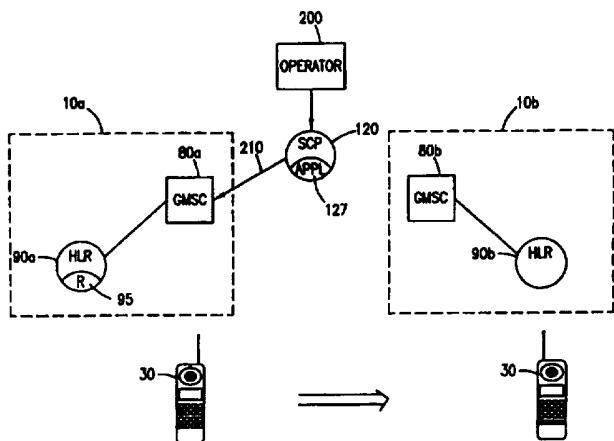




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(54) Title: SYSTEM AND METHOD FOR NUMBER PORTABILITY CONTROL IN A MOBILE COMMUNICATIONS NETWORK



(57) Abstract

A centralized database (120) within a Public Switched Telephone Network (PSTN) interfacing with a donor Public Land Mobile Network (PLMN) (10a) stores correlation data correlating a network address representing the new home location register (HLR) (90b) associated with a ported mobile station's identification number. As the centralized database is updated, such correlation data are further downloaded to the donor HLR (90a). Thereinafter, in situations where the GMSC (80a) associated with the donor PLMN (10a) receives an incoming signal where no centralized database query has yet been performed, the donor HLR (90a) accordingly retrieves the stored network address correlated with the ported mobile station and forwards the incoming signal using the retrieved network address as the Called Party Number. The original mobile station identification number is also included into the Generic Address Parameter (GAP) of the routed IAM signal. The modified IAM signal is then routed to the proper Gateway Mobile Switching Center (GMSC) (80b) and accordingly forwarded to a mobile switching center (MSC) currently serving the ported mobile station.

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SYSTEM AND METHOD FOR NUMBER PORTABILITY CONTROL IN A MOBILE COMMUNICATIONS NETWORK

CROSS REFERENCE TO RELATED APPLICATION

5 This application is related to U.S. Application for Patent Serial No. 08/656,723, filed June 3, 1996, entitled "Routing An Incoming Call To A Ported Mobile Station Within A Telecommunications Network" (Docket No. 27943/65) hereby incorporated by reference herein.

10

BACKGROUND OF THE INVENTION

Technical Field of the Invention

15 The present invention relates to a mobile telecommunications network and, in particular, to the routing of an incoming call to a mobile station relocated from a first home location register to a second home location register.

Description of Related Art

20 Within the Global System for Mobile (GSM) Communication or the Personal Communications System (PCS), each mobile station is assigned a unique identification number known as a Mobile Station Integrated Services Digital Network (MSISDN) number. A MSISDN number is dialed whenever a caller wants to communicate with a particular mobile station. The telecommunications network determines, by analyzing a part of the dialed MSISDN number, the particular home location register (HLR) which is associated with that mobile station and which stores routing information identifying the mobile switching center (MSC) currently serving the mobile station. By

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retrieving and utilizing such routing information, the telecommunications network is able to locate the mobile station in response to an incoming call so that a call connection can be established between the incoming caller
5 and the mobile station.

Mobile subscribers often relocate from a first service area served by a first HLR to a second service area served by a second HLR as they relocate from one city to another or one geographic area to another. By
10 relocating, a particular mobile station's pre-existing subscriber agreement with the first HLR is terminated and a new subscription agreement with the second HLR must be established. However, a specific series of MSISDN numbers are pre-assigned to each HLR. Therefore, by relocating
15 from one HLR to another, the mobile station accordingly must be assigned a new MSISDN number within the series pre-assigned to the new second HLR. Changing the assigned MSISDN number is a cumbersome process in part because the mobile subscriber has to take his mobile station in for
20 service and also inconveniently notify all relevant parties of his new MSISDN number (directory number).

American Telephone & Telegraph (AT&T) has proposed the concept of the use of a location routing number (LRN) to alleviate some of the analogous problems associated
25 with wireline terminals of subscribers who move from one region or network to another without changing their MSISDN numbers. In accordance with the LRN concept, a centralized database storing a network address representing the end office currently serving the wireline
30 terminal is queried by a signal transfer point (STP) or a service switching point (SSP) within a Public Switched

Telephone Network (PSTN) to route an incoming call to the correct end office. However, the above LRN concept is inapplicable for the mobile telecommunications environment because a mobile station is not physically attached to a 5 single end office or mobile switching center (MSC). As a mobile station travels from one geographic area to another geographic area, a number of MSCs provide mobile service to the traveling mobile station. Therefore, implementing a centralized database with a network address 10 representing a particular end office or MSC does not solve the above number portability problem within the mobile telecommunications environment.

A patent application titled "Routing An Incoming Call To A Ported Mobile Station Within A Telecommunications Network", filed by Gun-Shin Chien on _____, 1996 (hereinafter referred to as the Chien application), hereby incorporated by reference herein, discloses a system and method for maintaining a centralized database for storing data correlating a particular MSISDN with a network 15 address representing the home Public Land Mobile Network (PLMN) and, more particularly, the home location register (HLR) within that particular PLMN currently serving the ported mobile station. Accordingly, when the centralized database is queried, the network address representing the 20 current HLR serving the ported mobile station is returned.

Even though the Chien application enables the routing of an incoming call to a ported mobile station within a mobile telecommunications network, there are certain 25 system characteristics which are not optimal for certain applications.

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Since the telecommunications network cannot determine whether the mobile station has been ported or not just by analyzing the received MSISDN, even if only one number is ported out of a particular PLMN, all incoming calls intended for that particular PLMN have to be inefficiently queried by the centralized database. As an illustration, out of the 214-555-XXXX series, even if only one number is ported, incoming calls for each and every one of the 214-555-XXXX number series have to be queried by the centralized database. Even if a call is originated by a mobile station within the donor PLMN, the call must still be queried by the donor GMSC to the centralized database.

Furthermore, not all STPs, SSPs, and GMSCs connected to the donor PLMN or HLR have query capability. If an incoming signal is routed through an SSP not having query capability, the incoming signal will be incorrectly delivered to the donor HLR. Since the donor HLR no longer stores subscriber information pertaining to the ported mobile station, the routing of the incoming call fails.

Accordingly, there is a need for a mechanism to reroute incoming signals to the current PLMN serving a ported mobile station when such signals are received by the donor PLMN instead of being rerouted by a centralized database.

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SUMMARY OF THE INVENTION

The present invention provides a method and apparatus for transporting a telecommunications signal to a mobile station relocated (ported) from a first home location register (HLR) to a second HLR. Such a signal includes an incoming call signal for establishing a call connection

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with the ported mobile station. A network address representing an HLR associated with a mobile station and a mobile identification number representing that particular mobile station are correlated and stored in a 5 centralized database. The data correlating the mobile identification number with the network address are further downloaded to the first HLR. In case a Gateway Mobile Switching Center (GMSC) associated with the first HLR receives an incoming signal intended for the ported mobile 10 station without being rerouted by the centralized database, a signal requesting routing information is transmitted to the first HLR. The first HLR then retrieves the correlated network address representing the second HLR by indexing on the mobile identification number 15 identifying the received signal. The retrieved network address is returned back to the GMSC. The GMSC accordingly reroutes the incoming signal to a Mobile Switching Center (MSC) currently serving the ported mobile station by utilizing the received network address as the 20 Called Party Number. The original mobile identification number is further included in the Generic Address Parameter (GAP) of the rerouted signal.

BRIEF DESCRIPTION OF THE DRAWINGS

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

30 FIGURE 1 is a block diagram illustrating the network interconnection of multiple Public Land Mobile Networks (PLMNs) to a Public Switched Telephone Network (PSTN);

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FIGURE 2 illustrates a mobile station relocating from a first home location register (HLR) associated with a first PLMN to a second HLR associated with a second PLMN;

5 FIGURE 3 is a block diagram illustrating the location routing number (LRN) system for routing an incoming call to a ported mobile station;

10 FIGURE 4 is a block diagram illustrating the gateway routing number (GRN) system for routing an incoming call to a ported mobile station as disclosed in the Chien application;

FIGURE 5 is a block diagram illustrating multiple service switching points (SSPs) connected to a particular PLMN wherein at least one of said SSPs does not have database query capability;

15 FIGURE 6 is a block diagram illustrating a gateway mobile switching center (GMSC) within a particular PLMN not having database query capability;

20 FIGURE 7 is a block diagram downloading data correlating the mobile station integrated service directory number (MSISDN) associated with a ported mobile station with a network address representing the new home location register (HLR) to the donor HLR (the HLR where the mobile station has been ported from);

25 FIGURE 8 is a block diagram illustrating the forwarding of an incoming signal from a first PLMN to a second PLMN; and

FIGURE 9 is a signal sequence diagram illustrating the forwarding of an incoming signal from a first PLMN to a second PLMN.

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DETAILED DESCRIPTION OF THE DRAWINGS

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FIG. 1 is a block diagram illustrating the network interconnection of multiple Public Land Mobile Networks (PLMNs) 10a-10b to a Public Switched Telephone Network (PSTN) 20. A mobile station 30 (also known as a mobile terminal or equipment) is associated with one of the PLMNs 10 as the home PLMN 10a. Within each PLMN 10, e.g., PLMN 10a, there are a number of different mobile switching centers (MSCs) 40 servicing the geographic area covered by the network. A mobile station 30 communicates with a radio base station (not shown) connected to one of the MSCs 40 via over-the-air communications links 50. The mobile station 30 served by one PLMN 10a then communicates with other wireline and wireless terminals by means of connections to the PSTN 20. A Service Switching Point (SSP) performing as an Access Tandem (SSP/AT) 60 within the PSTN 20 routes the mobile calls generated from the one PLMN 10a to wireline terminals serviced by one of its service switching points performing as end offices (SSP/EOs) 70 within the PSTN 20, or to another PLMN 10b by way of its gateway mobile switching center (GMSC) 80b.

For an incoming call intended for the mobile station 30, the incoming call is first routed to the GMSC 80a serving the home PLMN 10a. The GMSC 80a sends a signal requesting routing information to the home location register (HLR) 90a associated with that mobile station 30. The HLR 90a (which stores subscriber information and keeps track of the current location of the mobile station 30) returns a routing instruction back to the GMSC 80a. The returned routing instruction includes a network address indicating which MSC 40 (for example, MSC 40a) is currently serving the mobile station 30. Upon receipt of

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such routing information, the GMSC 80a transmits the incoming call to the serving MSC 40a. The serving MSC 40a then establishes a speech connection with the mobile station 30 located within its MSC serving area.

With the continuing development in the mobile telecommunications technology and the increasing number of mobile subscribers, an innovative concept called "number portability" is becoming popular. The number portability concept allows a mobile subscriber to relocate or "port" from an existing service area to a new PLMN area without changing the mobile subscriber's assigned MSISDN number or directory number. By not changing the assigned MSISDN number, the mobile subscriber need not have his mobile station manually serviced to encode a new MSISDN number. The mobile subscriber also need not inconveniently notify his friends and associates of his new MSISDN number.

Reference is now made to FIG. 2 where a mobile station 30 associated with a first HLR 90a within a first PLMN 10a is shown relocating or porting 140 to a second HLR 90b within a second PLMN 10b (inter-PLMN number portability). The mobile station 30 is initially registered with the PLMN 10a as the home PLMN. All incoming calls either from the PSTN 20 or another PLMN are received by the GMSC (not shown in FIG. 2, see FIG. 1) within the PLMN 10a and accordingly routed to the serving MSC 40a. As described previously, the GMSC properly routes an incoming call to the serving MSC 40a because the dialed MSISDN number includes a value indicative of which HLR within the home PLMN 10a is storing the requisite subscriber information. Consequently, the GMSC analyzes

the received MSISDN number, determines the appropriate HLR, requests routing information from the determined HLR, and then routes the incoming call to the appropriate MSC.

In accordance with the concept of number portability
5 and as illustrated by the relocation 140, the mobile station 30 terminates his subscription agreement with the existing HLR 90a and registers with the new HLR 90b within the new PLMN 10b without changing his MSISDN number. However, because the MSISDN number has not been updated
10 in the mobile station to reflect the new HLR 90b and the new PLMN 10b, all future incoming calls are still routed to the old PLMN 10a. The GMSC within the PLMN 10a is not able to reroute the received incoming calls to the relocated mobile station 30 because the GMSC is no longer
15 able to determine the correct HLR storing the subscriber information by merely analyzing the received MSISDN number.

FIGURE 3 is a block diagram illustrating the location routing number (LRN) concept for routing an incoming call
20 to a ported wireline terminal as introduced by American Telephone & Telegraph (AT&T). In accordance with AT&T's LRN concept, a centralized database storing a network address representing the end office serving the ported wireline terminal is queried by the next to last signal
25 network in the call path. A signal transfer point (STP) or service switching point (SSP) within the next to last network (e.g., PSTN 20) performs the query to route the call. A first wireline terminal 100a connected to an SSP/EO 110a originates an outgoing call connection towards
30 a second wireline terminal 100b within the PSTN 20 by dialing a directory number representing the second

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wireline terminal 100b. However, the second wireline terminal 100b used to be served by a first SSP/EO 110d but has been ported to a second SSP/EO 110c (as illustrated by a dotted line 140). Using a conventional routing mechanism, the call setup request is routed towards the first SSP/EO 110d as specified by the dialed directory number representing the wireline terminal 100b. When the call setup signal is received by a query capable SSP 110b, the SSP 110b performs a database query to a centralized 5 database service control point (SCP) 120. The SCP 120 stores correlation data correlating each ported directory number with a network address representing the new SSP/EOc serving the ported terminal. In response to the query request, the SCP 120 returns a network address 10 representing the second SSP/EO 110c currently serving the wireline terminal 100b. The SSP 110b uses the retrieved network address as the new Called Party Number (CdPn) in the transmitted call setup signal such as an Initial Address Message (IAM). The originally dialed directory 15 number representing the wireline terminal 100b is also included into a Generic Address Parameter (GAP) within the IAM signal and "piggy-back" to the serving SSP/EO 110c. Since the CdPn points to the serving SSP/EO 110c, the IAM signal is rerouted to the SSP/EO 110c instead of to the 20 first SSP/EO 110d. The second SSP/EO 110c may be directly connected to the SSP 110b, or be connected through a number of signal transferring nodes as illustrated by a dotted line 125. Once the IAM signal is received by the second SSP/EO 110c, the encapsulated directory number 25 representing the wireline terminal 100b is extracted from the GAP, the physical location of the wireline terminal 30

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100b is determined by indexing its line module (LM) 125, and a call connection is established with the ported wireline terminal 100b via a wireline 130.

By introducing a centralized database for storing a network address representing the new SSP/EO, the LRN concept solves some of the number portability problems within the PSTN environment. However, such LRN implementation is inapplicable for the PLMN environment. A mobile station within a PLMN 10 is rarely associated with just one end office or mobile switching center (MSC). Due to its inherent nature of not being connected to any physical communications medium, a mobile station freely travels into a number of different geographic areas. Each time a mobile station leaves a first MSC service area and enters into a second MSC service area, the serving PLMN has to transfer the service from the first MSC to the second MSC. After the transfer, the first MSC is no longer involved in the call connection. Therefore, the idea of storing the network address representing a particular end office or MSC within a centralized database is inapplicable for the PLMN environment.

FIG. 4 is a block diagram illustrating the gateway routing number (GRN) concept for routing an incoming call to a ported mobile station within the PLMN environment as disclosed in the Chien application. Instead of maintaining a centralized database for storing a network address representing a particular end office currently serving the mobile station 30, a centralized database for storing a network address representing a PLMN or, more particularly an HLR 90 currently serving the mobile

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station 30, is instead maintained (hereinafter referred to as a Gateway Routing Number - GRN).

A wireline terminal 100 connected to the SSP/EO 110a within the PSTN 20 or any other telecommunications terminal originates an outgoing call connection by dialing a mobile identification number such as a Mobile Station Integrated Service Digital Network (MSISDN) number representing the mobile station 30. The call connection signal is routed via the conventional routing mechanism until it reaches a query capable SSP 110b within the PSTN 20 as described in FIG. 3. The SSP 110b then sends a query signal 135 to the centralized database such as an SCP 120 requesting the GRN representing the home HLR associated with the mobile station 30. The SCP 120 indexes its memory table 250 with the received MSISDN number and retrieves the correlated GRN. The retrieved GRN is then transmitted back to the SSP 110b via a return signal 145. The SSP 110b assigns the retrieved GRN as the Called Party Number (CdPn) for the call setup signal 140, such as an Initial Address Message (IAM), and transmits it over to the PLMN 10. The dialed MSISDN number is also included into one of the optional parameters, such as a Generic Address Parameter (GAP), within the IAM signal 140. By analyzing the transmitted GRN representing the home HLR 90, the PSTN 20 is able to route the IAM signal 140 to the entry point - GMSC 80 of the serving PLMN 10. Upon receipt of the IAM signal 140, an application module 85 within the GMSC 80 extracts the included MSISDN number from the GAP and transmits a Mobile Application Part (MAP) based signal 150 such as a Send Routing Information (SRI) signal to the indicated HLR 90. The transmitted SRI

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signal 150 further includes the extracted MSISDN number and uses the received GRN as the Global Title (GT) for Called Party Address.

When the HLR 90 receives the SRI signal 150, it 5 determines the corresponding International Mobile Subscriber Identity (IMSI) for the received MSISDN number and transmits another MAP based signal 160 requesting routing number to the serving MSC 40. The serving MSC 40 determines the current geographic location of the mobile 10 station 30 and accordingly returns a routing number to the HLR 90 via an acknowledgment signal 170. The HLR 90, in turn, returns the routing number to the GMSC 80 via yet another acknowledgment signal 180. The GMSC 80 then reroutes the original IAM signal 140 to the serving MSC 15 40 as indicated by the received routing number. As a result, a call connection between the originating terminal 100 and the ported mobile terminal 30 is established via the radio link 50.

Even though the GRN implementation as disclosed by 20 the Chien application enables the routing of an incoming call to a ported mobile station, there are certain characteristics and limitations which are less than optimal for particular applications. Reference is now made to FIG. 5 illustrating multiple SSPs 110b - 110n 25 connected to a donor PLMN 10 wherein at least one of said SSPs does not have database query capability. In order for the above GRN implementation to work within the PLMN environment, all SSPs 110b-110n serving a particular PLMN 10 must be equipped to perform database query to the 30 centralized database SCP 120. However, especially during the initial implementation phase of the GRN or LRN

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concept, not all SSPs or STPs will have the database query capability. As a result, only the signals being routed over the signal link 140b - 140c connected to the SSPs 110b - 110c having query capability are able to be 5 rerouted to the new HLR (not shown). On the other hand, all incoming calls through the 140n signal link connected to the SSP 110n not having the query capability will still be routed to the donor PLMN 10 where data associated with the mobile station no longer exist. The incoming signal 10 routed by the SSP 110n is forwarded to the GMSC 80 acting as an entry point for the PLMN 10. The GMSC 80 analyzes the received Called Party Number and, as a result, transmits an HLR interrogation signal to the donor HLR 90. Even though the received MSISDN points to the donor HLR 15 90, because the mobile station has been ported away from the donor PLMN 10, the HLR 90 no longer stores subscriber information enabling the telecommunications network to establish a call connection with the ported mobile station. Accordingly, the HLR interrogation by the donor 20 HLR 90 and the call setup request by the GMSC 80 fail.

As an illustration of another limitation imposed by the GRN implementation, reference is now made to FIG. 6 illustrating the GMSC 80a within the donor PLMN 10a not having database query capability. A mobile station 30a 25 has been ported from the donor PLMN 10a to the new PLMN 10b. If another mobile station 30b within the donor PLMN 10a requests a call connection towards the ported mobile station 30a by dialing the associated MSISDN, the serving MSC/VLR 40a recognizes the first three prefixes as its own 30 and routes the signal requesting call connection directly to its own GMSC 80a. The serving MSC/VLR 40a assumes that

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the HLR 90a stores the current location of the mobile station 30 and that the GMSC 80a needs to perform the HLR interrogation. The GMSC 80a, not knowing that the mobile station 30a has already been ported away from the donor 5 PLMN 10a, initially has to perform a database query toward the home HLR 90a. Since the donor HLR 90a no longer stores the requisite subscriber information, the HLR interrogation fails. The GMSC 80a then has to perform another query toward the centralized database SCP 120. 10 Furthermore, in case the GMSC 80a is not equipped to perform the query with the SCP 120, the rerouting of the incoming call fails.

Reference is now made to FIG. 7 illustrating the communication of an update signal from the centralized 15 database SCP 120 to the donor HLR 90a in accordance with the teachings of the present invention. Whenever the mobile station 30 is ported from a first HLR 90a within the first PLMN 10a to a second HLR 90b within the second PLMN 10b, an operator 200 responsible for maintaining the 20 centralized database SCP 120 is notified. The operator 200 accordingly informs the centralized database SCP 120 with data correlating the MSISDN associated with the ported mobile station 30 with the network address representing the new HLR 90b. As a result, the 25 correlation data are indexed and stored in the centralized database SCP 120. An application module 127 within the centralized database SCP 120 then transmits a signal downloading the updated data to the donor HLR 90a. The transmitted signal includes the MSISDN associated with the 30 ported mobile station 30 and the network address representing the new HLR 90b. In a manner similar to

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handling an incoming signal, the specified MSISDN of the transmitted signal is analyzed by the telecommunications network and the update signal is routed to the appropriate GMSC 80a within the PLMN 10a (signal link 210). The GMSC 5 80a, by analyzing the received MSISDN, forwards the update signal to the donor HLR 90a. The donor HLR 90a then stores the data correlating the ported MSISDN with the network address representing the second HLR 90b in a register (R) 95. As described previously, the network 10 address representing the second HLR 90b also identifies the GMSC 80b and the PLMN 10b serving the ported mobile station 30. As a result, for all mobile stations ported out of the donor HLR 90a, the SCP 120 and the HLR 90a both store the correlation data.

15 Reference is now both made to FIGS. 8 and 9 illustrating the forwarding of an incoming call to the ported mobile station 30 by utilizing the correlated data downloaded in the donor HLR 90a in accordance with the teachings of the present invention. An incoming signal 20 230, i.e., IAM, for the ported mobile station 30 is received by the GMSC 80a serving the donor PLMN 10a as indicated by the MSISDN included in the Called Party Number parameter. As described previously, there are several ways an incoming signal can reach the GMSC 80a 25 without causing a query to be performed to the centralized database. One instance includes a situation where a connected STP or SSP routing the incoming signal is not equipped to handle the database query. As another instance, in case another mobile station within the donor 30 PLMN 10a originates a call connection towards the ported mobile station, the call setup request signal is received

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directly by the GMSC 80a from the MSC/VLR currently serving that particular mobile station requesting call origination.

After receiving the incoming signal 230, the GMSC 80a
5 transmits a Mobile Application Part (MAP) based signal
240, such as a Send Routing Information (SRI) signal,
requesting routing information to the donor HLR 90a. The
donor HLR 90a determines that the mobile station 30
associated with the specified MSISDN has been ported away
10 from the PLMN 10a, and the stored network address
representing the new HLR 90b is retrieved and transmitted
back to the requesting GMSC 80a via a return signal 255.
In response to a receipt of the network address
representing the second HLR 90b, the GMSC 80a transmits
15 the received IAM 230 over the mobile network 260 with the
received network address as the new Called Party Number.
The originally received MSISDN is further included as the
GAP within the transmitted IAM signal. In accordance with
the conventional signal routing mechanism, the transmitted
20 IAM signal 230 is routed to the GMSC 80b serving the
second HLR 90b. In order to route the received IAM signal
230 to the serving MSC/VLR, the GMSC 80b transmits another
SRI signal 270 requesting routing instruction to the
second HLR 90b currently serving the ported mobile station
25 30. After receiving the SRI signal 270, the second HLR
90b transmits another MAP based signal, such as a Provide
Roaming Number (PRN) signal 280, to the MSC/VLR 40
currently serving the ported mobile station 30. Using a
return signal such as an PRN_Ack signal 290, the roaming
30 number is then returned back to the second HLR 90b. The
second HLR 90b, in turn, returns the received roaming

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number using another return signal such as an SRI_Ack signal 300 to the GMSC 80b. Utilizing the received roaming number, the GMSC 80b forwards the received IAM signal 230 to the indicated MSC/VLR 40. Once the serving 5 MSC/VLR 40 receives the incoming IAM signal requesting a call connection with the ported mobile station 30, the serving MSC/VLR 40 determines the exact location of the ported mobile station 30, alerts the mobile station 30, and establishes a call connection via the radio channel 10 50.

By downloading data correlating a ported MSISDN with the network address representing a new HLR 90a to the donor HLR 90a, all call origination requests made by mobile stations within the donor PLMN 10a are rerouted 15 directly to the second PLMN 10b without performing additional centralized database queries. Furthermore, all SSPs, STPs or GMSCs serving the donor PLMN 10a do not have to be capable of performing database queries to provide the number portability functionality within the mobile 20 telecommunications environment. The donor HLR containing the downloaded correlation data properly forwards the calls not handled by the centralized database to the new PLMN currently serving the ported mobile station.

Although a preferred embodiment of the method and 25 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 embodiment disclosed, but is capable of numerous rearrangements, modifications 30 and substitutions without departing from the spirit of the

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invention as set forth and defined by the following claims.

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WHAT IS CLAIMED IS:

1. A system for routing an incoming signal to a mobile station that has an identification number and has been ported from a first home location register (HLR) within a first Public Land Mobile Network (PLMN) to a second HLR within a second PLMN, said system comprising:

5 a register associated with said first HLR;

a centralized database for receiving and storing data correlating said identification number with a network 10 address representing said second HLR;

a signal link connecting said first HLR with said centralized database; and

15 a first application module associated with said centralized database for copying said data from said centralized database to said register associated with said first HLR.

2. The system of claim 1 wherein said identification number comprises a Mobile Station 20 Integrated Services Digital Network (MSISDN) number.

3. The system of claim 1 wherein said centralized database comprises a Signal Control Point (SCP).

25 4. The system of claim 1 further comprising:

a Gateway Mobile Switching Center (GMSC) associated with said first PLMN; and

30 a second application module associated with said first HLR for retrieving said correlated network address representing said second HLR from said register and for

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transmitting said retrieved network address to said GMSC in response to a receipt of a signal requesting routing instruction from said GMSC.

5 5. The system of claim 4 wherein said signal comprises a Mobile Application Part (MAP) based Send Routing Information (SRI) signal.

10 6. A method for storing data correlating an identification number associated with a mobile station with a network address representing a first home location register (HLR) serving said mobile station, wherein said mobile station has been ported from a second HLR to said first HLR, said method comprising the steps of:

15 transmitting a first signal updating a centralized database with said data correlating said identification number with said network address;

 storing said data within said centralized database by indexing on said received identification number;

20 transmitting a second signal updating said second HLR with said data correlating said identification number with said network address; and

 storing said data within said second HLR.

25 7. The method of claim 6 further comprising the steps of:

 receiving a third signal requesting routing information by said second HLR, said third signal including said identification number as a called party number;

30 retrieving said network address correlated with said received identification number; and

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transmitting said retrieved network address to a Gateway Mobile Switching Center (GMSC) associated with said second HLR.

5 8. The method of claim 7 wherein said third signal requesting routing information comprises a Mobile Application Part (MAP) based Send Routing Information (SRI) signal.

10 9. The method of claim 7 wherein said third signal requesting routing information is sent by said GMSC in response to a receipt of an incoming signal with said identification number as a called party number, said method further comprising the steps of:

15 receiving said transmitted network address by said GMSC; and

16 rerouting said received incoming signal to a Public Land Mobile Network (PLMN) associated with said first HLR by utilizing said received network address as said called party number.

25 10. The method of claim 9 wherein said incoming signal comprises a plurality of parameters and wherein said step of rerouting said incoming signal further comprises the step of incorporating said identification number into one of said plurality of parameters.

30 11. The method of claim 6 wherein said identification number comprises a Mobile Station Integrated Services Digital Network (MSISDN) number associated with said mobile station.

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12. The method of claim 6 wherein said centralized database comprises a Service Control Point (SCP).

13. A method for transmitting a signal requesting routing information towards a first home location register (HLR) serving a mobile station having an assigned identification number, said mobile station ported from an area served by a second HLR to an area served by said first HLR without changing said identification number, said method comprising the steps of:

10 storing correlating data in said second HLR correlating said identification number with said network address representing said first HLR;

15 receiving an incoming signal identified with said identification number by a first Gateway Mobile Switching Center (GMSC) associated with said second HLR;

 retrieving said network address representing said first HLR from said second HLR in response to said incoming signal;

20 rerouting said incoming signal to a second Gateway Mobile Switching Center (GMSC) associated with said first HLR by utilizing said retrieved network address as a called party number; and

25 transmitting a signal requesting routing information from said second GMSC to said first HLR serving said mobile station.

14. The method of claim 13 wherein said identification number comprises a Mobile Station Integrated Service Digital Network (MSISDN) number.

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15. The method of claim 13 wherein said incoming signal comprises an Initial Address Message (IAM).

16. The method of claim 13 wherein said incoming
5 signal comprises a plurality of parameters and wherein said step of rerouting said incoming signal to said second GMSC further comprises the step of incorporating said identification number into one of said plurality of parameters.

10

17. The method of claim 13 further comprising the steps of:

15 storing said correlation data in a centralized database correlating said identification number with said network address representing said first HLR; and
copying said correlation data to said second HLR.

18. The method of claim 17 wherein said centralized database comprises a Service Control Point (SCP) connected
20 to a Service Switching Point (SSP) for routing incoming calls.

19. The method of claim 17 wherein said step of retrieving said network address is performed only if said
25 network address has not been retrieved from said centralized database before said incoming signal is received by said first GMSC.

20. A system for transmitting a signal requesting routing information towards a first home location register
30 (HLR) serving a mobile station having an assigned identification number, said mobile station ported from an

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area served by a second HLR to an area served by said first HLR without changing said identification number, said system comprising:

means for storing correlating data in said second HLR
5 correlating said identification number with said network address representing said first HLR;

means for receiving an incoming signal identified with said identification number by a first Gateway Mobile Switching Center (GMSC) associated with said second HLR;

10 means for retrieving said network address representing said first HLR from said second HLR in response to said incoming signal;

means for rerouting said incoming signal to a second Gateway Mobile Switching Center (GMSC) associated with 15 said first HLR by utilizing said retrieved network address as a called party number; and

means for transmitting a signal requesting routing information from said second GMSC to said first HLR serving said mobile station.

20

21. The system of claim 20 wherein said identification number comprises a Mobile Station Integrated Service Digital Network (MSISDN) number.

25

22. The system of claim 20 wherein said incoming signal comprises an Initial Address Message (IAM).

30

23. The system of claim 20 wherein said incoming signal comprises a plurality of parameters and wherein said means for rerouting said incoming signal to said second GMSC further comprises means for incorporating said

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identification number into one of said plurality of parameters. 24. The system of claim 20 further comprising:

a centralized database;

5 means for storing said correlation data in said centralized database correlating said identification number with said network address representing said first HLR; and

means for copying said correlation data to said 10 second HLR.

25. The system of claim 24 wherein said centralized database comprises a Service Control Point (SCP) connected to a Service Switching Point (SSP) for routing incoming 15 calls.

26. The system of claim 25 wherein said means for retrieving said network address is performed only if said network address has not been retrieved from said 20 centralized database before said incoming signal is received by said first GMSC.

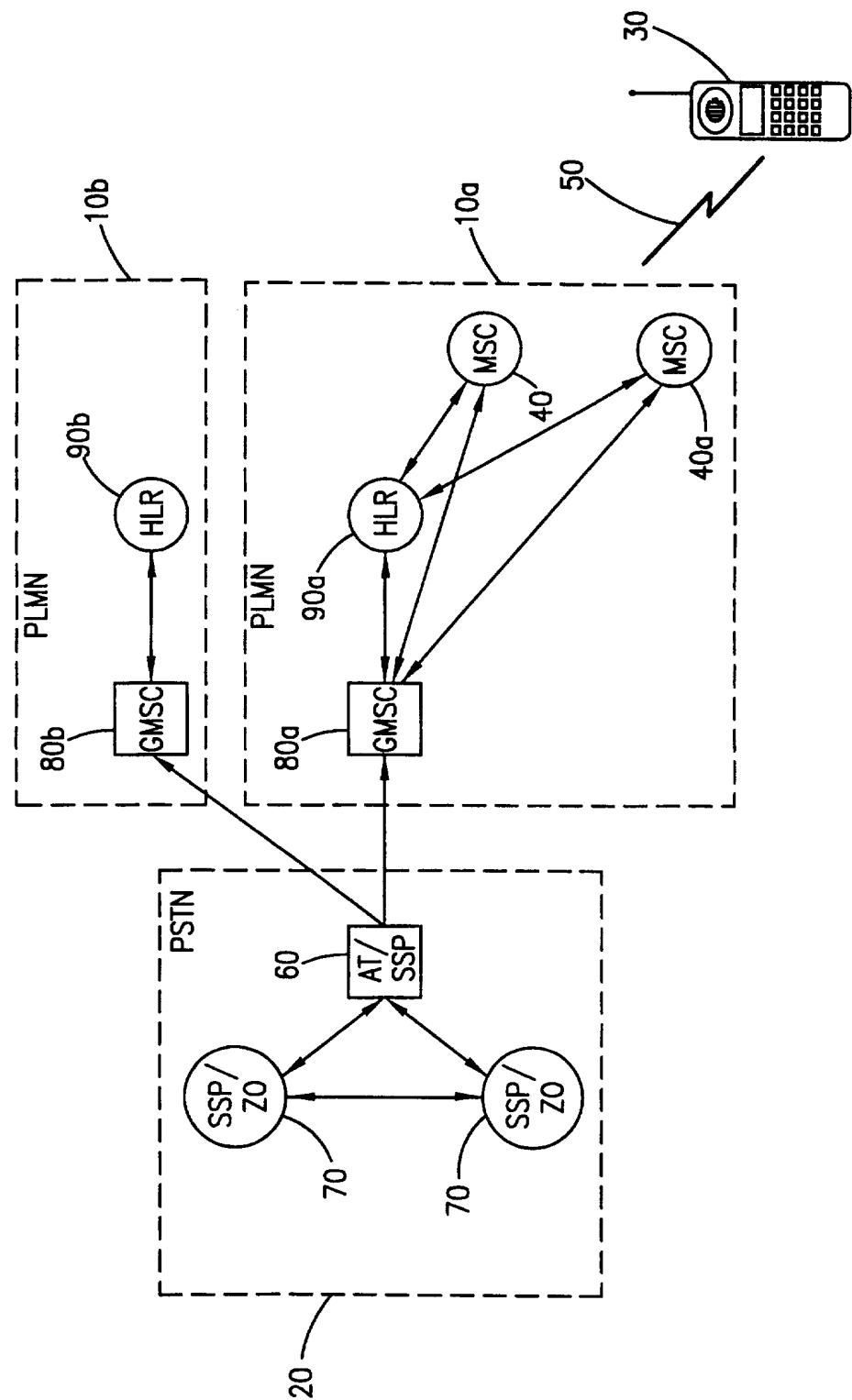


FIG. 1 (PRIOR ART)

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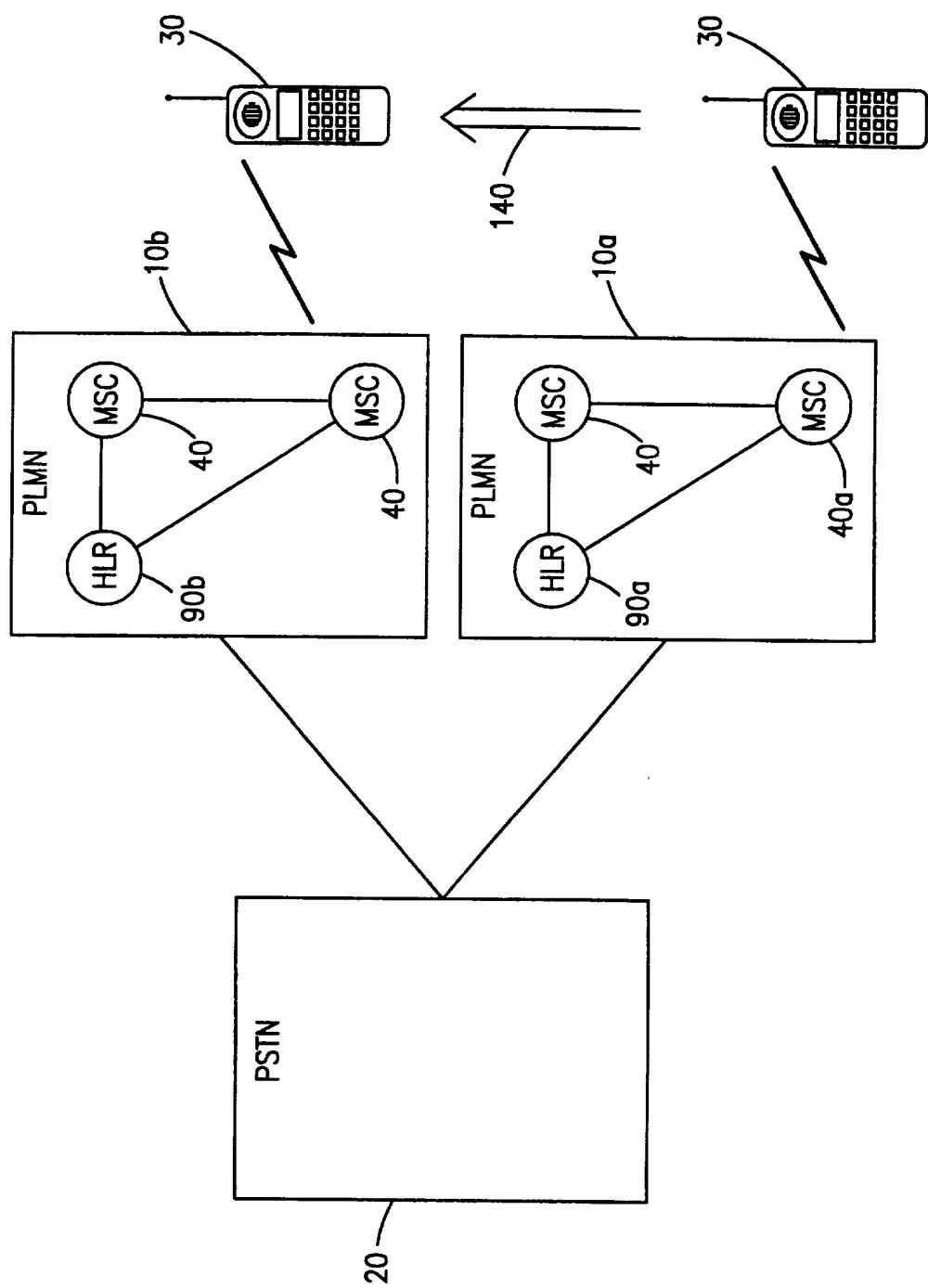


FIG. 2

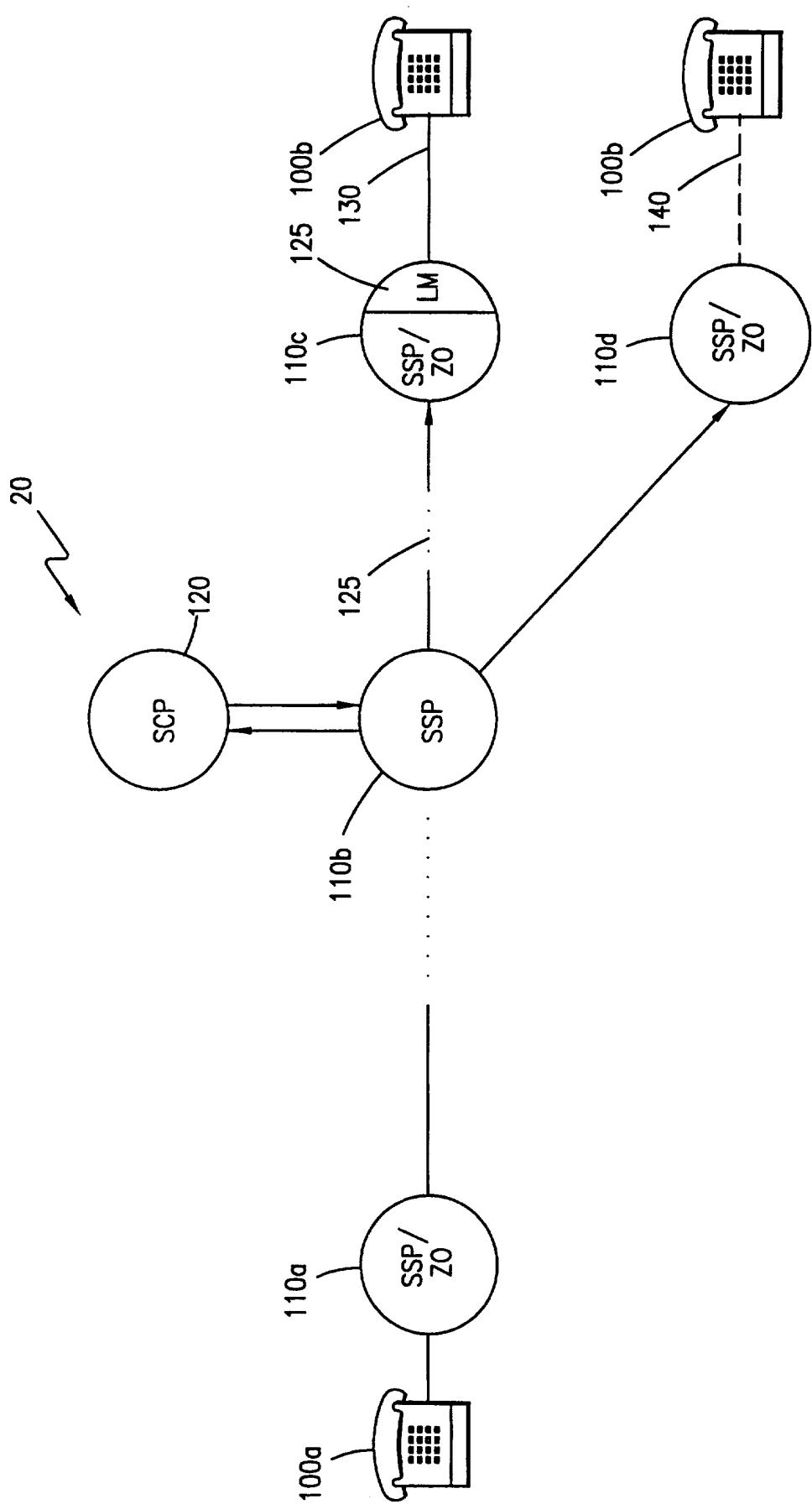


FIG. 3

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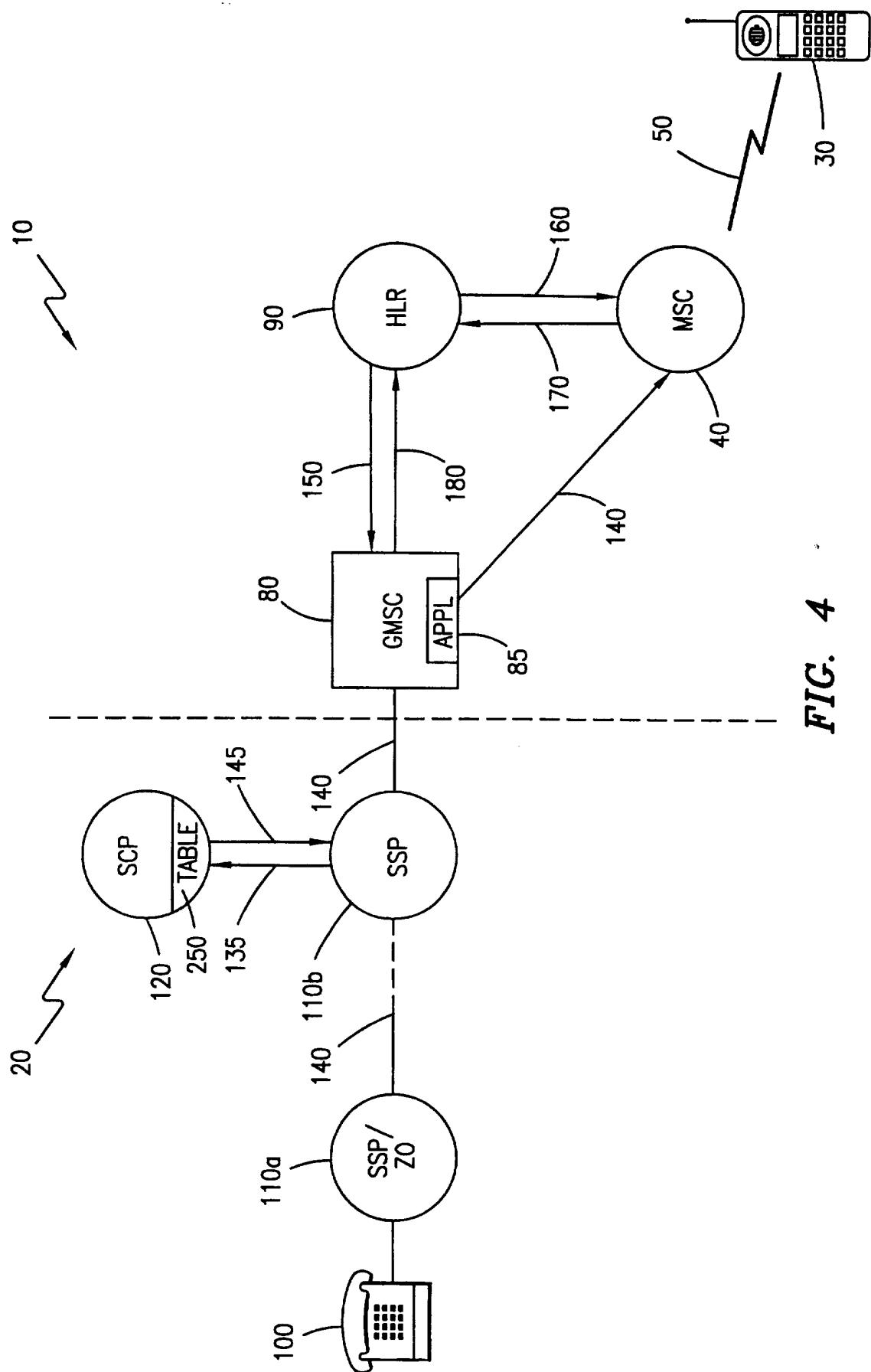


FIG. 4

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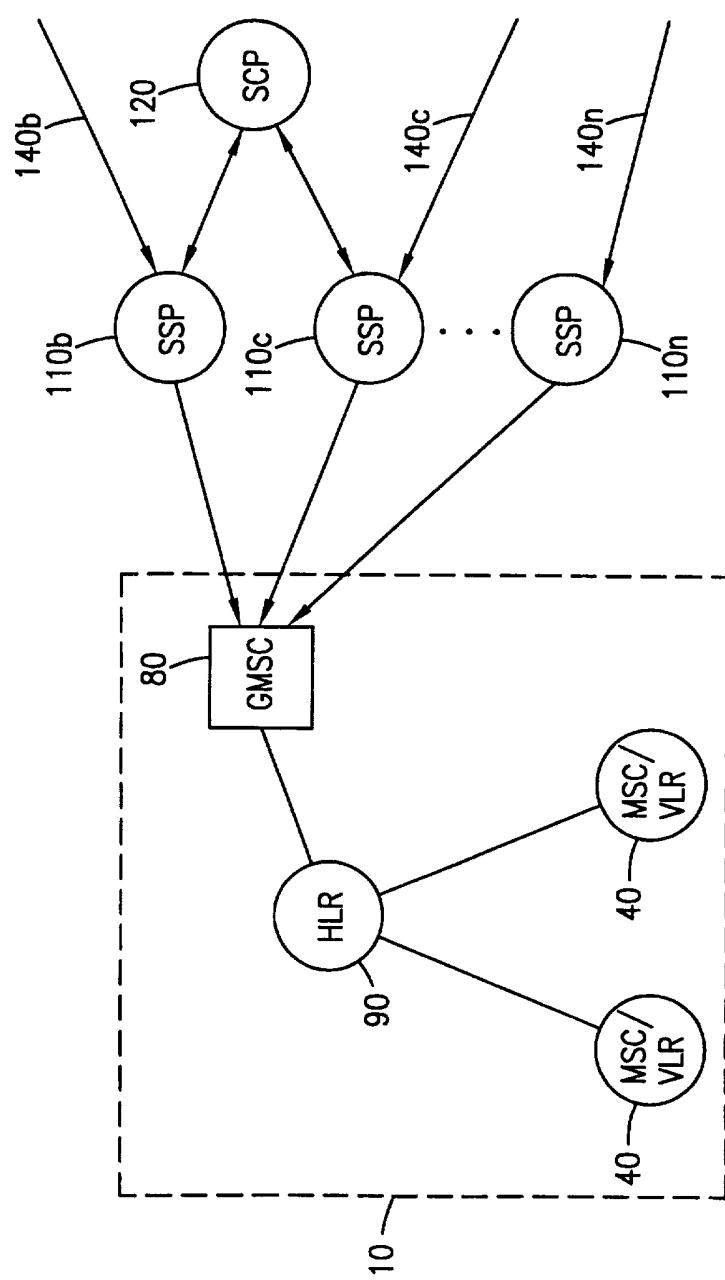


FIG. 5

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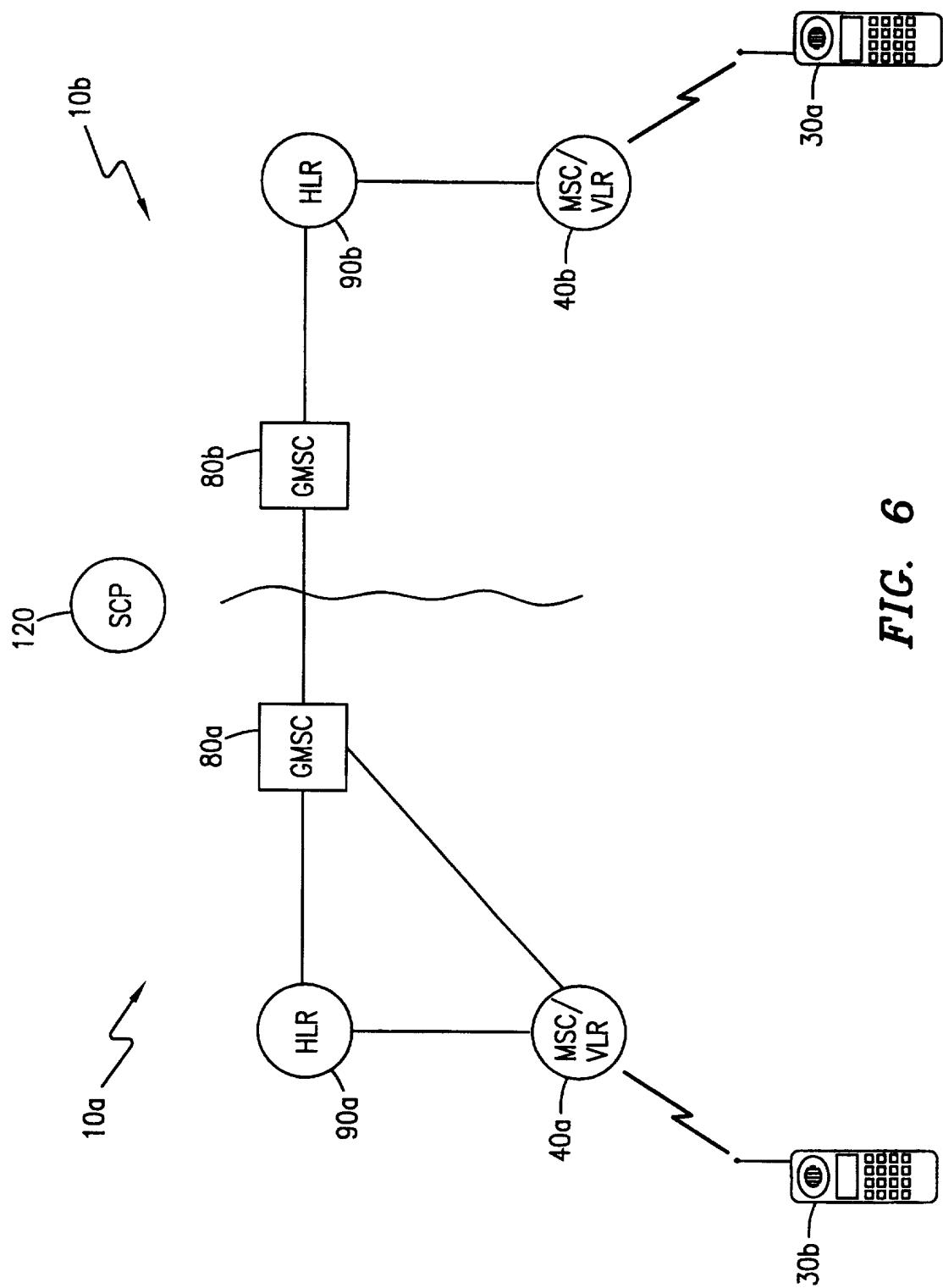


FIG. 6

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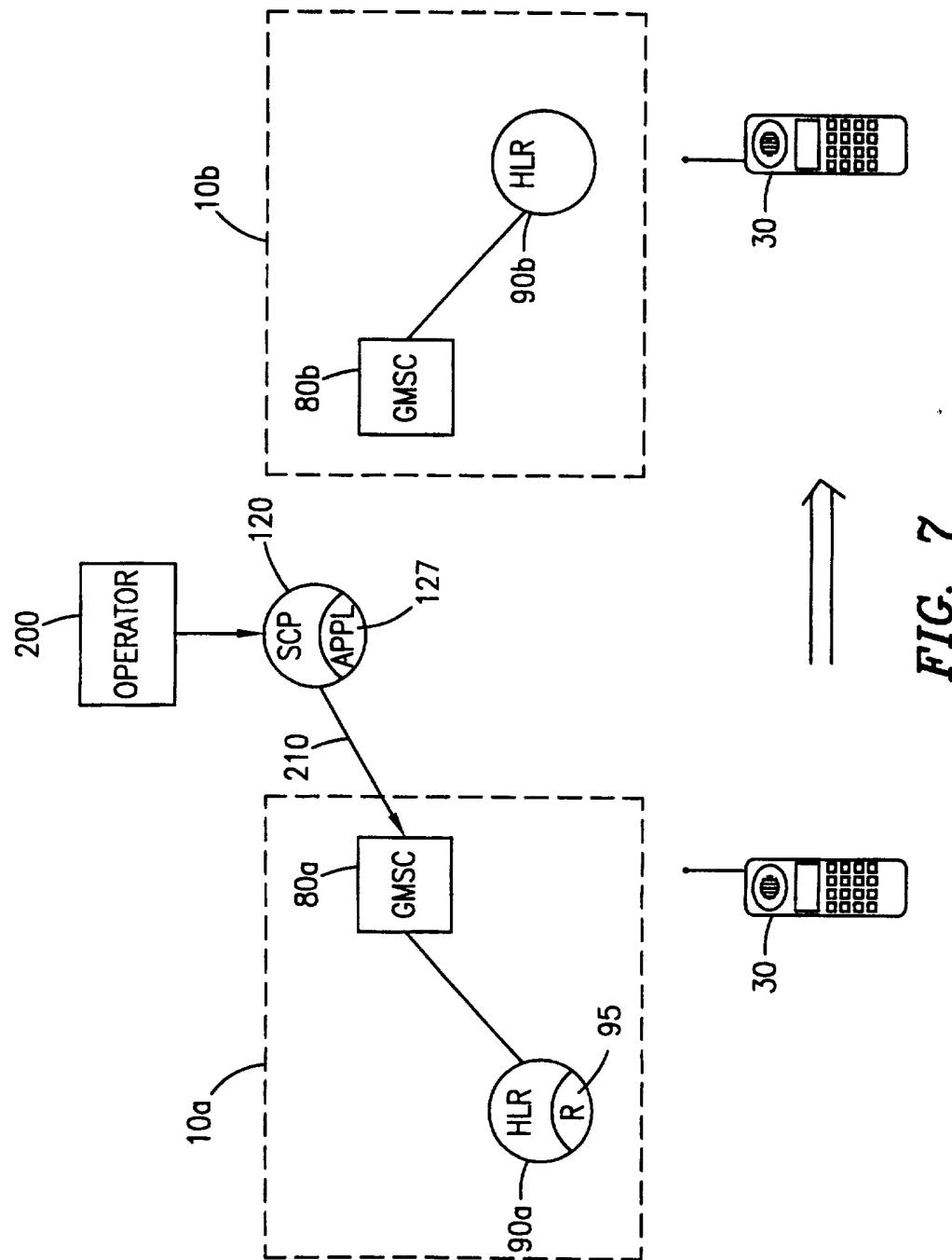


FIG. 7

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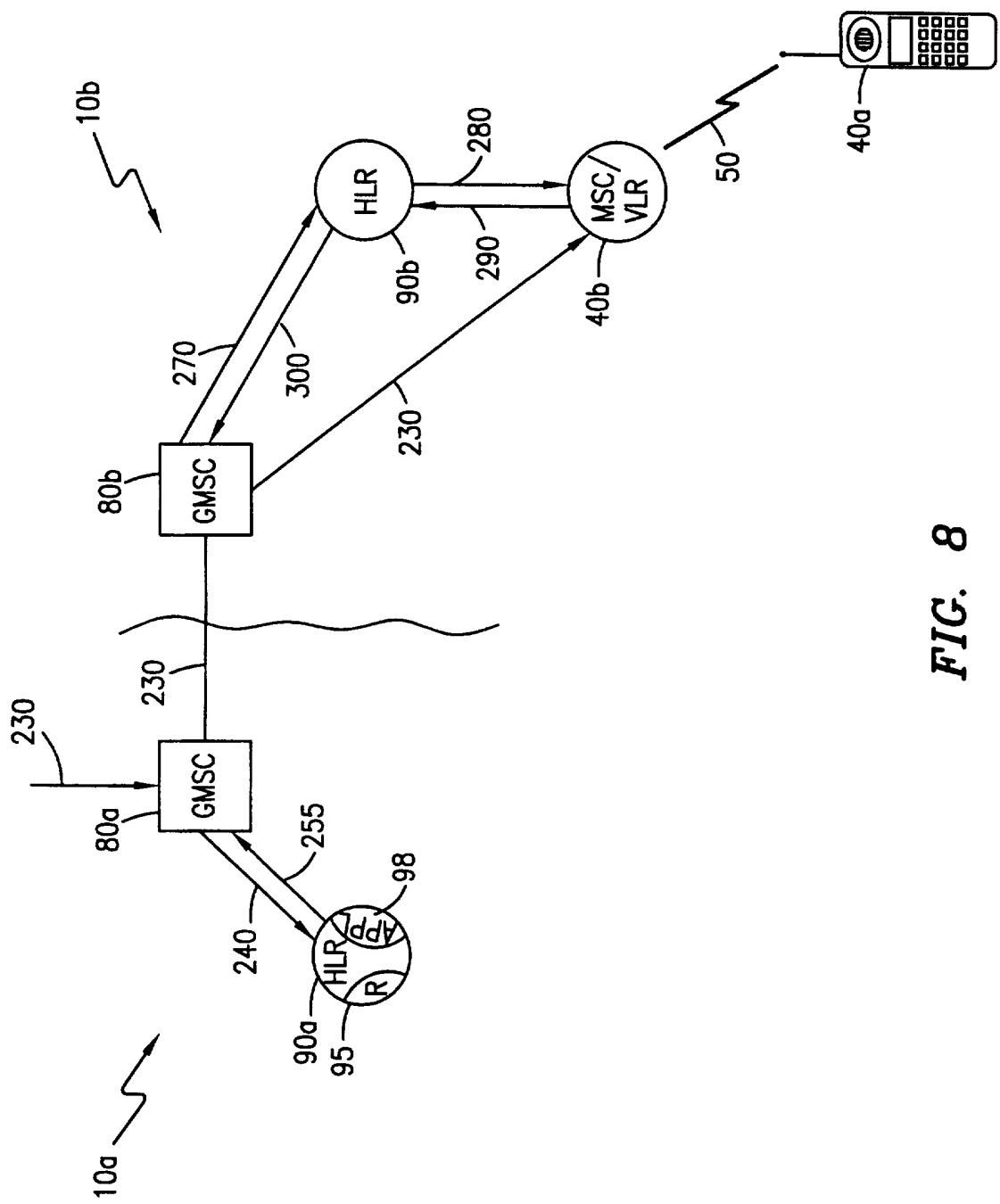


FIG. 8

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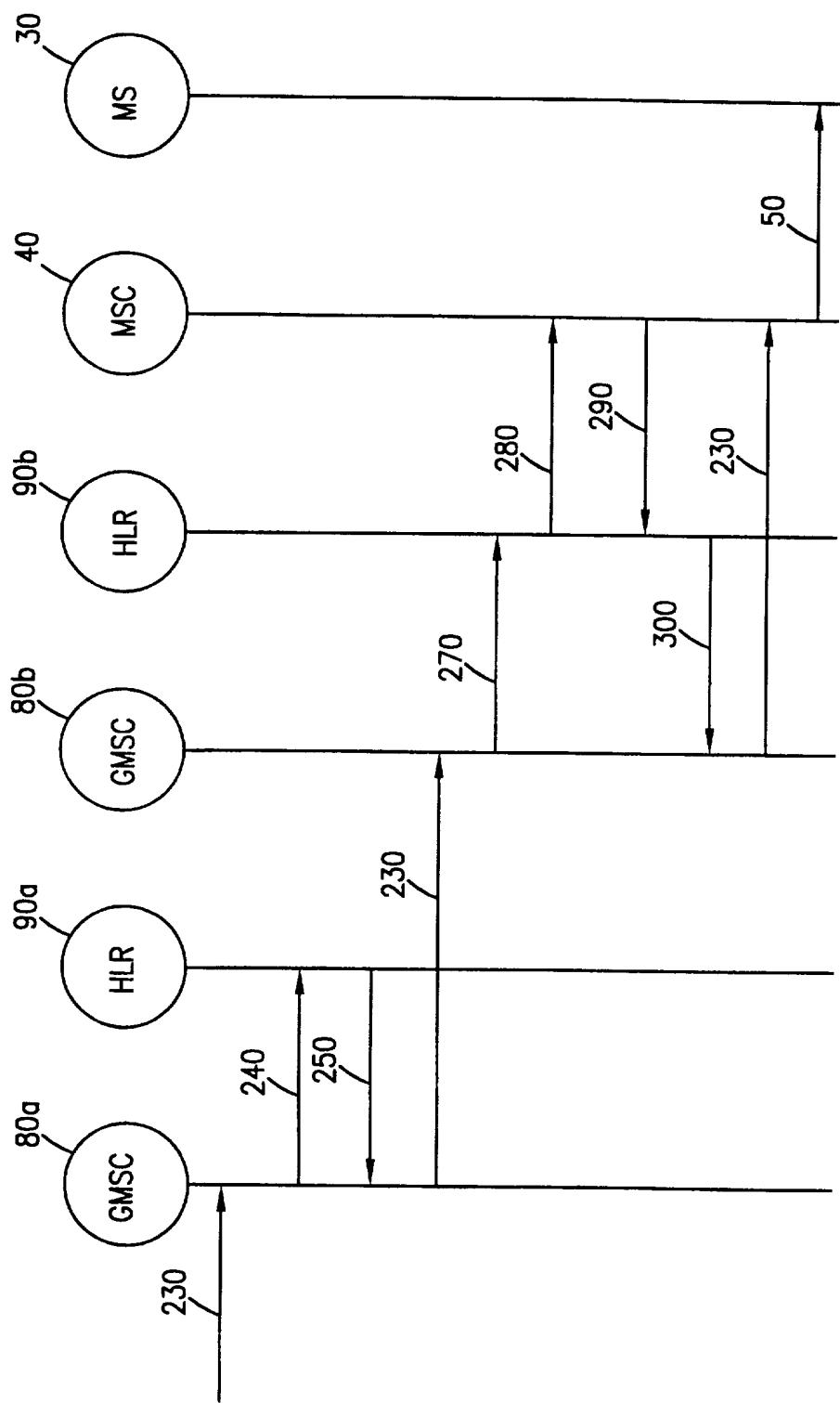


FIG. 9

INTERNATIONAL SEARCH REPORT

Intern. Application No

PCT/US 97/09551

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category ^a	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>WO 96 11557 A (ORANGE PERSONAL COMM SERV LTD ;COLBY JAMES EDWARD (GB); NEILL DOMI) 18 April 1996</p> <p>see page 6, line 9 - page 11, line 5</p> <p>---</p>	<p>1,2,6,7, 9,11,13, 14,20, 21,24</p>
A	<p>GIORDANO ET AL: "PCS Number Portability" WIRELESS NETWORKS-CATCHING THE MOBILE FUTURE - 5TH IEEE INTERNATIONAL SYMPOSIUM ON PERSONAL, INDOOR AND MOBILE RADIO COMMUNICATIONS (PIMRC'94), vol. 4, 1994, AMSTERDAM, NL, pages 1146-1150, XP002037912</p> <p>see the whole document</p> <p>-----</p>	<p>1,3,6, 12,13, 15,18, 20,22, 24,25</p>

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

^a Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
26 September 1997	~ 9. 10. 97
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Maalismaa, J

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. Appl. No.

PCT/US 97/09551

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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