

## 1A Voice Storage System:

# New Custom Calling Services

By D. P. WORRALL

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*In creating new customer services, systems engineers traditionally conduct market needs analysis, engineering feasibility studies, and project economic analysis. Finally, they prepare development requirements. In addition, systems engineering designs the service from the customer's point of view. This article describes new custom calling services as the customer sees them and highlights some interesting features of the services.*

### I. INTRODUCTION

The introduction of No. 1 ESS in 1965 signaled the beginning of new telephone services to the residence and business customer. Some of these services, called Custom Calling Services (CCS), were made available to customers served by ESS central offices and allowed customers to make more efficient use of their telephone service. Custom Calling Services include Call Waiting, Call Forwarding, Three-way Calling, and Speed Calling.

Call Waiting, the most popular service, notifies customers of a second call when they are already on a call. The customer has the option of answering the second call and placing the first call on hold. The service has been very popular with customers who use the telephone frequently.

Another popular service is Call Forwarding, which allows customers to "transfer" all of their incoming telephone calls to another telephone number. When the service is activated, calls to the customer's number will automatically be forwarded to another number which the customer specified when the service was activated. Originally, calls could only be forwarded within the local dialing area of the customer, but cus-

customer reaction to that limitation soon caused a change so that calls can now be forwarded anywhere. The service is popular with small business customers who forward their calls between their business locations and their homes.

Three-way Calling, previously called Conference Calling, allows customers to add on a third party to an established telephone call and then talk with both parties at the same time in a full three-way conversation. Customers involved in community affairs use Three-way Calling to help arrange group activities.

Speed Calling, previously called Abbreviated Dialing, offers customers the capability to dial frequently called numbers with only one or two digits. Customers may choose an eight-number list and/or a 30-number list. Initially, customers could only change their list of numbers via a telephone company service order. This process was time consuming and expensive and detracted from the value of the service. The service has been upgraded to allow customers to change the contents of their Speed Calling lists directly from their own telephone. This service improvement has increased the value of Speed Calling to customers. Customers not only enter frequently called numbers into the list but also special numbers, such as fire, police, first aid, and poison control, for easier and faster access to emergency services.

At the end of 1978, CCS services were available to 15 million customers served by ESS central offices. Customers currently subscribe to over 4 million CCS services. Since 1965, there has been a rapid growth and wide distribution of ESS central offices, allowing marketing organizations to more effectively advertise and sell these services to our customers. The results of these efforts can easily be seen in Fig. 1.

But today's communications-oriented society requires still more advanced telecommunications services. Market studies have indicated customer interest in a wide variety of new and modern telephone related services. Some of this interest stems from the limitations of today's CCS. These services require the physical presence of the customer at a telephone to actually use or obtain value from the services. But in today's very active and mobile society, customers desire control over their communications services even when they are not at their telephones.

Several of these service needs, which are the subject of this paper, concern the ability of a customer:

- (i) to receive a message from someone when the customer is not at home or is too busy to answer the telephone,
- (ii) to send a message to someone when the customer cannot, or chooses not to, reach them directly,
- (iii) to give information to callers, and
- (iv) to control services when the customer is not at home. The

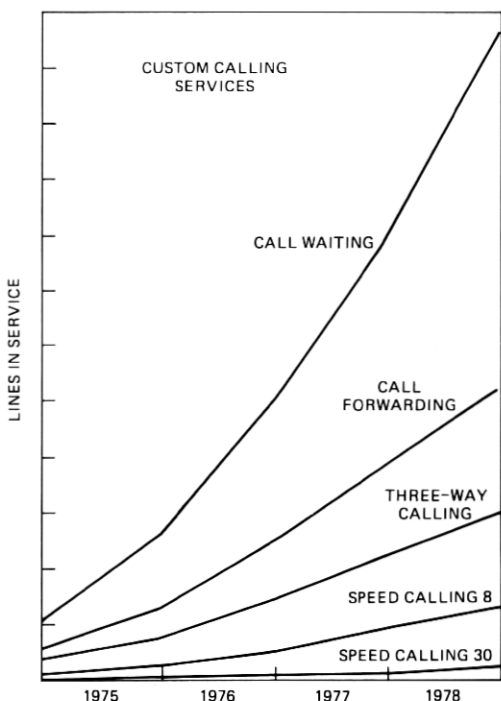


Fig. 1—Bell System sales.

evolution of these “customer needs” into actual telephone services has resulted in the addition of Call Answering, Advance Calling, Custom Announcement, and Remote Access services to the existing Custom Calling Services.

Call Answering provides telephone answering and message recording service for both residence and small business customers. The service offers the general capability to answer a call, deliver to the caller a customer-recorded greeting, and then record a message from the caller. Messages are accumulated and delivered to the customer upon request. The service is under control of the customer, may be used from rotary dial or dual-tone multifrequency (DTMF) signaling telephones, and requires no special equipment on the customer's premises.

Advance Calling service adds a new dimension to telephone service. Advance Calling offers customers the capability to record a message and have it sent to a designated telephone number at a future time. It is for use by customers when direct communications is not desirable or not possible because lines are busy or the call spans large time-zone differences.

Custom Announcement Service allows customers to record an informational announcement, which is delivered to anyone who calls the

customer's telephone number. It is for use by small businesses, schools, social groups, and churches as an information distribution service.

Remote Access will allow customers to access and control these new services from another telephone when they are not at the telephone with the service.

The chart below summarizes the original and new CCS and divides them into terminating and originating categories.

Each of the new CCS services will be described in more detail in the following sections.

<i>Terminating Services</i>	<i>Originating Services</i>
Call Waiting*	Three-way Calling*
Call Forwarding*	Speed Calling*
Call Answering†	Advance Calling†
Custom Announcement†	

## II. SERVICE DEVELOPMENT

Detailed service specification work began with an in-depth analysis of various market studies, which were done by AT&T to identify the demand for new services. Combining these market data with an understanding of the technology to provide these new services resulted in a general outline of a service, with many possible service options. Potential customers were interviewed individually and in groups to further understand customer needs and interests in the services and options.

When a form of a service already existed, studies were conducted to determine their basic capabilities, their strengths, and their weaknesses. Users of these services were questioned to determine their likes and dislikes about the services. Human factors studies were done to optimize the human interface to the proposed new services.

All of this information was used to generate service descriptions and detailed specifications for service operations. The services were developed to offer infrequent users the basic capabilities. Also the services contained enough flexibility and options to satisfy a wide variety of needs for frequent users. Many unique service capabilities are incorporated which are not available from existing alternatives.

The following sections describe in detail the new service offerings. Since the development of new services is an ever-evolving process, the actual services designed may differ slightly from the following descriptions. Customer reactions to the services will be evaluated and changes and enhancements will be designed to meet customer needs.

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\* Original Custom Calling Services, now called CCS I.

† New Custom Calling Services, now called CCS II.



### III. CALL ANSWERING SERVICE

Call Answering (CA) service is a sophisticated telephone answering and message storage service which provides a variety of service capabilities and options to meet the needs of different users. The service answers calls, delivers a customer-recorded greeting to the caller, records a message from the caller, and then stores the message for later retrieval by the customer. Initially, two forms of CA service will be offered. First, a Daily Call Answering (DCA) service is designed for customers with an infrequent or occasional need for an answering service (e.g., night out, weekends, vacations, etc.). This service is simple to access and control and may be activated at any time from the customer's telephone *without* prior arrangement with the Bell operating company (BOC). A maximum number of messages stored is established for DCA customers. The service is available to customers with rotary dial or DTMF signaling. The customer will be charged for the duration of service activation, plus a charge for each call received.

The second CA service, Monthly Call Answering (MCA) has been designed for the user who has a regular need for CA service. It provides greater message storage capacity and message handling capability than the DCA service. A customer desiring MCA service must subscribe to the service by contacting the BOC Business Office and will be charged a monthly fee, plus a usage charge based on the number of calls received.

The CA service can be regarded as having four phases: service activation; call answering and message recording; message retrieval; and service deactivation. Before describing each phase, several terms needed to be defined. A *greeting* is the recording which is delivered to the calling party by the CA service. The greeting may be either a standard BOC-provided message or one which has been personally recorded by the customer. A *message* is a recording made by a caller (in response to a customer greeting), which is stored for later retrieval by the customer. *Prompting announcements* or *prompts* are a special set of CA service announcements that will assist a customer in using the service.

### IV. CALL ANSWERING—SERVICE ACTIVATION

To activate DCA service, a customer dials the service activation code (Table I) and a prompt asks the customer to select either the standard or personal greeting by dialing either 2 or 7. A customer who chooses the personal greeting is instructed to start recording after the record tone. If the customer stays on the line after finishing the recording, the personal greeting is replayed for the customer's approval.

To activate MCA service, a customer dials the service activation code.

**Table I—Custom Calling Services II Access Codes**

	Code†
Call Answering	
Activation	1151
Message retrieval	1152
Deactivation	1153
Monitor	1154
Advance Calling	
Message recording	1141
Status check	1145
Custom Announcement	
Activation	1158
Deactivation	1159
Remote Access	Seven-digit telephone number
Privacy Code Change	1161

† Customers with DTMF signalling telephones may use \* instead of the digits 11 (i.e., \*51 instead of 1151).

(Note, the service access codes are the same for DCA and MCA service.) The service identifies the customer as a monthly subscriber. The customer then receives prompting instructions to enter a service control code. An MCA customer may record a new greeting, replay an existing greeting, choose the standard greeting, or choose the number of rings before CA answers. An MCA customer may also hang up during this prompting announcement, in which case the CA service will be activated with the existing greeting that is on file for that customer.

For both DCA and MCA customers, CA service is activated when the customer hangs up. Customers may verify activation of the service by dialing their own telephone numbers and having the call answered by CA service. A customer wishing to change or modify a greeting may do so at any time by simply performing the activation procedure again.

## V. CALL ANSWERING—CALL ANSWER AND MESSAGE RECORDING

Once CA service has been activated, the service begins to answer calls to the customer's telephone. The most typical call type to be answered by CA service is the "no-answer" call. If a DCA customer does not answer the call within three ringing cycles (approximately 18 seconds), the call will be switched from the customer's line and connected to CA service. For MCA, the customer selects the number of rings (from 0 to 7) during activation. If 0 rings is selected, the call is immediately answered by CA service, regardless of the busy/idle status of the customer's line.

When a call is answered by CA, a CA service Logo (a short series of tone signals uniquely identifying CA service) and the customer's greeting are delivered to the caller. The CA service automatically provides a record tone at the end of the greeting and switches to a recording

mode to record a message from the caller. A message is considered received if the service detects the presence of voice signals for a duration of at least one-half second. After the message is recorded, it is duplicated for reliability, and stored in that customer's message file for later retrieval. Voice signals shorter than one-half second are erased and not stored for the customer. This prevents customers from hearing disconnect tones and noises from callers who did not wish to leave a message.

A caller has ten seconds from the record tone to begin a message. Recording does not start until the service detects the presence of audio signals after the record tone. Thus, messages stored for a customer do not include the silent interval prior to the first voice signal. Also, the trailing silence at the end of a message is erased, so customers need not listen to silence during message retrieval. The service stops recording if 3 seconds of continuous silence is detected or if the maximum message length is reached. The service automatically disconnects the call at the end of message recording.

In addition to answering a call when the customer does not, CA service provides the unique capability to answer calls when the customer's line is busy. Furthermore, CA service has the capability to handle several calls at the same time. Typically, the basic service will answer only two simultaneous calls, but monthly customers have the option (at an additional charge) to specify up to 15 simultaneous calls to be answered by CA service. Additional calls, exceeding a customer's simultaneous calls limit, would receive normal busy tone.

Another unique aspect of CA service is that whenever CA service is answering a call and/or taking a message, the customer's line is free to handle other calls. The customer may answer other calls or place an outgoing call. The line is not tied up while a message is being recorded.

Because CA has been designed to supplement the existing Custom Calling Services, its interactions with Call Waiting (cw) and Call Forwarding (cf) have been carefully designed. If a customer has both cw and CA, during the activation phase of CA, the cw service is momentarily inhibited so that the cw tone sequence will not be recorded into the customer's greeting. During a period when CA is active, cw and CA interact to maximize the opportunity for the customer to receive a call. When the customer is dialing or the customer's phone is ringing, cw tone cannot be given so the call is answered by CA service. When the customer is busy on an established call and another call arrives, the normal cw tone is provided. The customer may flash the switchhook and answer the second call. If the customer does not answer the cw call, normal procedure for cw service is to provide a second cw tone 10 seconds after the initial cw tone. If CA service is active, the second cw tone is not provided, but at the time the tone

would have occurred, the call is answered by CA. This procedure gives the customer with CW and CA service a great deal of flexibility in handling incoming calls.

With the above arrangement for CW and CA service, a customer can "answer" at least four calls at the same time. The first call is answered directly, the second could be answered by CW, and the third and fourth calls could be answered by CA service.

A customer may have CF service, as well as CA service. In this case, both services *cannot* be active at the same time. One service must be deactivated before the other service can be activated. A call can be either forwarded to another telephone number or answered by CA service but not both.

After CA service answers a call, MCA customers may screen incoming calls by listening to the message which is being left. Customers dial the monitor access code (Table I), and CA service bridges the customer onto the call which has been answered. The bridge is a one-way bridge, allowing the customer to only listen to the message being left. If the customer desires, he may be connected directly to the caller by flashing the switchhook. The caller is switched off of CA service and is connected to the customer. Any message which may have been recorded at that time is saved and stored away with all other messages for that customer.

To protect customers and the BOC from abusive use of CA service, several constraints are placed on message recording capabilities. These constraints include limits on (i) the length of an individual message—the service stops recording when the maximum message length for that customer has been reached; (ii) the number of messages stored for a customer at any one time—when the limit is reached, the service automatically turns itself off until some of the messages are retrieved; and (iii) the amount of time a message may remain in storage—the service will erase any message exceeding this storage limit. Typically, the limits are 30-second messages, 30 messages in storage at one time, and seven days storage. Each of these limits may be specified for individual MCA customers.

Another way has been provided to establish the limits. The system has a capability which will provide customers with a fixed amount of storage. The service will answer calls and take messages of any length until the storage for that customer is full. The limit on message length or number of messages, or both, is thereby removed with this option.

## VI. CALL ANSWERING—MESSAGE RETRIEVAL

Whenever messages reside in a CA customer's message file, two message waiting signals are given to the customer to notify him of the existence of these messages. Whenever a customer goes off-hook to

place a call, the initial 2 seconds of dial tone is interrupted (i.e., turned on and off rapidly). A customer may dial during the interrupted dial tone. The second signal, a short burst (500 ms) of ringing is applied to the line whenever a customer disconnects from a completed call. The customer may, at his discretion, retrieve messages or ignore either signal.

The message retrieval procedure is basically the same for both DCA and MCA customers. The customer dials a retrieval code (Table I) and is connected to CA service. The CA service responds to the customer with a prompt stating "You have had  $M$  calls since you last played back your messages and you have  $N$  messages waiting," where  $M$  equals the number of calls answered by CA and  $N$  equals the number of messages for the customer. Each message recorded for that customer is now delivered in the same order in which the messages were received. A unique feature of CA service is that just prior to returning *each* message, CA service automatically tells the customer both the day of the week and the time of day when that message was recorded—for example, "Thursday—9:15 a.m." The message is then delivered to the customer. Messages are separated by a short tone and approximately 3 seconds of silence.

Daily CA customers have very basic message handling capabilities during retrieval. Messages for a DCA customer are delivered once in chronological order. After complete delivery of all messages, a service prompt indicates that if the customer continues to listen, the messages will be repeated two more times. During any of the message deliveries, the DCA customer may "skip" the delivery of a message by dialing the digit 4. The message is skipped and the next message in the sequence is started. Whenever an DCA customer hangs up during retrieval, all messages which were delivered completely at least once (or skipped) are automatically erased from the message file. All other messages are retained.

Monthly CA customers have complete message handling capabilities including *save*, which saves a message until the next message retrieval request; *repeat*, which immediately begins delivery of the current message again; *pause*, which causes a 5-second hold on message delivered; and *skip*, which causes the current message to be stopped and the next message in the sequence to begin. Successive dialing of *skip* or *repeat* causes MCA service to sequence ahead one message at a time or to sequence backward one message at a time.

Whenever an MCA customer hangs up from message retrieval, all messages delivered completely at least once (or skipped) and not specifically saved, are erased from the message file. All other messages are retained until the next retrieval request.

When messages are erased from storage, various information is

tabulated and stored for billing and service analysis purposes. This information includes length of message, duration of storage, date and time of message recording and message retrieval, number of messages, and the busy/idle status of the customer's line when call was answered. This information will be analyzed in detail to better characterize customer answering service needs.

## **VII. CALL ANSWERING—SERVICE DEACTIVATION**

A CA customer may turn off or deactivate the service at any time. The procedures are the same for DCA and MCA customers, but the action taken by CA service is different. The procedure is for the customer to dial the deactivation code (Table I) and listen to a service prompt indicating that the service will be turned off. If one or more messages are still in storage, they will be delivered if the customer continues to listen. Whenever a DCA customer disconnects from the deactivation request, all of the customer's messages, the personal greeting, and the service active indicators are erased. Necessary billing information, such as duration of service activation and the number of calls, is collected and an accounting entry is made to bill that customer for the service.

Whenever an MCA customer disconnects from a deactivation request, only the CA service active indicator is removed. The customer's personal greeting and any messages in the customer's message file are retained. The MCA customer will still receive message waiting indicators until the message file is empty.

## **VIII. CALL ANSWERING—SERVICE OPTIONS**

Several CA service options exist that will allow the BOC to customize the service parameters of CA service to fit the needs of individual customers or groups of customers. Each of the following service parameters may be adjusted to fit the needs of the market place: length of personal greeting, maximum length of messages, number of messages stored at one time, length of time messages remain in storage, and number of simultaneous calls answered for each customer. In addition, a Remote Access option can be applied to CA service. Remote Access will be described in more detail later.

## **IX. ADVANCE CALLING SERVICE**

Advance Calling (AC) is a message-sending service available to all customers served by properly equipped ESS central offices. It offers customers the capability to send a recorded message to a designated telephone number at a future time. Considerable interaction between the customer and the service is required to allow customers to specify

the telephone number, to specify the time of delivery, and to actually record the message. Extensive studies were done to develop easy and logical input procedures for AC.

The basic service operation is for the casual or infrequent user of the service who may not remember the operating procedures. Special user prompting announcements guide and assist customers through the entire procedure. However, frequent users need not be burdened by instructional prompts. For instance, when the service is prompting for digits to be entered, either time or telephone number, the reception of any digit cancels the prompt and the service begins collecting digits. Thus, a customer may "dial thru" prompting announcements. In addition, customers with DTMF signaling may dial the digit to cancel prompting announcements preceding a message recording operation to speed up service operation.

Since there is a significant amount of information to be entered into AC service, the chances for dialing mistakes is higher than normal. The AC service allows certain errors to be corrected. For instance, if the service detects an invalid area code or an invalid time of day, the service asks the customer to re-enter the information. If the customer detects a mistake while dialing, customers with DTMF signaling may dial the digit \* to signal the service that an error has been made. The service then prompts the customer to enter the correct information. Furthermore, all information dialed by the customer is repeated to the customer for verification.

The AC service operates in three distinct phases. The first phase, called message recording, allows the customer to select the telephone number to which the message should be delivered, specify the time for delivery (optional), and record the message. The second phase, called delivery, is automatically performed by AC service. It places calls to the specified telephone number and upon answer, delivers the customer's message. The third phase, called delivery status check, allows the customer to determine if and when a message has been delivered. If a message has not yet been delivered, a customer may cancel any future attempts to deliver it. Each phase of AC service will be discussed in more detail.

## **X. MESSAGE RECORDING PHASE**

Any residence or small business customer may access AC service by dialing the service access code (Table I) on a DTMF signaling or rotary dial telephone. The customer is greeted with a prompting announcement indicating that AC service has been reached and the customer should dial the telephone number where the message should be delivered. The prompt states, "Please dial the telephone number to which

you want your message delivered. Dial the entire number exactly as if you were dialing it directly." The customer then enters the telephone number, and it is spoken back to the customer for verification. The verification response states, "The number to which you want your message delivered is (number entered)." If incorrect, the customer may reenter the telephone number by following error correction procedures.

The customer is then asked to choose between Customer Specified Delivery (CSD) or Service Specified Delivery (SSD) by entering the appropriate control digit. The announcement states, "If you wish to select the time you want your message delivered, please dial the number 9. If not, please dial 7." If CSD is selected, the service prompts the customer to enter the time of day (hours and minutes and a.m./p.m. indication) at which the first attempt to deliver the message is to be made. The service asks the customer to, "Please indicate in your local time when you want your message sent. First dial the hour and the minutes. Then dial A for a.m., or P for p.m." (Twenty-four hour time notation is not used by the service since tests show a very large error rate with that time convention.) The time entered by the customer is spoken back for verification. The announcement states, "Thank you. The time you want your message sent is (day of week) (time) (a.m., p.m., noon, or midnight)" for example, "Thursday—3:15 p.m." Customers may only enter delivery attempt time within 24 hours of the current time of day. If a customer does not wish to specify the time (i.e., chooses SSD), the first attempt to deliver the message is made 15 minutes after the message is entered, but no attempts are made during the late night hours.

The customer is then prompted to record the message. The service prompt states, "When you hear the tone please record your message. You will have (number) minutes of recording time. After recording your message, please dial 2 to approve it for delivery." The actual maximum length of a message is a service parameter to be adjusted as experience is gained with the service. Initially, a 1-minute message is planned for AC service. The message must exceed a 1/2-second minimum message length, and the recording will end if the maximum message length is reached or the customer remains silent for 3 seconds (whichever occurs first). If the customer dials 3, the message is then played back for verification. The service prompt states, "(tone) Thank you. Your message will now be played back for your approval. After hearing your message, you may approve it for delivery by dialing the number 2. If you want to re-record your message, dial the number 6 (tone)." The playback of the recorded message begins within 1 second. When the customer dials the number 2, the message is scheduled for delivery.



Whenever a customer makes a mistake detectable by the system, an appropriate prompting announcement informs the customer of the mistake made and voice-responds any information entered. For instance, if a customer entered only six digits of a telephone number, the service would respond with, "We're sorry. You have not dialed enough digits. The numbers you dialed are (numbers)."

The service duplicates the recorded message for reliability, schedules the delivery of that message at the appropriate time, and records necessary information for future billing purposes.

## XI. DELIVERY PHASE

If the customer specified the delivery time, (Customer Specified Delivery, CSD), the first attempt to deliver that message is made at that time. If the customer selected System Specified Delivery (SSD), the service will schedule the first attempt 15 minutes after the message is entered, unless the time falls into a nondelivery time period. Selected hours during the day may be specified as nondelivery periods for SSD messages. Typically included are the late night hours (10 p.m. to 7 a.m.) in the time zone where the message will be delivered. In addition, retry attempts for SSD messages will not be made during central office busy hours where the call originates. For both CSD and SSD, no delivery attempts will be made during an administrative period lasting 10 minutes at midnight.

The tentative time for the first delivery attempt,  $t_1$ , is given by:

$$t_1 = \begin{cases} T + 15 \text{ min } (-0, +15 \text{ min}) & \text{SSD} \\ T^1 & (-0, +5 \text{ min}) \quad \text{CSD} \end{cases},$$

where

$T$  = time of message entry into AC

$T^1$  = customer-specified delivery time.

As referred to above,  $t_1$  is only a tentative first delivery time because it may be necessary to adjust  $t_1$  to avoid nondelivery periods. The exact time for the first delivery,  $T_1$ , is determined from  $t_1$  by the algorithm in Fig. 2.

At the time of delivery, the service places a call, over the regular telephone network, to the telephone number specified by the customer. Voice-presence circuits will "listen" to the call progress tones associated with the call attempt, and the service will be able to determine the status of the call. It will know that a busy or reorder condition was reached or that the called number is ringing. Any other call condition that might be reached is treated as a ringing connection. If the call attempt reaches busy, the attempt ends and a record is made of the busy condition. If a ringing connection is reached, the service will wait

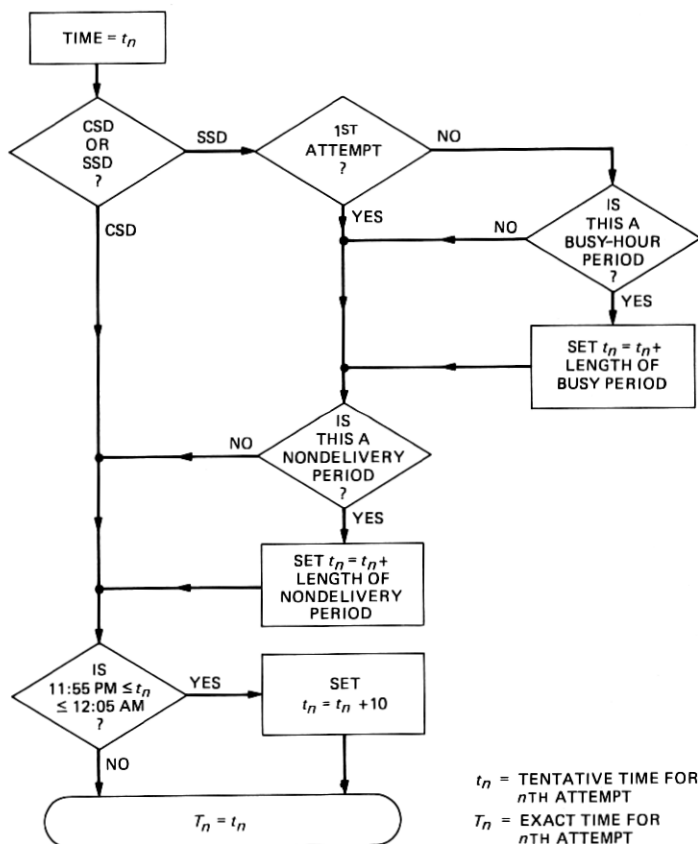


Fig. 2—Delivery time algorithm (find  $T_n$  from  $t_n$ ).

for approximately 30 seconds (five ringing cycles) for answer before abandoning the attempt and records the no-answer call condition. The time of the next attempt is then calculated.

The algorithm for determining the next attempt time considers how many attempts have already been made, whether the previous attempt reached busy or a no-answer condition, and whether CSD or SSD was selected. In general, the time between attempts gets longer as the number of attempts increases. Advance calling will make from six to ten attempts in no more than 13 hours for CSD and in no more than 24 hours for SSD. It was felt that if a customer specified the time of delivery, the message was important and, therefore, delivery should be attempted more frequently.

To determine the tentative time of the next delivery attempt,  $t_n$ , when  $n \neq 1$

$$t_n = T_{n-1} + \Delta t_n,$$

where  $\Delta t_n$  is found in the appropriate Delivery Time Table in Tables II and III. Based on the call condition reached on the previous attempt and whether a CSD or SSD message is being processed, select from the Delivery Time Table the appropriate time interval and add it to  $T_{n-1}$ . The Delivery Time Tables also include a range adjustment factor to allow the service to smooth out traffic loads over time periods to prevent peaking of call attempts.

In addition to the time-table calculations for  $t_n$ , several other conditions must be evaluated:

(i) The total number of attempts,  $N$ , for any message cannot exceed 10.

(ii) If attempt  $n$  encounters a busy after attempt  $n - 1$  encountered a no answer, set  $n = 2$ . This allows for a faster retry on the next attempt to increase the probability of delivery since it appears that the customer is now home but busy on the telephone.

(iii) When the above adjustment has been made, but the next call attempt encounters a no-answer condition, set  $n = N - 1$ , allowing the service to extend the time of the next attempt since it appears that the customer is really not available.

(iv) If there have been three consecutive no-answer conditions and the last attempt occurred between 11 a.m. and 2 p.m., add an additional 3 hours to  $t_n$  calculated from the table. This allows the service to move several call attempts into the evening hours to maximize the probabil-

Table II—Delivery Time Table—CSD

$t_n$ if attempt $n - 1$ reached (minutes)		
$n$	Busy	No Answer
2	5 (-0,+5)	30 (-0,+15)
3	10 (-0,+5)	60 (-15,+15)
4	15 (-5,+5)	60 (-15,+15)
5	20 (-5,+10)	90 (-15,+30)
6	25 (-5,+10)	120 (-15,+45)

Table III—Delivery Time Table—SSD

$t_n$ if attempt $n - 1$ reached (minutes)		
$n$	Busy	No Answer
2	15 (-0,+15)	60 (-15,+30)
3	30 (-15,+15)	120 (-15,+30)
4	60 (-15,+15)	180 (-15,+45)
5	75 (-15,+30)	180 (-15,+45)
6	90 (-15,+30)	240 (-15,+60)

ity of delivery to customers who work during the day and are home during the evening.

Once  $t_n$  is determined from the Delivery Time Tables and the additional constraints above,  $T_n$  is calculated from  $t_n$  by the algorithm in Fig. 2.

The generation of the delivery algorithm for AC was based on evaluations of network completion studies and studies of calling habits of telephone customers. But at best, the delivery algorithm is a "best guess." As AC service is used by customers, detailed data on call attempts, time of day, and busy/idle conditions reached will be recorded and analyzed. Results of that analysis will be used to modify the delivery algorithm to maximize the probability of delivery with the fewest number of attempts.

When the called telephone is answered on any delivery attempt, the answering party is greeted by a service Logo and a standard announcement identifying the call as AC service and explaining that a recorded message will be delivered if the customer will continue to listen. The announcement states, "This is the Bell System Advance Calling Service with a personal message recorded earlier for delivery to you. If you stay on the line, your message will be played three times." The message is then delivered for the customer.

The message is considered delivered if the customer hangs up during the introductory greeting or the delivery of the message. No further attempts will be made. The service will record, for billing purposes, the length of the call made to deliver the message.

## XII. DELIVERY STATUS CHECK

A unique aspect of AC service, is that customers may check on the delivery status of their messages up to 48 hours after the message is entered into the system. A customer may check the status of a message or messages by dialing a Delivery Status Check access code (Table I) from the same telephone where the message was originated. If a message or several messages exist for a single destination, the status of each message will be returned with an indicator of the day and time each message was entered into the system (i.e., "your message of Thursday 3:15 p.m. was..."). If messages have been recorded for delivery to several telephone numbers, the customer is asked to enter the telephone number of the message for which the status is desired. The appropriate status is then returned.

For each message status requested, one of five possible responses is given:

(i) The message could not be delivered (the service has stopped all further attempts);

(ii) The message has not been delivered, but further attempts are continuing;

(iii) The delivery call was completed, but the called party hung up before the message was delivered;

(iv) The message was partially delivered when the called party hung up; or

(v) The entire message was delivered.

When a delivery call is completed, the day and time of the completion is included in the status report.

Another feature of AC is that when a customer receives a status report that a message has not yet been delivered, the customer may cancel any future delivery attempts for that message by dialing the cancel code, 0. The service then verifies the cancellation of a message. The status of messages remains available to customers until a delivered or undelivered status is reported to the customer or until 48 hours have elapsed since the message was recorded. The actual message is erased when delivery is made or when no further attempts to deliver are to be made.

### **XIII. BILLING**

There are two parts of the billing for AC service. Customers are charged for entering a message into the service, regardless of the outcome of the delivery attempts. This message recording charge covers the cost of recording, all delivery attempts, and one status check. Additional status checks are charged on a per-call basis. Customers are also billed at standard call rates in effect at the time of day the message is delivered for any local message unit charges or toll charges associated with any delivery attempt that is completed.

### **XIV. CUSTOM ANNOUNCEMENT SERVICE**

Custom Announcement Service (CAS) will provide customers, mainly small businesses and community organizations, with a low traffic announcement service. The service operations are identical to CA service, except that callers cannot leave messages and the customer's telephone is never rung while the service is active. Customers may activate or deactivate the service at any time by dialing the proper access codes (Table I). During activation, a customer records the announcement desired.

The CAS offers the customer the advantage of having the telephone completely free for making outgoing calls. It also allows customers to specify how many simultaneous calls would be answered by CAS. When CAS is combined with Remote Access (to be described next), a customer may set up a recorded announcement service on a telephone number

without actually equipping that number with a telephone. The service would be controlled from any other telephone using remote access procedures.

## **XV. REMOTE ACCESS**

The above description of CA, AC, and CAS has assumed that the customers only access the service from their homes or business telephones. But there is an identified need for customers to be able to access their services when they are away from their regular telephones. A Remote Access (RA) feature is available for CA, AC, and CAS, which will permit customers to access their services from any DTMF signaling telephone.

Each customer who selects the RA feature must use a customer-changeable, variable-length (maximum nine digits) Privacy Code (PC) so that the service can identify the customer. In addition, customers are given a special seven-digit telephone number which they can call when RA is desired. All customers in the same central office code (the first three digits of a telephone number) will use the same RA telephone number.

When a customer wants to access a service from a telephone other than the telephone on which the service is active, a call must be placed to the special RA telephone number (plus area code if needed). This call will be a charged call with the appropriate local message unit or toll charges applied. Upon terminating to the service, customers will be prompted to enter their home or business telephone number and their PCs. This must be done using DTMF signaling. The service will check the telephone number and the PC entered. If a match exists, the customer is prompted to enter the access code for any service desired (see Table I).

If a match does not exist between the telephone number and the PC, the caller is given a second try. If the second try fails, the caller is disconnected from the service. To deter attempts to "break" a PC (over one billion combinations possible) and gain unauthorized access to a customer's service, records are kept on the number of error attempts made over some time interval. When a preset threshold is reached, RA capability is turned off for that telephone number for some period of time and is then turned on again.

Once customers properly complete the PC check, they enter service access codes and have complete control over their services just as if they were at their base telephones. The only restriction imposed is that customers must use DTMF signaling to control the services via RA. A customer may access CA service to turn it on or off, retrieve messages, or change a personal greeting; AC service to send a message, check on the status of a message or cancel a message; or CAS to turn it on or off

to record a new announcement. Note, that a customer must subscribe to RA on a monthly basis, but via RA, a customer could access and use DCA service.

When an RA customer first subscribes to the service, the BOC assigns a null PC. This permits the customer to gain initial access to the service. When customers pass the PC check using the null PC, they can dial the Privacy Code Change (PCC) access code (Table I) and input any new PC desired. By using the PCC feature regularly, customers can repeatedly change their PCs. Further, no BOC records are made of customer's PCs.

For all services, RA may be assigned to a telephone number without actually having a telephone equipped on that line. This is very attractive for AC since it allows customers in areas where AC is not directly available to send AC messages via RA. To allow customers to make efficient use of RA for AC service, an additional "recycle" capability was designed. At the end of the message recording phase, when a customer would normally have been disconnected, provisions have been made to allow customers to enter the AC access code again to "recycle" back to the beginning of the message recording sequence so that a second message could be sent via the same RA call. Recycle is also available during other phases of AC service. Thus, with the recycle capability a customer could, on a single RA call, send several AC messages, check the status of previous messages, cancel previous AC messages if not yet delivered, and retrieve CA service messages from storage.

As experience is gained with customers using RA, the remote access procedures described here may be extended to other CCS services, e.g., Call Forwarding.

## **XVI. THE FUTURE**

The new services described in this paper offer the telephone customers new and unique communications services. They allow customers to make more efficient use of telecommunications. These initial services establish a solid foundation on which to build future improvements and additional capabilities. The extent to which these services are enhanced will be directly determined by the customers themselves. Many enhancements have already been studied and defined for CA and AC services. The development only awaits customer feedback from the initial services.

One thing is certain for the future. The technology used to provide these new services offers potential for other services that will have an impact on the way people will communicate with each other.

