocessors, the Peripheral Maintenance software design for these frames reflects significant changes from those used to handle conventional frames in past generics. For example, the new design takes into account the intelligence built in the microprocessors in the implementation of the configuration and recovery actions.

The Peripheral Maintenance software also has special interfaces with Announcement Handling to ensure that audio is not unnecessarily lost. For example, before one of the MAS submembers can be removed from service for diagnostics, sufficient delay time must take place to ensure that all recordings in progress on that MAS submember complete and are operationally duplicated to the other in-service MAS submember and that all other announcement processes complete.

Craft procedures for maintaining the MAS and PUC hardware are different from those for other frames in the office. There may be delays which must be observed when removing, restoring, or diagnosing MAS submembers. Special care must be taken to preserve audio on the MAS disks.

4.3.5 Recent change and verify

Certain MAS entities, such as the basic equipment configuration, must be defined with other office dependent data at generic retrofit time. This includes the assignment of the MAS playback, monitor, and

record channels, auxiliary audible ringing, barge-in playback trunks, and PAS-dedicated TSI SPCs. The nailed-up connections between serving TSI SPCs and dedicated TSI SPCs for MAS frame playback channels and barge-in playback trunks are also exclusively defined at retrofit time. Although individual announcement services can be established initially in the No. 4 ESS, it is expected that the Recent Change system will be the primary means by which this is done.

Recent Change is the system used by the No. 4 ESS to modify the No. 4 ESS translations data base. New capabilities have been added to the Recent Change system to allow the addition, modification, and deletion of PAS announcement and cut-through applications. The MSC counting applications can likewise be added and deleted via recent changes. Modifications have been made to existing recent change system for code grouping to allow directory number translations for MAS announcements and recording updates. Modifications have been made to existing dial-up port recent changes to allow MSC counting results to be output to remote data terminals. Modifications have been made to existing trunk subgroup recent changes to allow geographic separations data to be collected on calls to MAS announcements.

The Verify system is the means to retrieve and display the data residing in the No. 4 ESS translations data base. New capability has been added in conjunction with the new recent changes to retrieve data concerning MAS announcements, MSC counting applications, cut-through applications, and dial-up.

4.3.6 Network management

Network Management software is a direct contributor to cut-through service. The call-gap timer is set to a present time, plus a time interval (gap). The first call to arrive upon expiration of the timer will be forwarded to a prespecified DDD number. The timer is then reset to the present time, plus the gap interval. Mass Announcement System calls which arrive before the timer has expired are connected to a prespecified customized announcement at the No. 4 ESS MAS office. This process is continued until the cut-through service is deactivated. The gap interval also includes an offset interval used to distribute calls over time to prevent bunching of calls from several offices at once. The offset interval also prevents favoring calls from one office.

Other Network Management functions which affect MAS are as follows:

(*i*) Inhibiting reroute control of MAS calls to prevent traffic overflow from one MAS island to another. The data found in the office translations can be used to specify nonreroutable codes.

(*ii*) Gap control is a normal Network Management control available in MAS and non-MAS offices that may be used to meter the amount of

traffic (i.e., selective choke) or to override cut-through values in MAS offices. To provide Network Management capability so as to protect the network during heavy calling periods or during traffic congestion due to facility failures, an override of the service-order specified call gap interval is made available in MAS offices. Intermediate No. 4 ESS offices which are non-MAS offices can apply gap controls also to protect the network. Gap control can be applied on a 3-, 6-, 7- or 10-digit basis. Calls which are not allowed to complete are connected to an emergency or no circuit office announcement as specified by the gap control. Gap control is accomplished via a new control page (CNO8) and the already existing Network Management cathode-ray tube (CRT) display system. The same gap intervals are available as for cut-through applications.

(*iii*) Reports are output to ONAC whenever gap controls are applied, removed, or have their interval changed by the network manager.

(*iv*) In addition to the normal display page capability provided by the Network Management CRT display system, the control page provides inventory displays for MAS cut-through, MAS MSC counting, and MAS announcements. In addition, the capability to select the previous 5, 10, or 15 min worth of data is also available. Mass calling congestion is most likely to accompany the MAS-type of services. Therefore, these displays of MAS data are made available to monitor this type of traffic, determine the source of the problem, and control this traffic if necessary.

4.3.7 *Traffic and plant measurements*

All MAS-related measurements used to administer and maintain No. 4 ESS MAS offices and the interconnecting network are called traditional measurements. These types of measurements have traditionally provided the data required to measure service volume and quality, detect weak spots in system performance, guide maintenance activities, engineer future equipment additions, and determine the division of revenues. Eighty-one new MAS-related measurements have been provided and are collected on a 15-min basis and stored in the traffic and plant measurement data base.

Geographical survey measurements are contained in a 32 by 32 matrix which provides information about the place of origin of calls to selected MAS announcements. This information may be valuable to the sponsors of some announcements. For example, the information might be used to analyze the impact of advertising in various geographical areas. This geographical survey matrix contains completion peg counts based on incoming trunk subgroup and the announcement called.

4.3.8 *Counting of media stimulated calls and dial-up port*

The MSC counting service uses two existing capabilities in the No. 4

ESS, namely, CCIS direct signaling and dial-up port. The use of CCIS direct signaling for MSC count transmittal is actually the first application of CCIS direct signaling in the field. The MSC counting service is comprised of two basic functions: slave application processing and master application processing.

4.3.8.1 Slave processing for MSC counting. When start time arrives for an MSC counting slave application and it is activated, all the involved counters are cleared and an indicator is set so that Call Processing pegs counts for each dialed number associated with the slave application.

The counts for a slave application are sent to the master No. 4 ESS machine every 5 min using CCIS direct signaling messages. The specific times for sending these counts are determined by the slave service start time together with the skewing factor. The skewing factor is a number ranging from 0 to 300 s which represents the offset, in seconds, from the start time when the first set of counts is to be sent. Counts are sent every 5 min thereafter. This skewing factor is intended to even the load on the network and on the master No. 4 ESS machine.

Each MSC counting CCIS direct signaling message consists of eight signaling units. Included in this message is the master application number to which the counts are being sent and two four-digit line numbers together with their associated 5-min peg counts. The number of CCIS direct signaling messages required to send all the counts for a given slave application is equal to the number of line numbers associated with the slave application divided by two.

The rate at which these CCIS direct signaling messages are sent is metered so that a maximum of one message per second is sent for a given application. The impact of this number of messages is minimal when compared to the potential CCIS network capacity. This ensures that MSC counting services will not by themselves force a CCIS terminal into congestion.

In cases of CCIS blockage or network overload, returned MSC counting CCIS direct signaling messages are accepted by the slave office. Receipt of such a returned message triggers implementation of a control to meter more stringently the rate at which messages are sent to that destination. When a control is applied, only one message is sent to that destination every 10 s. Such a control applies for 2 min and can be extended if any of these more stringently metered messages are returned. The counts from each of these returned messages are added into the current peg count so that these counts are not lost.

When stop time arrives, counts continue to be sent for five more minutes to ensure that the master No. 4 ESS receives all the counts. If counts could not be sent during this 5-min period after stop time, a report is sent to ONAC listing all the unsent counts.

4.3.8.2 Master processing for MSC counting. Fifteen min before the start time, the master application is initialized. All the associated counters are cleared. If a dial-up connection is not required, a report is output to ONAC stating that the application has started. If a dial-up connection is required for this application and a connection to the same destination is already up, a report is output to ONAC that the application has started and these numbers start to appear on the sponsor's output terminal. If a dial-up connection is required and one is not already up, dial-up port software is used to dial up the ONAC count distributor automatically 15 min prior to the master application start time. Every minute after start time the last four digits of each directory number together with the cumulative count for that directory number are output from the No. 4 ESS. The ONAC count distributor transmits this count information to the sponsor's location(s). This count distributor provides local monitoring for problems and information content and increases reliability.

If a dial-up connection goes down, a report is sent to ONAC and another report to the No. 4 ESS office personnel. Three automatic attempts are made to reestablish the connection, each of these attempts being 2 min apart. Another report is issued as to whether or not the connection could be reestablished. The counts, however, are not cleared in the reestablishment process.

Counts continue to be sent to the sponsor for approximately 8 min. after stop time for the master application. Then a final message is printed to the sponsor stating that the service has stopped.

A number of MSC counting manual capabilities exist as follows:

(*i*) A master application can be initialized manually.

(*ii*) An option exists for manually zeroing counts.

(*iii*) A master application can be stopped if problems arise or if a graceful shutdown is desired for an open ended application. (Once a master application is manually stopped, it will not automatically start again. It must be manually initialized.)

4.3.9 Audits and system integrity

To ensure the integrity of the various data bases involved with MAS, several Audits have been developed. These Audits periodically look for inconsistencies between the contents of MAS

(*i*) administration software structures in call store,

(*ii*) administration software structures backed up in file store,

(*iii*) translations,

(*iv*) firmware data structures.

If an error is found, the corrective action involves reinitializing all data structures pertaining to the involved announcement(s), including those in the MAS hardware. Thus, all audio for the involved announcement(s) is lost.

Special treatment was necessary for System Integrity and especially for Announcement Handling and Peripheral Maintenance to ensure that MAS announcement audio is not lost during office phases up to and including a phase 4. All call store data structures related to MAS announcements are cleared in phases 2, 3, and 4. Certain call store MAS announcement structures are then rebuilt by retrieving backup data from file store. Audio for announcements in transient states is lost. [All MAS audio can be removed during phase 4 by manually depressing a Direct Data Insert (DDI) key on the Master Control Center (MCC) panel and subsequently running a phase with the Modify Recovery Action key set.]

All the new MAS-related calls, described in the call processing section, are taken down in phases 2, 3, and 4. These calls are considered transient because they cannot be rebuilt. (These calls are still connected to a call register (in the case of update calls) or they are connected to a dedicated TSI. In both of these cases, the connection information resides in call store which has been cleared.)

V. SUMMARY

An MAS announcement capability has been developed for No. 4 ESS to take advantage of its position in the DDD network. A large complex software package coupled with two new hardware frames introduced in the 4E5 generic of the No. 4 ESS provides capabilities so that sponsors can offer PAS announcements, counting of media stimulated calls, and cut-through services on a local, regional, or national basis. This development provides high capacity, flexible services that also include network protection aspects. Many of the MAS announcement capabilities are unique capabilities for toll switching offices. The MAS software package, which is comprised of approximately 150,000 words, is organized into functional areas and involves almost all functional areas in the No. 4 ESS.