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(71) Applicant (for all designated States except US): ITXC IP HOLDINGS S.A.R.L. [LU/LU]; 8-10 Rue Mathias Hardt, L-1717 (LU).

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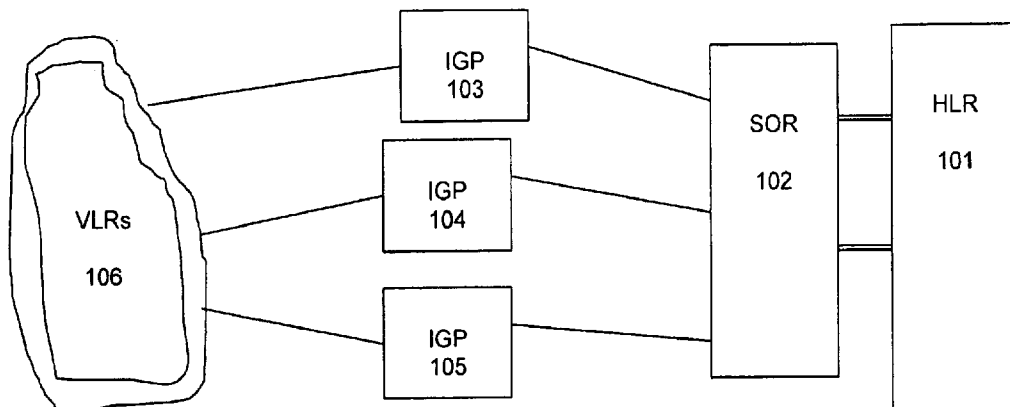
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(54) Title: METHOD AND APPARATUS FOR STEERING OF ROAMING



(57) Abstract: A system and method for implementing steering of roaming (SOR) services in wireless networks is disclosed. The SOR platform operates on messages transmitted by a home location register (HLR), intercepting them and denying use of a visited network unless it is the preferred visited network of a home network.

METHOD AND APPARATUS FOR STEERING OF ROAMING

TECHNICAL FIELD

This invention relates to wireless networks, and more particularly, to an improved method and apparatus for causing a roaming wireless device to be steered towards a particular visited carrier.

BACKGROUND OF THE INVENTION

Worldwide wireless voice and data access has recently become more prevalent. Wireless devices may be carried to many countries, almost anywhere in the world, and provide both voice and data access for a user. When a user roams outside of the area of his home network, he is said to be "roaming". Many prior art systems allow for such roaming by permitting the user to connect to a network in the area where he is roaming.

For explanation purposes, we define herein a visited network as the network, other than the home network to which a wireless device user is a subscriber, to which a user has access. We also refer herein to the home network as the wireless network of which the wireless device is a subscriber. Thus, for example, if a user is normally a registered subscriber in New Jersey, but travels to Toronto, Canada, a local wireless network operator in Toronto Canada to which the user has access, but to which the user is not a registered normal subscriber, would be deemed a visited network. The term visited network therefore, is with reference to a particular wireless device in that a network may be a visited network for one wireless device but may be the home network for another wireless device.

In order to provide the aforementioned roaming services, the various visited wireless networks must be capable of working with the home network. More particularly, if a user is a subscriber to home network in New Jersey, and travels to the United Kingdom, the visited network in the United Kingdom must have some way of coordinating with the home network back in the United States to insure proper authentication, billing, call routing, etc.

One manner in which this is typically accomplished is that the user's wireless device is detected by a visited network in the United Kingdom first. The United Kingdom visited network detecting the wireless device detects enough information to ascertain the identity of the home network associated with the wireless device. The visited network then contacts a home location register (HLR), maintained by the

home network. For purposes of explanation, we assume herein that the HLR is a part of the home network, although it may be physically separate.

Usually, one of the first messages sent from the visited network to the home network has a well known standardized format, and is known in the art as a Location Update (LU) message. The HLR is a data base maintained by the home network that includes all of the necessary information and authentication data associated with a particular user. This information can then be transmitted back to the visited network, usually to a specific mobile switch within that visited network. In this manner, the home network can reject or authorize use of a visited network. One of the key messages transmitted from the HLR, to the visited network, in response to the LU, is called the Insert Subscriber Data message, or simply, the ISD. Generally however, there is a request from the visited network and a responsive message from the home network that either authorizes or refuses the request by the wireless device to use the visited network.

Additionally, the foregoing provides a manner in which the visited network can then bill the home network for the appropriate amount of air time and service. In this manner, a user of any network can use another network in some remote location, and this visited network will coordinate with the user's home network to facilitate billing, authentication, and other similar issues.

A slight complication to the above occurs when there are plural accessible visited networks at the user's location. Specifically, consider the situation of which a subscriber from New Jersey is roaming in Great Britain, and there are three networks that are accessible from the user's location. An issue arises as to which of the three networks should accept the user, interface with the user's home network back in New Jersey, and process the call or data access from the user's wireless device. Typically, contention among three such visited networks has been resolved by the handset picking the network with maximum signal strength, and/or applying a randomization factor when signal strengths are useable. Other factors may be utilized as well, such as a list of preferred networks which could be resident on the device's Subscriber Identity Module (SIM) card. This situation, however, means that the home network, with which the subscriber and wireless device are associated, has limited or no control over which visited network handles the call/data transmission.

A more sophisticated prior art system uses something called Steering of Roaming (SOR). An SOR system is depicted in relevant part in Figure 1. SOR systems are intended to permit the home network to either determine or at least influence the particular choice of visited network to be used when plural such visited networks are available.

The prior art SOR platform 102 of Figure 1 is operatively coupled to a home location register (HLR) 101, implemented on a computer with software and run by the home network. The various visitor location registers (VLR) are associated with the variety of the visited networks to which a traveling user may come within range.

In operation, when a user comes within range of a particular visited network, a VLR 106 associated with that visited network must first request authentication and other relevant information from the HLR 101. A message requesting same is sent from the particular VLR 106 through one of International Gateway Providers (IGP) 103 -105 to HLR 101. One of these initial messages is most termed a location update (LU) message.

The SOR platform 102 determines if the requesting VLR 106 is associated with the particular visited network that the home network desires a roaming subscriber use. If not, the SOR platform 102 will intercept the request message and simply send back a rejection, leading the particular visited network to believe that the subscriber is either not authorized, or for some other reason is not permitted use of the visited network. In this manner, the wireless device will try other available visited networks, until a visited network is accepted by the SOR platform. Normally, within one or two tries, the visited network to which the home network desires to steer the call will be accessed, and the call will then be passed through the SOR 102 to the HLR for approval.

Several problems exist with the prior art approach of Figure 1. First, the home network HLR 101 must maintain its own associated SOR platform 102. The SOR platform 102 is relatively expensive, and the home network operator would thus prefer, in certain circumstances, that the IGP providers 103-105 offer the service provided by the SOR platform 102. However, if an IGP includes a particular SOR platform, many messages will not be subjected to the SOR feature. This is because the various visited networks, and their associated VLR's 106, may utilize a different IGP to communicate with the HLR. Neither the home network, nor the HLR 101,

has any real control over communications path utilized by a visited network to communicate the LU message.

Thus, for example, if IGP 103 includes an SOR feature 102, then VLR's that communicate with HLR 101 through the other IGPs 104 to 105 will not be subjected
5 to the SOR feature. This is displayed in Figure 2. As a result, it means that either all IGP's must have their own SOR platform, or the system will not work properly much of the time. This is because, in the arrangement shown in Figure 2, the SOR functionality will only be applied to messages arriving via IGP 103, but not to messages arriving through the other IGPs. And, even if all IGPs have their own SOR,
10 the coordination among all of them for the system to work properly would be cumbersome.

In view of the foregoing, there exists a need in the art for a more efficient manner in which to provide steering of roaming services.

There also exists a need in the art to provide steering of roaming services from
15 an International Gateway Provider, so that the home network operator of the HLR does not have to invest in the costly hardware and software required for such services.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a prior other arrangement for implementing steering of roaming
20 services;

Figure 2 shows an additional arrangement for implementing steering of roaming services; and

Figure 3 is a conceptual diagram showing steering of roaming services implemented in accordance with the present invention.
25

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The above drawbacks and others of the prior art are overcome in accordance with the present invention which relates to a system and method for permitting one of plural IGP communications providers to provide steering of roaming (SOR) service,
30 without requiring the home network or home location register (HLR) to maintain its own SOR platform. In accordance with an exemplary embodiment of the invention, the routing of messages from the HLR is slightly modified to send back its ISD or similar message through a particular one or more communications paths. These

communications paths may then be configured to implement the SOR functionality in the reverse direction, intercepting the authorization or ISD, and precluding it from being sent if the visited network is not the preferred provider.

For purposes of further explanation, we refer now to Figure 3. The arrangement of Figure 3 includes three IGPs 103-105, and an additional communications provider (CP) 302. The CP 302 may in actuality be one of the IGPs, but need not be. Additionally, SOR 301 is shown as being placed between the CP 302 equipment and the VLRs 106. This configuration is exemplary only, and it is also contemplated that the SOR 301 may be disposed elsewhere in the system.

In operation, when a roaming user comes within the range of a particular visited network, the VLR 106 associated with that particular visited network detects the user's wireless device, and its request to establish communications (e.g.; to make a call). This essentially establishes a connection between the wireless device and the visited network. The visited network then sends a Location Update (LU) message to the HLR, likely through one of IGPs 103-105. Upon receipt of the LU message, the HLR 101 of Figure 3, which has no SOR capabilities, will send back an Insert Subscriber Data (ISD) message. The ISD message serves, among other purposes to authenticate and authorize the user to use the visited network. It also serves to ensure the visited network operator that the home network will agree to pay the charges for use of the visited network, presumably then billing such charges back to the subscriber.

In accordance with the invention, the HLR's network is arranged to transmit all outgoing ISD's authorizing use of the visited network through a specified communications provider 302. Thus, regardless of which IGP or other channel is used by the VLR to communicate with the HLR, all ISDs and/or similar authorization messages are sent back to the visited network via a selected CP 302, which is known in advance to work in cooperation with the SOR platform 301. The HLR or its network can easily be reprogrammed to ensure all outgoing such messages are sent only through the desired CP 302.

Upon reception of the ISD in SOR platform 301 of figure 3, whatever rules and/or algorithm is desirable can be invoked to determine if the visited network should be accepted by the home network or not, for this subscriber and instance. While the specific rules and algorithm may be arranged in any desired fashion,

typically they involve considerations of items such as preferred providers, volume discounts, number of attempts etc. These rules implemented by SOR 301 may be similar or identical to such rules as implemented in present day such systems.

5 If the SOR platform 301 determines that the user should be permitted to use the particular visited network in issue, then the SOR platform 301 passes the ISD messages to the VLR, essentially transparently. Of course there is a slight delay to perform the aforementioned processing.

10 If the SOR platform 301 determines that permission should be denied, then the SOR platform 301 sends a reject message to the particular VLR 106 that requested use of the visited network by the particular roaming subscriber. This LU-reject message informs the VLR and ultimately, the roaming wireless device, that the request has been rejected.

15 It is noted that in some cases, before the VLR will accept the reject message, some authentication information from the HLR is necessary. This information may be captured by the SOR from other messages, or may be programmed in advance.

20 In addition to the LU-reject message, an abort message designated a TCAP abort may optionally be sent from the SOR to the HLR of the home network. This abort message serves to inform the HLR that the registration attempt has been aborted. In this case, thereafter, both the VLR and HLR are thus aware that the registration attempt has failed through the visited network associated with the VLR. The handset may then try a different visited network, eventually connecting to a visited network that the SOR platform 301 will authorize.

25 By using the foregoing technique, only one communications channel connected to the HLR needs to have the SOR capability. In prior art systems, if only one of the plural channels had the SOR capability, the system would not work properly because LU messages could arrive on the remaining communications channels (IGP's) used by the HLR, thereby circumventing the SOR function.

30 It is noted that if, after a predetermined number of tries, the wireless device has still not connected to the preferred visited network, the SOR may authorize the connection anyway so that the subscriber does not experience too many rejections and retries. Thus, it is advantageous for the SOR platform 301 to keep track of how many unsuccessful attempts to connect to visited networks have been made by the

wireless device within a predetermined time period just prior to the SOR 301 processing a response message.

During the process of the VLR 106 contacting the HLR 101, and the remaining authentication/authorization process described above, the wireless device
5 remains in a wait state. If the service request is denied, the device may simply try another network, but that subsequent attempt will preferably be after the HLR 101 has already been informed of the first attempt and failure, as described above. Therefore, the system will not present the HLR requests to connect to more than one visited network at the same time.

10 It is also noted that in cases where CP 302 ceases to function or has temporary outages, the HLR could transmit through another of the IGPs or other communications providers. Preferably, in the case of such outages, the HLR could utilize one or more other IGPs that have the SOR capability. However, if there are no other IGPs available that have the SOR capability, the system would simply not
15 implement the SOR functionality during times of an outage.

While the above describes the preferred embodiment of the invention, various other modifications and additions will be apparent to those of skill in the art. For example, the messaging described herein may be arranged to be compatible with standards such as MAP, TCAP, SS7, GSM-A-IREG, or other known standards. Such
20 modifications are intended to be covered by the claims appended hereto.

CLAIMS

1. A method of processing a request from a visited network for a wireless device to utilize said visited network, said method comprising the steps of:
- transmitting, to a home network, a request message for a wireless device,
5 associated with said home network, to utilize said visited network;
transmitting a responsive message from said home network to said visited network;
intercepting and altering said responsive message after it is transmitted, and transmitting said altered message to said visited network.
- 10 2. The method of claim 1 wherein said step of transmitting to a home network comprises transmitted from a visitor location register to a home location register.
3. The method of claim 1 wherein said responsive message is an authorization message permitting said wireless device to utilize said visited network.
4. The method of claim 3 wherein said intercepting and altering comprises
15 changing a message that would permit said wireless device to utilize said visited network to a message that prohibits said wireless device to utilize said visited network.
5. The method of claim 4 wherein, in response to a response message being altered from one that would permit to one that prohibits, a second message is optionally also sent to the home location register or the home network, said second
20 message advising said home network or said home location register that said response message has been so altered.
6. A method of altering messages sent from a home network associated with a wireless device to a visited network said wireless device is attempting to utilize, said method comprising receiving from said home network a message authorizing said
25 utilization, determining whether said visited network is a preferred visited network, if so, passing said message through to said visited network in a manner that permits said utilization, and if not, altering said message to preclude said utilization prior to passing said message to said visited network.
7. The method of claim 6 further comprising permitting said utilization even if
30 said visited network is not a preferred visited network if at least a predetermined number of previous tries to connect to different visited networks have been attempted by said wireless device within a predetermined time frame.

8. The method of claim 7 wherein all response messages permitting authorization are automatically transmitted via a preferred communications path.
9. Apparatus for use with a wireless home network for authorizing use of a wireless device associated with said home network on a visited network, said
5 apparatus comprising plural communications channels for receiving requests from various visited networks for a wireless device to utilize said visited network, and sending back a response message to authorize or to refuse to authorize said utilization of said visited network, said sending including sending all messages authorizing said use through one or more specified communications providers.
- 10 10. The apparatus of claim 9 wherein said specified communications providers are those that provide steering of roaming services.
11. The apparatus of claim 10 wherein if all of said one or more specified communications providers are non-operational, other communications providers are utilized to send said messages authorizing said use, said other communications
15 providers not having steering of roaming services.
12. A method of precluding a home network from authorizing use of a wireless device on a visited network, said method comprising intercepting an authorization message and converting it to a message effectively denying authorization, transmitting said denial message to said visited network, and transmitting a second
20 message to said home network advising said home network that said authorization message has been intercepted and so converted.
13. The method of claim 12 wherein said home network includes a Home Location Register, and said visited network includes a Visiting Location Register.
14. A wireless network having a home location register, said home location
25 register being connected to plural communications channels for receiving request messages from visited networks requesting authorization to service wireless devices associated with said home network, said home location register utilizing only a specified set of communications channels to respond to said request messages, irrespective of on which of said plural communications channels said request
30 messages arrive.
15. The wireless network of claim 14 wherein said specified set is a subset of said plural communications channels.

16. The wireless network of claim 14 wherein said specified set is a set having SOR capabilities.

17. The wireless network of claim 15 wherein said specified set is a set having SOR capabilities.

FIG. 1

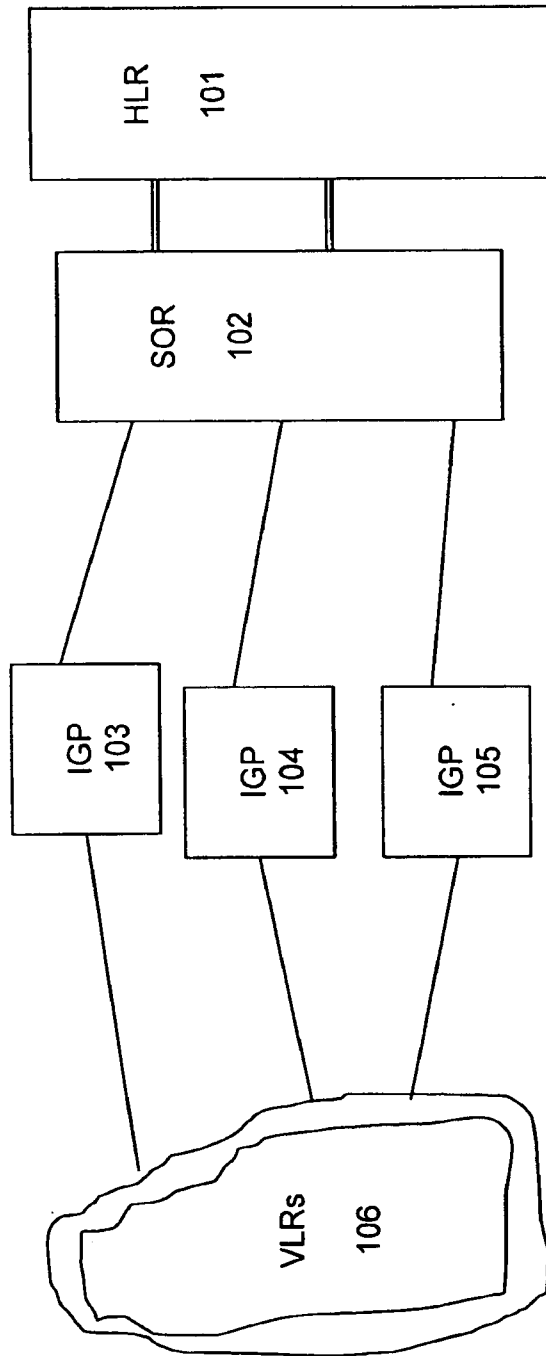


FIG. 2

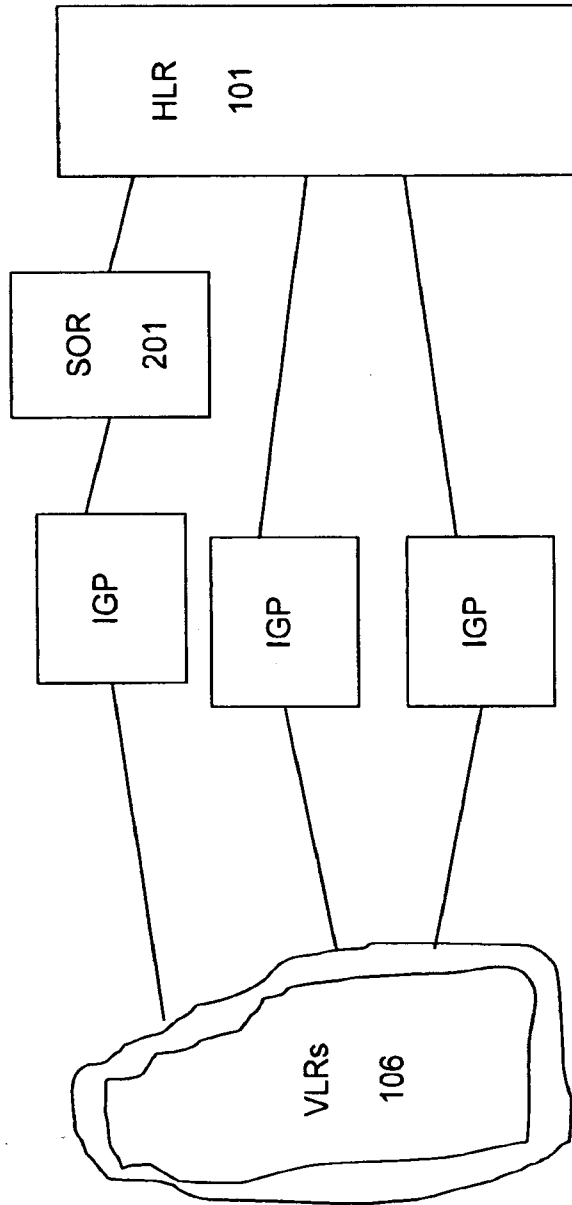


FIG. 3

