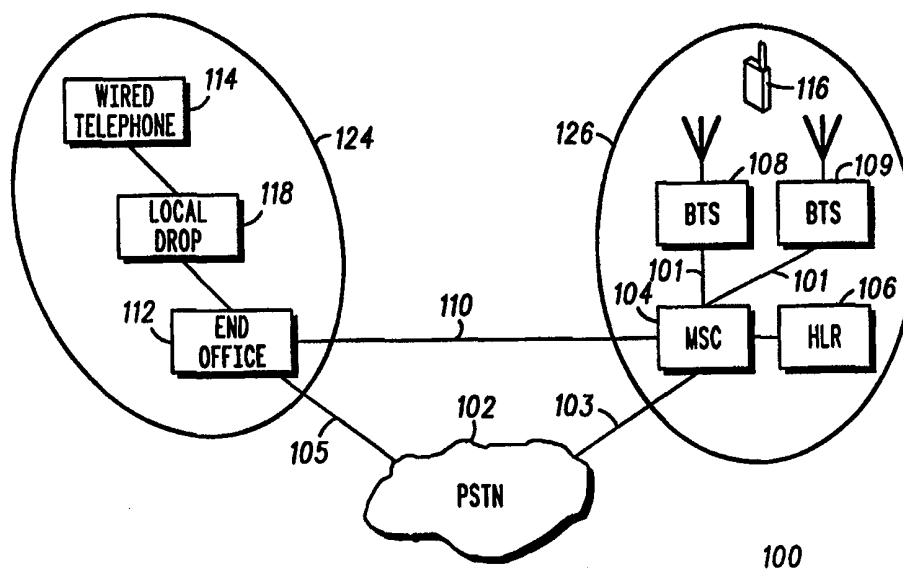




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(54) Title: COMMUNICATION SYSTEM AND METHOD FOR RINGING WIRED TELEPHONES AND WIRELESS TELEPHONES SUBSTANTIALLY SIMULTANEOUSLY



(57) Abstract

The present invention provides a communication system (100) and a method for ringing wireline telephones (114) and wireless telephones (116) substantially simultaneously. The communication system (100) includes a Public Switched Telephone Network (PSTN) (102) that provides wired service of a wireline telephone (114) and a Mobile Switching Center (MSC) (104) coupled to the PSTN (102). A Home Location Register (HLR) (106) is coupled to the MSC (104). A base transceiver station (108) is coupled to the MSC (104). A Switched Access Services (110) connection couples the MSC (104) to the wireline telephone (114). A call request is received at the MSC (104). A set of telephone to ring that includes both a wireline telephone (114) and a wireless telephone (116) is determined based upon the HLR (106). Each of the set of telephones is rung substantially simultaneously. The processing of the call is transferred to the first answering telephone.

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**COMMUNICATION SYSTEM AND METHOD FOR RINGING
WIRED TELEPHONES AND WIRELESS TELEPHONES
SUBSTANTIALLY SIMULTANEOUSLY**

5

Field of the Invention

10 The present invention relates generally to communication systems,
and more particularly to a communication system and method for ringing
wireline telephones and wireless telephones substantially simultaneously.

Background of the Invention

15 Current communication systems include both wireline telephones
and wireless telephones. Wireline telephones communicate with other
wireline telephones by obtaining a dial tone at their residence. A phone
number is dialed, the phone number being a unique physical identifier of
another physical telephone. The call request passes through an End
20 Office operated by the Local Exchange Carrier (LEC) who provides service
in the area. The End Office is connected to a Public Switched Telephone
Network (PSTN), which sends the call request to the requested telephone
through an End Office, which can be the same End Office as the originator
used, if the call is in the same service area, or a different End Office if the
25 call is going to a different service area.

 Wireless cellular telephones connect with other wireless cellular
telephones by transmitting a call request to a Base Transceiver Station
(BTS). The BTS sends the call request to a Mobile Switching Center
(MSC), which locates the requested cellular telephone. The MSC locates
30 the desired telephone by accessing a database, typically called a Home
Location Register (HLR). The HLR stores the identification of the switch
serving the subscriber at the time of the call. That information is used to
route the call to the serving switch. When the call is received at that
switch, a page is sent to the desired telephone by the BTS in the service
35 area. If the desired cellular telephone answers the page, the two cellular
telephones are connected, and the call is initiated.

Wireline and wireless telephones can currently communicate by connecting the MSC to the PSTN. In this manner, a call request from a wireless telephone to a wireline telephone would proceed as follows. The wireline telephone would, after receiving a dial tone, enter the phone number of the wireless cellular telephone. The phone number is a physical phone number associated with each wireless cellular telephone. The call request passes from the local drop through the End Office to the PSTN. The PSTN is connected to the MSC and passes the call request to the MSC. The MSC locates the wireless cellular telephone as it would during a wireless to wireless communication. In this manner, the wireline/wireless communication is established.

A call from a wireless cellular telephone to a wireline telephone is processed in similar fashion. The wireless telephone dials the number of the wireline telephone. The request is passed to the BTS, which in turn passes the request to the MSC. The MSC, in realizing that the request is for a wireline telephone, passes the request to the PSTN to which it is connected. The PSTN passes the request to the End Office associated with the phone number dialed, and the End Office rings the telephone associated with the number dialed.

In this manner, calls are able to be made between wireline telephone and wireless telephones. However, there is currently no connection of the MSC to the End Office to provide service to a wireline telephone without using the PSTN. Further, there currently does not exist a method or communication system for ringing a wireline telephone and a wireless telephone simultaneously. Consequently, a need exists for a method and communication system that can ring both a wireline and a wireless telephone substantially simultaneously.

Brief Description of the Drawings

FIG. 1 depicts a communication system in accordance with a preferred embodiment of the present invention;

FIG. 2 depicts a Home Location Register in accordance with the preferred embodiment of the present invention;

FIG. 3 depicts a flow chart for ringing a wireline telephone and a wireless telephone substantially simultaneously in accordance with the preferred embodiment of the present invention; and

5 FIG. 4 is a flow chart illustrating operation of additional call processing functions in accordance with the preferred embodiment of the present invention.

Detailed Description of a Preferred Embodiment

The present invention provides a method and communication system for ringing wireline and wireless telephones substantially simultaneously. The communication system includes a wired portion and a wireless portion. The wired portion includes a Public Switched Telephone Network (PSTN) having wired service of a wireline telephone, such as located at a residence or a business location. The PSTN is preferably connected to an End Office under the jurisdiction of a Local Exchange Carrier (LEC). The LEC provides access and connection to a plurality of houses, businesses, or the like. The wireless portion of the communication system includes a Mobile Switching Center (MSC) and a plurality of base transceiver stations (BTS's) coupled to the MSC. A Home Location Register (HLR) is coupled to the MSC and includes a list of wireline telephone numbers, wireless telephone numbers, and logical numbers that include both wireline and wireless telephone numbers.

The wired portion and the wireless portion are connected with two connections. The first connection is between the MSC and the PSTN and represents the typical interconnection for call delivery between wireline and wireless networks. The second connection is between the MSC and the End Office, and is provided by a Switched Access Services (SAS) connection coupling the MSC to the wireline telephone. The SAS connection is a trunked interface between the End Office and the MSC. This configuration provides the MSC with the ability to control calls destined for the wireline telephone.

The present invention can be better understood with reference to FIGs. 1-4. In accordance with a preferred embodiment of the present invention, FIG. 1 depicts a wireless communication system 100. Wireless communication system 100 allows communication with both wireless telephones, of which one such wireless telephone 116 is depicted, and wireline telephones, of which one such wireline telephone 114 is depicted. Only one wireless telephone 116 and one wireline telephone 114 are shown for clarity, although in a typical system, there would be a plurality of wireline and wireless telephones.

Communication system 100 preferably includes a wired portion 124 and a wireless portion 126. Wired portion 124 includes a Public Switched

Telephone Network (PSTN) 102. PSTN 102 is a collection of switches that provide local and long distance service to the wireline community. PSTN 102 is typically comprised of toll and end office switches. Wired portion 124 also includes a plurality of Local Exchange Carriers (LECs) that control a plurality of End Offices. One such End Office 112 is depicted for clarity. End Office 112 is the service provider in a particular geographical area responsible for providing local access and service. PSTN 102 includes many End Offices along with interexchange carriers. Each End Office 112 provides a number of local drops, such as local drop 118. Local drop 118 provides access to PSTN 102 at each wireline location, such as a residence or business.

Communication system 100 also includes a wireless portion 126. Wireless portion 126 is a preferably a digital cellular network, such as a Code Division Multiple Access (CDMA) system. Wireless portion 126 may also be any wireless system that can be connected to a PSTN. For example, wireless portion 126 can be a Personal Digital Cellular (PDC) system, a Group Special Mobile (GSM) system, a Time Division Multiple Access (TDMA) system, a Cellular Digital Packet Data (CDPD) system, or next generation CDMA systems. Wireless portion 126 includes a Mobile Switching Center (MSC) 104 and a plurality of base transceiver stations (BTS) 108 and 109. It should be understood that MSC 104 may be coupled to a plurality of BTSs, but only two are shown for clarity. Base transceiver stations 108 and 109 are preferably Motorola SC9600 base transceiver stations and MSC 104 is preferably a Motorola EMX2500 MSC. Base transceiver stations 108 and 109 are suitably coupled to MSC 104 via T1/E1 interconnects 101. MSC 104 is preferably connected to PSTN 102 through T1/E1 links 103. The End Office 112 is connected to PSTN 102 through T1/E1 links 105. The present invention provides a connection 110 between End Office 112 and MSC 104 to provide access therebetween without using PSTN 102.

In the preferred embodiment, connection 110 is a switched access interconnect using ISUP over SS7. In an alternate embodiment, connection 110 is a metallic interconnect that results in a wired line to the residence or business and terminates at the MSC. The metallic interconnect has the same effect as the switched access services

connection, in that all wireline originations and terminations appear at the MSC.

5 Subscribers to the service described herein have their wireline originations routed to MSC 104 for further processing irrespective of what telephone number is dialed. The present invention facilitates such routing by including Switched Access Services connection 110 between End Office 112 and MSC 104. In the same manner, wired terminations appear at MSC 104 prior to being routed to End Office 112. One example of an SAS interconnect is the Feature Group 'D' interconnect employed between
10 Interexchange Carriers (IEC's) and LEC's for preferred long distance service.

 MSC 104 is coupled to Home Location Register (HLR) 106. As depicted in FIG. 2, HLR 106 includes a list of wireline telephone numbers 201 and wireless telephone numbers 211. HLR 106 further includes a
15 Location Services Node (LSN) 260 that includes a fixer 230, a map database 240, and software 250 for determining the location of a remote unit, such as a wireless telephone. Fixer 230 calculates the approximate geographical location of a wireless telephone. One such method is disclosed in U.S. Patent No. 5,327,144, to Stilp et al., incorporated herein
20 by reference. Fixer 230 may determine the location of the wireless telephone in concert with wireless portion 126, or fixer 230 may determine the location of a wireless telephone in coordination with the wireless telephone.

 Map database 240 is used to define, on a per-wireless telephone basis, the operating zones for the wireless telephone 116 based upon the approximate geographical location. The operating zones can include the low and high rate zones for the wireless telephone. In this manner, map database 240 provides the ability for communication system 100 to
25 determine whether a subscriber using a wireless telephone is currently in a low-rate zone that has a low-rate for a communication, such as the user's home system, or in a high-rate zone, such as when the user has roamed to an airport, shopping center, or the like.
30

 Software 250 computes zone comparisons and, based on the results of these comparisons, can provide the wireless telephone with
35 information relating to the wireless telephone's location. Examples of the information provided are billing information, zone notification, and the like.

Additionally, software 250 is used to influence the routing of a call to the wireless telephone based on the location of the wireless telephone. For instance, the wireless telephone number can be removed from the set of telephones to ring when the wireless telephone is in a predetermined region. This predetermined region may be when the wireless telephone is within a predetermined distance of a wireline telephone, such as a home wireless telephone or a work telephone. In this manner, a user may select to not include a wireless telephone within a logical phone number when the wireless telephone is within a predetermined distance of work or home, thereby saving system processing and charges to end users.

For each wireless telephone 116, there is a directory number 211 that calling parties must dial to connect with wireless telephone 116. Associated with wireless number 211 in HLR 106 will be a list of physical entities that should be rung whenever this number is called. HLR 106 also includes a plurality of logical numbers 221. Logical numbers 221 can include multiple numbers of phones to ring, including both wireless telephones and wireline telephones. Logical number 221 may be the existing wireline directory number, the existing wireless directory number, or an entirely new number. For each case, the call must eventually be routed to MSC 104 for processing, since MSC 104 is the central point of control for multiple ringing due to its coupling with HLR 106.

Preferred operation of communication system 100 occurs as depicted in FIG. 3. This embodiment assumes that the existing wireline directory number is dialed. A call request is received (301) at the End Office. The call request can be generated by a wireline telephone or a wireless telephone. Based on the number dialed and local number portability support, the End Office recognizes that this call should be rerouted to the MSC. The MSC then determines (303) a set of telephones to ring. As used herein, ringing refers to sending a signal to a wireline telephone or a wireless telephone indicating that a call is being requested to that phone. In the preferred embodiment, the set of telephones includes a wireline telephone and a wireless telephone. The MSC accesses the HLR, which looks up phone numbers in a table. Each number that is dialed may have multiple entries in the HLR table, and each entry may refer to a wireline telephone or a wireless telephone. The MSC then determines (305) if one of the numbers in the HLR is a wireline telephone

number. If a number is associated with a wireline telephone, the MSC passes the request to the appropriate End Office through the SAS connection. The wireline telephone is then rung (307). The MSC then determines (309) if there is a wireless telephone number associated with this logical telephone number. If there is, the MSC instructs the appropriate BTS or BTSs affording coverage to the wireless telephone to ring (311) the wireless telephone to alert the wireless telephone of the pending call, a process known as paging.

In this manner, both a wireline telephone and a wireless telephone can be rung substantially simultaneously. In the preferred embodiment, the telephone that answers the ring first will have the call transferred (313) thereto, thereby completing the call request. For instance, if the wireline telephone answers the call first, the call will be processed at the wireline telephone as if made directly to the wireline telephone. If the wireless telephone answers the call first, the wireless telephone will process the call as if the call had been made directly to the wireless telephone.

FIG. 4 depicts additional functionality (315) that the present invention provides. It is a feature of the present invention that a telephone that does not answer and obtain control of the incoming call may be used for outgoing calls or may be called as in current operation. For instance, if a call is made to a logical number that is associated with both a wireline telephone and a wireless telephone, and the wireless telephone answers the call before the wireline telephone, the wireless telephone processes the call. The wireline telephone is still in service and can be called directly by another phone dialing its direct number, or can request (403) to make an outbound call. The wireline telephone can then make (405) the outbound call.

In addition, a phone that answers a call can transfer the call to the non-answering telephone. In the preferred embodiment, this would be done by requesting (401) to transfer the call by pressing a code on the telephone, such as by pressing the "*" key and then a two digit number, or alternately by forwarding the call by dialing the number of the other telephone. In the preferred embodiment, the "*" key would be pressed followed by a two-digit code indicating that the user of the telephone would like to transfer the call to the other telephone associated with this logical number. If the request is to transfer the call (407), the MSC would look up

(409), in the HLR, the other telephone number associated with the logical number of the receiving telephone. The call would then be transferred (411) to the second telephone for processing, and the first telephone would then be unassigned to be used as an outgoing line or to receive a direct-dialed inbound call.

It is a feature of the present invention that the ringing of the wireless telephone may be selectively modified based on the location of the subscriber. When a call is received at the MSC for a particular subscriber, it is possible to ring only the wireline telephone, only the wireless telephone, or both. The decision would be based on the location of the wireless telephone and the directory number dialed. In the list of entities to be rung stored with each logical directory number, those numbers which are wireless numbers may have associated with them a zone of applicability. If the wireless telephone is currently operating in the zone of applicability, the wireless telephone will be rung. If the wireless telephone is outside the zone of applicability, the wireless telephone will not be rung. In this manner, one could have a single wireless telephone that would behave as having two directory numbers. This allows coupling of an office number and a home number on the same physical telephone. When at home, the office number would no longer ring the wireless telephone, thus maintaining privacy of the home number, and vice versa.

Thus, the present invention provides a system and method for ringing wireline and wireless telephones substantially simultaneously. By associating phone numbers of both a wireline telephone and a wireless telephone with a logical number in an HLR, both phones are rung when the logical number is called. A further feature of the present invention is that the telephone that does not answer the call is still in service and can be used as both an inbound and outbound telephone. Consequently, the telephone that does not answer can originate calls and can be called when the physical number of the telephone is called. Further, if the logical number of both a wireline and a wireless telephone is called and one of the phones in service, the caller can either be given a busy signal, or the phone that is not in service and is associated with the logical number can be rung and connected with the caller. This is accomplished by having a logical number associated with both wireline and wireless telephones in

the HLR, and by providing direct connection between the wired portion and the wireless portion through a Switched Access Services connection.

5 While this invention has been described in terms of certain examples thereof, it is not intended that it be limited to the above description, but rather only to the extent set forth in the claims that follow.

Claims

I claim:

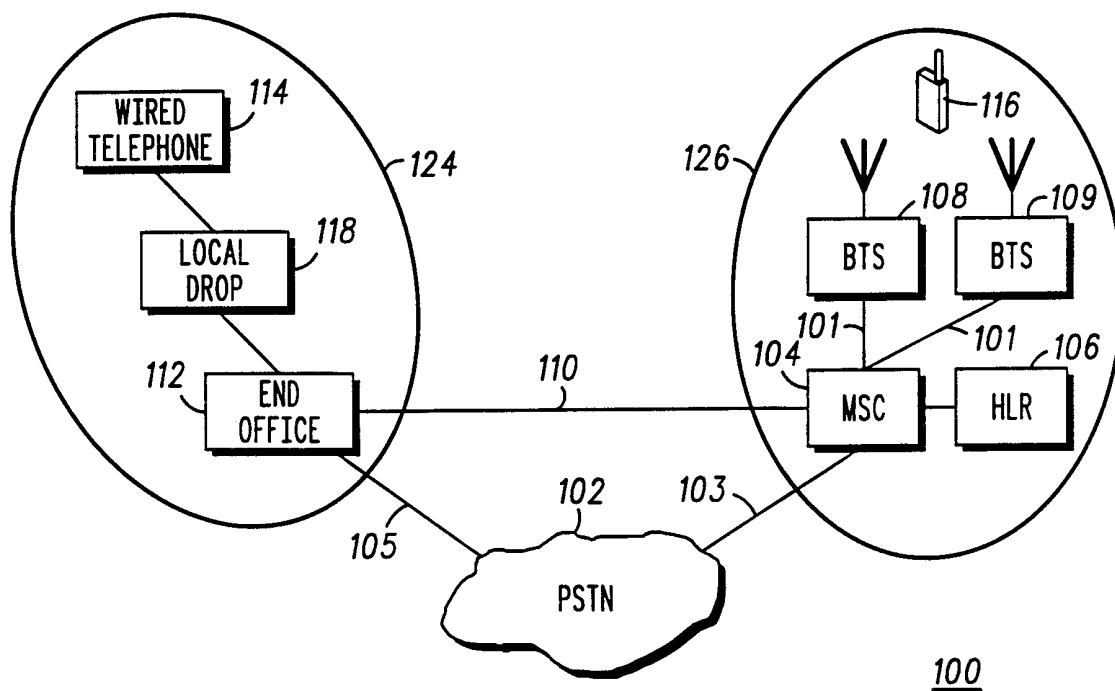
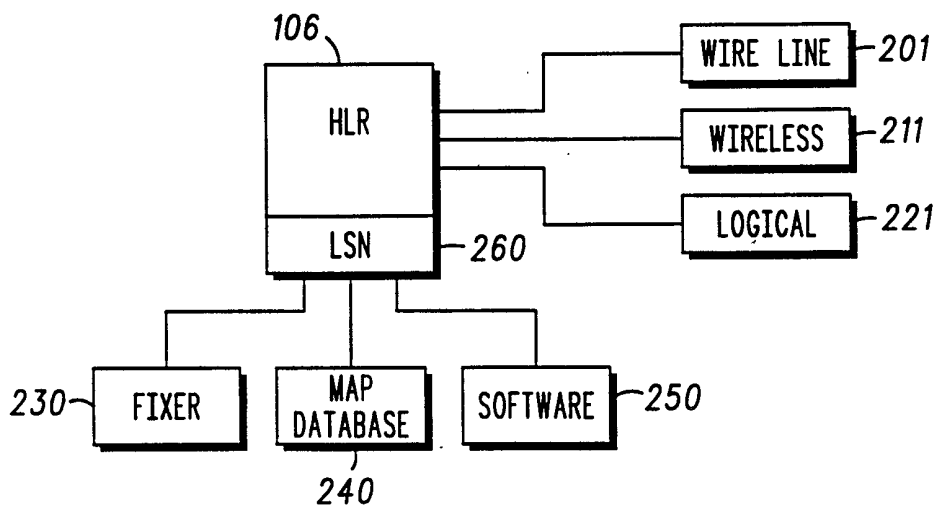
- 5 1. A communication system for ringing wireline telephones and wireless telephones substantially simultaneously, the communication system comprising:
- a Public Switched Telephone Network having wired service of a wireline telephone;
- 10 a Mobile Switching Center coupled to the Public Switched Telephone Network;
- a Home Location Register coupled to the Mobile Switching Center and including entries for both wireline telephones and wireless telephones;
- a base transceiver station coupled to the Mobile Switching Center;
- 15 and
- a Switched Access Services connection coupling the Mobile Switching Center to the wireline telephone.
- 20 2. A communication system in accordance with claim 1, further comprising an End Office interposed between the Switched Access Services connection and the wireline telephone.
- 25 3. A communication system in accordance with claim 1, wherein the Mobile Switching Center includes an End Office.
4. A communication system in accordance with claim 1, further comprising a metallic interconnect interposed between the Mobile Switching Center and the wireline telephone.
- 30 5. A communication system in accordance with claim 1, wherein the Home Location Register includes a Location Services Node, the Location Services Node comprising:
- a fixer for attaining the approximate geographical location of the wireless telephone;
- 35 a map database for defining the operating zones for the wireless telephone based upon the approximate geographical location; and

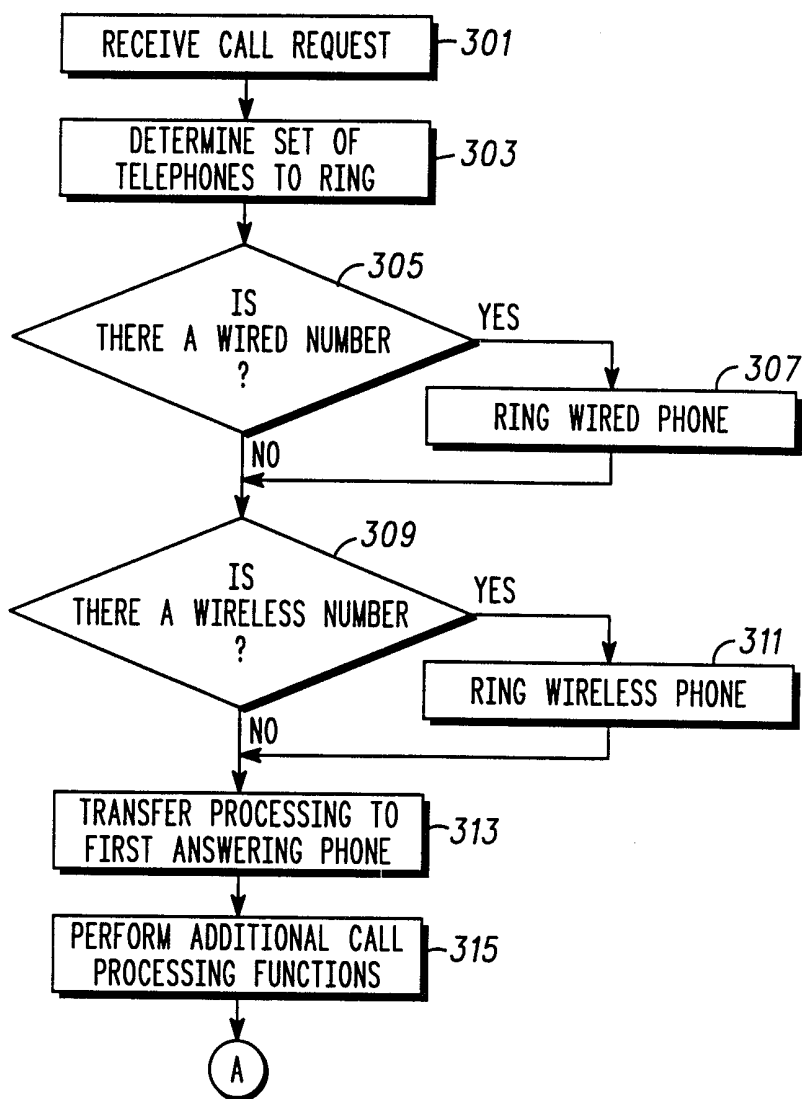
software for comparing the approximate geographical location with the operating zones to control ringing of the wireline telephones and the wireless telephones.

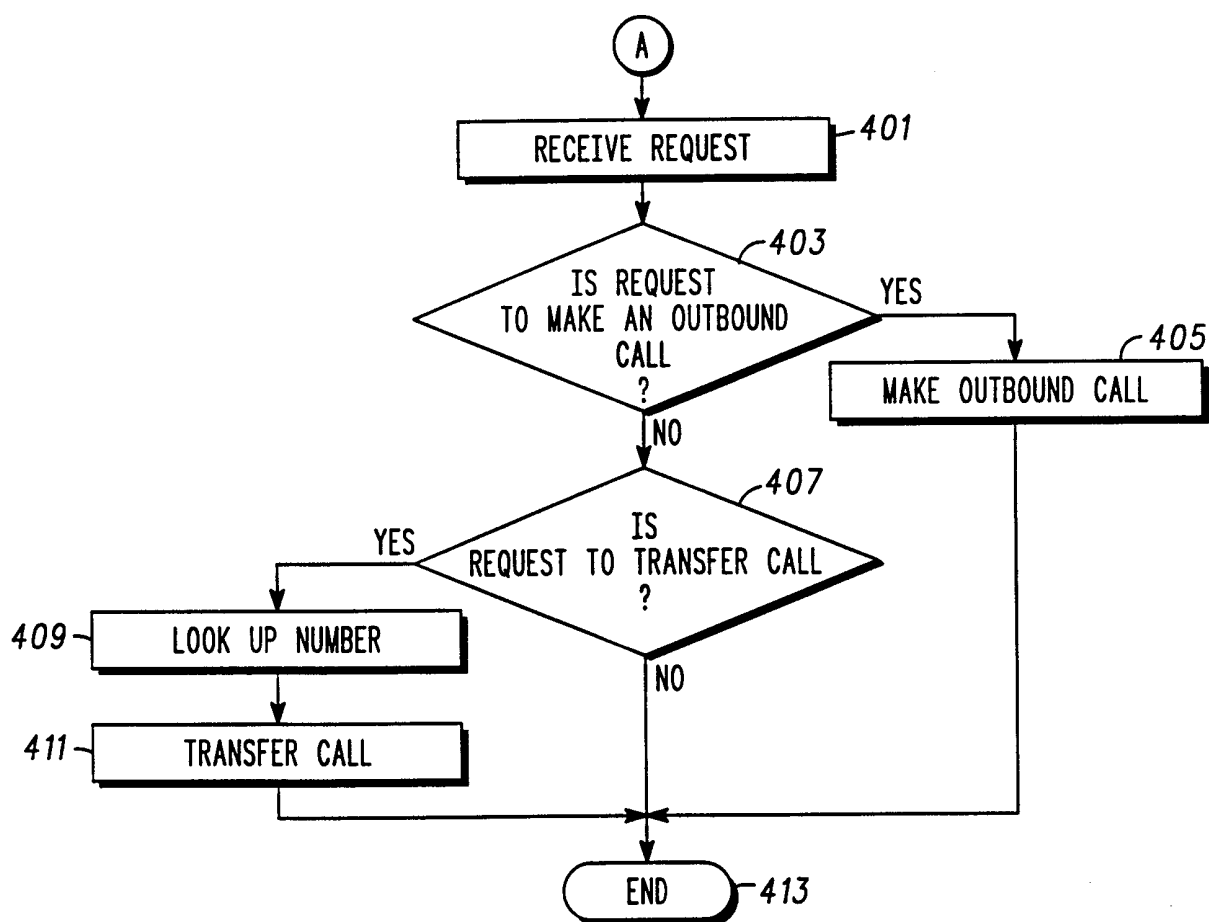
- 5 6. A communication system in accordance with claim 1, wherein the Home Location Register includes a logical number that includes an entry for a wireline telephone number and an entry for a wireless telephone number.
- 10 7. A communication system in accordance with claim 6, wherein the Home Location Register includes a plurality of entries for wireline telephone numbers and wireless telephone numbers, and further includes a logical number that includes a desired wireline telephone number and a desired wireless telephone number associated therewith.
- 15 8. A communication system for ringing wireline telephones and wireless telephones substantially simultaneously, the communication system comprising:
- a wired portion comprising a Public Switched Telephone Network having wired service of a wireline telephone and an End Office interposed
- 20 between the Public Switched Telephone Network and the wireline telephone;
- a wireless portion comprising a Mobile Switching Center, a base transceiver station coupled to the Mobile Switching Center, and a Home Location Register coupled to the Mobile Switching Center; and
- 25 a Switched Access Services connection coupling the wired portion and the wireless portion.
- 30 9. A communication system in accordance with claim 8, wherein the Switched Access Services connection is a trunked interface interposed between the wired portion and the wireless portion.
- 35 10. A method for ringing multiple telephones in a communication system that includes a Public Switched Telephone Network having wired service of wireline telephones, a Mobile Switching Center coupled to the Public Switched Telephone Network, a Home Location Register coupled to the Mobile Switching Center and including a list of wireline and wireless

telephone numbers, a base transceiver station coupled to the Mobile Switching Center, and a Switched Access Services connection coupling the Mobile Switching Center to the wireline telephones, the method comprising the steps of:

- 5 receiving a call request at the Mobile Switching Center;
 determining, based upon the Home Location Register, a set of telephones to ring, the set of telephones including a wireline telephone and a wireless telephone;
- ringing each of the set of telephones to ring substantially
- 10 simultaneously; and
 transferring processing of the call request to a first answering telephone of the set of telephones to ring.

**FIG. 1****FIG. 2**

*FIG. 3*

*FIG. 4*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/01533

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : H04Q 7/22; H04M 3/42, 11/00

US CL : 455/414, 433, 445

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/414, 417, 433, 445, 461, 525; 379/201, 211, 212

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,315,636 A (PATEL) 24 May 1994, col. 4, lines 62-67 col. 5, lines 3-68, col. 7, line 12 through col. 8, line 52 and Fig. 1.	1-9
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Y		10
Y	US 5,454,032 A (PINARD et al.) 26 September 1995, abstract.	10
Y	US 5,206,901 A (HARLOW et al.) 27 April 1993, col. 6, lines 5-25 and Fig. 2.	10
A,P	US 5,793,859 A (MATTHEWS) 11 August 1998, col. 6, lines 25-33.	1-10
A	US 5,673,308 A (AKHAVAN) 30 September 1997, Fig. 1.	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	*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
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