

## DESCRIPTION

### ROAMING MOBILE COMMUNICATION SYSTEM AND METHOD

#### 5 TECHNICAL FIELD

The present invention relates to roaming mobile communication system and method for carrying out a roaming between mobile communication networks.

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#### BACKGROUND ART

In the mobile communication which is becoming widely used in recent years, communication schemes with different  
15 systems are adopted by a plurality of communication business companies, such as NTT scheme, J-TACS scheme, N-TACS scheme, GSM scheme, PDC scheme, etc. Then, when a mobile subscriber <sup>MOVES</sup> ~~moved~~ to another business company's service area, the so called roaming is provided as a  
20 service for enabling calling and call receiving from that service area of a different system.

For this roaming which enables the call termination connection regardless of where the mobile subscriber is located, the following two schemes are conventionally  
25 known. Namely, a scheme in which a visited location register of a visited network temporarily allocates a roaming number at a time of call termination connection, and a scheme in which a gateway location register of a visited network allocates a roaming number at a time of  
30 position registration.

First, the former one of the conventionally known schemes described above, that is a scheme in which a visited location register of a visited network temporarily allocates a roaming number at a time of call termination  
35 connection, will be described. In order to describe this

within the subscribed mobile communication network, the position information of that subscriber is updated at each home location register HLR. However, in order for the mobile subscriber to make a communication by moving to the not subscribed mobile communication network, it is necessary for the mobile subscriber to make a roaming contract with that mobile communication network in advance.

As shown in Fig. 5, when a mobile subscriber 60 moves (1) to that roaming contracted mobile communication network 11, a position registration request (2) is made with respect to the visited mobile switching center VMSC44 of that mobile communication network 11. When the position registration request (2) is received, the visited mobile switching center VMSC44 carries out a position registration request (3) with respect to a gateway location register GLR31. When the position registration request (3) is received, the gateway location register GLR31 does not store an information of a subscriber who requested the position registration for the first time, so that a region for storing an information of that subscriber is secured, and a roaming number is allocated (4) to that subscriber. In addition, the gateway location register GLR31 notifies (5) the roaming number to a home location register ~~HLR20 which~~ <sup>HLR20 which</sup> constantly stores the subscriber information of that subscriber, and the home location register HLR20 stores (6) this roaming number.

Next, when a received call for the mobile subscriber 60 occurs, as shown in Fig. 6, this received call is routed (1) as an IAM to a gateway mobile switching center GMSC50 of the mobile communication network 10 to which this subscriber is subscribing, according to the subscriber number of that subscriber. The gateway mobile switching center GMSC50 requests (2) an information for routing the received call to that mobile subscriber 60, with respect to the home location register HLR20.

When the routing information request (2) from the gateway mobile switching center GMSC50 is received, the home location register HLR20 searches an information of that subscriber, and when the roaming number is stored,  
5 returns (3) this roaming number to the gateway mobile switching center GMSC50. The gateway mobile switching center GMSC50 routes (4) the received call as the IAM to the gateway mobile switching center GMSC51 of the mobile communication network 11 visited by that subscriber,  
10 according to this roaming number. The gateway mobile switching center GMSC51 of the mobile communication network 11 visited by that subscriber requests (5) an information for routing the received call to that mobile subscriber, with respect to the gateway location register GLR31. The  
15 gateway location register 31 returns (6) the position information of that subscriber to the gateway mobile switching center GMSC 51. The gateway mobile switching center GMSC51 terminates the call to the mobile subscriber 60 by carrying out the paging according to the received  
20 position information.

However, in the conventional schemes described with references to Fig. 1 to Fig. 6 described above, ~~the~~ when the mobile subscriber roams between a communication network (Fig. 1 to Fig. 3) adopting a scheme in which a visited  
25 location register of a visited network (that is a roaming destination mobile communication network) temporarily allocates a roaming number at a time of call termination connection, and a mobile communication network (Fig. 4 to Fig. 6) adopting a scheme in which a gateway location  
30 register of a visited network allocates a roaming number at a time of position registration, because the roaming number allocation schemes are different in these mobile communication networks, there is no method for allocating the roaming number to that mobile subscriber, and as a  
35 result, there has been a drawback that the mobile

which a visited location register of a visited network temporarily allocates a roaming number at a time of call termination connection, and a mobile communication network (second mobile communication network) adopting a scheme in  
5 which a gateway location register of a visited network allocates a roaming number at a time of position registration. Then, this interworking location register is connected with a home location register and a visited location register of the first mobile communication network  
10 and a home location register and a gateway location register of the second mobile communication network through control channels.

According to one aspect of the present invention, as shown in Fig. 8, in a case where a subscriber of the first  
15 mobile communication network roams to the second mobile communication network, when a position registration is made at a visited network, the roaming number RON (ROAMING NUMBER) allocated by the gateway location register GLR of the visited network is stored in the interworking location  
20 register ILR, and at a time of call termination for that subscriber, when the home location register HLR of the home network (that is, the mobile communication network to which the mobile subscriber is subscribing) requests the roaming number, the interworking location register ILR returns the  
25 roaming number RON, and the call termination connection is made.

Also, according to another aspect of the present invention, as shown in Fig. 9, in a case where a subscriber of the second mobile communication network roams to the  
30 first mobile communication network, when a position registration is made at a visited network, the visited location register number of the visited network is stored in the interworking location register ILR while the interworking location register number <sup>is</sup> ~~is~~ stored in the home  
35 location register HLR of the home network, and at a time of

subscriber himself has moved in. Namely, when the mobile subscriber 280 moves (1) to the roaming contracted mobile communication network 211, a position registration request (2) is made with respect to a visited mobile switching center VMSC273 of that mobile communication network. When the position registration request (2) is received, the visited mobile switching center VMSC273 carries out a position registration request (3) with respect to a gateway location register GLR241. When the position registration request (3) is received, the gateway location register GLR241 does not store an information of a subscriber who requested the position registration for the first time, so that a region for storing an information of that subscriber is secured, and a roaming number is allocated (4) to that subscriber.

In addition, the gateway location register GLR241 notifies (5) this roaming number to the interworking location register ILR251. The interworking location register ILR251 stores (6) this roaming number, while notifying (7) ~~the~~<sup>its</sup> own (that is, the interworking location register ILR251's) ID number to a home location register HLR220 of the first mobile communication network 210 which constantly stores a subscriber information of that subscriber. Then, the home location register HLR220 stores (8) the notified ID number of the interworking location register ILR251 as an ID number of a visited location register for this subscriber.

Next, a call termination control in a case where a received call occurred for the mobile subscriber 280 of the first mobile communication network 210 who is roaming to the second mobile communication network 211 will be described with reference to Fig. 12.

In this case, first, according to the subscriber number of that subscriber, the received call is routed (1) as an IAM to a gateway mobile switching center GMSC261 of

the first mobile communication network 210 to which that subscriber is subscribing. The gateway mobile switching center GMSC261 requests (2) an information for routing the received call of that mobile subscriber, with respect to  
5 the home location register <sup>HLR220</sup>~~220~~ of the first mobile communication network 210. When the routing information request (2) from the gateway mobile switching center GMSC261 is received, that home location register HLR220 searches an information of that subscriber, and learns an  
10 ID number of the visited location register for that subscriber. In this example, the ID number of the visited location register is an ID number of the interworking location register ILR251.

In addition, the home location register HLR220  
15 requests (3) an allocation of a roaming number for the purpose of routing the received call of that subscriber to a switching center of the mobile communication station visited by that subscriber, with respect to that visited location register (that is, the interworking location  
20 register ILR251). When the roaming number allocation request is received, the interworking location register ILR251 already stores the roaming number for that  
subscriber<sup>(4)</sup>, so that it returns (5) that stored roaming number to the home location register HLR220.

25 As the home location register HLR220 notifies (6) that roaming number to the gateway mobile switching center GMSC261, and the gateway mobile switching center <sup>GMSC261</sup>~~261~~ routes  
(7) the received call as an IAM according to that roaming number, that received call reaches to a gateway mobile  
30 switching center GMSC262 of the mobile communication network visited by that subscriber.

The gateway mobile switching center GMSC262 requests  
(8) an information for the purpose of routing the received call of that mobile subscriber 280 to the visited mobile  
35 switching center, with respect to a gateway location

respect to a visited location register VLR231.

When the position registration request (3) is received, the visited location register VLR231 does not store an information of a subscriber who requested the  
5 position registration for the first time, so that a region for storing an information of that subscriber is secured, and a position information of that subscriber is stored. In addition, the visited location register VLR231 notifies (4)  
an ID number of a visited mobile switching center and an ID  
10 number of a visited location register to the interworking location register ILR251.

The interworking location register ILR251 stores (5) an ID number of a visited mobile switching center and an ID number of a visited location register, and in addition,  
15 notifies (6) that this subscriber is roaming to the first mobile communication network 210, by storing in correspondence to that subscriber number the fact that it is roaming to the first mobile communication network 210,  
and notifying <sup>its</sup> ~~the~~ own ID number with respect to the home  
20 location register 221 of the second mobile communication network 211. The home location register HLR221 of the second mobile communication network 211 stores (7) the fact that this subscriber is roaming to the first mobile  
communication network 210, by storing an ID number of the  
25 interworking location register.

Next, a call termination control in a case where a received call occurred for the mobile subscriber 282 of the second mobile communication network 211 who is roaming to the first mobile communication network 210 will be  
30 described with reference to Fig. 14.

In this case, first, according to the subscriber number of that subscriber, the received call is routed (1) as an IAM to a gateway mobile switching center GMSC262 of the second mobile communication network 211 to which that  
35 subscriber is subscribing. The gateway mobile switching

center GMSC262 requests (2) an information for routing the received call of that mobile subscriber, with respect to the home location register <sup>HLR221</sup>~~221~~ of the second mobile communication network 211.

5        When the routing information request (2) from the gateway mobile switching center GMSC262 is received, that home location register HLR221 searches an information of that subscriber, and learns that it is roaming to the first mobile communication network 210. In addition, the home  
10    location register HLR221 requests (3) an allocation of a roaming number for the purpose of routing the received call of that subscriber to a switching center of the mobile communication station visited by that subscriber, with respect to the interworking location register ILR251.

15        When the roaming number allocation request<sup>(3)</sup> is received, the interworking location register ILR251 makes a roaming number request (4) with respect to the visited location register VLR231 of the first mobile communication network 210. Then, this visited location register VLR231  
20    temporarily allocates (5) a roaming number to that subscriber, and notifies (6) this roaming number to the interworking location register ILR251.

      The interworking location register ILR251 notifies (7) the notified roaming number to the home location register  
25    HLR221 of the second mobile communication network 211, and in addition, this home location register HLR221 notifies (8) this roaming number to the gateway mobile switching center GMSC262. The gateway mobile switching center <sup>GMSC262</sup>~~262~~  
30    routes the received call as an IAM according to that roaming number, and this reaches (9) to a visited mobile switching center VMSC271 for that subscriber.

      In this second embodiment, the interworking location register ILR251 operates as a home location register from a viewpoint of the first mobile communication network 210,  
35    and as a gateway location register from a viewpoint of the

CLAIMS



1. A roaming mobile communication system, characterized by comprising:

5 a first mobile communication network in which a visited location register of a visited network visited by a mobile subscriber temporarily allocates a roaming number at a time of call termination connection for a received call to a mobile subscriber;

10 a second mobile communication network in which a gateway location register of a visited network visited by a mobile subscriber allocates a roaming number at a time of position registration of a mobile subscriber; and

an interworking location register, which is connected  
15 between the first mobile communication network and the second mobile communication network, which functions as a visited location register from a viewpoint of the ~~the~~ first mobile communication network and as a home location register from a viewpoint of the second mobile  
20 communication network when a mobile subscriber of the first mobile communication network roams to the second mobile communication network, and which functions as a home location register from a viewpoint of the first mobile communication network and as a gateway location register  
25 from a viewpoint of the second mobile communication network when a mobile subscriber of the second mobile communication network roams to the first mobile communication network, in a position registration and call termination connection control at a time of roaming of a mobile subscriber.

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2. The roaming mobile communication system as described in claim 1, characterized in that

the first mobile communication network has a switching center for controlling communication channels, a home  
35 location register for storing information on mobile



the other mobile communication network among the first mobile communication network and the second mobile communication network supports a mobile communication in which a mobile subscriber and a mobile terminal are integrally identified by a subscriber number and a correspondence between a mobile subscriber and a mobile terminal is fixed, and has a home location register for integrally holding a subscriber information on a mobile subscriber and a mobile terminal information on a mobile terminal which are identified by a subscriber number, and the interworking location register has information filter means for reading out a subscriber information and a mobile terminal information from the home location register of the other mobile communication network by using a subscriber number of a mobile subscriber as a key, and extracting a roaming subscriber information by filtering only information necessary for roaming from read out subscriber information and mobile terminal information, and controls to store the roaming subscriber information extracted by the filter means in the user gateway location register of said one mobile communication network by using a subscriber number of the subscriber as a key, at a time of carrying out a position registration for a mobile subscriber belonging to the other mobile ~~mobile~~ communication network to said one mobile communication network through a mobile terminal belonging to said one mobile communication network.

8. A roaming mobile communication method, characterized by comprising the steps of:

connecting a first mobile communication network in which a visited location register of a visited network visited by a mobile subscriber temporarily allocates a roaming number at a time of call termination connection for a received call to a mobile subscriber, and a second mobile

communication network in which a gateway location register of a visited network visited by a mobile subscriber allocates a roaming number at a time of position registration of a mobile subscriber, through an  
5 interworking location register; and

controlling a system formed by the first mobile communication network, the second mobile communication network, and the interworking location register such that the interworking location register functions as a visited  
10 location register from a viewpoint of the ~~the~~ first mobile communication network and as a home location register from a viewpoint of the second mobile communication network when a mobile subscriber of the first mobile communication network roams to the second mobile communication network,  
15 and functions as a home location register from a viewpoint of the first mobile communication network and as a gateway location register from a viewpoint of the second mobile communication network when a mobile subscriber of the second mobile communication network roams to the first  
20 mobile communication network, in a position registration and call termination connection control at a time of roaming of a mobile subscriber.

9. The roaming mobile communication method as described  
25 in claim 8, characterized in that

at the connecting step, the first mobile communication network has a switching center for controlling communication channels, a home location register for storing information on mobile subscribers belonging to the  
30 first mobile communication network, and a visited location register for temporarily storing information on visiting mobile subscribers, the second mobile communication network has a switching center for controlling communication channels, a home location register for storing information  
35 on mobile subscribers belonging to the second mobile





terminal are integrally identified by a subscriber number and a correspondence between a mobile subscriber and a mobile terminal is fixed, and has a home location register for integrally holding a subscriber information on a mobile  
5 subscriber and a mobile terminal information on a mobile terminal which are identified by a subscriber number, and  
the controlling step controls the system such that, the interworking location register reads out a subscriber information and a mobile terminal information from the home  
10 location register of the other mobile communication network by using a subscriber number of a mobile subscriber as a key, extracts a roaming subscriber information by filtering only information necessary for roaming from read out  
subscriber information and mobile terminal information, and  
15 stores an extracted roaming subscriber information in the user gateway location register of said one mobile communication network by using a subscriber number of the subscriber as a key, at a time of carrying out a position registration for a mobile subscriber belonging to the other  
20 mobile ~~mobile~~ communication network to said one mobile communication network through a mobile terminal belonging to said one mobile communication network.

15. A location register apparatus for a roaming mobile  
25 communication system, characterized by comprising:  
connection means for connecting a first mobile communication network in which a visited location register of a visited network visited by a mobile subscriber temporarily allocates a roaming number at a time of call  
30 termination connection for a received call to a mobile subscriber, and a second mobile communication network in which a gateway location register of a visited network visited by a mobile subscriber allocates a roaming number at a time of position registration of a mobile subscriber;  
35 and

function means for functioning as a visited location register from a viewpoint of the ~~the~~ first mobile communication network and as a home location register from a viewpoint of the second mobile communication network when  
5 a mobile subscriber of the first mobile communication network roams to the second mobile communication network, and functioning as a home location register from a viewpoint of the first mobile communication network and as a gateway location register from a viewpoint of the second  
10 mobile communication network when a mobile subscriber of the second mobile communication network roams to the first mobile communication network, in a position registration and call termination connection control at a time of roaming of a mobile subscriber.

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16. The location register apparatus for a roaming mobile communication system as described in claim 15, characterized in that

the first mobile communication network has a switching  
20 center for controlling communication channels, a home location register for storing information on mobile subscribers belonging to the first mobile communication network, and a visited location register for temporarily storing information on visiting mobile subscribers;

25 the second mobile communication network has a switching center for controlling communication channels, a home location register for storing information on mobile subscribers belonging to the second mobile communication network, and a gateway location register for storing  
30 information on mobile subscribers not belonging to the second mobile communication network while mobile subscribers not belonging to the second mobile communication network are visiting; and

the connection means is connected with the home  
35 location register and the visited location register of the



filter means for reading out a subscriber information and a mobile terminal information from the home location register of the other mobile communication network by using a subscriber number of a mobile subscriber as a key, and  
5 extracting a roaming subscriber information by filtering only information necessary for roaming from read out subscriber information and mobile terminal information, and the function means controls to store the roaming subscriber information extracted by the filter means in the user  
10 gateway location register of said one mobile communication network by using a subscriber number of the subscriber as a key, at a time of carrying out a position registration for a mobile subscriber belonging to the other mobile ~~mobile~~ communication network to said one mobile communication  
15 network through a mobile terminal belonging to said one mobile communication network.

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