



METHOD AND APPARATUS FOR DETERMINING ADJACENT COMMUNICATION SITES IN A MOBILE COMMUNICATION SYSTEM

Field of the Invention

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The invention relates in general to telepoint communication systems, and in particular to a method and apparatus for determining adjacent telepoint base stations for call hand off in a telepoint communication system.

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Background of the Invention

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Telepoint communication systems that provide mobile communication to telepoint subscribers are well known in the art. In such systems, a call may be established by a telepoint subscriber when a subscriber is within communication range of a telepoint base station (TBS). However, a disadvantage of this communication system is, once a call is established via the TBS, the telepoint subscriber is restricted to remain within the communication range of the TBS for the duration of the call. Recently, telepoint communication systems that support call hand off have been introduced. With call hand off, a telepoint subscriber can roam out of the communication range of one TBS into the communication range of another TBS during a call, thus providing telepoint subscribers with greater mobility when engaged in a call. A method of call hand off is disclosed in an application to the USPTO by the same assignee, serial no. 08/306093, titled "Method and apparatus for providing call hand off in a telepoint communication system", applicant docket no. CM00368Y-Sharp, and is incorporated by reference.

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For a telepoint communication system to support call hand off, each TBS in a telepoint communication system has to maintain a database of site identifiers of adjacent TBSs, commonly referred to as configuration information. Using the configuration information in the database a TBS can route a call to an adjacent TBS while the call is in progress, thereby allowing a telepoint subscriber to roam out of the communication range of a TBS and into the communication range of an adjacent TBS. Determining the configuration information to be stored in the database of a TBS conventionally requires manually determining the adjacent TBSs. The manual process of determining the configuration information for a TBS may

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not be difficult to accomplish for a cluster of TBSs comprising a TBS and a number of TBSs immediately adjacent to the TBS, however, a typical telepoint communication system has thousands of TBSs comprising numerous clusters of TBSs making the configuration process both
5 expensive and error prone. Additional difficulties that need to be addressed when manually configuring a TBS for call hand off include the topology and the radio frequency coverage profile of each TBS in a telepoint communication system. Further, the configuration information may need to be updated when changes are made to a telepoint communication system,
10 such as, when the telepoint communication system expands and TBSs are added, or when TBSs are removed for maintenance.

Hence, a need exists for an economical and quick method for determining adjacent TBSs in a telepoint communication system enabling each TBS to be configured to support call hand off. In addition, it is
15 preferable that the method include maintaining the configuration information current to reflect changes in the telepoint communication system.

Summary of the Invention

20 In carrying out the objects of the present invention in one form, there is provided a method for determining adjacent communication sites for call hand off in a mobile communication system having a plurality of communication sites, the method comprising the steps of:

- a) periodically transmitting by the plurality of communication sites
25 a corresponding plurality of site identifiers (SIDs);
- b) receiving some of the plurality of SIDs by a mobile communication unit from a plurality of adjacent communication sites of the plurality of communication sites; and
- c) when registering the mobile communication unit with one of the
30 plurality of adjacent communication sites of the plurality of communication sites, transmitting by the mobile communication unit the some of the plurality of SIDs to the one of the plurality of adjacent communication sites of the plurality of communication sites, and storing the some of the plurality of SIDs
35 at the one of the plurality of adjacent communication sites of the plurality of communication sites, thereby enabling the one of the plurality of adjacent communication sites of the plurality of communication sites to hand off a call





to another one of the plurality of adjacent communication sites of the plurality of communication sites.

5 In carrying out the objects of the present invention in another form, there is provided a mobile communication unit in a mobile communication system having a plurality of communication sites, the mobile communication unit comprising:

a) a transceiver for communicating with a plurality of adjacent communication sites of the plurality of communication sites, wherein each of the plurality of communication sites periodically transmits a corresponding plurality of site identifiers (SIDs) for reception by the transceiver;

b) an active site database for storing at least one SID of the plurality of SIDs; and

c) a controller coupled to the transceiver and the active site database for storing the plurality of SIDs received by the transceiver in the active site database, and for registering with one of the plurality of adjacent communication sites of the plurality of communication sites, and the controller for transmitting each SID in the active site database to the one of the adjacent communication sites of the plurality of communication sites.

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Brief Description of the Drawings

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 block diagram of the mobile communication unit in the telepoint communication system in FIG. 1 in accordance with the preferred embodiment of the present invention.

30 FIG. 3 illustrates a flow chart detailing the operation of the mobile communication 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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A telepoint communication system typically comprises a plurality of communication sites numbering four to five thousand. FIG. 1 illustrates a



telepoint communication system 100 that supports either one way outbound calling, or two way, inbound and outbound, calling which supports call hand off to a mobile communication unit 170. The telepoint communication system 100 comprises a Public Switched Telephone Network (PSTN) 105, that
5 preferably supports Integrated System Digital Network (ISDN), the mobile communication unit (MCU) 170 and a plurality of adjacent communication sites comprising telepoint base stations (TBSs) 110,115,120 and 125. It is understood that, while a typical telepoint communication system comprises a plurality of telepoint base stations, the adjacent telepoint base stations
10 shown in FIG. 1 110,115,120 and 125 illustrate some of the plurality of telepoint base stations. In a preferred embodiment of the present invention the mobile communication unit (MCU) 170 and the telepoint base stations (TBSs) 110, 115,120 and 125 are similar to the telepoint communication unit Silverlink 2000 personal telephone, and telepoint base stations model
15 S35XGB1200BP or S35XGB1400BP or S35XGB1600BP manufactured by Motorola Inc. The TBSs 110,115,120 and 125 are coupled to the PSTN 105 via communication links 130, 135,140 and 145 respectively, that may comprise one or more basic rate interfaces (BRIs) as defined by the ISDN specifications. Each of the TBSs 110, 115, 120 and 125 periodically
20 transmits a beacon which includes a predetermined site identifier (SID), which uniquely identifies each of the TBS 110, 115 120 or 125 in the telepoint communication system 100. The transmission of the beacon and the SID are described in the common air interface (CAI) release two of the European Telecommunication Standards Institute (ETSI) specification ETS
25 300-131 in June 1993, and is included herein by reference. The area circumscribed by the circles 150, 155,160 and 165 represent the area of communication coverage around the TBSs 110, 115, 120 and 125 respectively. The area of communication coverage of a TBS, for example the TBS 110, is the area 150 around the TBS 110 within which the MCU 170
30 can reliably receive the periodic transmissions of the SID from the TBS 110. The TBSs 110,115,120 and 125 are located adjacent to one another producing areas of overlapping communication coverage of the TBSs 110,115,120 and 125. Areas A through area I represent areas of overlapping communication coverage of two or more TBSs. For example,
35 area F represents the area of overlapping communication coverage of TBSs 120 and 125, such that, when the MCU 170 is in area F, the MCU 170 can receive the periodic SID transmissions from the TBSs 120 and 125.



Similarly, areas G,H and I represent areas of overlapping communication coverage of two TBSs, 125 and 110, 110 and 115, and, 115 and 120, respectively. In addition, area A represents an area of overlapping communication coverage of three TBSs, 115, 120 and 125, area B represents an area of overlapping communication coverage of three TBSs, 120, 125 and 110, area C represents an area of overlapping communication coverage of three TBSs, 125, 110 and 115, and similarly area D represents an area of overlapping communication coverage of three TBSs, 110, 115 and 120, while area E represents an area of overlapping communication coverage of four TBSs, 110, 115,120 and 125. For a TBS 110, 115,120 or 125, the area of communication coverage may extend to a distance of 100 meters from the TBS. It should be noted that while FIG. 1 shows a simplified representation of the area of communication coverage of a TBS as a circle, the actual area of communication coverage of a TBS is dependent on various factors, such as, the topography of the coverage area, the height off the TBS, frequency of the radio wave transmitted by the TBS and the power of the transmitter in the TBS.

FIG. 2 illustrates a block diagram of the mobile communication unit 170 comprising a controller 220, a transceiver 210 and an active site database 215. The transceiver 210, coupled to an antenna, supports radio communication links with the TBSs 110,115,120 and 125 when the MCU 170 is within the area of communication coverage of the TBSs 110,115,120 and 125 as described above. The transceiver 210, like the TBSs 110,115,120 and 125 operate on predetermined radio channels of the telepoint communication system 100, and monitors the predetermined radio channels to detect transmissions of SIDs from the TBSs 110,115,120 and 125. The controller 220 is operably coupled to the transceiver 210 and the active site database, and comprises a microcontroller such as the Motorola HC11. The controller 220 further comprises a registration routine 220 and site identifier (SID) time out timers 225. The registration routine 220 is for registering the MCU 170 with one of the plurality of adjacent TBSs 110, 115,120 and 125 of the telecommunication system 100. In one embodiment of the present invention the registration routine 220 is a software program stored in the controller 205 which contains the procedures necessary for the MCU 170 to register with one of the TBSs 110,115,120 or 125. The SID time out timers 225 is a plurality of timers that may be implemented in hardware and/or software of the controller 205, wherein a SID time out timer 225 has a



predetermined time out interval and is set when an SID is stored in the active site database 215. The SID time out timers 225 ensure that each of the SIDs stored in the active site database 215 is received regularly within the predetermined time out interval by the transceiver 210. When an SID time out timer 225 expires, an indication is provided to the controller 220 that an SID stored in the active site database 215 has not been received by the transceiver 210 within the predetermined time out interval, and consequently the SID stored in the active site database 215 is removed from the active site database 215.

Hence, a mobile communication unit in a telepoint communication system can continuously monitor the reception of SIDs as the mobile communication unit travels in the telepoint communication system, store only the SIDs which the mobile communication unit receives regularly such that when the mobile communication unit registers with a telepoint base station, the mobile communication unit provides the stored SIDs to the telepoint base station. Advantageously, the present invention does not use nor rely upon any manual process, thus overcoming the difficulties associated with manually determining and configuring the telepoint base stations with SIDs of adjacent telepoint base stations.

FIG. 3 illustrates a flowchart detailing the operation of the MCU 170 that begins with determining reception 305 of SIDs from the TBSs 110,115,120 and 125. Depending on the location of the MCU 170 in the area of communication coverage of the TBSs 110, 115,120 and 125, the MCU can receive from one to four SIDs. For example, when the MCU 170 is within the area of communication coverage 160 of the TBS 120 away from area F and I, the MCU 170 receives an SID from the TBS 120. Alternatively, when the MCU 170 is in area E, the MCU 170 receives four SIDs from each of the TBSs 110,115,120 and 125. When an SID is not received 305, the SID time out timers 225 of SIDs currently stored in the active site database 215 are checked for expiry 335, and SIDs having a time out timer 225 that has expired 335 are removed 340 from the active site database 215 while SIDs having a time out timer 225 that has not expired 335 are left in the active site database 215, and having updated the time out timers 225 the process returns to awaiting receipt 305 of an SID. When an SID which is not stored 310 in the active site database 215 is received 305, the received SID is stored 315 in the active site database 215, and an SID time out timer 225 is started 315 for the received SID. However, when the received SID had



been previously stored 310 in the active site database 215, the time out timer of the SID is re-set 330. Subsequent to receiving 305, storing 310 and starting an SID time out timer 225 for an SID, a determination is made whether to register 325 with the TBS of the received SID. When the
5 determination is to register, all the SIDs in the active site database 215 are transmitted to the TBS during the registration and the process returns to awaiting receipt 305 of an SID. Similarly, the process returns to awaiting receipt 305 of an SID when the determination is not to register 320.

As a mobile communication unit travels in a telepoint communication
10 system, the present invention advantageously provides configuration information to each telepoint base station in the telepoint communication system with which the mobile communication unit registers. This process can very quickly configure the telepoint base stations in a telepoint communication system, especially when several hundred or even several
15 thousand mobile communication units are operating on a typical telepoint communication system. To further improve the rate at which configuration information is disseminated among telepoint base stations, telepoint base stations may communicate with adjacent telepoint base stations and exchange site identifiers, thereby providing configuration information to
20 telepoint base stations without a mobile communication unit registering with the telepoint base stations.

SIDs are continuously transmitted by TBSs in a telepoint communication system, and as a result, the SIDs received and stored in a mobile communication unit traveling in the telepoint communication system,
25 and the TBS with which the mobile communication unit is registered, continuously change. These changes cause continuous communication of configuration information updates to telepoint base stations from the mobile communication units and between telepoint base stations, and the continuous updating allows any changes in the telepoint communication
30 system to be very quickly reflected in the configuration information in the telepoint base stations. Hence, when TBSs are removed from the telepoint communication system for maintenance or repair, or when new TBSs are added, the configuration information in the TBSs are automatically updated. Thus, the present invention advantageously maintains configuration
35 information current in a telepoint communication system.

In accordance with the present invention, a mobile communication unit can be utilised to provide configuration information comprising SIDs of



adjacent TBSs, to TBSs in a telepoint communication system. This is achieved by the mobile communication unit continuously receiving SIDs from adjacent TBSs and maintaining an active site database of the site identifiers that are received regularly when the mobile communication unit is moving in the area of communication coverage of the adjacent TBSs; and transmitting the site identifiers stored in the active site database by the mobile communication unit to an adjacent TBS when the mobile communication unit registers with the adjacent TBS, thereby enabling the adjacent TBS to hand off a call to another adjacent TBS.

Hence, the method and apparatus of the present invention provides an economical and quick method for determining adjacent telepoint base stations in a telepoint communication system enabling telepoint base stations to be configured to support call hand off by having mobile communication units communicate configuration information to telepoint base stations as mobile communication units travel in the area of communication coverage of a telepoint communication system. In addition, as the communication of configuration information is continuous, the present invention maintains the configuration information current to reflect changes in the telepoint communication system.

What is claimed is:



CLAIMS

1. A method for determining adjacent communication sites for call hand off in a mobile communication system having a plurality of communication sites, the method comprising the steps of:
- 5 a) periodically transmitting by the plurality of communication sites a corresponding plurality of site identifiers (SIDs);
- b) receiving some of the plurality of SIDs by a mobile communication unit from a plurality of adjacent communication sites of the plurality of communication sites; and
- 10 c) when registering the mobile communication unit with one of the plurality of adjacent communication sites of the plurality of communication sites, transmitting by the mobile communication unit the some of the plurality of SIDs to the one of the plurality of adjacent communication sites of the plurality of communication sites, and storing the some of the plurality of SIDs at the one of the plurality of adjacent communication sites of the plurality of communication sites, thereby enabling the one of the plurality of adjacent communication sites of the plurality of communication sites to hand off a call to another one of the plurality of adjacent communication sites of the plurality of communication sites.
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2. The method of claim 1 wherein step (b) comprises the step of monitoring predetermined communication channels of the telepoint communication system by the mobile communication unit to receive the some of the plurality of SIDs from the plurality of adjacent communication sites of the plurality of communication sites.
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3. The method of claim 1 comprising after step (b) the step of storing each SID of the some of the plurality of SIDs in response to determining the each SID of the some of the plurality of SIDs is not currently stored in the mobile communication unit.
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4. The method of claim 3 wherein the step of storing each SID of the some of the plurality of SIDs comprises the steps of:
- 35 storing each SID of the plurality of SIDs in the mobile communication unit;





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starting a corresponding time out for each SID of the some of the plurality of SIDs when storing each SID of the some of the plurality of SIDs in the mobile communication unit; and

5 removing each SID of the some of the plurality of SIDs from storage in the mobile communication unit when the corresponding time out expires.

5. The method of claim 1 comprising after step (b) the step of re-setting a corresponding time out for each SID of the some of the plurality of SIDs in response to determining the each SID of the some of the plurality of SIDs is
10 currently stored in the mobile communication unit.

6. A method in a mobile communication unit for determining adjacent communication sites for call hand off in a mobile communication system having a plurality of communication sites, the method comprising the steps
15 of:

a) registering with one of a plurality of adjacent communication sites of the plurality of communication sites; and

b) transmitting a plurality of (SIDs) received from the plurality of adjacent communication sites to the one of the plurality of adjacent communication sites, thereby enabling a call in progress via the one of the
20 plurality of adjacent communication sites of the plurality of communication sites to be handed off to another one of the plurality of adjacent communication sites of the plurality of communication sites.

25 7. The method of claim 6 prior to step (a) comprises the steps of receiving the plurality of SIDs from the corresponding plurality of adjacent communication sites of the plurality of communication sites; and storing the plurality of SIDs.

30 8. The method of claim 7 of receiving the plurality of SIDs (a) further comprises the step of monitoring predetermined communication channels of the telepoint communication system to receive the plurality of SIDs from the plurality of adjacent communication sites of the plurality of communication sites.

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9. The method of claim 7 before the step of storing the plurality of SIDs comprises the step of determining each SID of the plurality of SIDs is not currently stored.
- 5 10 The method of claim 7 of storing the plurality of SIDs comprising the steps of:
- setting a time out for each SID of the plurality of SIDs when storing each SID of the plurality of SIDs; and
 - removing each SID of the plurality of SIDs from storage when the
- 10 corresponding time out expires.
11. The method of claim 7 after receiving the plurality of SIDs from the corresponding plurality of adjacent communication sites of the plurality of communication sites comprises the step of re-setting a corresponding time
- 15 out for each SID of the plurality of SIDs in response to determining the each SID of the plurality of SIDs is currently stored.
12. A mobile communication unit in a mobile communication system having a plurality of communication sites, the mobile communication unit
- 20 comprising:
- a) a transceiver for communicating with a plurality of adjacent communication sites of the plurality of communication sites, wherein each of the plurality of communication sites periodically transmits a corresponding plurality of site identifiers (SIDs) for reception by the transceiver;
 - 25 b) an active site database for storing at least one SID of the plurality of SIDs; and
 - c) a controller coupled to the transceiver and the active site database for storing the plurality of SIDs received by the transceiver in the active site database, and for
- 30 registering with one of the plurality of adjacent communication sites of the plurality of communication sites, and the controller for transmitting each SID in the active site database to the one of the adjacent communication sites of the plurality of communication sites.
- 35 13. The mobile communication unit of claim 12 wherein the controller comprises:





a registration routine for registering the mobile communication unit with the one of the adjacent communication sites of the plurality of communication sites; and

- time out timers having a predetermined time out interval for ensuring
- 5 each of the plurality of SIDs stored in the active site database is received regularly within the predetermined time out interval by the transceiver, and for indicating when one of the plurality of SIDs stored in the active site database is not received by the transceiver within the predetermined time interval, thereby causing the one of the plurality of SIDs to be removed from
- 10 the active site database.

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