

**METHOD AND APPARATUS FOR ROUTING A CALL TO A
MOBILE COMMUNICATION UNIT IN A TELEPOINT
COMMUNICATION SYSTEM**

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Field of the Invention

This invention relates in general to telepoint communication systems, and in particular to a method and apparatus for routing an inbound call in a telepoint communication system.

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Background of the Invention

Cordless Telephone Second generation (CT2) communication systems that utilise available public switched telephone network (PSTN) infrastructure to provide micro cellular wireless communication services are known in the art. A conventional CT2 communication system comprises a plurality of portable communication units and a variety of equipment that are coupled to the PSTN. This equipment includes a switching unit and a plurality of telepoint base stations (TBS). In earlier CT2 communication systems, subscribers could initiate calls but could not receive calls, however, recent developments of integrating a paging receiver into the portable communication units, and the use of the switching unit allow calls to be made to, and received by, CT2 subscribers.

With these recent developments, when the PSTN receives an incoming call for a CT2 subscriber unit, the call is routed to the switching unit while the caller is put on hold. The switching unit translates the called number into a pager number and pages the CT2 subscriber, thereby providing the subscriber unit with a selected call back number of the switching unit. Upon receiving the page, the subscriber unit alerts the subscriber who initiates a call to the call back number of the switching unit. Upon receiving the call from the subscriber unit, the switching unit couples the incoming call with the call from the subscriber unit, thereby enabling direct communication between the caller and the CT2 subscriber unit.

Another method of providing a CT2 subscriber with the additional capability of receiving a call, requires the mobile communication unit to register with a TBS, and the registration information maintained in a central database of a switching unit coupled to the PSTN. When an inbound call for the CT2 subscriber is received, the PSTN forwards the call to the switching unit. Subsequently, an outbound call is made by the switching unit to the

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CT2 subscriber via the TBS using the registration information in the central database. When the call to the CT2 subscriber unit is established, the switching unit couples the inbound and outbound calls, thereby enabling direct communication between the calling party and the CT2 subscriber via the switching unit.

The methods described above provide a significant improvement to early CT2 communication systems by allowing CT2 subscriber units to receive calls. However, a significant disadvantage of the paging method is the uncomfortably long period of time a caller is kept on hold while a call to a subscriber unit is established. Yet another disadvantage of the paging method is the need for CT2 subscriber units to be equipped with integrated paging receivers thereby increasing the cost and complexity of the subscriber units. Also, as paging throughput is dependent on user traffic, the paging process can introduce an additional unpredictable delay, further prolonging the time a calling party is kept on hold.

A disadvantage of both methods is the use of an expensive switching unit. The switching unit is coupled to the PSTN using trunk telephone lines, and consequently, is expensive to install, use and maintain. In addition, as the switching unit provides the coupling for each call to a CT2 subscriber, the number of switches i.e. the size of the switching unit, determines the throughput. Hence, to ensure an acceptable grade of service a large switching unit is required.

Therefore, a need exists for a quick and economical method for processing an incoming call in a telepoint communication system that will not require a switching unit to be coupled to the PSTN, preferably does not use paging, and establishes a call from caller to subscriber within a substantially shorter, predictable period of time.

Summary of the Invention

In carrying out the objects of the present invention in one form, there is provided an apparatus coupled to a public switched telephone network (PSTN) for routing an inbound call on the PSTN to a mobile communication unit in a telepoint communication system, the apparatus comprising: at least one telepoint base station (TBS) coupled to the PSTN for receiving registration information from the mobile communication unit; and a controller coupled to the PSTN and the at least one TBS for receiving the registration information from the at least one TBS and storing the registration information therein, and for receiving an inbound call



notification from the PSTN in response to the PSTN receiving the inbound call for the mobile communication unit, and for communicating routing information to the PSTN in response to receiving the inbound call notification, thereby enabling the PSTN to route the inbound call to the at least one TBS and, thence to the mobile communication unit.

In carrying out the objects of the present invention in another form, there is provided a method for routing an inbound call to a mobile communication unit in a mobile communication system comprising a communication network coupled to a mobility management unit and at least one location, and wherein the mobile communication unit is within communicable range of the at least one location, wherein the method comprises the steps of: transmitting registration information from the at least one location to the mobility management unit in response to the at least one location receiving the registration information from the mobile communication unit; transmitting an inbound call notification from the communication network to the mobility management unit in response to the communication network receiving the inbound call; and transmitting a call routing message from the mobility management unit to the communication network in response to the mobility management unit receiving the inbound call notification, thereby enabling the communication network to route the inbound call to the at least one location and, thence to the mobile communication unit.

Brief Description of the Drawing

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FIG. 1 illustrates a telepoint communication system in accordance with a preferred embodiment of the present invention.

FIG. 2 illustrates a table representing information stored in a mobility management unit of the telepoint communication system in FIG. 1 in accordance with the preferred embodiment of the present invention.

FIG. 3 illustrates a flowchart detailing operation of a telepoint base station in the telepoint communication system in FIG. 1 in accordance with the preferred embodiment of the present invention.

FIG. 4 illustrates a flowchart detailing operation of a mobility management unit in the telepoint communication system in FIG. 1 in accordance with the preferred embodiment of the present invention.

Detailed Description of the Invention

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FIG. 1 illustrates a telepoint communication system 100 comprising a communication network such as a public switched telephone network (PSTN) that preferably supports integrated services digital network (ISDN) and intelligent network application service elements (ASE), in accordance with a preferred embodiment of the present invention. Telephone subscribers 105 and 107 are coupled to the PSTN 110 via communication channels 103 and 109 respectively, while telepoint base stations (TBS) or locations 120 and 122 are coupled to the PSTN 110 via communication channels 112 and 113 respectively. In accordance with the preferred embodiment, each of the communication channels 103, 109, 112 and 113 are one or more ISDN basic rate interfaces (BRI), where each BRI can simultaneously support two communication links. A mobility management unit (MMU) or controller 115 is coupled to the PSTN 110 via communication channel 114, which in the preferred embodiment, comprises an International Telecommunication Union (ITU formerly the Consultative Committee on International Telephone and Telephone (CCITT)) signal system number seven data link commonly referred to as an SS7 link, and at least one BRI link. The MMU 115 in accordance with the preferred embodiment comprises a computer which includes database 117, wherein the database 117 comprises a semiconductor memory, or magnetic or optic storage media. Mobile communication units 125 and 130 communicate over radio communication channels with the TBS's 120 and 122, which in turn couple the mobile communication units 125 and 130 to the PSTN 110 via communication channels 112 and 113.

Alternatively, with reference to FIG. 1, a concentrator may be coupled via communication channels 152, 153 and 154 to telepoint base stations 160, 165 and 170 respectively, and the PSTN 110. In accordance with an embodiment of the present invention, the communication channels 152, 153 and 154 comprise a proprietary communication link. The concentrator 155 is coupled to the PSTN 110 via communication channel 150 that may comprise, for example, one or more ISDN primary rate interfaces (PRI). Conventionally, a PRI can simultaneously support 24 to 30 communication links. Hence, dependent upon the number of TBSs 120 and 122 coupled to the concentrator 155, and the total number of communication links required by the TBSs 120 and 122, an appropriate number of PRIs is employed. In accordance with one embodiment the MMU 115 communicates with the

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concentrator 155 via the PSTN 110 and communication channel 150, however in an alternate embodiment separate data links, for example a X.25 data link that couples the concentrator 155 and the MMU 115 directly, may be used. Hence, the concentrator 155 is coupled to a plurality of
5 telepoint base stations 160, 165 and 170, the MMU or controller 115, and the PSTN 110 for transmitting the registration information 132 to the MMU 115 via the PSTN 110 in response to receiving the registration information 132 from one of the plurality of telepoint base stations 160, 165 and 170. In addition, the concentrator 155 routes the inbound call 133 to the mobile
10 communication unit 125 or 130 via the one of the plurality of telepoint base stations 160, 165 and 170 in response to receiving the inbound call 133 from the PSTN 110.

Information communicated from the mobile communication unit 125 or 130 to the TBS 120 or 122 comprises registration information 132. In the
15 preferred embodiment the registration information 132 comprises a personal identifier (PID) that uniquely identifies the mobile communication unit 125 or 130. Information communicated between the telephone subscribers 105 or 107 and the PSTN 110 include an inbound call 133 comprising a subscriber or telephone number affiliated with the mobile
20 communication unit 125 or 130. In response to receiving and recognising the inbound call 133 is for one of the mobile communication units 125 or 130, the PSTN 110 transmits an inbound call notification 135 to the MMU 115. In response to receiving the inbound call notification 135, the MMU 115 transmits a call routing message or routing information 140 to the
25 PSTN 110. In the preferred embodiment the inbound call notification 135 comprises a query call which includes the subscriber number provided by the inbound call 133, and the call routing message 140 comprises a TBS identifier (TBS ID) that uniquely identifies the TBS 120 or 122, and the PID of the mobile communication unit for whom the inbound call is intended.
30 The TBS ID may also include a subscriber or telephone number that is affiliated with the TBS 120 or 122. Upon receiving the call routing message 140, the PSTN 110 responds by routing the inbound call 133 to the TBS 120 or 122 in accordance with the call routing message 140.

For the mobile communication unit 125 or 130 to receive the inbound
35 call 133, the location of the mobile communication unit 125 or 130 in the area of coverage of the telepoint communication system 100 is tracked and stored in the database 117 of the MMU 115. With reference to FIG. 2, the information in the database 117 may be organised as illustrated in table 200 having three columns representing subscriber ID 205, personal ID 210



and TBS ID 215. The personal ID 210 is a unique identifier assigned to each of the mobile communication units 125 and 130. Conventionally, the personal ID 210 is programmed into a mobile communication unit 125 or 130 during manufacture. When the mobile communication unit 125 or 130 is introduced into the telepoint communication system 100, the mobile communication unit 125 and 130 is assigned a subscriber ID 205, and the assigned subscriber ID 205 and the personal ID 210 of the mobile communication unit 125 and 130 is stored in the database 117. In the preferred embodiment, the subscriber ID 205 is a telephone number that is affiliated with the mobile communication unit 125 or 130 by the assignment, hence, it is the number used when calling the mobile communication unit 125 or 130. The TBS ID 215 is assigned to each of the TBS 120 or 122 when the telepoint communication system 100 is configured. The MMU 115 uses the TBS ID 215 to communicate with the TBS 120 or 122. The IDs in the TBS ID 215 column of table 200 represent the ID of the TBS 120 or 122 that last received registration information 132 from the mobile communication unit 125 or 130, and consequently transmitted the registration information 132 to the MMU 115. Hence, in accordance with the preferred embodiment of the present invention the information in the TBS ID 215 column is dynamic and changes as the mobile communication units 125 and 130 roam among the TBSs 120 and 122 in the telepoint communication system 100. As an example, the information in the first row of table 200 indicates that the mobile communication unit 125 or 130 having personal ID 013015, is assigned subscriber ID 456-1234, and a transmission of the registration information 132 from the mobile communication unit 125 or 130 was last received from the TBS 120 or 122 having the ID 317-4205. In the preferred embodiment of the present invention, the call routing message 140 transmitted from the MMU 115 to the PSTN 110 comprises the PID 210 and the TBS ID 215, which enable the PSTN 110 to route the inbound call 133 to the mobile communication unit 125 or 130. In addition, each of the TBS ID 215 comprises a pre-assigned hunting line or group line for each of the TBS 120 and 122, such that, a call received on the hunting or group line will be routed by an available line in the group. When all lines in a group are engaged the PSTN 110 transmits a "no available line" message to the caller. Hence, the TBS 120 and 122 are coupled to the PSTN 110 for receiving the registration information 132 from the mobile communication units 125 and 130. The MMU or controller 115 is coupled to the PSTN 110 for receiving the registration information 132 from the TBS 120 and 122 and storing the



registration information 132 therein. The MMU 115 also receives the inbound call notification 135 from the PSTN 110 in response to the PSTN 110 receiving the inbound call 133 for the mobile communication unit 125 or 130, and the MMU 115 communicates the call routing message 140 to
5 the PSTN 110 in response to receiving the inbound call notification 135, thereby enabling the PSTN 110 to route the inbound call 133 to the TBS 120 or 122 and, thence to the mobile communication unit 125 or 130.

Thus, transmissions of the registration information 132 by the mobile communication unit 125 or 130 enables the MMU 115 to advantageously
10 track the location of the mobile communication unit 125 or 130 in the telepoint communication system 100, allowing the MMU 115 to provide routing information that routes an inbound call for the mobile communication unit 125 or 130 to the location of the mobile communication unit 125 or 130 quickly and predictably, unlike prior art systems that locate
15 the mobile communication unit 125 or 130 after an inbound call for the mobile communication unit 125 or 130 is received.

FIG. 3 illustrates a flowchart detailing the operation of the TBS 120 or 122. When the mobile communication unit 125 or 130 transmits registration information 132 while located within communicable range of the TBS 120 or 122, the TBS 120 or 122 receives 305 the registration information 132. In
20 the preferred embodiment the communicable range of the TBS 120 or 122 is the area around the TBS 120 or 122 within which the TBS 120 or 122 and the mobile communication unit 125 or 130 can communicate reliably over a communication link. In response to receiving the registration information 132, the TBS 120 or 122 adds its TBS ID 215 to the registration
25 information 132 and transmits 310 the registration information 132 to the MMU 115. Upon receipt of the registration information, the MMU 115 stores the registration information 132, including the PID 210 and the TBS ID 215, in the database 117. In the preferred embodiment, the mobile communication unit 125 or 130 transmits registration information 132
30 periodically, or upon determining it is out of range of the TBS 120 or 122, or when the mobile communication unit 125 or 130 is powered ON, or when a user initiates the transmission of the registration information 132. When the inbound call 133 for the mobile communication unit 125 or 130 is received
35 on the PSTN 110, the inbound call 133 is routed to the TBS 120 or 122 as will be described below. Upon receiving 315 the inbound call 133, the TBS 120 or 122 polls 320 the mobile communication unit 125 or 130 using the PID 210 provided with the inbound call 133. When the TBS 120 or 122 receives 330 a response from the mobile communication unit 125 or 130



within a predetermined timeout duration, the TBS 120 or 122 routes 335 the inbound call 133 to the mobile communication unit 125 or 130, and direct communication between the mobile communication unit 125 or 130 and the caller may begin. However, when a response is not received 330 from the
5 mobile communication unit 125 or 130 within the predetermined timeout duration, the TBS 120 or 122 transmits 325 a mobile communication unit not available message to the caller.

With reference to FIG. 4, when the TBS 120 or 122 sends the registration information 132 of the mobile communication unit 125 or 130 to
10 the MMU 115 as described above, the MMU 155 receives 405 the registration information 132 and stores 410 the registration information 132 in the database 117. When the PSTN 110 receives the inbound call 133 for the mobile communication unit 125 and 130, the PSTN 110 in the preferred embodiment determines the inbound call 133 is for the mobile
15 communication unit 125 or 130, from the subscriber ID 205 provided by the inbound call 133. In response to the PSTN 110 receiving the inbound call 133, the PSTN 110 transmits the inbound call notification 135 to the MMU 115. In the preferred embodiment the inbound call notification 135 comprises the subscriber ID 205. Upon receiving 415 the inbound call
20 notification 135, the MMU 115 uses the subscriber ID 205 to look up 420 the registration information 132 of the mobile communication unit 125 or 130 in the database 117. When the MMU 115 does not successfully locate 425 the registration information 132 in the database 117, the MMU 115 transmits 430 a communication unit not registered message to the caller via
25 the PSTN 110. However, when the MMU 115 successfully locates 425 the registration information 132 in the database 117, the MMU 115 transmits 435 the call routing message 140 to the PSTN 110, thereby enabling the PSTN 110 to route the inbound call 133 to the TBS 120 or 122, and thence to the mobile communication unit 125 or 130.

30 In accordance with the present invention, conventional features of a PSTN may be utilised to communicate information on the PSTN between a TBS and a MMU enabling the location of a mobile communication unit to be determined, and subsequently an inbound call for the mobile communication unit can be routed to the mobile communication unit. This is
35 achieved by utilising the distributed processing capability inherent in the telepoint base station instead of using an additional switching unit coupled to the PSTN. With distributed processing, existing telepoint base stations are enhanced to provide two way calling capability to the mobile communication units in a telepoint communication system. In addition, with



5 this invention no changes are required to mobile communication units to provide the added capability of receiving calls to existing mobile communication units in a telepoint communication system, hence, totally avoiding the expensive and troublesome task of recalling existing mobile communication units from the field for modifications at a service centre.

10 Hence, this invention provides a quick and economical method for processing an incoming call in a telepoint communication system without coupling a switching unit to the PSTN, and without modifications to the mobile communication units. In addition, as this invention does not rely on paging to locate the subscriber, an inbound call for a subscriber may be established within a substantially shorter, predictable period of time.

What is claimed is:



CLAIMS



1. Apparatus coupled to a public switched telephone network (PSTN) for routing an inbound call on the PSTN to a mobile communication unit in a telepoint communication system, the apparatus comprising:
- at least one telepoint base station (TBS) coupled to the PSTN for receiving registration information from the mobile communication unit; and
- a controller coupled to the PSTN and the at least one TBS for receiving the registration information from the at least one TBS and storing the registration information therein, and
- for receiving an inbound call notification from the PSTN in response to the PSTN receiving the inbound call for the mobile communication unit, and
- for communicating routing information to the PSTN in response to receiving the inbound call notification, thereby enabling the PSTN to route the inbound call to the at least one TBS and, thence to the mobile communication unit.
2. The apparatus of claim 1, wherein the PSTN comprises a PSTN supporting integrated system digital network (ISDN).
3. The apparatus in claim 2, wherein the PSTN comprises a PSTN supporting intelligent network application service element (ASE).
4. The apparatus of claim 1, wherein the controller comprises a mobility management system.
5. The apparatus of claim 1, wherein the at least one TBS is coupled to the PSTN with at least one basic rate interface (BRI).
6. The apparatus of claim 1, wherein the controller is coupled to the PSTN with a communication channel, wherein the communication channel comprises at least one International Telecommunication Union (ITU, formerly the Consultative Committee on International Telephone and Telephone (CCITT)) signal system number 7 data link and at least one BRI.



7. The apparatus of claim 1, wherein the controller and the at least one TBS are coupled via at least one X.25 data link.

8. The apparatus of claim 1, further comprising a concentrator, wherein
5 a plurality of telepoint base stations, the controller, and the PSTN are coupled to the concentrator for transmitting the registration information to the controller via the PSTN in response to receiving the registration information from one of the plurality of telepoint base stations, and the concentrator for communicating the routing information to the mobile
10 communication unit via the one of the plurality of telepoint base stations in response to receiving the routing information from the PSTN.

9. A method for routing an inbound call to a mobile communication unit in a mobile communication system comprising a communication network
15 coupled to a mobility management unit and at least one location, and wherein the mobile communication unit is within communicable range of the at least one location, wherein the method comprises the steps of:

a) transmitting registration information from the at least one location to
20 the mobility management unit in response to the at least one location receiving the registration information from the mobile communication unit;

b) transmitting an inbound call notification from the communication
25 network to the mobility management unit in response to the communication network receiving the inbound call; and

c) transmitting a call routing message from the mobility management unit to the communication network in response to the mobility management unit receiving the inbound call notification, thereby enabling the
30 communication network to route the inbound call to the at least one location and, thence to the mobile communication unit.

10. The method of claim 9 wherein the registration information comprises a personal identifier (PID) affiliated with the mobile communication unit ,
35 wherein step (a) comprises the step of transmitting the PID affiliated with the mobile communication unit, to the at least one location.

11. The method of claim 9 wherein the at least one location in step (a) comprises at least one base station, wherein the mobile communication



unit is within communicable range of the at least one base station, and wherein the mobile communication unit is registered with the at least one base station.

- 5 12. A method for routing an inbound call to a mobile communication unit in a telepoint communication system, wherein the telepoint communication system comprises at least one base station and a mobility management unit operably coupled to a public switched telephone network (PSTN), and wherein the mobile communication unit is within communicable range of
- 10 the at least one base station, wherein the method comprises the steps of:
- a) transmitting registration information from the at least one base station to the mobility management unit in response to the at least one base station receiving the registration information from the mobile communication unit;
- 15 b) transmitting an inbound call notification from the PSTN to the mobility management unit in response to the PSTN receiving the inbound call for the mobile communication unit; and
- 20 c) transmitting a call routing message from the mobility management unit to the PSTN in response to the mobility management unit receiving the inbound call notification, thereby enabling the PSTN to route the inbound call to the at least one base station and, thence to the mobile communication unit.
- 25 13. The method of claim 12 after step (a) comprises the step of storing the registration information at the mobility management unit in response to the mobility management unit receiving the registration information.
- 30 14. The method of claim 12 prior to step (b) comprises the step of recognising the inbound call is for the mobile communication unit in response to the PSTN receiving the inbound call.
- 35 15. The method of claim 12 prior to step (c) comprises the step of determining the registration information from the mobile communication unit is stored at the mobility management unit in response to the mobility management unit receiving the inbound call notification.