A combined business communication system and an automatic call distributor (ACD) system where each station (S1) in the system is available to handle, on a per call basis, either calls distributed by ACD or regular incoming calls. The system is arranged to accept from any user at any station an ID (509) uniquely associated with that user. The ID in turn then controls (512) the ACD system to direct calls to the user in accordance with the ID (509) information without regard to the station location (S1) of that user. Calls between system users are completed either in accordance with station identification numbers or in accordance with the ID number of the desired user.
FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

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CALL COMPLETION CIRCUIT AND METHOD

This invention relates to a communication system having a plurality of stations, each having an identity used by the system for the completion of communication connections thereto in which the system comprises a processor.

An automatic call distributor (ACD) system is one application of this concept. However, the call completion arrangement described here has applications in communication systems generally. In ACD systems incoming calls are completed to stations in accordance with a predetermined completion pattern. This pattern may, for example, depend upon the location of the origination of the call, or upon the trunk type of the incoming call. Often, the incoming call is to be completed to one or more specifically designated attendants. This presents a problem when the attendants are free to move between station terminals.

Often, when one attendant desires to call another specific attendant, but the calling party may not know the present physical location of the desired called party the problem is how to call the specific attendant. Also, in a typical ACD operation it is often necessary to display status information on an attendant-by-attendant basis. This requirement is difficult to achieve in situations where the attendants are free to move between terminals.

The problems are solved in accordance with the invention in a communication system in which the system comprises a memory for accepting from a system user at any station a unique identification number assigned to that user, the processor temporarily associates an accepted user identification number from a particular station with the particular station, and the processor completes calls to the particular station either in accordance with the receipt of signals representative of the station identity.
or in accordance with the receipt of the accepted user personal identification number presently associated with the particular station.

**Summary of the Invention**

We have designed a system having the capability that each station or terminal position may be used for regular calls as well as for use in an ACD system, both incoming and outgoing. The users, prior to handling a call from any station or terminal, dial a special dial code, thereby entering their personal dial codes (PDC) into the central processor. The present station location of each personal dial code is stored in status memory 16-2 in the station log in identification table (STA_LID). From that point onward until a new dial code is entered, or until the PDC is either removed or entered on another terminal, calls may be placed to the terminal either by dialing the terminal identification number or by dialing the PDC number of the user.

The system is also designed to allow intercom calls between terminals either in accordance with the identity of the terminal or in accordance with the identity of a person, not necessarily an ACD agent, presently using that terminal.

**Brief Description of the Drawing**

The solution to the foregoing problems, together with the operation and utilization of the present invention, will be more fully apparent from the following description taken in conjunction with the drawing, in which:

- FIG. 1 shows a pictorial view of a combined ACD and communication system; and
- FIGS. 2 and 3 show flow charts of the operation of the call completion arrangement.

**General Description - Background**

Before beginning a general discussion of the specific features claimed it may be helpful to review in general terms the operation of an overall system in which
the claimed feature can be utilized. It should be borne in
mind that such a feature can be used in any number of
similar type systems and thus background information on
only one type of system will be presented. In addition,
since communication system features may be used with
different types of systems each dependent on different
hardware constraints and upon different programming
techniques, no attempt will be made to detail all of the
steps used to control the overall system, as such would
cloud the issue and unnecessarily lengthen this
specification. Quantities mentioned were engineered for
particular time and memory requirement and will not be the
optimum for all such systems.

It will of course be obvious to one skilled in
the art that in order for the feature described and claimed
herein to be used with any communication system, the
feature must be blended into the overall structure of the
system in which it is used and must be tailored to mesh
with all of the other features and operations of such a
system. Thus, in order to avoid confusion and in order to
allow those skilled in the art to utilize the invention
claimed herein, this specification will concentrate on
providing an understanding of the problems and constraints
typically found in a communication system where the feature
may be used. This specification will provide the
logical steps necessary for the implementation and blending
of the described feature into such a larger system, having
many such features.

**Typical Overall System Operation**

One such communication system where the structure
claimed herein can be used is a station oriented stored
program control, business communication system. FIG. 1
shows a block diagram of such a system which combines the
usual key system features (hold, visual indication, etc.)
with many features only recently available.

These features are fully detailed in five issued
U.S. patents, each directed to a different operational
feature of a communication system. These patents are U.S. Patent Nos. 4,109,113; 4,150,259; 4,150,257; 4,125,748.

Call processing in the system is under the control of processor 15 in common control 14. Each station, such as Station S1, and line port, such as 12-1, is scanned to detect any changes in status. In response to any change (e.g., on-hook, off-hook, button depression, etc.), the processor, per instructions in the stored program in memory 16 translates these changes into system commands. The system also generates commands via a bidirectional data bus 101 to the multibutton electronic telephone set, also called a MET set, shown in detail in FIG. 2, to light the light emitting diodes (LEDs) and ring the tone ringer associated with the MET set. All of the MET sets provide TOUCH-TONE dialing, tone ringing, and LED indications. The LED indicators will be discussed hereinafter. The tone ringer provides two distinctive audible signals - low-pitched tone ringing to indicate incoming CO calls and high-pitched tone ringing to indicate incoming station-to-station (intercom) calls.

Nonbutton key sets can be used as station positions where only station-to-station (intercom) calling and/or outward dialing, via dial access pooled facilities or a central answer position, are required. In this implementation, the first (lower) 3 buttons on each MET station set are always the same. They are: Hold, and two system access buttons, each associated with the intercom number of the particular station. The system access buttons are used to receive calls from other stations within the communication system (intercom) and to originate such calls or to access system facilities such as lines, paging ports, etc. Incoming calls may terminate on either system access button depending on their busy/idle status. If the lower one is busy, a second incoming call comes to the second (upper) one, giving a visual call waiting indication accompanied by a single audible ring if the station is off-hook. The system access buttons are also
used in conferencing and call transfer features. The remainder of the buttons on the MET station sets can be assigned to any of the button-activated station or answering position features.

As shown in FIG. 1 there are three pairs of wires coming out of the electronic key telephone set to the interface unit: T&R, data in, data out. The T&R pairs are connected to switching network 11. In the example shown a space division network with n links is shown. It may be replaced by a time division network with n time slots. The data link between the set and the processor is used to transmit information to the processor which will configure the switching network and send LED control signals back to the telephone sets accordingly. System facilities, such as system facility 10, is understood to include origination registers, tone circuits, stations, lines, trunks or any port which can be communication coupled to a link of the network.

Common control 14 consists of processor 15, interface units 17 and 18 and memory 16. The memory unit consists of a program store 16-1, and a data store 16-2. The data store is subdivided into the following:

A. Translation which contains the hardware configuration data. For example, the button assignments and station class of service.

B. Status which stores the state of the system at a given moment. For the station, it contains
   (a) Station state: switchhook; whether actively connected to the network or not.
   (b) Button state: for each button

C. Temporary Data which is used to process a call and is a scratch-pad area.

A typical common control processor works on a 25 ms work cycle. A high level executive program, TSK_DSP, controls the order of tasks executed in a work cycle. At the beginning of each cycle, a hardware real time interrupt is received by the processor. The interrupt handling routine
sets a flag and returns to the interrupted task which in
turn will relinquish control to TSK_DSP control, as soon as
it reaches a convenient break point. The task dispenser
decides which task is to be executed next according to a
schedule. Basically these tasks fall into three
categories:

1. Scan: Scan for physical changes (e.g., a new button
depression by a station). If a change is detected
and confirmed, it will be stored in a temporary
buffer to be processed later.

2. Process: After all scans are completed, changes
will be processed.

3. Maintenance: If there is time left in the 25 ms
cycle, the system will perform routine maintenance
functions until the next work cycle begins.

The following features can be implemented by the system
discussed herein.

**Station-To-Station Calling**

This feature allows a station user to directly
dial other stations within the system without the
assistance of the attendant. This is accomplished by
selecting an idle system access button and dialing the
intercom code of the desired station.

**General Description**

In the status memory (FIG. 1, item 16-2) there is
stored for each button on each station set the following
information:

(a) The instantaneous state of each LED (on/off) for
the two LEDs associated with the button;

(b) the long term state of each LED (flash, wink, on,
off). This is called the Station Button Status for
the status LED.

Also, for each station set, there is a status memory
location for recording:

(c) the last detected instantaneous state of the
station's switch-hook and buttons;

(d) the desired state of the station's tone ringer
(on/off, volume setting, frequency setting).

Periodically, the processor (FIG. 1, item 15) takes the information in (b) and uses it to update the instantaneous information in (a).

Periodically in the scan cycle, the processor takes the information in (a) and (d) and assembles it into a single long message for a single station in the format required by the MET station set. That message is stored in status memory 16-2 in the station lamp scan output table (SLSO). This data is transmitted to the MET using the data interface (FIG. 1, item 17). The MET set returns to the processor, via the data interface, the instantaneous state of its switch-hook and buttons, which is stored in status memory 16-2 in the data structure station MET input/output table (SEIO).

The returned data is compared with that in (c) above and if there are any changes, records these in a temporary buffer for that station in 16-2 called station change/timing byte table (SCTB). At a different time, another processor action picks up this stimulus and causes the appropriate feature actions to be initiated in response to that stimulus.

Whenever the processor program wishes to turn on or off an LED on a MET, or set it to wink or flash, it writes the appropriate bits into the status memory described in (b) and this function will automatically occur as a consequence of the two periodic actions described above.

For each button, there is a translation record stored in the translation memory (16-2 of FIG. 1), SBID (station button identification), to identify the type of button. This information is coded in numerical forms, e.g., a value of 1 identifies a personal line button, a value of 2 identifies a pooled line button, 3 identifies a track button, etc.

For a speech-type button (e.g., system access, auto-intercom, personal line, pooled line, call coverage,
etc.), there are 4 possible states which will be shown to the user on the status LEDs: Namely, busy — (LED flash), hold — (LED wink).

This information is stored in the status data memory (16-2 in FIG. 1) coded in numerical forms. For a nonspeech-type button like message-waiting, the same data format is used although the valid states may reduce to 2 (busy and idle).

As described, the scan routine in the system detects and reports a button operation by the MET user to a buffered area to wait for the process routines to process. When such a change is processed by the process routines, the button identification information, SBID, stored in 16-2 is first checked, then the button status information stored in 16-2 is checked. The processor is thus able to interpret the button operation to a specific user command and uses the proper programs stored in 16-1 to process the change. For example, button selection of

(1) an idle (from SELP or SELS) speech-type (from SBID) button implies call origination requiring the associated facilities. (2) a ringing (from SEIO or SELS) speech-type (from SBID) button implies answer a ringing call.

**Detailed Description — Personal Dial Code**

FIG. 2 shows an overview of the three basic decisions which must be made any time a user decides to place a telephone call. Process 402 represents the condition where the agent or other communication system user wishes to log in using the personal dial code (PDC).

To do this, the user operates the asterisk (*) button twice followed by the three-digit personal dial code repeated twice.

Process 403 represents a situation where the user wishes to place a call to a particular station by using the intercom number of the station, and the situation in process 404 depicts the situation where the user wishes to place a call to another party by using the personal dial
code of that called party. In this last situation, the user would operate the asterisk and number symbol buttons (*#) followed by the three-digit number of the called party. Using this mode of calling, the physical location of the terminal is not important, but rather the call is directed to the terminal where the called party is presently located.

In addition to the ACD environment where agents routinely move from station to station, such a feature would find acceptance, for example, in a conference-room situation where many people gather, each one using the same telephone to establish their log-in presence. Thus, incoming calls to any of the people at the conference would all terminate at the same conference room telephone.

As shown in process 501 (FIG. 3), the user presses the system access button on a telephone station set and dials the desired digits. If the first digit dialed is not an asterisk (*), then box 502 directs the call to process 504 where it is determined that this is neither a log-in or a call by personal dial code and thus no further action is necessary. If the first digit dialed is an asterisk (*), then process 503 waits for the second digit. If the second digit is not an asterisk (*) or pound number symbol (#), then again the call is treated as a regular intercom dial call via process 504. If the second digit however, is an asterisk (*), then the system determines that the user is logging-in to this terminal and process 505 then accepts the three-digit personal dial code and process 506 then accepts three more digits which should be identical to the first three digits.

Process 507 compares these two sets of digits, and if they are not the same, provides reorder tone via process 510 to the user. However, if both sets of PDC digits match, then process 507 calls process 508 which in turn updates the system records in the STA_LID table in 16-2 to show that the personal identification code is logged-in at the terminal from which the digits were
entered.

Turning now to box 503, if the second digit dialed following an asterisk (*) is a pound number symbol (#), then the system determines that the user at this terminal is calling another party via the personal dial code of the called party. In this situation, process 509 accepts the three-digit personal dial code and process 511 then determines whether or not this code is presently logged-in to this system. If the answer is no, reorder tone is provided to the calling user. If, on the other hand, process 511 determines that the accepted three-digit personal identification code is valid and the associated agent is logged-in to the system, then the call is placed to the terminal where the personal dial code was last logged-in via process 512. This is accomplished via a table of associations stored in the data array STA_LID in 16-2 which is constructed by process 508.

Conclusion

While we have shown one embodiment of call completion to users or attendants, other completion routines can be used. For example, a user logging-in with a PDC could always be associated with a particular split and thus incoming calls having certain parameters can be completed to that user without regard to the station at which the user is located. This can be accomplished by establishing a store of personal dial codes corresponding to certain splits and when a user or attendant logs-in at a terminal that terminal will be assigned to the pre-established split. This would be accomplished by modifying the log-in process to take the proper information from the PDC store and place it in the station-split association table in status memory 16-2. It is also easily possible to allow calls incoming to be completed to a terminal out of turn if a personal dial code is received.
Claims

1. A communication system having a plurality of stations, each having an identity used by the system for the completion of communication connections thereto, the system comprises:
   a processor (15);
   CHARACTERIZED IN THAT
   the system comprises:
   a memory (16) for accepting from a system user at any station a unique identification number assigned to that user;
   the processor (15) temporarily associates an accepted user identification number from a particular station with the particular station, and
   the processor (15) completes calls to the particular station either in accordance with the receipt of signals representative of the station identity or in accordance with the receipt of the accepted user personal identification number presently associated with the particular station.

2. The communication system set forth in claim 1 CHARACTERIZED IN THAT
   the processor (15) operative in response to special signals received from the users in conjunction with the accepted user identification number for distinguishing between calls which are to be completed in accordance with the terminal identity or in accordance with the accepted user identification number.

3. The communication system set forth in claim 1 CHARACTERIZED IN THAT
   the system is arranged to complete calls to selected users in accordance with a call completion algorithm, and wherein the processor (15) directs calls to users selected by the algorithm to the particular terminal presently associated with the selected attendant.

4. The communication system set forth in claim 1 CHARACTERIZED IN THAT
the system is arranged to complete calls to
selected users in accordance with a call completion
algorithm, and wherein the processor (15) directs calls to
users selected by the unique identification number.

5. The communication system set forth in claim 5
CHARACTERIZED IN THAT
the processor (15) verifies the accuracy of the
identifying signals.

6. The method of operating a communication system
having a plurality of terminals each terminal having an
identity used by the system for the completion of
communications connections thereto, the method including
the steps of
- accepting from a user at any terminal a unique
identification number assigned to that user,
- temporarily associating an accepted user
identification number from a particular terminal with the
particular terminal, and
- completing calls from a calling user to the
particular terminal either in accordance with the receipt
of signals representative of the terminal identity or in
accordance with the receipt of the accepted user
identification number presently associated with the
particular terminal.

7. The method set forth in claim 6 wherein the
completion step is operative in response to special
signals received from the users in conjunction with the
accepted user identification number for distinguishing
between calls which are to be completed in accordance with
the terminal identity or in accordance with the accepted
user identification number.

8. The method set forth in claim 6 wherein the
the system is arranged to complete calls to selected users
in accordance with a call completion algorithm, and wherein
the completion step includes the step of directing calls to
users selected by the algorithm to the particular terminal
presently associated with the selected user.
# INTERNATIONAL SEARCH REPORT

**International Application No:** PCT/US83/00455

## I. CLASSIFICATION OF SUBJECT MATTER

(If several classification symbols apply, indicate all)  
According to International Patent Classification (IPC) or to both National Classification and IPC  
**INT. CL. H04M 3/50, H04Q 3/64**

## II. FIELDS SEARCHED

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Documentation searched other than Minimum Documentation to the extent that such documents are included in the fields searched.

## III. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US, A, 4,286,118, Published 25 August 1981, MERAFFEEY et al.</td>
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<td>X</td>
<td>US, A, 4,313,035, Published 26 January 1982, JORDAN et al.</td>
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**Notes:**  
*A* special categories of cited documents: 13  
"A" document defining the general state of the art which is not considered to be of particular relevance  
"E" earlier document but published on or after the International filing date  
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)  
"O" document referring to an oral disclosure, use, exhibition or other means  
"P" document published prior to the international filing date but later than the priority date claimed  
"T" later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention  
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step  
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art  
"A" document member of the same patent family

## IV. CERTIFICATION

**Date of the Actual Completion of the International Search**  
20 AUGUST 1983

**Date of Mailing of this International Search Report**  
24 AUG 1983

**International Searching Authority**  
ISA/US

**Signature of Authorized Officer**  
THOMAS W. BROWN

Form PCT/ISA/210 (second sheet) (October 1981)
**V. OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE**

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. [ ] Claim numbers .......... because they relate to subject matter \[1\] not required to be searched by this Authority, namely:

2. [x] Claim numbers .......... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out \[1\], specifically:

   Claim 5 depends from itself.

**VI. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING**

This International Searching Authority found multiple Inventions in this international application as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. [ ] As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest
- [ ] The additional search fees were accompanied by applicant's protest.
- [ ] No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (supplemental sheet (2)) (October 1981)