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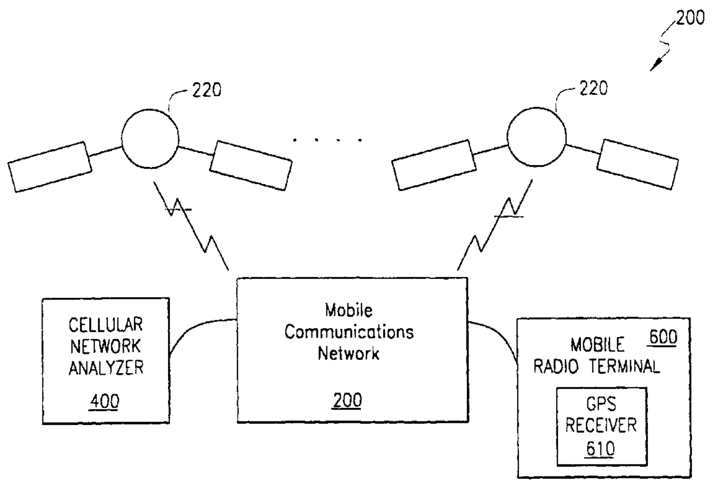
(54) Title: SYSTEM AND METHOD FOR ENABLING A USER OF A MOBILE RADIO TERMINAL TO INFLUENCE THEIR OWN RADIO QUALITY



(57) Abstract: A system and method are provided that addresses the problematic radio shadow effect by enabling a user of a mobile radio terminal to influence their own radio quality. Basically, the system includes a mobile communications network located between a mobile radio terminal and a cellular network analyzer. The mobile radio terminal is operable to estimate its own current position within the mobile communications network, and is further operable to compare the estimated current position with a radio quality map received from the cellular network analyzer to determine the radio quality in the vicinity around the mobile radio terminal. Thus, the mobile radio terminal is capable of informing its user as to the radio quality around the current position of the mobile radio terminal which then enables the user to influence their own radio quality by moving or stopping the mobile radio terminal.

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SYSTEM AND METHOD FOR ENABLING A USER OF A MOBILE RADIO TERMINAL TO INFLUENCE THEIR OWN RADIO QUALITY

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention generally relates to the mobile telecommunications field and, in particular, to a system and method for enabling a user of a mobile radio terminal to influence their own radio quality by moving or stopping the mobile radio terminal.

Description of Related Art

In the communication of radio signals such as are employed in mobile communications networks, the quality of the radio signal received by a mobile radio terminal from a base station can be adversely affected by natural phenomena. This natural phenomena includes the problematic radio shadow effect which is created by buildings or natural obstacles such as hills that are located between the mobile radio terminal and the base station. Radio shadow which is also known as log-normal fading effectively decreases the strength of radio signals received by the mobile radio terminal.

Referring to FIGURE 1, there is a simplified diagram illustrating an exemplary situation wherein the natural phenomena of radio shadow can occur when a building 102 or natural obstacles such as a hill 104 is located between a mobile radio terminal 106 (shown in an automobile) and a base station 108. One traditional way that network operators have used to address the problematic radio shadow effect in mobile communications networks is briefly described below.

JP 10042360 (Japanese Abstract) discloses a system which notifies a user of a portable radio communication device, located in a blind zone, as to the location of a particular area where communications can take place with a high speed radio communication base station. The portable radio communication device includes a Global Positioning Satellite (GPS) receiver used to estimate the present location of the user. The system includes a control central center that uses a low speed radio data line at the time of the start of communication with the portable radio communication to notify the user of the location of an optimum region and/or the location of a place near their present location where communications can take place with a high speed radio communication base station. This is a complicated solution for enabling the user of the portable radio communication device to exit the blind zone (e.g., radio shadow).

Unfortunately, the traditional ways used to address the problematic radio shadow effect fail to enable the user of a mobile radio terminal to influence their own radio quality prior to the mobile radio terminal entering a geographic area experiencing radio shadow. Moreover, the traditional ways used to address the problematic radio shadowing effect fail to provide a simple solution for enabling the user of the mobile radio terminal to exit a geographic area currently experiencing radio shadow. Therefore, there is a need for a system and method capable of informing a user of a mobile radio terminal as to the radio quality around the current position of the mobile radio terminal thus enabling the user to influence their own radio quality by moving or stopping the mobile radio terminal.

BRIEF DESCRIPTION OF THE INVENTION

The present invention is a system and method that addresses the problematic radio shadow effect by enabling a user of a mobile radio terminal (e.g., mobile phone, communicator (comprising both a mobile phone and an organizer), pager) to influence their own radio quality. Basically, the system includes a mobile communications network located between a mobile radio terminal and a cellular network analyzer. The mobile radio terminal is operable to estimate its current position, direction and speed within the mobile communications network, and is further operable to compare the estimated current position with a radio quality map received from the cellular network analyzer to determine the radio quality in the vicinity around the mobile radio terminal. Thus, the mobile radio terminal is capable of informing its user as to the radio quality around the current position of the mobile radio terminal which then enables the user to influence their own radio quality by moving or stopping the mobile radio terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the system and method of the present invention may be had by reference to the following detailed description when taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a simplified diagram illustrating an exemplary situation where the problematic radio shadow effect can adversely affect communications between a traditional mobile radio terminal and a traditional base station;

FIGURE 2 is a block diagram illustrating the basic components associated with an exemplary system of the present invention;

FIGURE 3 is a block diagram illustrating in greater detail a mobile communications network of the exemplary system shown in FIGURE 2;

FIGURE 4 is a block diagram illustrating in greater detail a cellular network analyzer of the exemplary system shown in FIGURE 2;

FIGURE 5 is a diagram illustrating an exemplary radio quality map that can be generated by the cellular network analyzer shown in FIGURE 4;

FIGURE 6 is a block diagram illustrating in greater detail a mobile radio terminal of the exemplary system shown in FIGURE 2; and

FIGURE 7 is a flowchart illustrating the basic steps of the preferred method in accordance with the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to the Drawings, wherein like numerals represent like parts throughout FIGURES 2-7, there are disclosed an exemplary system 200, an exemplary mobile radio terminal 600, and a preferred method 700 in accordance with the present invention.

Although the present invention is described in a manner to address the problematic radio shadow effect commonly known in the industry as log-normal fading (see FIGURE 1), it should be understood that the present invention can also be used to address other transmission problems commonly known in the industry as path loss and rayleigh fading. Accordingly, the system 200, the mobile radio terminal 600 and the preferred method 700 described should not be construed in a limited manner.

Referring to FIGURE 2, there is a block diagram illustrating the basic components associated with the system 200 of the present invention. Basically, the system 200 includes a mobile communications network 300 located between a mobile radio terminal 600 (only one shown) and a cellular network analyzer 400. The mobile radio terminal 600 (e.g., mobile phone, communicator (comprising both a mobile phone and an organizer), pager) is operable to estimate its own current position, direction and speed within the mobile communications network 300. For example, the mobile radio terminal 600 may use a Global Position System (GPS) including GPS satellites 220 and a GPS receiver 610 to estimate its current position within the mobile communications network 300. The mobile radio terminal 600 is also operable to compare the estimated current position with a radio quality map received from the cellular network analyzer 400 to determine the radio quality in the vicinity around the mobile radio terminal. Thus, the mobile radio terminal 600 is capable of informing its user as to the radio quality around the current position of the mobile radio terminal which then enables the user to influence their own radio quality by moving or stopping the mobile radio terminal.

Referring to FIGURE 3, there is a block diagram illustrating in greater detail the exemplary mobile communications network 300. Certain details associated with the mobile communications network 300 are known in the industry and as such need not be described herein. Therefore, for clarity, the description provided below in relation to the mobile communications network 300 omits some components not necessary to understand the invention.

The mobile communications network 300 includes an arbitrary geographic area that has been divided into a plurality of radio coverage areas, or cells C1 to C10. Each cell C1 to C10 has a base station B1 to B10, denoted with the same number as the cell. The mobile communications network 300 as illustrated supports nine mobile radio terminals M1 to M9 and ten mobile test units MTU1 to MTU10 each of which can move within a single cell and can also move from one cell to another cell. Each of the nine mobile radio terminals M1 to M9 (at least one can be the mobile radio terminal 600) and ten mobile test units MTU1 to MTU10 (see the cellular network analyzer 400 of FIGURE 4) can incorporate a GPS receiver that interacts with the GPS satellites 220 to determine their current position within the mobile communications network 300. As shown, the mobile communications network 300 also includes a mobile radio telephone exchange MSC which is hard-wired to all of the illustrated ten base stations B1 to B10. The mobile radio telephone exchange MSC is connected to a public switched telephone network PSTN which is, in turn, connected to the cellular network analyzer 400.

It should be understood that the representation of the mobile communications network 300 shown in FIGURE 1 is for purposes of illustration only and is not intended as a limitation on the possible implementations of the present invention. As such, the present invention is normally applied with a mobile communications network that includes more than ten cells, ten base stations, nine mobile radio terminals and ten mobile test units.

Referring to FIGURE 4, there is a block diagram illustrating in greater detail the exemplary cellular network analyzer 400. Basically, the cellular network analyzer 400 can be used by a network operator to monitor and report the overall radio quality within the mobile communications network 300. To help do this, the cellular network analyzer 400 utilizes the mobile test units MTU1 to MTU10 to generate a radio quality map 500 (see FIGURE 5) indicative of the radio conditions (e.g., radio quality) within at least a portion of a geographical area serviced by the mobile communications network 300. Thus, the geographic areas having an unacceptable radio quality due to the radio shadow effect can be identified by measurements taken at the mobile test units MTU1 to MTU10 located throughout the mobile communications network 300.

The cellular network analyzer 400 controls the mobile test units MTU1 to MTU10 (only three shown in FIGURE 4) each of which can be placed in a vehicle that is on the move in the mobile communications network 300. Like the mobile radio terminal 600, each mobile test unit MTU1 to MTU10 may incorporate a GPS receiver 405 and use the GPS satellites 220 to estimate their current position within the mobile communications network 300. Also, each mobile test unit MTU1 to MTU10 can initiate or receive a test call(s) at a time, place and under network conditions given by measurement orders sent from a communication server 410. The communication server 410 operates to receive information from each mobile test unit MTU1 to MTU10 including their current position and a variety of network signaling parameters (described below) measured during the test call(s) by way of the mobile communications network 300 and the PSTN.

The communication server 410 is coupled via a data communication network 412 to an administration center 415 that includes an operator console 420 and a configuration station 425. The operator console 420 is the main center for managing (e.g., defining the measurement orders, performing software upgrades and configuring the mobile test units) the autonomous mobile test units MTU1 to MTU10. The operator console 420 also operates to originate and terminate the test call(s) to the mobile test units MTU1 to MTU10. In other words, the operator console 415 allows the network operator to control the operations of the cellular network analyzer 400.

The configuration station 425 operates to define the geographical areas and order the different measurements taken by the mobile test units MTU1 to MTU10 so as to prepare the radio quality map 500 (see FIGURE 5). More specifically, the configuration station 425 operates to manage the geographical information and generate statistical data using the measured signaling parameters to prepare the radio quality map 500. The radio quality map 500 can be presented on a presentation station 430 and/or forwarded to the mobile test units MTU1 to MTU10 by the operator console 420. The mobile test units MTU1 to MTU10 can also present the radio quality map 500 to the user. In addition, the configuration station 425 operates as an interface with a database management system 440 that stores the information (e.g., measurement results, configuration data) used by the cellular network analyzer 400.

The components (e.g., communication server 410, administration center 415 and the database management system 440) of the cellular network analyzer 400 can communicate via the data communication network 412 based on the TCP/IP (Transmission Control Protocol/Internet Protocol) standard. The use of the TCP/IP standard enables the components to be geographically distributed and also allows the components to be connected via LAN (Local Area Network), WAN (Wide Area Network), fixed or dial-up lines, or ISDN (Integrated Services Digital Network) (for example).

Referring to FIGURE 5, there is illustrated an exemplary radio quality map 500 that is formed by overlapping a geographical area layer (e.g., road map) and a radio quality statistical layer (e.g., reception levels). More specifically, the cellular network analyzer 400 operates to create at least one sub-area within the geographical area layer wherein measurements are performed by a select number of the mobile test units MTU1 to MTU10. The use of the sub-area enables the network operator to execute different measurements within different sub-areas such that certain sub-areas may be given higher attention than other sub-areas, these sub-areas can be locations with a higher subscriber density and traffic load or areas with known or suspected problems (e.g., radio shadow problems).

The different sub-areas can have arbitrarily shaped polygons which are interactively defined and named by the network operator, and are stored in the database management system 440. In addition, the sub-areas can be used to facilitate the presentation and analysis of the measurement reports as well as to control the behavior of the mobile test units MTU1 to MTU10 through measurement orders. Again, the sub-areas which form the geographical area layer (e.g., road map) are overlapped onto the radio quality statistical layer (e.g., reception levels) to form the quality map 500.

The radio quality statistical layer can be used to view the collected measurement results (measured network signaling parameters) taken by the mobile test units MTU1 to MTU10. Similar to the geographical layer, the radio quality statistical layer can include a matrix of parcels which can be an arbitrary shaped region subdivided by a grid to form uniformly shaped parcels.

The cellular network analyzer 400 operates to create the radio quality statistical layer using the network signaling parameters measured by the mobile test units MTU1 to MTU10. To create the radio quality statistical layer, the cellular network analyzer 400 operates to merge the data from a select number of mobile test units MTU1 to MTU10, and then operates to distribute this data into geographically distributed statistical accumulators. The statistical accumulators such as mean value, median value, standard deviation and/or distribution are used in the statistical layer instead of the measured network signaling parameters.

The measured network signaling parameters (statistical parameters) that can be presented within the parcels of the radio quality statistical layer includes measurements taken by mobile test units MTU1 to MTU10 such as:

- Geographic measurement point.
- Serving cell identity.
- Base station Identity Code.
- ARFCN (Absolute Radio Frequency Channel Numbers) number.
- Mean value, median value, standard deviation, number of samples and group distribution for the following parameters:
  - Rx level, full and sub value
  - TEMS Speech Quality Index
  - C1/C2 Cell reselection parameters
  - Radio Link Timeout Counter
  - Rx quality, full and sub value
  - Call Setup Time, mobile terminated
  - Call Setup Time, mobile originated
  - Transmit power of mobile station

- Total number of call attempts
- The following network access parameters:
    - Call setup success rate mobile originated
    - Call setup success rate mobile terminated
    - Number of attempts to obtain initial radio access
    - Call success rate of obtaining initial radio access
    - Number of attempts to obtain a traffic channel assignment
    - Call success rate of obtaining a traffic channel assignment
    - Number of attempts to access PSTN
    - Call success rate of accessing PSTN
    - Number of successful call setups
- Call completion rate of total number of successful call setups (successful call release)

FIGURE 5 shows an exemplary radio quality statistical layer including measured Rx levels, but it should be understood that any of the above-mentioned network parameters can be represented within the radio quality statistical layer including an area with a high level of dropped and/or blocked calls. In addition, the radio quality statistical layer may include the use of simulated radio quality values instead of the use of measured radio quality values.

After completing or updating the radio quality map 500, the cellular network analyzer 400 operates to forward the radio quality map 500 to the mobile radio terminal 600. The quality map 500 can be forwarded to the mobile radio terminal 600 during predetermined actions including, for example, the powering-on and handing-off of the mobile radio terminal. Moreover, when the mobile radio terminal 600 is located in a small cell or a rural area network it may be useful to define how close to the edge of the radio quality map 500 the mobile radio terminal could be before initiating a download of a new quality map.

Referring to FIGURE 6, there is illustrated the exemplary mobile radio terminal 600 of the present invention. The mobile radio terminal 600 may be used within a mobile communications network 300 based on the Global System for Mobile Communications (GSM) specification. In addition, the mobile communications network 300 may be based on other specifications or standards including, for example, the Advanced Mobile radio terminal System (AMPS), the Digital Advanced Mobile radio terminal System (D-AMPS) and the Personal Digital Cellular (PDC) System.

The mobile radio terminal 600 includes a receiver 610 that operates to estimate the current position of the mobile radio terminal within the mobile communications network 300. As described above, the Global Position System (GPS) may be used by the mobile radio terminal 600 to estimate its current position, direction and speed within the mobile communications network 400. The mobile radio terminal 600 also includes a memory 620 that operates store the radio quality map 500 received from the cellular network analyzer 400. Again, the radio quality map 500 is indicative of the radio quality within a predetermined geographical area including all or only a portion of the area serviced by the mobile communications network 300. The mobile radio terminal 600 includes a controller 630 operable to compare the stored radio quality map 500 with the current position of the mobile radio terminal to determine the radio quality in the vicinity around the mobile radio terminal. The user may also view the radio quality map 500 relative to their current position. The controller 630 is coupled to the receiver 610 and the memory 620.

Furthermore, the mobile radio terminal 600 includes an interface unit 640, coupled to the controller 630, operable to inform the user of the mobile radio terminal as to the radio quality around the current position of the mobile radio terminal. More specifically, the interface unit 640 is capable of informing the user that they are about to enter an area currently providing unacceptable (poor) radio quality thus enabling the user to avoid the problematic area by moving or stopping the mobile radio terminal. The unacceptable radio quality may be due to the problematic radio shadow effect or other transmission related problems.

In addition, the interface unit 640 is also capable of informing the user that is currently located in an area providing unacceptable radio quality which direction they would have to move so as to enter an area that is providing acceptable radio quality. The interface unit 640 can inform the user or give directions to the user in one of several ways including, for example, visual, voice or tones.

Referring to FIGURE 7, there is a flowchart illustrating the basic steps of the preferred method 700 which enables the user of the mobile radio terminal 600 to influence their own radio quality by moving or stopping the mobile radio terminal. Beginning at step 702 of the preferred method 700, the current position, direction and speed of the mobile radio terminal 600 are estimated using the GPS satellites 220 and the GPS receiver 610. It should also be understood that other positioning systems (e.g., Location Radio Based Navigation (LORAN) or triangulation) can be used to estimate the current position of the mobile radio terminal 600.

At stage 702, the radio quality map 500 indicative of the radio quality within a portion or all of the area serviced by the mobile communications network 300 is received from the cellular network analyzer 400 and stored within the memory 620 of the mobile radio terminal 600. As described above, the radio quality map 500 is generated by the cellular network analyzer 400 with the aid of the mobile test units MTU1 to MTU10 that operate to measure the network signaling parameters within the mobile communications network 300.

At stage 704, the controller 630 operates to compare the radio quality map 500 with the estimated current position of the mobile radio terminal 600 to determine the radio quality around the current position of the mobile radio terminal.

At stage 706, the interface unit 604 operates to inform the user of the mobile radio terminal 600 as to the radio quality around the current position of the mobile radio terminal such that the user can then influence their own radio quality by moving or stopping the mobile radio terminal. More specifically, the interface unit 640 operates to inform the user that they are about to enter an area currently providing unacceptable (poor) radio quality thus enabling the user to avoid the problematic area by moving or stopping the mobile radio terminal. In addition, the interface unit 640 is also capable of informing the user, currently located in an area providing unacceptable radio quality, which direction to move so as to enter an area that is providing acceptable radio quality.

It should be emphasized that the term "comprises/comprising" when used in this application is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof."

From the foregoing, it can be readily appreciated by those skilled in the art that the present invention provides a system and method capable of informing a user of a mobile radio terminal as to the radio quality around the current position of the mobile radio terminal thus enabling the user to influence their own radio quality by moving or stopping the mobile radio terminal.

Although one embodiment of the method and apparatus of the present invention has been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

WHAT IS CLAIMED IS:

1. A mobile radio terminal comprising:

a receiver for estimating a current position of the mobile radio terminal;

a memory for storing a map indicative of radio conditions within an area including the current position of the mobile radio terminal;

a controller, coupled to said receiver and said memory, for comparing the map and the current position of the mobile radio terminal to determine the radio conditions around the current position of the mobile radio terminal; and

an interface unit, coupled to said controller, for informing a user of the mobile radio terminal as to the radio conditions around the current position of the mobile radio terminal.

2. The mobile radio terminal of Claim 1, wherein said user upon being informed of the radio conditions around the current position of the mobile radio terminal can influence their own radio quality by moving or stopping the mobile radio terminal.

3. The mobile radio terminal of Claim 1, wherein said interface unit is further capable of informing the user that they are about to enter a geographical area providing unacceptable radio quality.

4. The mobile radio terminal of Claim 3, wherein said geographical area providing unacceptable radio quality further includes a location experiencing radio shadow.

5. The mobile radio terminal of Claim 4, wherein said radio shadow is attributable to transmission problems including log-normal fading or path loss.

6. The mobile radio terminal of Claim 1, wherein said interface unit is further capable of informing the user which direction to move so as to enter a geographical area providing acceptable radio quality.

7. The mobile radio terminal of Claim 1, wherein said receiver further includes a Global Positioning Satellite receiver.

8. The mobile radio terminal of Claim 1, wherein said map further includes a geographical map presenting measured radio quality values.

9. The mobile radio terminal of Claim 1, wherein said quality map further includes a geographical map presenting simulated radio quality values.

10. A system comprising:

a mobile communications network;

a cellular network analyzer for generating a quality map indicative of radio quality within at least a portion of a geographical area of said mobile telecommunications system;

a mobile radio terminal capable of receiving the generated quality map from said cellular network analyzer, said mobile radio terminal further includes:

a receiver for estimating a current position of the mobile radio terminal within the geographical area of said mobile telecommunications network;

a memory for storing the received quality map;

a controller, coupled to said receiver and said memory, for comparing the quality map and the current position of the mobile radio terminal to determine the radio quality around the current position of the mobile radio terminal; and

an interface unit, coupled to said controller, for informing a user of the mobile radio terminal as to the radio quality around the current position of the mobile radio terminal.

11. The mobile communications network of Claim 10, wherein said interface unit is further capable of informing the user that they are about to enter an area currently providing poor radio quality.

12. The mobile communications network of Claim 11, wherein said area currently providing poor radio quality further includes a location experiencing radio shadow attributable to transmission problems including log-normal fading or path loss.

13. The mobile communications network of Claim 10, wherein said interface unit is further capable of informing the user which direction to move so as to enter an area currently providing acceptable radio quality.

14. The mobile communications network of Claim 10, wherein said cellular network analyzer further includes a plurality of mobile test units each capable of recording a plurality of signaling parameters used to generate the quality map.

15. The mobile communications network of Claim 14, wherein said quality map further includes a statistical layer representing the recorded signaling parameters and a geographical layer representing a geographic area.

16. A method for enabling a user of a mobile radio terminal to influence their own radio quality, said method comprising the steps of:

estimating a current position of the mobile radio terminal;

receiving and storing a quality map indicative of radio quality within a geographical area including the current position of the mobile radio terminal;

comparing the quality map and the current position of the mobile radio terminal to determine the radio quality around the current position of the mobile radio terminal; and

informing said user of the mobile radio terminal as to the radio quality around the current position of the mobile radio terminal, wherein said user can then influence their own radio quality by moving or stopping the mobile radio terminal.

17. The method of Claim 16, wherein said step of informing further includes informing said user that they are about to enter an area currently providing unacceptable radio quality.

18. The method of Claim 17, wherein said area currently providing unacceptable radio quality further includes a location experiencing radio shadow.

19. The method of Claim 16, wherein said step of informing further includes informing said user which direction to move so as to enter an area currently providing acceptable radio quality.

20. The method of Claim 16, wherein said step of receiving and storing a quality map further includes generating the quality map by measuring a plurality of signaling parameters using a plurality of mobile test units.

21. The method of Claim 20, wherein said quality map further includes a statistical layer representing the measured network signaling parameters overlaying a geographical layer representing the geographic area of a mobile telecommunications system.

22. The method of Claim 16, wherein said step of estimating a current position of the mobile radio terminal further includes receiving signals from a plurality of Global Positioning Satellites.

23. A mobile communications network comprising:

a mobile radio terminal capable of receiving a quality map from a cellular network analyzer, said mobile radio terminal further includes:

a receiver for estimating a current position of the mobile radio terminal within a geographical area of said mobile communications network;

a memory for storing the received quality map;

a controller, coupled to said receiver and said memory, for comparing the quality map and the current position of the mobile radio terminal to determine the radio quality around the current position of the mobile radio terminal; and

an interface unit, coupled to said controller, for informing a user of the mobile radio terminal that they are about to enter an area currently providing unacceptable radio quality.

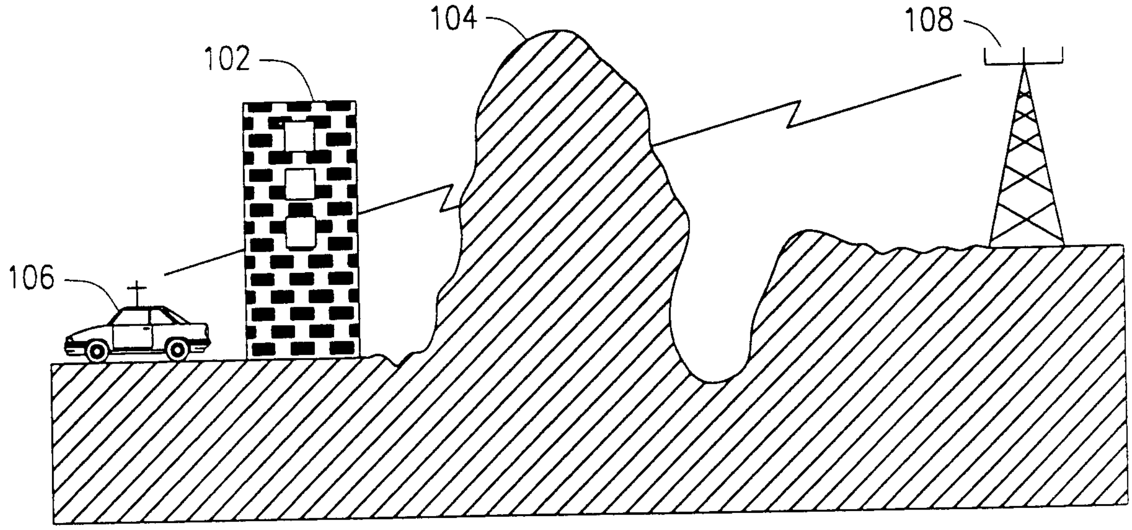

104
108
102
106

FIG. 1

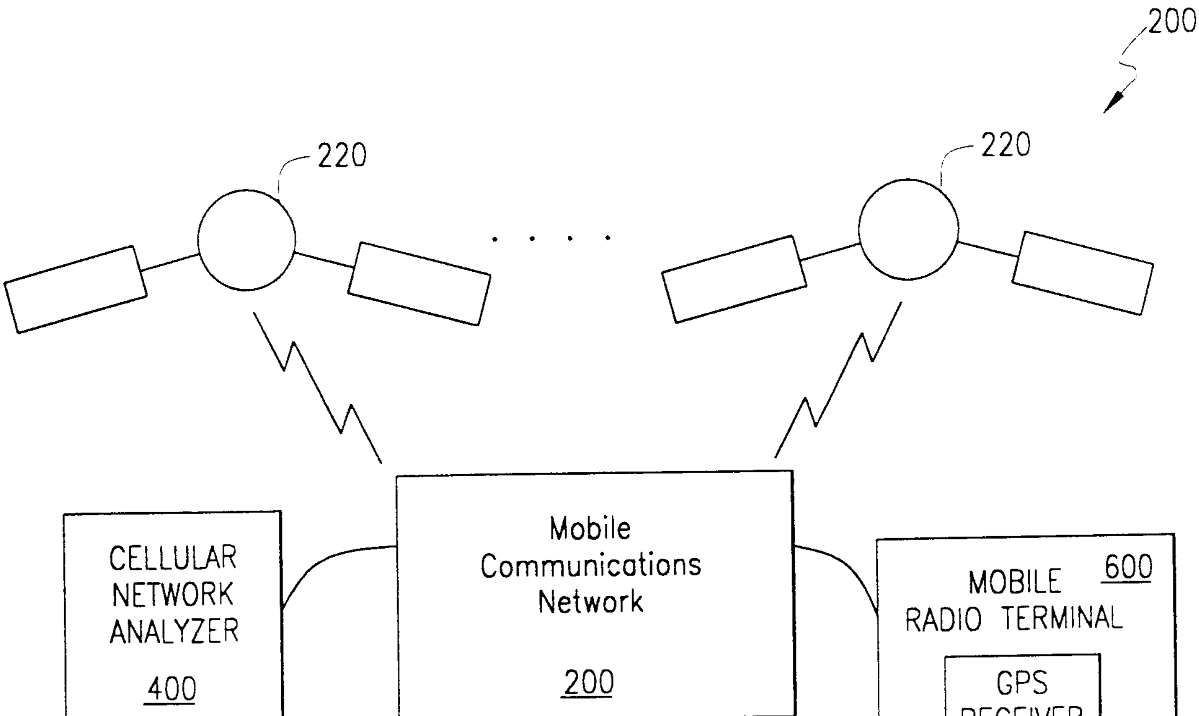
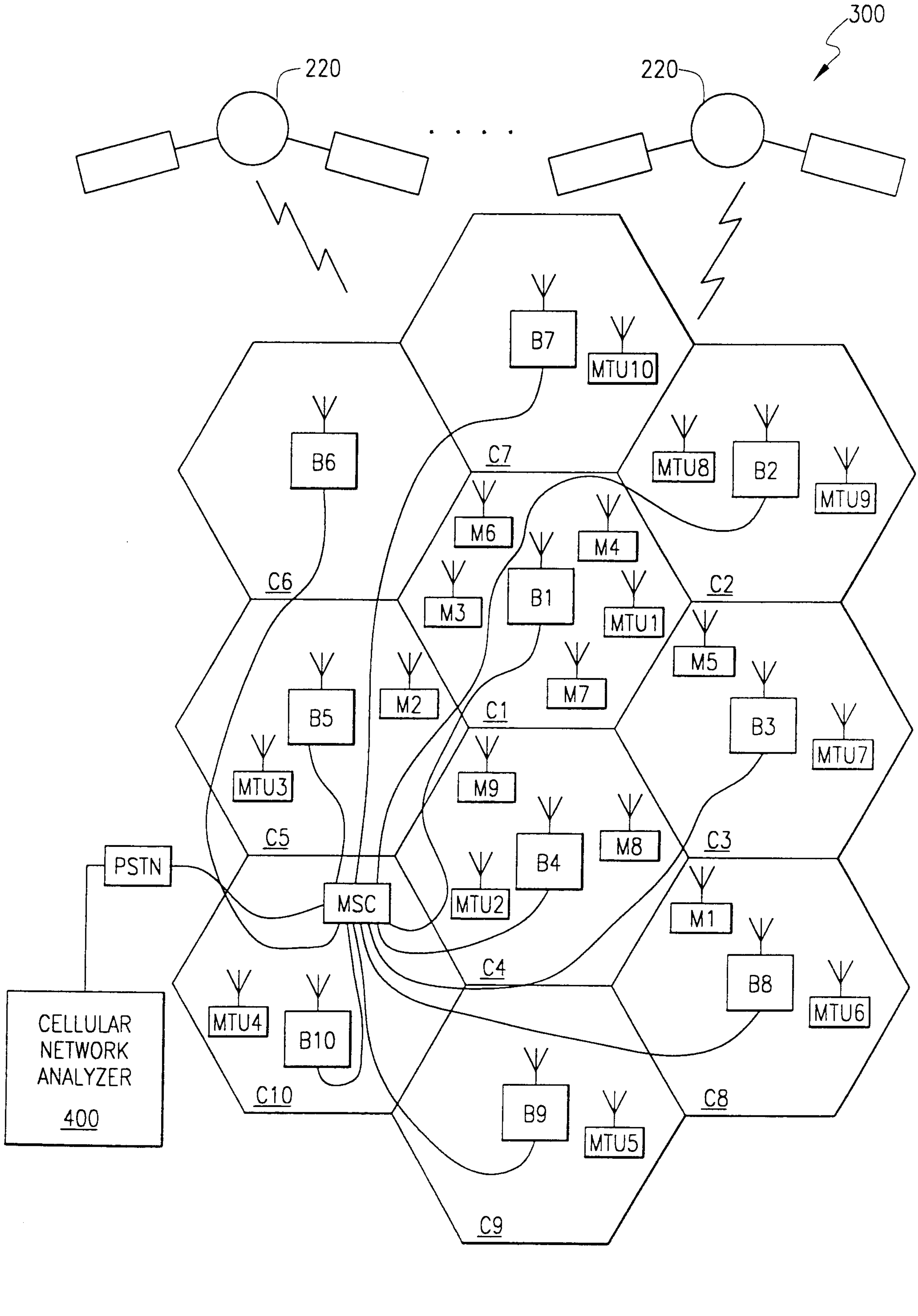

200
220
220
CELLULAR NETWORK ANALYZER
400
Mobile Communications Network
200
MOBILE RADIO TERMINAL
600
GPS RECEIVER
610

FIG. 2


300
220
220
B7
MTU10
B6
C7
MTU8
B2
MTU9
M6
M4
B1
M3
MTU1
C6
C2
M5
M7
B5
M2
C1
B3
MTU7
MTU3
M9
M8
B4
C5
C3
PSTN
MSC
MTU2
M1
C4
B8
CELLULAR
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ANALYZER
400
MTU4
B10
MTU6
C10
B9
C8
MTU5
C9

FIG. 3

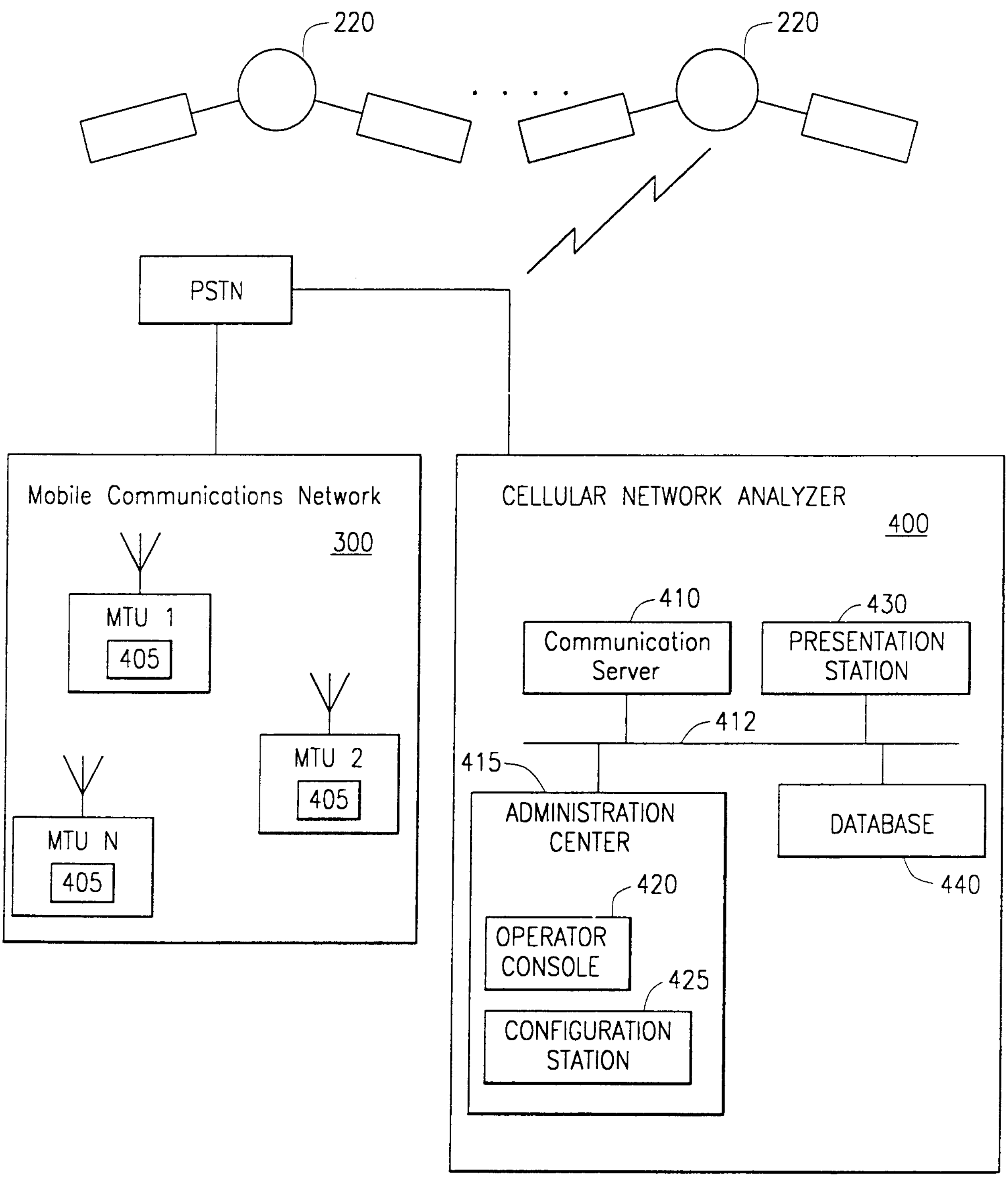
220
220
PSTN
Mobile Communications Network
300
MTU 1
405
MTU 2
405
MTU N
405
CELLULAR NETWORK ANALYZER
400
410
Communication Server
430
PRESENTATION STATION
412
415
ADMINISTRATION CENTER
DATABASE
440
420
OPERATOR CONSOLE
425
CONFIGURATION STATION

FIG. 4

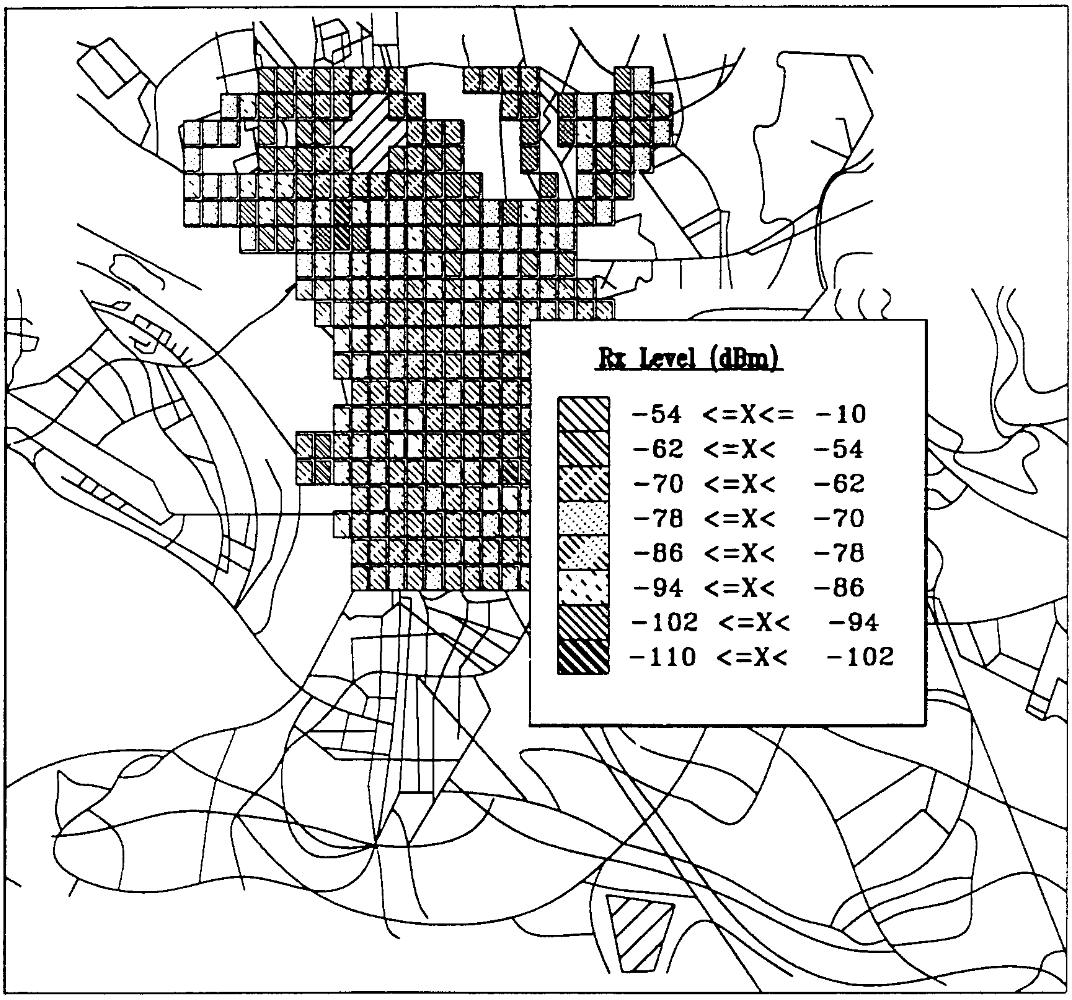
Rx Level (dBm)
-54 <=X<= -10
-62 <=X< -54
-70 <=X< -62
-78 <=X< -70
-86 <=X< -78
-94 <=X< -86
-102 <=X< -94
-110 <=X< -102

FIG. 5

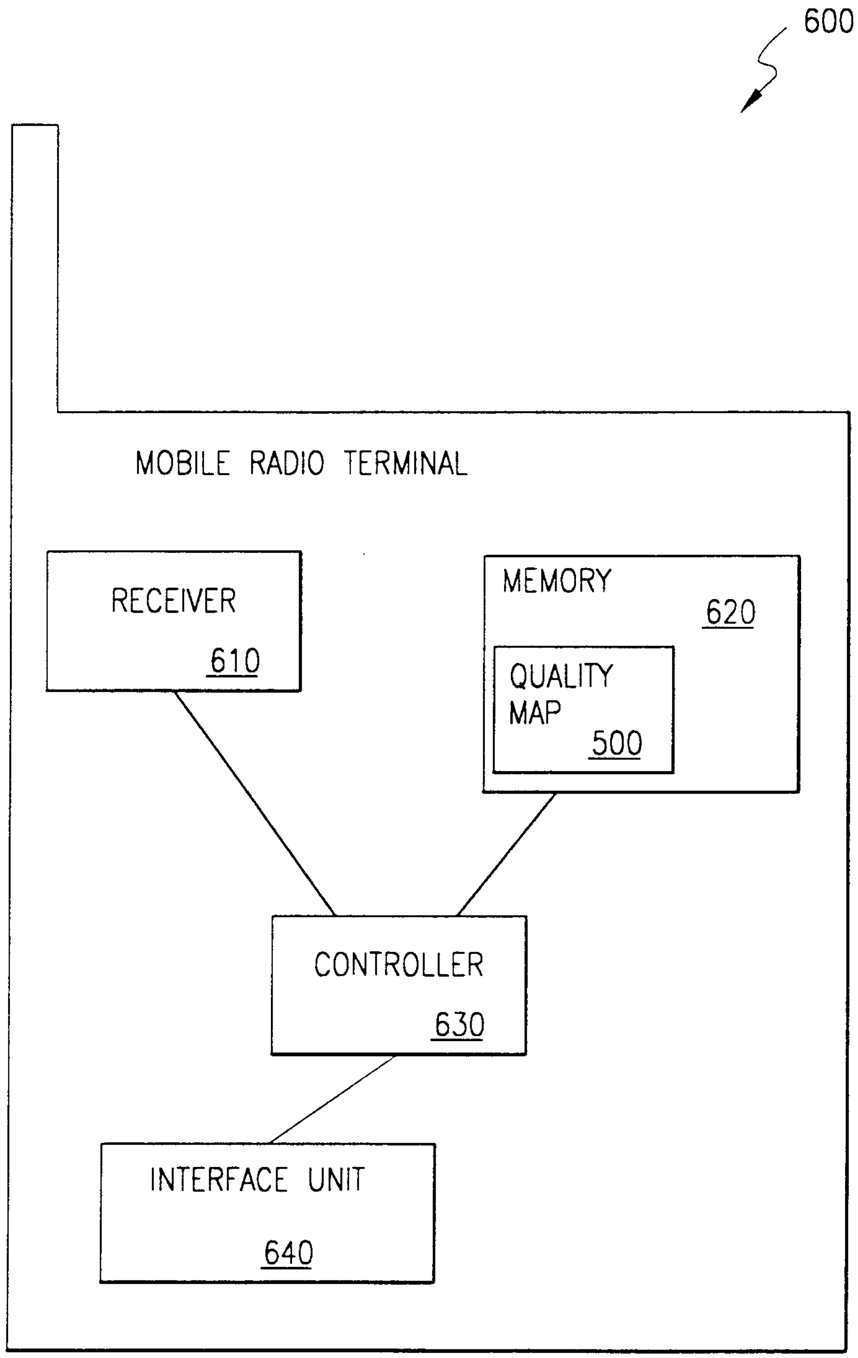
600
MOBILE RADIO TERMINAL
RECEIVER
610
MEMORY
620
QUALITY
MAP
500
CONTROLLER
630
INTERFACE UNIT
640

FIG. 6

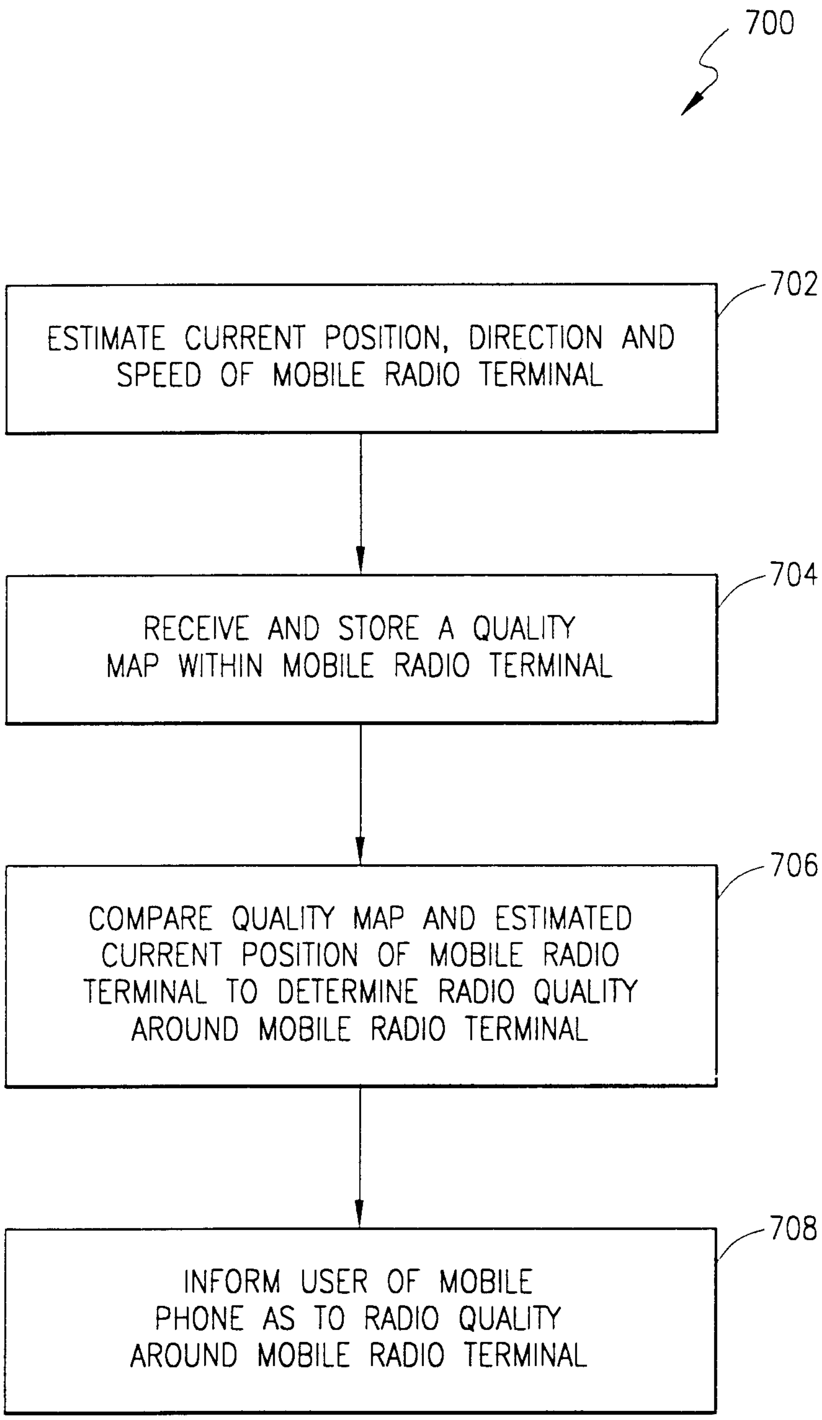
700
702
ESTIMATE CURRENT POSITION, DIRECTION AND SPEED OF MOBILE RADIO TERMINAL
704
RECEIVE AND STORE A QUALITY MAP WITHIN MOBILE RADIO TERMINAL
706
COMPARE QUALITY MAP AND ESTIMATED CURRENT POSITION OF MOBILE RADIO TERMINAL TO DETERMINE RADIO QUALITY AROUND MOBILE RADIO TERMINAL
708
INFORM USER OF MOBILE PHONE AS TO RADIO QUALITY AROUND MOBILE RADIO TERMINAL

FIG. 7