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(54) Title: GEOGRAPHICAL INFORMATION FOR LOCATION–BASED SERVICES

(57) Abstract

A method of providing subscriber location information to a radio telecommunication network (10) and an integrated communication network which integrates the radio telecommunication network with at least one wireline communication network. When a subscriber utilizes a mobile station (11) to access the radio telecommunication network, a radio base station (RBS) (13) sends to a mobile switching center (MSC) (15), a cell identity of the cell (12) in which the registration is received from the mobile station. The cell identity is converted in a cell/coordinate (25) table to a range of geographic coordinates that approximate the coverage area of the cell. The geographic coordinates are then sent from the MSC to the radio telecommunication network or to a gateway (23) for the integrated communication network in a network access message. The coordinates may replace or supplement cell–related information in the network access message.

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GEOGRAPHICAL INFORMATION FOR LOCATION-BASED SERVICES

BACKGROUND OF THE INVENTION

Technical Field of the Invention

This invention relates to telecommunication systems and, more particularly, to a method of providing geographical information to telecommunications networks for implementing location-based services.

Description of Related Art

As telecommunications technology evolves, it is anticipated that telecommunications networks such as cellular radio networks, data networks, the Public Switched Telephone Network (PSTN), and the Internet, etc., which today are distinct and separate networks, will be integrated into one communications network. Different access technology will enable subscribers to access the integrated network via different access methods such as by radio link, copper pair, coax cable, etc. Once access has been made, the integrated network will use a common communications protocol. It is only the access technology which is distinct for each access method that a subscriber may utilize to access the network.

Cellular radio telecommunications networks have long dealt with issues concerning the mobility of subscribers and the ability of the network to keep track of mobile stations as subscribers roam from area to area. In addition, cellular networks have implemented location-based services that utilize a Cell-ID (the identification of the cell that is serving the mobile station) to enable or disable certain services that are location-dependent. In addition, cellular networks have traditionally based their charges at least partially on the location of the mobile station.

Other types of networks that have traditionally not been concerned with the mobility of subscribers are now beginning to define mobility in their networks. For example, the Internet Engineering Task Force (IETF) is currently studying ways for a subscriber to travel with a personal computer (PC) and connect it to a local area

network (LAN) in another city, and have messages automatically forwarded to the subscriber's Internet Protocol (IP) address when he logs on. This requires that the subscriber's location be sent to the subscriber's Internet Service Provider (ISP) upon system access. Likewise, the subscriber may connect a wireless access device to his PC and access the network via a radio link. When he does so, the cell that is serving the geographical area where the subscriber is located will report its Cell-ID to the serving mobile switching center (MSC). In existing cellular networks, the MSC utilizes on this Cell-ID to designate the location of the mobile subscriber. However, the Internet, or any other integrated communications network, will not understand and cannot utilize the reported cell information. Therefore, there is a need to implement the capability to handle mobile subscribers in networks that have traditionally handled only non-mobile or "fixed" subscribers. This capability must be implemented without using cell-related information which has traditionally been utilized in cellular radio telecommunications networks.

Although there are no known prior art teachings of a solution to the aforementioned deficiency and shortcoming such as that disclosed herein, U.S. Patent No. 5,208,756 to Song (Song), U.S. Patent No. 5,218,367 to Sheffer et al. (Sheffer), U.S. Patent No. 5,602,903 to LeBlanc et al. (LeBlanc), and U.S. Patent No. 5,657,487 to Doner (Doner) discuss subject matter that bears some relation to matters discussed herein. Each of these patents disclose methods of geographically locating a mobile station by analyzing signal strength information received in a plurality of cells in a cellular telecommunications network. These methods may be utilized to automate one of the steps in the method of the present invention, and each of these patents is hereby incorporated by reference in their entirety herein.

Review of each of the foregoing references reveals no disclosure or suggestion of a method such as that described and claimed herein. It would be advantageous to have a method of providing subscriber location information to networks that have traditionally handled only fixed subscribers. This location information would be provided in a format that is usable by all networks, and provides the networks with the information needed to handle mobile subscribers and provide location-based services. The present invention provides such a method.

SUMMARY OF THE INVENTION

In one aspect, the present invention is a method of providing subscriber location information to an ANSI-41 radio telecommunication network in which the subscriber utilizes a mobile station to access the network. A radio base station (RBS) sends to a mobile switching center (MSC), a cell identity of a cell in which a registration is received from the mobile station. The cell identity is converted in a cell/coordinate table to a range of geographic coordinates that approximate the coverage area of the cell. Preferably, both the cell identity and the geographic coordinates are then sent from the MSC to the network in a network access message. Alternatively, only the geographic coordinates are sent.

In another aspect, the present invention is a method of providing subscriber location information to a Global System for Mobile Communications (GSM) radio telecommunication network in which the subscriber utilizes a mobile station to access the network. A radio base station (RBS) sends to a base station controller (BSC), a cell identity of a cell in which a registration is received from the mobile station. The cell identity is converted in a cell/coordinate table to a range of geographic coordinates that approximate the coverage area of the cell. The coordinates are then sent to a mobile switching center (MSC). The MSC then sends a network access message to the network and preferably includes both the cell identity and the geographic coordinates in the message. Alternatively, only the geographic coordinates are sent.

In yet another aspect, the present invention is a method of providing subscriber location information from a radio telecommunication network to an integrated communication network which integrates the radio telecommunication network with at least one wireline communication network. The method includes the steps of interfacing the radio telecommunication network and the wireline communication network with a gateway, determining geographical coordinates of the subscriber's location, inserting the geographical coordinates in a network access message, and sending the network access message from the radio telecommunication network to the gateway.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the following drawings, in conjunction with the accompanying specification, in which:

FIG. 1 is a simplified block diagram of an ANSI-41 cellular telecommunications network modified in accordance with the teachings of the present invention;

FIG. 2 is a simplified block diagram of a Global System for Mobile Communications (GSM) cellular telecommunications network modified in accordance with the teachings of the present invention; and

FIG. 3 is an illustrative example of a portion of a cell/coordinate table utilized in the method of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

FIG. 1 is a simplified block diagram of an ANSI-41 cellular telecommunications network 10 modified in accordance with the teachings of the present invention. A mobile station 11 is shown operating within the cell coverage area 12 of a radio base station (RBS) 13. When the mobile station registers, a Cell-ID 14 is sent to a serving mobile switching center (MSC) 15 over an interface 16 which may be implemented in accordance with IS-634 or a proprietary interface. Within the MSC is Radio Network Controller (RNC) software 17 and Mobile Switching Center (MSC) software 18. The RNC software processes the registration and sends the Cell-ID or a location area identity (LocArea-ID) to the MSC software for the location where the registration was received. A location area is a group of cells within which the mobile station may roam from cell to cell without having to re-register.

The MSC 15 interfaces with the rest of the service network 19 utilizing the ANSI-41 intersystem signaling protocol 21. The MSC sends a Registration Notification (REGNOT) Invoke message or a location updating message to the HLR 22. This message normally includes the Cell-ID or the LocArea-ID along with a MSC identity (MSCID). The HLR functions to provide radio network access, and is capable of recognizing cells or groups of cells. The service network may also include various

gateways 23 connecting to other networks, and a message center 24.

The RNC software 17 interfaces with the radio access part of the network, and handles radio access on a cell basis. Therefore the RNC software recognizes and utilizes cell-related identities such as Cell-IDs and LocArea-IDs. The present invention adds a cell/coordinate table 25 to the MSC 15. The cell/coordinate table converts Cell-IDs and LocArea-IDs to sets of latitude and longitude coordinates. The coordinates are then passed to the MSC software 18, and the coordinates are included in the ANSI-41 messages sent from the MSC to other nodes in the service network. Since some nodes in the service network such as the HLR 22 are currently programmed to recognize Cell-IDs and LocArea-IDs, the preferred embodiment of the present invention includes Cell-IDs and LocArea-IDs in the ANSI-41 messages as well.

Thus, the present invention distinguishes between the use of cell-related information for radio access and the use of geographic coordinates for location information in the rest of the network. The Cell-ID or LocArea-ID is converted to latitude and longitude coordinates in the MSC, between the RNC software 17 and the MSC software 18. The MSC software interfaces with the service network 19, and other networks through the gateways 23, therefore it is advantageous for the MSC software to use coordinates. When the registration message is sent from the MSC 15 to the HLR 22, the ANSI-41 message may include both cell-related information and coordinate information. Messages addressed to gateways or other nodes that do not recognize cell-related information may include only coordinate information.

The present invention is also applicable to networks implemented according to the Global System for Mobile Communications (GSM) standards. FIG. 2 is a simplified block diagram of a GSM cellular telecommunications network 30 modified in accordance with the teachings of the present invention. A mobile station 31 is shown operating within the cell coverage area 32 of a radio base station (RBS) 33, also referred to as a Base Transceiver Station (BTS). The RBS detects a registration from the mobile station, and sends Cell-ID information 34 to a base station controller (BSC) 35 over an Abis interface 36. The BSC is separate from the MSC 37 in GSM networks, and there is an A-interface 38 between the BSC and the MSC. Radio

Network Controller (RNC) software 39 is implemented within the BSC 35 while MSC software 40 is implemented within the MSC 37.

The RNC software 39 interfaces with the radio access part of the network, and handles radio access on a cell basis. Therefore the RNC software recognizes and utilizes cell-related identities such as Cell-IDs. In GSM networks, the cell/coordinate table 25 may be implemented in the BSC 35. The cell/coordinate table converts Cell-IDs and LocArea-IDs to sets of latitude and longitude coordinates. The coordinates are then passed to the MSC software 40 over the A-interface 38. The MSC software adds the coordinates to messages sent from the MSC to other nodes in the service network. The coordinates may either replace the cell-related information in the messages, or the coordinates may be placed in the messages in addition to the cell-related information.

The MSC communicates with a Visitor Location Register (VLR) 41 over a Mobile Application Part (MAP) interface 42. The MSC typically sends a MSC identity (MSCID), a LocArea-ID, and the coordinates to the VLR. The VLR sends the MSCID, a VLR number, and the coordinates to the rest of the service network 43 and the HLR 44. The service network may also include various gateways 45 connecting to other networks, and a message center 46.

FIG. 3 is an illustrative example of a portion of the cell/coordinate table 25 utilized in the method of the present invention. The RNC software may be modified to include the table of cells and latitude and longitude coordinates that are associated with each cell. Each cell may be associated with a range of latitude coordinates and a range of longitude coordinates since an exact location is not needed for providing a location-based service. If the MS is operating in a location area comprising several cells, the table combines the latitude and longitude ranges of each cell in the location area to determine a latitude and longitude range of the entire location area. Alternatively, the cell/coordinate table may be populated with the coordinates of the RBS which is currently serving the mobile station, particularly if the cells are very small (e.g., picocells). Even for larger cells, the coordinates of the RBS are sufficient for many services which need only the general area where the mobile station is located.

Coordinate data may be entered into the cell/coordinate table 25 manually by

the system operator. Generally, once the data is entered for the cells in a particular MSC, the data does not change unless cell planning calls for the addition of a new base station which not only adds a new cell, but may also decrease the size of neighboring cells. Alternatively, the process of entering coordinates may be automated. A number of prior art references are available which teach methods of determining cell boundaries and locating mobile stations within them. U.S. Patent No. 5,208,756 to Song, U.S. Patent No. 5,218,367 to Sheffer et al., U.S. Patent No. 5,602,903 to LeBlanc et al., and U.S. Patent No. 5,657,487 to Doner disclose methods of geographically locating a mobile station by analyzing signal strength information received in a plurality of cells in a cellular telecommunications network. Each of these patents is hereby incorporated by reference in their entirety herein.

The coordinate information from the cell/coordinate table 25 is added to the interfaces between the BSC and the MSC, and between the MSC and the rest of the radio network. The cell-related information may be dropped from interfaces between the radio network and other networks that have no use for this information. Adding coordinates to the interfaces enables, for example, an Internet service provider to determine a subscriber's geographic location when the subscriber logs on. In this way, the subscriber may still automatically download E-mail messages when he logs on, even though he is far from home. ISPs would, of course, have the option of charging an extra fee for delivery of messages when the subscriber is in a remote location rather than his home location. By way of additional example, a mobile subscriber may place a data call to a hotel chain's database to find the nearest hotel to his location. The call may be connected to the hotel database which utilizes the coordinates of the mobile station to determine the nearest hotel.

It is thus believed that the operation and construction of the present invention will be apparent from the foregoing description. While the method shown and described has been characterized as being preferred, it will be readily apparent that various changes and modifications could be made therein without departing from the scope of the invention as defined in the following claims.

WHAT IS CLAIMED IS:

1. A method of providing subscriber location information to a communication network comprising the steps of:

determining geographical coordinates of a subscriber's location; and

inserting the geographical coordinates in a network access message sent from the subscriber to the network.

2. The method of providing subscriber location information of claim 1 wherein the communication network is an ANSI-41 radio telecommunication network, and the subscriber utilizes a mobile station to access the network, wherein the step of determining the geographical coordinates of the subscriber's location includes the steps of:

sending, from a radio base station to a mobile switching center (MSC), a cell identity of a cell in which a registration is received from the mobile station; and

converting, in a cell/coordinate table in the MSC, the cell identity to geographic coordinates for the cell.

3. The method of providing subscriber location information of claim 2 wherein the step of converting, in a cell/coordinate table, the cell identity to geographic coordinates for the cell includes determining a range of latitude and longitude coordinates that approximate the coverage area of the cell.

4. The method of providing subscriber location information of claim 1 wherein the communication network is an ANSI-41 radio telecommunication network, and the subscriber utilizes a mobile station to access the network, wherein the step of determining the geographical coordinates of the subscriber's location includes the steps of:

sending, from a radio base station to a mobile switching center (MSC), a cell identity for a cell in which a registration is received from the mobile station;

determining in the MSC, a location area identity for a location area which

includes the cell; and

converting, in a cell/coordinate table in the MSC, the location area identity to geographic coordinates for the location area.

5. The method of providing subscriber location information of claim 4 wherein the step of converting, in a cell/coordinate table, the location area identity to geographic coordinates for the location area includes determining a range of latitude and longitude coordinates that approximate the coverage areas of a plurality of cells contained in the location area.

6. The method of providing subscriber location information of claim 4 wherein the step of converting, in a cell/coordinate table, the location area identity to geographic coordinates for the location area includes determining latitude and longitude coordinates for each radio base station that serves a cell contained in the location area.

7. The method of providing subscriber location information of claim 1 wherein the communication network is an ANSI-41 radio telecommunication network, and the subscriber utilizes a mobile station to access the network through a radio base station (RBS), wherein the step of inserting the geographical coordinates in a network access message sent from the subscriber to the network includes:

sending, from the RBS to a mobile switching center (MSC), a cell identity of a cell in which a registration is received from the mobile station; and

sending both the cell identity and the geographic coordinates from the MSC to the network in the network access message.

8. The method of providing subscriber location information of claim 1 wherein the communication network is an ANSI-41 radio telecommunication network, and the subscriber utilizes a mobile station to access the network through a radio base station (RBS), wherein the step of inserting the geographical coordinates in a network access message sent from the subscriber to the network includes:

sending, from the RBS to a mobile switching center (MSC), a cell identity of a cell in which a registration is received from the mobile station;

replacing the cell identity with an associated set of geographic coordinates; and

sending the geographic coordinates from the MSC to the network in the network access message.

9. The method of providing subscriber location information of claim 1 wherein the communication network is a Global System for Mobile Communications (GSM) radio telecommunication network, and the subscriber utilizes a mobile station to access the network, wherein the step of determining the geographical coordinates of the subscriber's location includes the steps of:

sending, from a radio base station to a base station controller (BSC), a cell identity of a cell in which a registration is received from the mobile station; and

converting, in a cell/coordinate table in the BSC, the cell identity to geographic coordinates for the cell.

10. The method of providing subscriber location information of claim 1 wherein the communication network is a Global System for Mobile Communications (GSM) radio telecommunication network, and the subscriber utilizes a mobile station to access the network, wherein the step of determining the geographical coordinates of the subscriber's location includes the steps of:

sending, from a radio base station to a base station controller (BSC), a cell identity for a cell in which a registration is received from the mobile station;

determining in the BSC, a location area identity of a location area which includes the cell; and

converting, in a cell/coordinate table in the BSC, the location area identity to geographic coordinates for the location area.

11. The method of providing subscriber location information of claim 1 wherein the communication network is a Global System for Mobile Communications (GSM) radio telecommunication network, and the subscriber utilizes a mobile station

to access the network through a radio base station (RBS), wherein the step of inserting the geographical coordinates in a network access message sent from the subscriber to the network includes:

sending, from the RBS to a base station controller (BSC), a cell identity of a cell in which a registration is received from the mobile station; determining the geographic coordinates for the identified cell in the BSC;

sending the geographic coordinates from the BSC to a mobile switching center (MSC); and

sending the geographic coordinates from the MSC to the network in the network access message.

12. A method of providing subscriber location information to an ANSI-41 radio telecommunication network in which the subscriber utilizes a mobile station to access the network, said method comprising the steps of:

sending, from a radio base station (RBS) to a mobile switching center (MSC), a cell identity of a cell in which a registration is received from the mobile station;

converting, in a cell/coordinate table, the cell identity to a range of geographic coordinates that approximate the coverage area of the cell; and

sending both the cell identity and the geographic coordinates from the MSC to the network in a network access message.

13. A method of providing subscriber location information from a radio telecommunication network to an integrated communication network which integrates the radio telecommunication network with at least one wireline communication network, said method comprising the steps of:

interfacing the radio telecommunication network and the wireline communication network with a gateway;

determining, in the radio telecommunication network, geographical coordinates of the subscriber's location;

inserting the geographical coordinates in a network access message; and

sending the network access message from the radio telecommunication

network to the gateway.

14. The method of providing subscriber location information from a radio telecommunication network to an integrated communication network of claim 13 wherein the step of determining geographical coordinates of the subscriber's location includes the steps of:

sending, from a radio base station (RBS) to a block of radio network control (RNC) software, a cell identity of a cell in which a registration is received from the mobile station;

determining by the RNC software, a location area identity for a location area which includes the cell; and

converting, in a cell/coordinate table, the location area identity to geographic coordinates for the location area.

15. The method of providing subscriber location information from a radio telecommunication network to an integrated communication network of claim 14 wherein the step of inserting the geographical coordinates in a network access message includes inserting both the location area identity and the geographic coordinates in the network access message.

16. The method of providing subscriber location information from a radio telecommunication network to an integrated communication network of claim 14 wherein the step of inserting the geographical coordinates in a network access message includes replacing the location area identity with the geographic coordinates in the network access message.

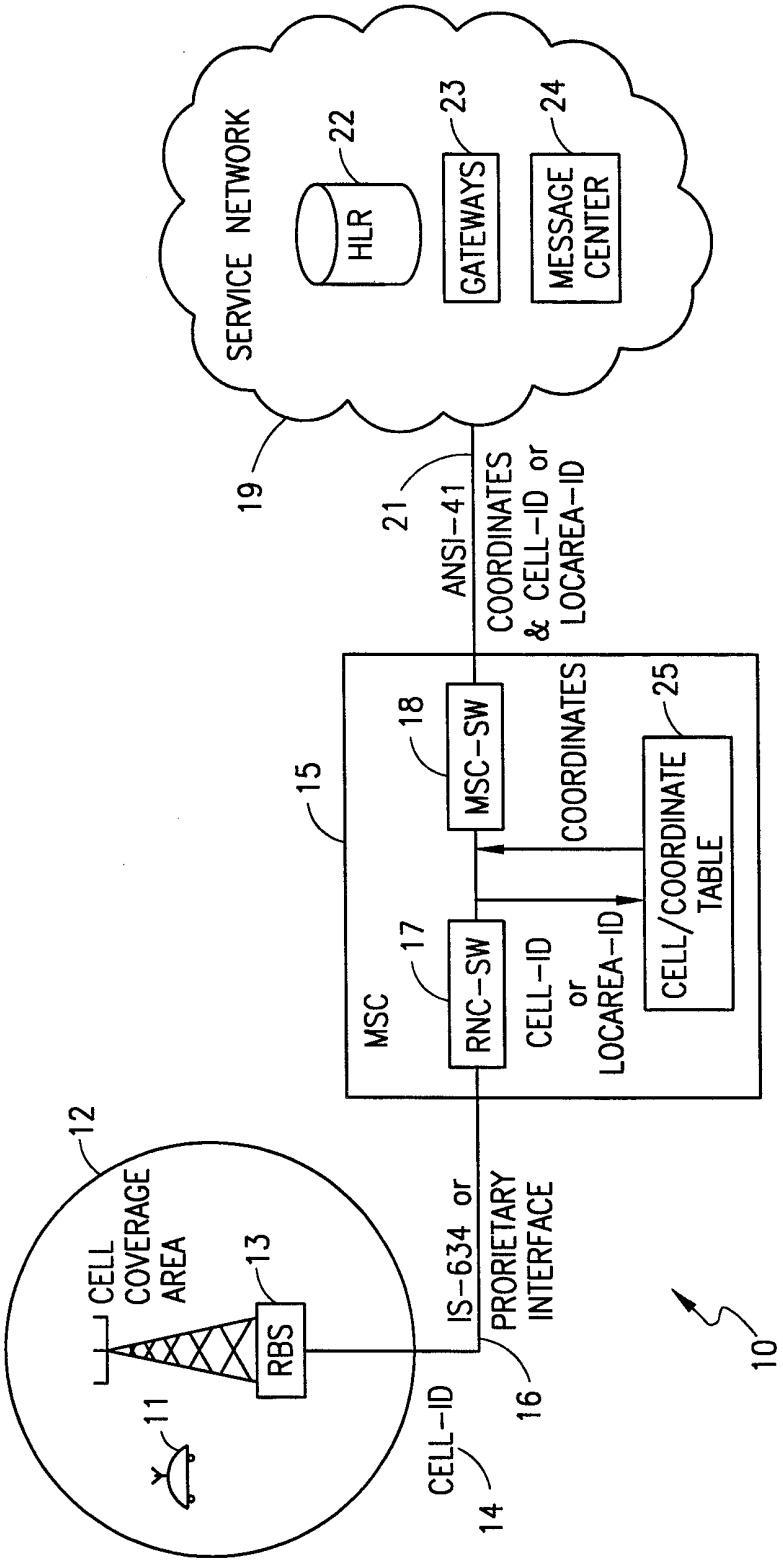
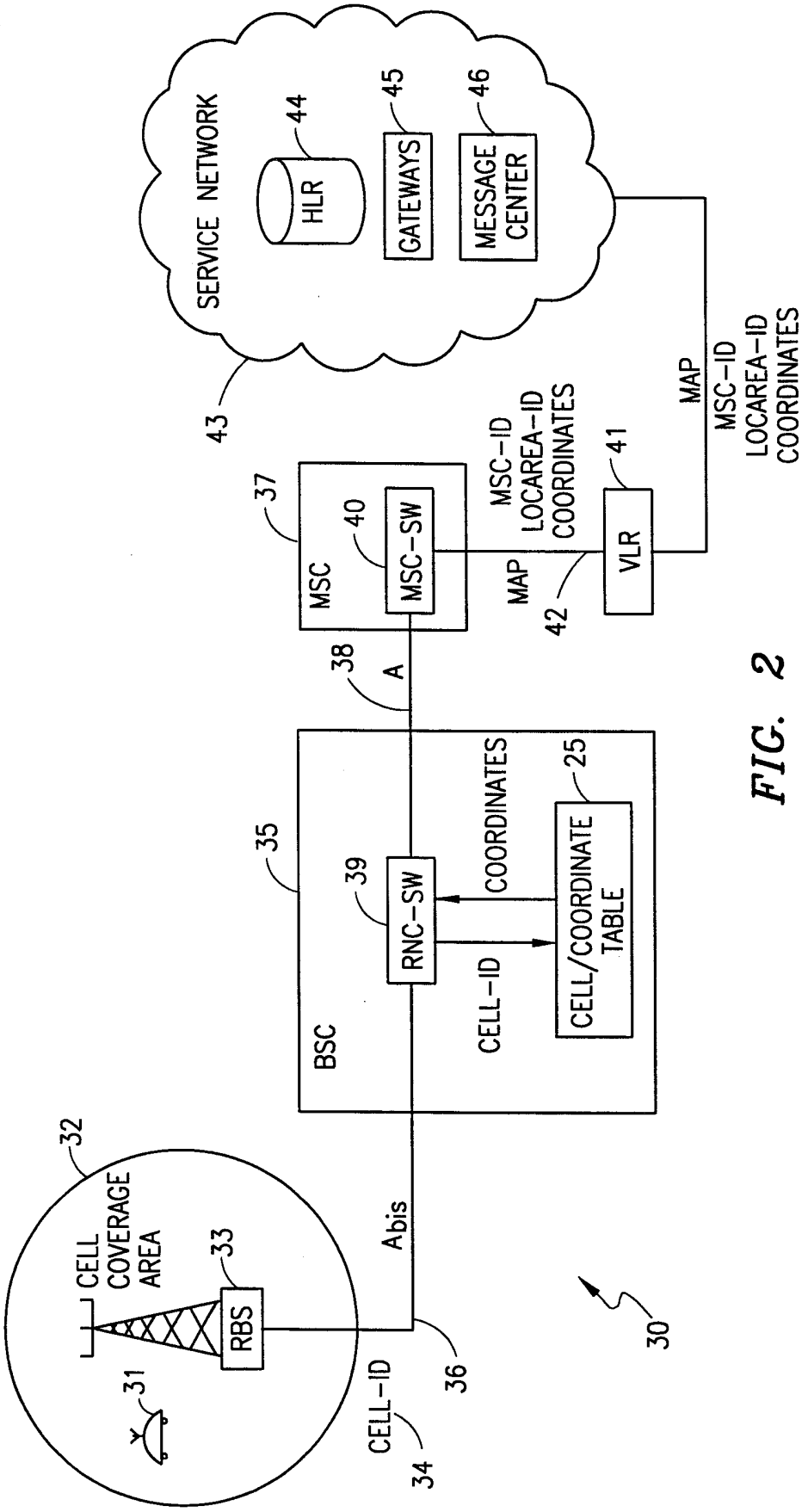

SERVICE NETWORK
HLR
GATEWAYS
MESSAGE CENTER
22
23
24
19
21
ANSI-41
COORDINATES & CELL-ID or LOCAREA-ID
MSC
15
MSC-SW
18
RNC-SW
17
COORDINATES
CELL-ID or LOCAREA-ID
CELL/COORDINATE TABLE
25
IS-634 or PRORIETARY INTERFACE
16
CELL-ID
14
CELL COVERAGE AREA
12
RBS
13
11
10

FIG. 1


SERVICE NETWORK
HLR
GATEWAYS
MESSAGE CENTER
44
45
46
43
MAP
MSC-ID
LOCAREA-ID
COORDINATES
MSC
MSC-SW
37
40
MAP
MSC-ID
LOCAREA-ID
COORDINATES
VLR
41
42
38
A
BSC
35
RNC-SW
39
COORDINATES
CELL/COORDINATE TABLE
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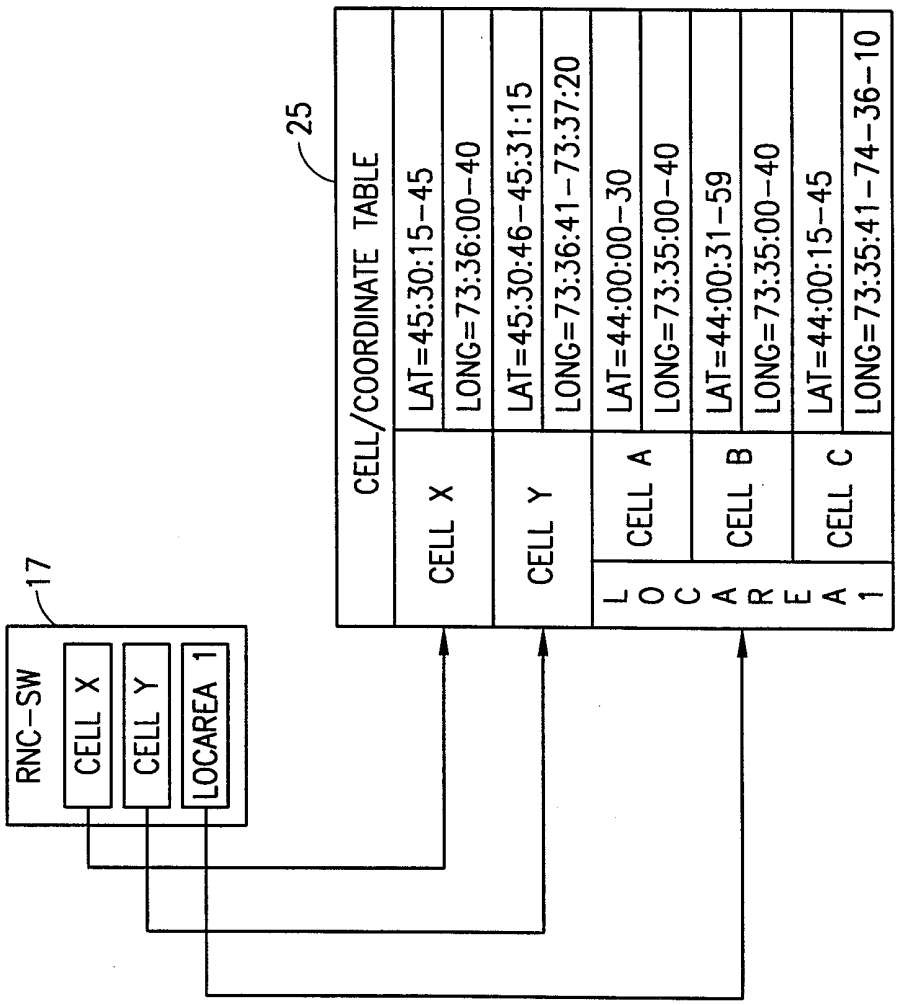
CELL-ID
Abis
CELL COVERAGE AREA
32
RBS
33
31
CELL-ID
34
36
30

FIG. 2


RNC-SW
17
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CELL Y
LOCAREA 1
25
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LONG=73:36:00-40
CELL Y
LAT=45:30:46-45:31:15
LONG=73:36:41-73:37:20
LOCAREA 1
CELL A
LAT=44:00:00-30
LONG=73:35:00-40
CELL B
LAT=44:00:31-59
LONG=73:35:00-40
CELL C
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LONG=73:35:41-74-36-10

FIG. 3