



**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

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 typical 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). Typically CT2 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 allows 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, 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, and direct communication between the caller and the CT2 subscriber unit may then proceed.

Another method of providing CT2 subscribers with the additional capability to receive calls, requires the portable communication units to register with at least one TBS, and the registration information maintained in a central database. With the use a switching unit coupled to the PSTN, when an inbound call for a 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 CT2 subscriber 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 allowing direct communication between the calling party and the CT2 subscriber via the switching unit.

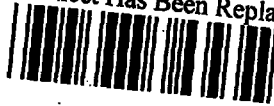
The methods described above provide a significant improvement to early CT2 communication systems by allowing CT2 subscriber units to receive calls. However, a significant disadvantage of the paging method is the uncomfortably long period of time a caller is kept on hold while a call to a subscriber unit 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 further 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 a method for processing a call in a telepoint communication system comprising a first and a second communication network, and a mobile management unit which tracks the location of a CT2 subscriber by maintaining a database of the affiliation of the CT2 subscriber with telepoint base stations, and channels an inbound call for the CT2 subscriber to the telepoint base station to which the CT2 subscriber is affiliated.



Brief Description of the Drawing

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

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

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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.

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FIG. 4 illustrates a flowchart detailing operation of the 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 public switched telephone network (PSTN) 102 which preferably supports integrated services digital network (ISDN), telepoint base stations (TBSs) 115, 120, 125, 131 and 132, a concentrator 134, a mobility management unit (MMU) 140 including a database 141, a telephone subscriber unit 135, and telepoint communication units (TCUs) 145, 146 and 147. The telepoint communication system 100 is a mobile communication system that provides mobile communication services to mobile communication units, including the TCUs 145, 146 and 147. The PSTN 102 comprises a circuit switched network 105 coupled to a packet switched data network 110 via communication channel 193. The circuit switch network 105 conventionally conveys voice traffic, and routes a call by establishing a dedicated circuit for the duration of the call. The packet switched data network 110 conventionally conveys data traffic, and routes each transmission during a call via available communication resources of the packet switched data network 110 at the time of transmission. Hence, unlike the circuit switched network 105, each transmission on the packet switched data network 110 may be routed via a different circuit of the packet switched data network 110. In a preferred embodiment of the present invention, the circuit

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switched network 105 comprises a circuit switch service of the PSTN 102, the packet switch data network 110 comprises a packet switch data service of the PSTN 102, and the communication channel 193 comprises an X.25 data communication link. The circuit switched network 105 is coupled to the

5 TBSs 115, 120 and 125 via communication channels 181, 182 and 183 respectively, and to the TBSs 131 and 132 via communication channel 180, the concentrator 134, and communication channels 186 and 187 respectively. Similarly, the packet switched data network 110 is coupled to the TBSs 115, 120 and 125 via communication channels 191, 192 and 193

10 respectively, and to the TBSs 131 and 132 via communication channel 188, the concentrator 134, and communication channels 186 and 187 respectively. In addition, the packet switched data network 105 is coupled to the MMU 140 via communication channel 195. The TBSs 115, 120, 125, 131, and 132, and the TCUs 145, 146 and 147, support a set of radio

15 communication channels which couple the TCUs 145, 146 and 147 to the PSTN 102 via the TBSs 115, 120, 125, 131, and 132. In the preferred embodiment, each TBS 115, 120, 125, 131, and 132 includes radio base stations which support a set of radio communication channels, a switching matrix which route calls between the PSTN 102 and the TCUs 145, 146

20 and 147 via the radio base stations, and a controller which controls the operation of the radio base stations and the switching matrix in accordance with a stored program. The TCUs 145, 146 and 147 each include a radio communication unit which supports a set of radio communication channels, user interfaces circuitry and a TCU controller which controls the operation

25 of the radio communication unit and the user interface circuitry in accordance with a stored program. The communication channels 180, 181, 182, 183, 185, 188, 191, 192, 193, 194 and 195 each support one or more simultaneous communication links. In the preferred embodiment, the communication channels 181, 182, 183, 185, 191, 192 and 193 comprise

30 one or more basic rate interfaces (BRI), where each BRI is capable of supporting at least 2 communication links, and the communication channels 194 and 195 each comprise at least an X.25 data communication link, or an International Telecommunication Union (ITU formerly the Consultative Committee on International Telephone and Telegraph

35 (CCITT)) signal system number 7 data link and at least one BRI. The concentrator 134 couples a cluster of adjacent TBSs 131 and 132 to the PSTN 102 via a high capacity communication link which supports the communication channels 180 and 188. In the preferred embodiment, the



high capacity communication link which supports the communication channels 180 and 188 is an ISDN primary rate interface (PRI) capable of providing 24 to 30 communication channels. The communication channels 186 and 187 support voice traffic and data. In the preferred embodiment, the communication channels 186 and 187 each comprise a proprietary data communication link which has been optimised to support high speed data and voice traffic between several TBSs 131 and 132 and the concentrator 134.

Information communicated in the telepoint communication system 100 when processing an inbound call 160 for the TCU 145, 146 or 147 comprises: registration information 150 that is communicated between the TCU 145, 146 or 147 and the TBS 115, 120, 125, 131 or 132 over radio communication channels when the TCU 145, 146 or 147 is within communicable range of the TBS 115, 120, 125, 131 or 132; routing information 170 communicated from the TBS 115, 120, 125, 131 or 132 to the MMU 140 via 114 the packet switched network 110 in response to the TBS 115, 120, 125, 131 or 132 receiving the registration information 150 from the TCU 145, 146 or 147; inbound call 160 which is received by the PSTN 102 from subscribers of the PSTN 102 including the telephone subscriber unit 135; inbound call notification 165 communicated from the circuit switched network 105 to the MMU 140 via 112 the packet switched data network 110 in response to receiving the inbound call 160; and routing information 175 communicated from the MMU 140 to the circuit switched network 105 via 112 the packet switched network 110 in response to receiving the inbound call notification 165, thereby enabling the circuit switched network 105 to route the inbound call 160 to the TCU 145, 146 or 147 via the TBS 115, 120, 125, 131 or 132 to which the TCU 145, 146 or 147 had earlier registered.

FIG. 2 illustrates a table 200 representing the information stored in the database 141 of the MMU 140 having three columns, a subscriber ID 205 (SID) column, a personal ID 210 (PID) column, and a TBS ID 215 column. The PID 210 is a unique ID that is assigned and stored in each TCU 145, 146 and 147 upon manufacture. In the preferred embodiment the PID uniquely identifies each of the TCUs 145, 146 and 147 in the telepoint communication system 100 and is used by the TBSs 115, 120, 125, 131 or 132 to route the inbound call 160 to the TCU 145, 146 or 147. The subscriber ID 205 also identifies the TCU 145, 146 and 147 in the telepoint communication system and is usually assigned by the operator of the



telepoint communication system 100, when the TCUs 145, 146 and 147 are commissioned into the telepoint communication system 100. The SID 205 assigned to the TCU 145, 146 or 147 is used by an originator of a call, for example a caller using a telephone subscriber unit 135, to communicate the inbound call 160 for the TCU 145, 146 or 147 to the circuit switched network 105 of the PSTN 102. In addition, the SID 205 identifies the inbound call 160 is for the TCU 145, 146 or 147, to the circuit switch network 105, thereby enabling the circuit switch network to process the inbound call accordingly. In the preferred embodiment, the SID 205 is one of a series of subscriber numbers of the PSTN 102 which are dedicated for assignment to the TCUs 145, 146 and 147. The TBS ID 215 is assigned to each of the TBSs 115, 120, 125, 131 and 132, and uniquely identifies each of the TBSs 115, 120, 125, 131 and 132 in the telepoint communication system 100. The TBS ID 210 is typically assigned by the operator of the telepoint communication system 100 when the TBSs 115, 120, 125, 131 and 132 are configured into the telepoint communication system 100. For the TCUs 145, 146 and 147 to operate in the telepoint communication system 100, the PIDs 210 and the corresponding SIDs 205 of the TCUs 145, 146 and 147 are stored in the database 141. The information in the SID 205 column and the PID 210 column of the database 141 will not change unless the TCUs 145, 146 or 147 in service in the telepoint communication system 100, are taken out of service. In contrast, the information stored in the TBS ID 215 column changes as the TCUs 145, 146 and 147 travel within the communication range of the TBSs 115, 120, 125, 131 and 132 and register with different TBSs 115, 120, 125, 131 and 132. For example, from table 200, the first row indicates that a TCU having the PID 210 of 013015 and the SID 205 of 456-1234, is registered with a TBS having TBS ID 215 of 317-4205.

Hence, the present invention enables a conventional PSTN, that provides circuit switched services and packet switched data services, to economically route calls for TCUs in a telepoint communication system at a service quality comparable to cellular telephone communication systems.

FIG. 3 illustrates a flowchart detailing the operation of the TBS 115, 120, 125, 131 or 132, in the telepoint communication system 100 for routing the inbound call 160, which includes the SID 205, to the TCU 145, 146 or 147. When the TCU 145, 146 or 147 transmits registration information 150 while located within communicable range of the TBS 115, 120, 125, 131 or 132, the TBS 115, 120, 125, 131 or 132 receives 305 the registration



information 150. The registration information 150 includes the PID 210 of the TCU 145, 146 or 147. Upon receipt of the registration information 150, the TBS 115, 120, 125, 131 or 132 transmits 310 routing information 170, which comprises its TBS ID 215 and the PID 210 received with the registration information 150, to the MMU 140 via 114 the packet switched data network 110. In the preferred embodiment, the TCU 145, 146 or 147 periodically transmits the registration information 150, causing the routing information 170 to be transmitted to the MMU 140 from the TBSs 115, 120, 125, 131 or 132, thereby allowing the MMU 140 to track, using the TBS ID 215, the TBS 115, 120, 125, 131 or 132 to which the TCU 145, 146 or 147 is registered, as the TCUs 145, 146 and 147 move within the communication range of the telepoint communication system 100. In addition, the TCUs 145, 146 and 147 can transmit the registration information 150 when the TCUs 145, 146 and 147 determine that the TBS 115, 120, 125, 131 or 132 is out of range, or when the TCUs 145, 146 and 147 are powered ON, or when initiated by a user. When the inbound call 160 for the TCU 145, 146 or 147 is received on the circuit switched network 105, the MMU 140 transmits the routing information 175 to the circuit switched network 105 via 112 the packet switched data network 110, as will be described later. The routing information 175 includes the destination TBS ID 215 and the destination PID 210 of the called TCU 145, 146 or 147. The circuit switched network 105 uses the destination TBS ID 215 to route the inbound call 160 and the destination PID 210 to the destination TBS 115, 120, 125, 131 or 132. When the inbound call 160 is not received 315 by the TBS 115, 120, 125, 131 or 132, the TBS 115, 120, 125, 131 or 132 remains in a loop awaiting the receipt of the registration information 150 or the receipt of the inbound call 160. However, when the TBS 115, 120, 125, 131 or 132 receives the inbound call 160 via 107 the circuit switched network 105 along with the destination PID 210, the TBS 115, 120, 125, 131 or 132 polls 320 the TCU 145, 146 or 147 using the destination PID 210. When the TBS 115, 120, 125, 131 or 132 fails to receive 325 a response to the polling 320 from the TCU 145, 146 or 147 within a predetermined time, the TBS 115, 120, 125, 131 or 132 transmits 330 a TCU not available message to the originator of the inbound call 160 via the circuit switched network 105. And, when the TBS 115, 120, 125, 131 or 132 receives 325 a response to the polling 320 from the TCU 145, 146 or 147 within the predetermined period of time, the TBS 115, 120, 125, 131 or 132 routes 335 the inbound call 160 to the TCU 145, 146 or 147.



FIG. 4 illustrates a flowchart detailing the operation of the MMU 140 in the telepoint communication system 100 for routing the inbound call 160 to the TCU 145, 146 or 147. When the MMU 140 receives 405 the routing information 170 from the TBS 115, 120, 125, 131 or 132, the MMU 140 stores 410 the routing information 170 in the database 141. The routing information 170 includes the originating PID 210 and the originating TBS ID 215, where the originating PID 210 is the PID of the TCU 145, 146 or 147 which transmitted the registration information 150 to the originating TBS 115, 120, 125, 131 or 132, which caused the originating TBS 115, 120, 125, 131 or 132 to transmit the routing information 170 to the MMU 140. When the inbound call 160 is received on the circuit switched network 105 for the TCU 145, 146 or 147, the circuit switched network receives the SID 205 of the TCU 145, 146 or 147. From the SID 205, the circuit switched network 105 recognises the inbound call 160 is a call from the TCU 145, 146 or 147, and in response, the packet switched network 105 transmits the inbound call notification, which includes the received SID 205, to the MMU 140 via the communication channel 194 and the packet switched data network 110. When the MMU 140 receives 415 the inbound call notification 165, the MMU 140 uses the received SID to look up 420 the routing information 170 stored in the database 141. When the MMU 140 does not find 425 the routing information 170 in the database 141, the MMU 140 transmits 430 a TCU not registered message to the originator of the inbound call 160, via 112 the packet switched data network 110 and the circuit switched network 105. Alternatively, when the MMU 140 finds 425 the routing information 170 in the database 141, the MMU 140 retrieves the routing information 170 from the database 141 and transmits 435 the retrieved routing information 175 to the circuit switched network 105 via 112 the packet switched data network 110, thereby enabling the circuit switched network 105 to route 107 the inbound call 160 to the TCU 145, 146 or 147.

Thus, using the packet switched data network 110 for data transmissions between the circuit switched network 105, TBSs 115, 120, 125, 131 and 132, the concentrator 134, and the MMU 140 enables the MMU 115 to advantageously track the location of the TCUs 145, 146 and 147 in the telepoint communication system 100, and provide routing information 175 to the circuit switched network that routes the inbound call 160 for the TCUs 145, 146 or 147 to the TCUs 145, 146 or 147 via the TBSs 115, 120, 125, 131 and 132, quickly and predictably, unlike prior art



systems that employ paging to locate the TCUs 145, 146 and 147 only after receiving the inbound call 160 for the TCUs 145, 146 or 147.

5 In accordance with the present invention, conventional circuit switch services and packet data services of a PSTN can be utilised to communicate information on the PSTN between a TBS and a MMU, enabling the location of a TCU to be determined, and subsequently enabling an inbound call for the TCU to be routed to the TCU within a duration of time which is similar to that provided in a cellular telephone communication system. This is achieved by utilising the distributed
10 processing capability inherent in the TBS instead of using an additional switching unit coupled to the PSTN, and the fast transmission of information on the packet switched data network. With distributed processing, existing TBS are enhanced to provide two way calling capability to CT2 subscribers. In addition, with this invention no changes are required to TCUs to provide
15 the added capability of receiving calls to existing CT2 subscribers, hence, totally avoiding the expensive and troublesome task of recalling the existing TCUs from the field for modifications at a service centre.

Hence, this invention provides a quick and economical method for processing an incoming call in a telepoint communication system without
20 the use of additional expensive call switching equipment coupled to the PSTN, and without modifications to the TCUs. 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.

25 What is claimed is:



CLAIMS

1. Apparatus for routing an inbound call for a mobile communication unit (MCU) in a mobile communication system comprising a first communication network, a second communication network and at least one base station, wherein the second communication network is coupled to the first communication network, and wherein the first and second communication networks are coupled to the at least one base station, and wherein the at least one base station transmits routing information thereto in response to receiving registration information from the MCU, thereafter, the first communication network transmits an inbound call notification in response to receiving the inbound call for the MCU, and the second communication network conveys the routing information and the inbound call notification between the first communication network, the second communication network and the at least one base station, the apparatus comprising:

a memory management unit (MMU) coupled to the second communication network for storing the routing information in response to receiving the routing information from the at least one base station via the second communication network, and for transmitting the routing information to the first communication network in response to receiving the inbound call notification from the first communication network via the second communication network, thereby enabling the first communication network to route the inbound call to the at least one base station, and thence to the MCU.

2. The apparatus of claim 1, wherein the first communication network comprises a circuit switched network.

3. The apparatus of claim 1, wherein the second communication network comprises a packet switched data network.

4. The apparatus of claim 1, wherein the first communication network comprises a communication network for conveying voice communication.



- 5 The apparatus of claim 1, wherein the second communication network comprises a communication network for conveying digital information.
- 5 6. An apparatus for coupling to a public switched telephone network (PSTN) having packet switched data services, to facilitate routing of an inbound call on the PSTN to a telepoint communication unit (TCU) in a telepoint communication system, the apparatus comprising:
- 10 at least one telepoint base station (TBS) coupled to the PSTN for transmitting routing information thereto in response to receiving registration information from the TCU; and
- a mobility management unit (MMU) coupled to the PSTN and the at
- 15 least one TBS for receiving the routing information from the at least one TBS on a packet switched data service of the PSTN for storage therein, thereafter, receiving an inbound call notification from the PSTN via the packet switched data service in response to the PSTN receiving the inbound call for the TCU, and transmitting the routing information to the
- 20 PSTN via the packet switched data service in response to receiving the inbound call notification from the PSTN, thereby enabling the PSTN to route the received inbound call to the at least one TBS, and thence to the TCU.
- 25 7. The apparatus of claim 6, wherein the PSTN comprises a PSTN supporting integrated system digital network (ISDN) having at least an X.25 packet switched data service.
8. The apparatus of claim 6, wherein the MMU in claim 6 comprises a
- 30 mobility management unit having at least X.25 packet switched data communication capability.
9. The apparatus of claim 6, wherein the at least one TBS is coupled to the PSTN with at least one basic rate interface (BRI).
- 35 10. The apparatus of claim 6, wherein the at least one TBS has X.25 packet switched data communication capability.



11. The apparatus of claim 6, wherein the MMU is coupled to the PSTN with a communication channel comprising at least one International Telecommunication Union (ITU formerly the Consultative Committee on International Telephone and Telegraph (CCITT)) signal system number 7 data link and at least one BRI.

12. The apparatus of claim 6, wherein the MMU and the at least one TBS is coupled via at least one X.25 packet switched data communication link.

13. The apparatus of claim 6, further comprising a concentrator coupled to the at least one TBS, the MMU, and the PSTN for receiving routing information from the at least one TBS in response to the at least one TBS receiving the registration information from the TCU, and thereafter transmitting the routing information to the MMU for storage therein, the concentrator routing the inbound call to the TCU in response to the PSTN routing the inbound call for the TCU to the concentrator.

14. The apparatus in claim 13, wherein the concentrator is coupled to the MMU with a X.25 packet switched data communication link of the PSTN.

15. The apparatus in claim 14, wherein the concentrator is coupled to the PSTN with at least one basic rate interface (BRI).

16. A method in a memory management unit (MMU) for routing an inbound call for a telepoint communication unit (TCU) in a telepoint communication system comprising a first communication network and a second communication network, wherein the second communication network is coupled to the first communication network and the MMU, and wherein the first and second communication networks are coupled to a plurality of telepoint base stations (TBSs), the method comprising the steps of:

a) receiving routing information via the second communication network from one of the plurality of TBSs in response to the one of the TBSs receiving registration information from the TCU;

b) in response to receiving the routing information from the one of the plurality of TBS, storing the routing information therein;



c) thereafter, receiving an inbound call notification from the first communication network via the second communication network in response to the first communication network receiving an inbound call for the TCU; and

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d) retrieving the routing information in response to receiving the inbound call notification; and

10 e) transmitting the retrieved routing information to the first communication network via the second communication network, thereby enabling the first communication network to route the inbound call to the one of the plurality of TBSs, and thence to the TCU.

17. The method of claim 16 further comprises the step of:

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transmitting a communication unit not registered message to the originator of the inbound call via the second communication network and the first communication network in response to receiving the inbound call notification via the second communication network when the routing information is not previously stored therein.

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18. The method of claim 16,

18a. wherein step (a) comprises the step of
25 receiving a personal identifier (PID) of the TCU and a telepoint base station ID (TBS ID) of the one of the plurality of telepoint base stations in response to the one of the plurality of TBSs receiving the PID from the TCU;

30 18b. wherein step (b) comprises the step of
in response to receiving the PID and the TBS ID from the one of the plurality of telepoint base stations, storing the PID and the TBS ID therein;

35 18c. wherein step (c) comprises the step of
receiving a subscriber ID (SID) affiliated with the TCU from the first communication network via the second communication



network in response to the first communication network receiving the SID with the inbound call;

18d. wherein step (d) comprises the step of
5 in response to receiving the SID with the inbound call, retrieving the PID and the TBS ID;
and

18e. wherein step (e) comprises the step of
10 in response to retrieving the PID and the TBS ID, transmitting the PID and the TBS ID to the first communication network via the second communication network.

19. A method in a telepoint base station (TBS) for routing an inbound call
15 for a telepoint communication unit (TCU) in a telepoint communication system comprising a first communication network and a second communication network, wherein the second communication network is coupled to the first communication network and a MMU, and wherein the first and second communication networks are coupled to the TBS, the
20 method comprising the steps of:

a) transmitting routing information to the MMU via the second communication network in response to receiving registration information from the TCU;
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b) thereafter, in response to receiving the inbound call routed from the first communication network, polling the TCU; and

c) upon receiving a response from the TCU, routing the inbound
30 call to the TCU.

20. The method of claim 19, further comprising the step of:

when a response is not received from the TCU within a
35 predetermined time, transmitting a mobile communication unit not available message to the originator of the inbound call via the first communication network.