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(54) Title:  A METHOD AND SYSTEM FOR DYNAMICALLY ALLOCATING SUBSCRIBER IDENTIFICATION

(57) Abstract:  According to an embodiment of the
invention, a method for mobile communica-
tion in a plurality of mobile networks is disclosed.
The method includes identifying a geographic
location of a Subscriber Identity Module (SIM)
card that is registered with a subscription pool,
accessing, from a partition of a plurality of parti-
tions of the SIM card, a network information cor-
responding to the identified geographic location,
the network information being provided from
the subscription pool; and processing the accessed
network information such that the SIM card acts
as a local mobile subscriber for the identified
geographic location.
A METHOD AND SYSTEM FOR DYNAMICALLY ALLOCATING SUBSCRIBER IDENTIFICATION

Field of the Invention

The invention relates to mobile communication. In particular, the invention relates to a method and system for dynamically allocating local subscriber identification in a visited/roaming mobile network.

Description of Related Art

With the rapid development of the global economy, communication between people in the world is more and more frequent, the number of roaming mobile subscribers is increasing, and the number of international roaming subscribers is also increasing rapidly. Mobile subscribers are frequently roaming between their home networks and one or more visited/roaming networks. Such home network and the visited networks may be in the same country, or may be present in different countries.

It is typically the case that in order for a subscriber of a "home" public land mobile network (PLMN) to use services provided by another "visited" PLMN, the operators of the two PLMNs must have entered into a "roaming agreement." When such a subscriber is using the services of the visited PLMN, the subscriber is also referred to here as a "visitor" or a "roamer." The roaming inter-networking process is complicated and uses a significant amount of resources (such as a public switched telephone network (PSTN) and GSM Mobile Application Part (MAP) sessions). For example, when a subscriber of a home PLMN is within a coverage area of a visited PLMN with which the home PLMN has a roaming agreement and a call is placed to a telephone number associated with that subscriber, the call is routed to the home PLMN. The home PLMN knows where the subscriber is roaming and forwards the call to the visited PLMN, which establishes the call. Due to the resources that expended to implement conventional roaming service, each home PLMN typically charges each such roaming subscriber a special inter-operator tariff (IOT) (also referred to here as a "roaming tariff") for each call that is made and received using such conventional roaming sendee. Such roaming tariffs can be substantial relative to the fees charged for non-roaming service. Also, when a visitor uses the international roaming service offered by a visited PLMN, subscribers of the visited PLMN still must include the country code when calling the visitor, even though the visitor is being serviced.
by the same visited PLMN as the subscribers and even though if visitor is in the same country as the subscribers.

Therefore, even though roaming is convenient for the user, the charges for using call-related or non-call, such as data, related services while roaming are high, because the roamer has to make an international call to his home country and is liable for International Direct Dialing (IDD) charges. Moreover, usually the caller is charged for IDD from his home country to the roaming country when receiving a call as well. Similarly, rates for using data services, while roaming, are also significantly higher compared to the rates for a local subscriber of the visited network.

One way of circumventing the mentioned problem is by using a local Subscriber Identity Module (SIM) card having a Mobile Station Integrated Services Digital Network (MSISDN) number of the visited network. A local MSISDN of each of the visited networks allows the roaming subscribers to use call and non-call, such as data, related services in the visited networks at cheaper local rates instead of expensive roaming rates.

Typically, a roaming subscriber buys SIM cards of the visited networks to get local rates. However, the roaming subscriber needs to swap his original SIM card with a SIM card of currently visited network and hence, may not be able to receive call-related and non-call related services on his home network MSISDN. In addition, when the roaming subscriber is back in the home network, he may not receive the call-related and non call-related services on his other MSISDNs of the visited networks. This technique is inconvenient for the roaming subscriber, as the roaming subscriber needs to replace his existing home network SIM card. This may also mean not having access to the information, such as telephone numbers and messages from the existing SIM card. The limitation of using multiple SIM cards become more pronounced when the subscriber frequently travels across different geographic locations that are served by different Mobile Network Operators (MNOs) because the roamer will have to carry a number of SIM cards and in order to use the local rates, the roamer needs to remember which SIM card needs to be used in which geographic location.

Hence, there is a need in the art for a solution that overcomes the aforementioned limitations.
Summary of the Invention

According to an embodiment of the invention, a method for mobile communication in a plurality of mobile networks is disclosed. The method includes identifying a geographic location of a Subscriber Identity Module (SIM) card that is registered with a subscription pool; accessing, from a partition of a plurality of partitions of the SIM card, a network information corresponding to the identified geographic location, the network information being provided from the subscription pool; and processing the accessed network information such that the SIM card acts as a local mobile subscriber for the identified geographic location.

According to another embodiment of the invention, a system for mobile communication in a plurality of mobile networks is disclosed. The system includes a subscription pool comprising at least one network information corresponding to at least one geographic location; a SIM card comprising a plurality of partitions, each partition of the plurality of partitions adapted to storing a network information; and a SIM module adapted to accessing and processing the stored network information such that the SIM card connects to a mobile network corresponding to the accessed information.

According to yet another embodiment of the invention, a subscription pool for mobile communication in a plurality of mobile networks is disclosed. The subscription pool includes at least one network information for each of a plurality of mobile networks, the plurality of mobile networks corresponding to a plurality of geographic location.

According to other embodiment of the invention, a SIM card for mobile communication in a plurality of mobile networks is disclosed. The SIM card includes a plurality of partitions adapted to storing different network information in each of the plurality of partitions.

Brief Description of the Accompanying Figures

The embodiments of the invention, together with its advantages, may be best understood from the following detailed description taken in conjunction with the accompanying figures in which

Figure 1 illustrates a method for mobile communication in a plurality of mobile networks according to an embodiment of the invention;

Figure 2A-2D illustrates processing of the accessed network information according to an embodiment of the invention;
Figure 3 illustrates a method for mobile communication in a plurality of mobile networks according to another embodiment of the invention; Figure 4 illustrates a Global System for Mobile Communications (GSM)/General Packet Radio Service (GPRS) network architecture according to an embodiment of the invention; and Figure 5 illustrates a subscription pool and a partitioned SIM card according to an embodiment of the present invention.

Detailed Description of the Invention

The technical solution of the present invention is hereinafter described in detail with reference to the accompanying drawings. The description and accompanying figures represent different components; where same components in different figures share same numeral.

Referring initially to Figure 1, a method 100 for mobile communication in a plurality of mobile networks according to an embodiment of the invention is disclosed. The method includes identifying at 105 a geographic location of a Subscriber Identity Module (SIM) card that is registered with a subscription pool; accessing at 110, from a partition of a plurality of partitions of the SIM card, a network information corresponding to the identified geographic location, the network information being provided from the subscription pool; and at 115 processing the accessed network information such that the SIM card acts as a local mobile subscriber for the identified geographic location.

A number of Mobile Network Operators (MNOs) operate the plurality of mobile networks in a plurality of geographic locations. The geographic location is defined by a MNO’s coverage area, i.e. the region within which the MNO provides its services at local subscription rates, i.e. at rates charged to its own mobile subscribers. The information for the geographic location is expressed through Location Area Identifier (LAI), which includes Mobile Country Code (MCC), the Mobile Network Code (MNC) and the Location Area Code (LAC).

The identification of the geographic location where the SIM is located is performed based on the geographic location signal broadcasted by at least one local mobile network that corresponds to geographic location of the SIM card. Base transceiver stations BTS continuously broadcast information about themselves and their environment on their broadcast control channel, e.g. the cell identity CI, information on neighbouring cells and
the location area identifier LAI. On the basis of the LAI, a mobile station MS receiving broadcast transmission from the base transceiver station BTS knows in which location area LA it is at a given time.

The network information, as stored in different partitions of the SIM, includes International Mobile Subscriber Identity (IMSI), which includes a Mobile Country Code (MCC), a Mobile Network Code (MNC) and a Mobile Station Identification Number (MSIN). The LAI of the network includes a Mobile Country Code (MCC), a Mobile Network Code (MNC) and a Geographic location Code (LAC). A comparison between the stored IMSI and LAI allows accessing the partition that includes information corresponding to the identified mobile network in the identified geographic network. Thus, the accessed network information represents information, the use of which connects the MS to the mobile network corresponding to the accessed network information as a local subscriber. In addition to the IMSI for different networks corresponding to different geographic locations stored in each of the plurality of partitions of the SIM, the network information further includes at least an authentication key, an authentication algorithms, an encryption algorithm, a decryption algorithm, and a Mobile Subscriber Integrated Services Digital Network Number (MSISDN). This information is specific to a particular subscription from a specific MNO in the identified geographic location.

Once the network information is accessed from a partition of the SIM, the accessed information is processed using the conventional SIM registration process that includes IMSI attach with the mobile network that corresponds to the accessed information. After the processing of the accessed network information, the MS with the SIM card acts as a local subscriber of the visited network and the visited network temporarily acts like a home network until another geographic location is identified. The processing generally comprises generating an access signal based on the accessed network information; transmitting the access signal to an authentication center of the mobile network corresponding to the identified geographic location; and connecting the SIM card to the mobile network of the identified geographic location when the authentication center of the mobile network, corresponding to the accessed network information, authenticates the network information included in the access signal. The access signal consists of a series of communication between the MS and the visited network. This would typically include channel request, IMSI Verification/ Request triplets, authentication, and encryption. Figure
2A-2D illustrates processing of the accessed network information according to an embodiment of the invention.

*Channel Request (Refer Figure 2A)*

The MS sends a Channel Request (CHAN_REQ) message to a Base Station System BSS on a Random Access Channel RACH. The BSS responds on the Access Grant Channel AGCH with an Immediate Assignment (IMM_ASS_CMD) message and assigns a Standalone Dedicated Control Channels SDCCH to the MS. The MS immediately switches to the assigned SDCCH and sends a Location Update Request (LOC_UPD_REQ) to the BSS. The MS sends the accessed IMSI to the BSS. The BSS acknowledges the message.

*IMSI Verification/Request triplets (Refer Figure 2B)*

The BSS forwards the Location Update Request to the Mobile Switching Centre MSG/Visitor Location Register VLR. The MSC/VLR forwards the IMSI to the HLR and requests verification of the IMSI as well as Authentication Triplets. The HLR forwards the IMSI to the Authentication Center AuC and request authentication triplets. The AuC generates the triplets and sends them along with the IMSI, back to the HLR. The HLR validates the IMSI by ensuring it is allowed on the network and is allowed subscriber services. It then forwards the IMSI and Triplets (RAND, SRES, k_c) to the MSC/VLR.

*Authentication (Refer Figure 2C)*

The MSC/VLR stores the SRES and the K_c and forwards the RAND to the BSS and orders the BSS to authenticate the MS. The BSS sends the MS an Authentication Request (AUTH_REQ) message to the MS. The only parameter sent in the message is the RAND. The MS uses the RAND to calculate the SRES and sends the SRES back to the BSS on the SDCCH in an Authentication Response (AUTH_RSP). The BSS forwards the SRES up to the MSC/VLR. The MSC/VLR compares the SRES generated by the AuC with the SRES generated by the MS. If they match, then authentication is completed successfully.

*Encryption (Refer Figure 2D)*

The MSC/VLR forwards the K_c for the MS to the BSS. The K_c is not sent across the Air Interface to the MS. The BSS stores the K_c and forwards the Set Cipher Mode (CIPH_MOD_CMD) command to the MS. The CIPH_MOD_CMD tells the MS which
encryption to use (for example, A5/X). The MS immediately switches to cipher mode using the suggested encryption algorithm (in this case, A5). All transmissions are now enciphered. It sends a Ciphering Mode Complete (CIPH_MOD_COM) message to the BSS. The MSC/VLR sends a Location Updating Accept (LOG_UPD_ACC) message to the BSS.

The subscription pool stores at least one network information of at least one Mobile Network Operator (MNO) for each of a plurality of geographic locations. The subscription pool is communicatively connected with a Home Network Mobile Operator (HMNO) of the SIM card, which is registered with the subscription pool. The HMNO may include rules for determining the type of services made available to the SIM card using the accessed network information for the identified geographic location. For example, the rules may include limitations based on pre-paid amount for a mobile subscriber, the amount and type of data service that can be used, the rates applicable depending upon the registration, etc.

Figure 3 illustrates a method 300 for mobile communication in a plurality of mobile networks according to another embodiment of the invention. As an additional step, the method includes at 305 determines whether the network information corresponding to the identified geographical location is available in one or more partitions of the SIM card. If so, then the network information corresponding to the identified geographic location of the SIM card is accessed, if the network information is already available in one of the partitions of the plurality of partitions.

However, if the network information corresponding to the identified geographic location is unavailable in any of the partition of the plurality of partitions, then at 310 the network information is requested from the subscription pool. The requested network information corresponding to the identified geographic location is downloaded and stored at 315 in one of the partitions of the plurality of partitions. The requesting and the downloading takes place over a mobile network of one of the MNOs of the identified geographic location and the mobile network of the HMNO. The connection between the network of HMNO and the network of one of the MNOs of the identified geographic network is established following the steps of location updates and setting up of connection using convention roaming techniques. In short, when the MS is turned on or is transferred via a handover to the network, the visited network sees the device, notices that it is not
registered with its own system, and attempts to identify its home network. The visited
network contacts the home network and requests service information (including whether or
not the mobile should be allowed to roam) about the roaming MS. If successful, the visited
network begins to maintain a temporary subscriber record for the device. Likewise, the
home network updates its information to indicate that the mobile is on the host network
(visiting network) so that any information sent to that device can be correctly routed. Once
the connection with MS in the visited network (corresponding to the identified geographic
location) is established under the conventional roaming set up, the roaming MS may
request the subscription pool, communicatively connected with the HMNO for example to
the HLR of the HMNO, to issue network information that corresponds to the visited
network in the identified geographic location. Once such information is transmitted as a
data message, using the network of HMNO and visited network, from the subscription
pool, the transmitted network information is downloaded and stored in one of the partitions
of the SIM card, thus making it available for processing in the visited network. The method
thus allows the roaming MS to utilize the conventional roaming only until the network
information corresponding to the visited network of the identified geographic location is
obtained from the subscription pool. Once, this network information is processed (as
described earlier), the MS having the partitioned SIM acts as a local subscriber of the
visited network in the identified geographic location and the visited network to which the
MS connects to acts as a home network until another geographic location is identified.

Subscription Pool & SIM Card in HMNO

Figure 4 illustrates a Global System for Mobile Communications (GSM)/ General
Packet Radio Service (GPRS) network architecture according to an embodiment of the
invention. The system describes the GSM/GPRS network 400 with the subscription pool
communicatively connected to the HMNO. The GSM/GPRS network includes a GSM core
network 401 and a GPRS network 430. GSM core network 401 includes a Mobile Station
(MS) 402, at least one Base Transceiver Station (BTS) 404, and a Base Station Controller
(BSC) 406. MS 402 is physical equipment or Mobile Equipment (ME), such as a mobile
phone or a laptop computer that is used by mobile subscribers, with a Subscriber Identity-
Module (SIM) card. The SIM card includes at least an International Mobile Subscriber
Identity (IMSI), which is a unique identifier of a subscriber. The SIM card includes a
number of partitions that are adapted to store network information for a number of mobile
networks corresponding to a plurality of geographic locations. BTS 404 is physical equipment, such as a radio tower, that enables a radio interface to communicate with the MS. Each BTS may serve more than one MS. BSC 406 manages radio resources, including the BTS. The BSC may be connected to several BTSs. The BSC and BTS components, in combination, are generally referred to as a Base Station System (BSS).

The GSM core network 401 also includes a Mobile Switching Center (MSG) 408, a Gateway Mobile Switching Center (GMSC) 410, a Home Location Register (HLR) 412, a Visitor Location Register (VLR) 414, an Authentication Center (AuC) 416, an Equipment Identity Register (EIR) 418 and a Subscription Pool 438, which stores network information for a number of mobile networks corresponding to a plurality of geographic locations. The stored network information may be transmitted from the subscription pool 438 to the SIM of the MS 402. MSG 408 performs a switching function for the network. The MSG also performs other functions, such as registration, authentication, location updating, handovers, and call routing. GMSC 410 provides a gateway between the GSM network and other networks, such as an Integrated Services Digital Network (ISDN) or Public Switched Telephone Networks (PSTNs) 420. In other words, the GMSC provides interworking functionality with external networks.

The HLR 412 is a database that contains administrative information regarding each subscriber registered in a corresponding GSM network. The HLR also contains the current location of each MS. The subscription pool 438 is communicatively connected with the HLR 412. VLR 414 is a database that contains selected administrative information from the HLR. The VLR contains information necessary for call control and provision of subscribed services for each MS currently located in a geographical area controlled by the VLR. The HLR and the VLR, together with the MSG, provide the call routing and roaming capabilities of GSM. AuC 416 provides the parameters needed for authentication and encryption functions. Such parameters allow verification of a subscriber's identity. EIR 418 stores security-sensitive information about the mobile equipment.

To gain access to GSM services, such as speech, data, and short message service (SMS), the MS first registers with the network to indicate its current location by performing a location update and IMSI attach procedure. The MS sends a location update message including its current location information to the MSC/VLR, via the BTS and the BSC. The location information is then sent to the MS's HLR. The HLR is updated with the location information received from the MSC/VLR. The location update is also performed
when the MS moves to a new location area. Typically, the location update is periodically performed to update the database as location updating events occur. Based on the location update, if the location is not served by the home network of the MS, the subscription pool provides a network information corresponding to the identified location and the same is transferred to the SIM of the MS.

GPRS network 430 is logically implemented on the GSM core network architecture by introducing two packet-switching network nodes, a Serving GPRS support node (SGSN) 432 and a Gateway GPRS support node (GGSN) 434. SGSN 432 is at the same hierarchical level as the MSG in the GSM network. The SGSN controls the connection between the GPRS network and the MS. The SGSN also keeps track of individual MS's locations and manages security functions and access controls. GGSN 434 provides a gateway between the GPRS network and a public packet data network (PDN) or other GPRS networks 436. That is, the GGSN provides interworking functionality with external packet data networks, and sets up a logical link to the MS through the SGSN. When packet-switched data leaves the GPRS network, it is transferred to an external TCP-IP network 436, such as an X.25 network or the Internet. In order to access GPRS services, the MS first attaches itself to the GPRS network by performing an attach procedure. The MS then activates a packet data protocol (PDP) context, thus activating a packet communication session between the MS, the SGSN, and the GGSN.

Subscription Pool and SIM Card

Figure 5 illustrates a subscription pool and a partitioned SIM card according to an embodiment of the present invention. The subscription pool 438 for mobile communication in a plurality of mobile networks includes at least one network information (Al-AX, B1-BX, Cl-CX, Dl-DX) for each of a plurality of mobile networks (510-516), the plurality of mobile networks corresponding to a plurality of geographic locations (502-508). The subscription pool is communicatively connected with a Home Mobile Network Operator (HMNO) of a SIM card (Refer Figure 4). The subscription pool may also be integrated with the HLR of the HMNO. Typically, the geographic location includes country based demarcation, as shown in the Figure 5. However, in other situations, it may be intra-country mobile network coverage areas. The network information includes at least an International Mobile Subscriber Identity (IMSI), an authentication key, an authentication algorithms, an encryption algorithm, a decryption algorithm and a Mobile Subscriber
Integrated Services Digital Network Number (MS ISDN) for each of the subscription, as represented in the Figure 5 (Al-AX, B1-BX, C1-CX, D1-DX). The subscription pool includes a transmission means for transmitting network information corresponding to the request received from a SIM card. Such requests are based on the geographic location identified by the SIM card. As the MS continues to move from one geographic location to another, the subscription pool dynamically transmits the network information in accordance with geographic location identified by the SIM card. The method of identifying the geographic location and connecting with the visiting mobile network corresponding to the geographic location as a local subscriber is described earlier in the description.

In one embodiment, the subscription pool includes ranking rules for categorizing and listing the MNOs for a specific geographic location in accordance with one or more ranking criteria. For example, the ranking rules may include the cheapest service rates for a specific type of service, customer satisfaction feedback based ranking, coverage area, etc. A skilled person would appreciate that there are a number of ranking rules that may be applied to the present invention. In another embodiment, the subscription pool includes a preference table for transmitting the network information in accordance with preference setting of the SIM card user. For example, the user of the roaming MS may indicate that he is interested in receiving network information for a mobile network in an identified geographic location that has the cheapest rate for data, or cheapest rates for voice, or highest customer feedback, etc. A skilled person would appreciate that there are a number of preference settings that may be applied to the present invention. The preference setting thus utilizes a look-up table to transmit the network information that aligns with the preference of the mobile user in the identified geographic location.

The SIM card 518 includes a plurality of partitions (slots 1-3) that are adapted to storing different network information in each of the plurality of partitions. The SIM card is registered with the subscription pool 438. The SIM card, through its SIM module that includes a processing unit, operating system and various application configured for specific application, is adapted to identify a geographic location of the SDvl card, accessing, from a partition of a plurality of partitions of the SIM card, a network information corresponding to the identified geographic location, the network information being provided from the subscription pool; and processing the accessed network information such that the SIM card connects with a mobile network corresponding to the processed network information.
In an embodiment, the accessed network information in a visited geographic location is released when the SIM card identifies another geographic location, the network information being re-useable for another SIM card when another SIM card identifies the same geographic location (Refer Figure 5, situation M to N). The release includes deletion of stored network information, using the SIM module, from the SIM card when another geographic location is identified the SIM card. However, in another embodiment, at user request, one of the network information of a visiting network may remain stored in a partition even when a new geographic location is identified (Refer Figure 5, situation O to P). The network information of a visiting network may even be permanently stored in one of the partitions of the plurality of partitions.

The SIM module and the subscription pool are configured to allow deletion of network information from the partition using rule based functionality or deletion function. The subscription pool includes look-up table to identify network information in use and the ones available for transmission, on request. Therefore, using the release feature and look up table, a limited number of network information for a specific geographic location may be utilized again, thus allowing optimized utilization of network information. In order to provide latency period between transmitting the recently released network information, the released network information is quarantined for a specific time period such as for at least a week. This allows avoiding people trying to contact the user of the SIM card ending up contacting the user of another SIM card, which now uses the network information released by the SIM card user.

In one embodiment, the network information is stored as a pre-loaded information, for example as a factory loaded SIM card, that is the network information may be loaded on a SIM based on a customer request received from the mobile user. In another embodiment, it may be stored as a downloaded information over a network, either as a response to customer request while the MS is still using its home network, for example making the customer request through an SMS based on expected travel in a visited network or may be dynamically downloaded as described earlier in the description.

Typically, one of the partitions of the plurality of partitions stores home mobile network information, which may be stored permanently (Refer Figure 5, partition!). In one embodiment, once the MS is connected to the visiting network using the accessed network information, the MS may utilize the mobile network (visiting network) of the identified geographic location for updating settings of home network subscription. For
example, requesting the HMNO to change the settings of home subscription like monthly subscription charges, services, etc. In another embodiment, the MS connected to the visiting network may utilize the mobile network (visiting network) of the identified geographic location for changing the home mobile network operator (HMNO) to another HMNO provided that the another HMNO is communicatively connected with the subscription pool. The connectivity of the another HMNO with the subscription pool allows for continuing using the visiting network as a local subscriber of the visiting network with the existing accessed network information. Alternatively, the MS may request a new network information for the same identified geographic location from the subscription pool through the another HMNO.

As described earlier, the subscription pool comprises ranking rules for categorizing and listing the MNOs for a specific geographic location in accordance with one or more ranking criterion. The subscription pool may also preference setting of the SIM card user in order to determine the network information corresponding to the geographic location that needs to be transmitted to the SIM card.

In an embodiment of the invention, for the same geographic location, the SIM card may have pre-loaded or over the network/air download of more than one network information from the subscription pool; and such more than one network information is stored in more than one partition of the plurality of partitions of the SIM card. This allows the MS to switch between different mobile networks within same geographic location, depending upon the preference setting of the user. For example, the user may selectively use voice services of one MNO while data services of another MNO within the same geographic network. The network information, as provided by the subscription pool, may include additional information identifying the network information for each preference setting of the user and the SIM module is adapted to utilize the mobile network based on the service in use.

In another embodiment, the MS user pre-requests network information based on an expected geographic location of the SIM card; and stores the pre-requested network information in one of the partitions of the plurality of partitions. This may take place as a customer request, for example through SMS, as a pre-loaded network information or over the air download.

In an embodiment, at the HMNO, the transmitted network information in use at the identified geographic location is associated with the home network information such that
calls made or data sent at home network MSISDN is directed to the network MSISDN of the identified location; and calls made or data sent from the network MSISDN of the identified location is displayed as received from home network MSISDN. This is achieved by a) updating the HMNO about the network information in use. This may be possible through a simple text message from the SIM to HMNO about the network information in use and/ or through location update, and b) maintaining an association look-up table (shown below) whereby home network MSISDN is linked to network information of the identified geographic location made available to the SIM card. Thus, based on the Network information in use, it is possible to identify the visiting network usage of the mobile user and therefore, a routing of calls and messages is possible. The mobile user need not worry about updating contacts and others about the number at which he is available during travel because for others, mobile user’s home MSISDN stays as the contact detail irrespective of the geographic location of the mobile user/ MS.

<table>
<thead>
<tr>
<th>Subscriber</th>
<th>Home Network Information</th>
<th>SIM Stored Network Information</th>
<th>Network Information in Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscriber 1</td>
<td>XXXXXXXXX</td>
<td>XXXXXXXX AAAAAAAA BBBB BBBB CCCCCCCC DDDDDDD</td>
<td>CCCCCCCC</td>
</tr>
<tr>
<td>Subscriber 2</td>
<td>QQQQQQQQQ</td>
<td>QQQQQQQQ LLLLLLLLLL</td>
<td>LLLLLLLLL</td>
</tr>
<tr>
<td>Subscriber 3</td>
<td>SSSSSSSSSS</td>
<td>SSSSSSSSSS FFFFFFFFFFF</td>
<td>SSSSSSSSSSS</td>
</tr>
</tbody>
</table>

In the example, calls made to subscriber 1 that uses MSISDN of XXXXXXXXX is automatically routed to MSISDN included in CCCCCCCC. Similarly, calls made from CCCCCCCC shows MSISDN of XXXXXXXX at the recipient end. Same principle is applicable for calls/ messages directed to or received from Subscriber 2 and Subscriber 3 that use network information LLLLLLLLLL and SSSSSSSSSSS respectively.

According to an embodiment of the invention, a system for mobile communication in a plurality of mobile networks is disclosed. The system (Refer Figures 4 & 5) includes a subscription pool 438 comprising at least one network information corresponding to at least one geographic location, a SIM card 518 comprising a plurality of partitions (slots 1-3), each partition of the plurality of partitions adapted to storing a network information; and a SIM module (represented partly operating system, etc. partition) by adapted to
accessing and processing the stored network information such that the SIM card connects to a mobile network corresponding to the accessed information.

The network information comprises at least an International Mobile Subscriber Identity (IMSI), an authentication key, an authentication algorithms, an encryption algorithm, a decryption algorithm and a Mobile Subscriber Integrated Services Digital Network Number (MSISDN).

The subscription pool stores at least one network information of at least one Mobile Network Operator (MNO) for each of a plurality of geographic location. In another embodiment, the subscription pool stores a plurality of network information of a plurality of MNOs for the plurality of geographic location.

The identification of geographic location where the MS having the SIM is located is based on the geographic location signal broadcasted by at least one local mobile network that corresponds to geographic location of the SIM card. The SIM module is adapted to determine whether network information corresponding to the identified geographical location is available in one or more partitions of the SIM card. Thus, the SIM module communicates with the partitioned memories and includes a comparator where it compares the stored network information and the geographic location signal.

The SIM module is adapted to access the network information corresponding to the identified geographic location, if the network information is already available in one of the partitions of the plurality of partitions. However, the SIM module is also adapted to request the network information from the subscription pool, if the network information corresponding to the identified geographic location is unavailable in one of the partition of the plurality of partitions; and download and store the network information corresponding to the identified geographic location in one of the partitions of the plurality of partitions.

In order to establish connection, the SIM module is adapted to process the accessed network information by generating an access signal based on the accessed network information; transmitting, using a MS transmitter, the access signal to an authentication center of the mobile network corresponding to the identified geographic location; and connecting the SIM card to the mobile network of the identified geographic location when the authentication center authenticates the network information included in the access signal.

In an embodiment, the SIM module is adapted to release the network information by deleting the network information from the partition storing the network information
corresponding to the identified geographic location when the SIM card identifies another
geographic location. The released network information is thus deleted from the partition
where the released network information was stored. In an embodiment, the subscription
module quarantines the released network information for a specific time period.

At least one network information, such as the home network information, is pre-loaded
in each partition of the plurality of partitions. However, the home network information
may be permanently stored in a partition, along with at least one network information of
visited network in another partition. The SIM module, in another embodiment, is adapted
to utilize the mobile network of the identified geographic location for updating settings of
the home network subscription or even changing the home network subscription to another
MNO, provided the that another MNO is communicatively connected with the subscription
pool.

In an embodiment, the HMNO includes an association table that is adassociate the
home network information and the network information of the identified geographic
location such that for calls made or data sent at home network MSISDN is directed to the
network MSISDN of the identified location; and calls made or data sent from the network
MSISDN of the identified location is displayed as received from home network MSISDN.
The HMNO may also include rules for determining the type of services made available to
the SIM card.

It is important to note that Figures 1 to 5 illustrate specific applications and
embodiments of the invention, and it is not intended to limit the scope of the present
disclosure or claims to that which is presented therein. Throughout the foregoing
description, for the purposes of explanation, numerous specific details, such as four
geographic location, four network information (subscriptions) for each geographic
location, three partitions in the SIM, etc. were set forth in order to provide a thorough
understanding of the invention. It will be apparent, however, to one skilled in the art that
the invention may be practiced without some of these specific details and by employing
different embodiments in combination with one another. The underlying principles of the
invention may be employed using a large number of different combinations.

Accordingly, the scope of the invention should be judged in terms of the claims which
follow.
CLAIMS:
1. A method for mobile communication in a plurality of mobile networks, the method comprising:
   identifying a geographic location of a Subscriber Identity Module (SIM) card that is registered with a subscription pool;
   accessing, from a partition of a plurality of partitions of the SIM card, a network information corresponding to the identified geographic location, the network information being provided from the subscription pool; and
   processing the accessed network information such that the SIM card acts as a local mobile subscriber for the identified geographic location.
2. The method according to claim 1, further comprising storing, in the subscription pool, at least one network information of at least one Mobile Network Operator (MNO) for each of a plurality of geographic locations.
3. The method according to any of the preceding claims, wherein the subscription pool is communicatively connected with a Home Network Mobile Operator (HMNO) of the SIM card.
4. The method according to any of the preceding claims, further comprising registering the SIM card with the subscription pool.
5. The method according to any of the preceding claims, wherein the HMNO comprises rules for determining the type of services made available to the SIM card using the accessed network information for the identified geographic location.
6. The method according to any of the preceding claims, wherein the network information comprises at least an International Mobile Subscriber Identity (IMSI), an authentication key, an authentication algorithms, an encryption algorithm, a decryption algorithm, and a Mobile Subscriber Integrated Services Digital Network Number (MSISDN).
7. The method according to any of the preceding claims, wherein the identification is based on the geographic location signal broadcasted by at least one local mobile network that corresponds to geographic location of the SIM card.
8. The method according to any of the preceding claims, wherein accessing comprises determining whether network information corresponding to the identified geographical location is available in one or more partitions of the SIM card.
9. The method according to any of the preceding claims, further comprising pre-loading the at least one network information individually in each partition of the plurality of partitions.

10. The method according to any of the preceding claims, further comprising accessing the network information corresponding to the identified geographic location of the SIM card, if the network information is already available in one of the partitions of the plurality of partitions.

11. The method according to any of the preceding claims, further comprising
   requesting the network information from the subscription pool, if the network information corresponding to the identified geographic location is unavailable in one of the partition of the plurality of partitions; and
   downloading and storing the network information corresponding to the identified geographic location in one of the partitions of the plurality of partitions.

12. The method according to any of the preceding claims, wherein the requesting and the downloading takes place over a mobile network of one of the MNOs of the identified geographic location and the mobile network of the HMNO.

13. The method according to any of the preceding claims, wherein the network information corresponding to the identified geographic location is transmitted from the subscription pool to the SIM card as a data message.

14. The method according to any of the preceding claims, wherein the transmitted network information is stored in one of the partitions of the plurality of the partitions.

15. The method according to any of the preceding claims, wherein the processing comprises:
   generating an access signal based on the accessed network information;
   transmitting the access signal to an authentication center of the mobile network corresponding to the identified geographic location; and
   connecting the SIM card to the mobile network of the identified geographic location when the authentication center authenticates the network information included in the access signal.

16. The method according to any of the preceding claims, further comprising releasing the network information when the SIM card identifies another geographic location, the network information being re-useable for another SIM card when the another SIM card identifies the geographic location.
17. The method according to any of the preceding claims, further comprising quarantining the released network information for a specific time period.

18. The method according to any of the preceding claims, wherein different partitions of the plurality of partitions are adapted to store a plurality of network information corresponding to different geographic locations.

19. The method according to any of the preceding claims, wherein the storing of mobile network information of different locations in different partitions is stored as a pre-loaded information or as a downloaded information over a network.

20. The method according to any of the preceding claims, wherein one of the partitions of the plurality of partitions stores home mobile network information.

21. The method according to any of the preceding claims, wherein the home network information is permanently stored.

22. The method according to any of the preceding claims, further comprising utilizing the mobile network of the identified geographic location for updating settings of home network subscription.

23. The method according to any of the preceding claims, further comprising utilizing the mobile network of the identified geographic location for changing the home mobile network operator (HMNO) to another HMNO provided that the another HMNO is communicatively connected with the subscription pool.

24. The method according to any of the preceding claims, wherein the subscription pool comprises ranking rules for categorizing and listing the MNOs for a specific geographic location in accordance with one or more ranking criterion.

25. The method according to any of the preceding claims, wherein the subscription pool dynamically updates the network information in accordance with geographic location identified by the SIM card.

26. The method according to any of the preceding claims, wherein the subscription pool transmits the network information corresponding to the geographic location in accordance with the preference setting of the SIM card user.

27. The method according to any of the preceding claims, wherein

   for the geographic location, more than one network information is transmitted from the subscription pool to the SIM card; and

   the more than one network information is stored in more than one partition of the plurality of partitions of the SIM card.
28. The method according to any of the preceding claims, wherein the more than one
network information is accessible in accordance with preference setting of the SIM
card user.

29. The method according to any of the preceding claims, further comprising
pre-requesting network information based on an expected geographic
location of the SIM card; and
storing the pre-requested network information in one of the partitions of the
plurality of partitions.

30. The method according to any of the preceding claims, further comprising permanently
storing the network information in one of the partitions of the plurality of partitions.

31. The method according to any of the preceding claims, further comprising associating,
at the HMNO, the network information in use at the geographic location with the home network information such that:
calls made or data sent at home network MSISDN is directed to the network
MSISDN of the identified location; and
calls made or data sent from the network MSISDN of the identified location
is displayed as received from home network MSISDN.

32. A system for mobile communication in a plurality of mobile networks, the system
comprising:
a subscription pool comprising at least one network information
corresponding to at least one geographic location;
a SIM card comprising a plurality of partitions, each partition of the plurality
of partitions adapted to storing a network information; and
a SIM module adapted to accessing and processing the stored network
information such that the SIM card connects to a mobile network corresponding to the
accessed information.

33. The system according claim 32, wherein the subscription pool stores at least one
network information of at least one Mobile Network Operator (MNO) for each of a
plurality of geographic location.

34. The system according to any of the preceding claims 32 to 33, wherein the subscription
pool stores a plurality of network information of a plurality of MNOs for the plurality
of geographic location.
35. The system according to any of the preceding claims 32 to 34, wherein the HMNO comprises rules for determining the type of services made available to the SIM card.

36. The system according to any of the preceding claims 32 to 35, wherein the network information comprises at least an International Mobile Subscriber Identity (IMSI), an authentication key, an authentication algorithms, an encryption algorithm, a decryption algorithm and a Mobile Subscriber Integrated Services Digital Network Number (MSISDN).

37. The system according to any of the preceding claims 32 to 36, wherein the identification is based on the geographic location signal broadcasted by at least one local mobile network that corresponds to geographic location of the SIM card.

38. The system according to any of the preceding claims 32 to 37, wherein the SIM module is adapted to determine whether network information corresponding to the identified geographical location is available in one or more partitions of the SIM card.

39. The system according to any of the preceding claims 32 to 38, wherein the at least one network information is pre-loaded in each partition of the plurality of partitions.

40. The system according to any of the preceding claims 32 to 39, wherein the SIM module accesses the network information corresponding to the identified geographic location, if the network information is already available in one of the partitions of the plurality of partitions.

41. The system according to any of the preceding claims 32 to 40, wherein the SIM module is adapted to:

request the network information from the subscription pool, if the network information corresponding to the identified geographic location is unavailable in one of the partition of the plurality of partitions; and

download and store the network information corresponding to the identified geographic location in one of the partitions of the plurality of partitions.

42. The system according to any of the preceding claims 32 to 41, wherein the SIM module is adapted to:

generate an access signal based on the accessed network information;

transmit, using a mobile device transmitter, the access signal to an authentication center of the mobile network corresponding to the identified geographic location; and
connect the SIM card to the mobile network of the identified geographic location when the authentication center authenticates the network information included in the access signal.

43. The system according to any of the preceding claims 32 to 42, wherein the SIM module is adapted to release the network information by deleting the network information from the partition storing the network information corresponding to the identified geographic location when the SIM card identifies another geographic location.

44. The system according to any of the preceding claims 32 to 43, wherein the subscription module quarantines the released network information for a specific time period.

45. The system according to any of the preceding claims 32 to 44, wherein different partitions of the plurality of partitions are adapted to store a plurality of network information of different geographic location.

46. The system according to any of the preceding claims 32 to 45, wherein a partition of the plurality of partitions stores home mobile network information.

47. The system according to any of the preceding claims 32 to 46, wherein the home network information is stored permanently.

48. The system according to any of the preceding claims 32 to 47, wherein the SIM module is adapted to utilize the mobile network of the identified geographic location for updating settings of the home network subscription.

49. The system according to any of the preceding claims 32 to 48, wherein the HMNO comprises an association table that is adapted to associate the home network information and the network information of the identified geographic location such that for calls made or data sent at home network MSISDN is directed to the network MSISDN of the identified location; and calls made or data sent from the network MSISDN of the identified location is displayed as received from home network MSISDN.

50. The system according to any of the preceding claims 32 to 49, further comprising features of any of the claims 1 to 31.

51. A subscription pool for mobile communication in a plurality of mobile networks, the subscription pool comprising at least one network information for each of a plurality of mobile networks, the plurality of mobile networks corresponding to a plurality of geographic location.
52. The subscription pool according to claim 51, wherein the subscription pool is communicatively connected with a Home Mobile Network Operator (HMNO) of a SIM card.

53. The subscription pool according to any of the preceding claims 51 to 52, wherein the network information comprises at least an International Mobile Subscriber Identity (IMSI), an authentication key, an authentication algorithms, an encryption algorithm, a decryption algorithm and a Mobile Subscriber Integrated Services Digital Network Number (MSISDN).

54. The subscription pool according to any of the preceding claims 51 to 53, wherein the subscription pool comprises a transmission means for transmitting network information corresponding to the request received from a SIM card.

55. The subscription pool according to any of the preceding claims 51 to 54, wherein the request is based on the geographic location identified by the SIM card.

56. The subscription pool according to any of the preceding claims 51 to 55, wherein the subscription pool comprises ranking rules for categorizing and listing the MNOs for a specific geographic location in accordance with one or more ranking criteria.

57. The subscription pool according to any of the preceding claims 51 to 56, wherein the subscription pool comprises preference table for transmitting the network information in accordance with preference setting of the SIM card user.

58. The subscription pool according to any of the preceding claims 51 to 57, further comprising features of any of the claims 1 to 50.

59. A SIM card for mobile communication in a plurality of mobile networks, the SIM card comprising a plurality of partitions adapted to storing different network information in each of the plurality of partitions.

60. The SIM card according to claim 59, wherein the different network information correspond to a plurality of geographic location.

61. The SIM card according to any of the claims 59 to 60, wherein the SIM card is registered with a subscription pool.

62. The SIM card according to any of the claims 59 to 61, further comprising a SIM module adapted to identifying a geographic location of the SIM card;
accessing, from a partition of a plurality of partitions of the SIM card, a
network information corresponding to the identified geographic location, the network
information being provided from the subscription pool; and
processing the accessed network information such that the SIM card connects
with a mobile network corresponding to the processed network information.

63. The SIM card according to any of the claims 59 to 62, further comprising features of
any of the claims 1 to 58.
FIGURE 1

105
Identifying a geographic location

100

110
Accessing a network information from a partition

115
Processing the accessed information
FIGURE 3

Identifying a geographic location

Network information in SIM?

NO

Requesting the network information from the Subscription Pool

Download the requested network information

YES

Accessing a network information from a partition

Processing the accessed information

105 200

310 305

315

110 115

4/6
FIGURE 5
# INTERNATIONAL SEARCH REPORT

**INTERNATIONAL CLASSIFICATION OF SUBJECT MATTER**

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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)

H04W

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 practicable, search terms used)

EPO-Internal, WPI Data, INSPEC

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<td>GB 2 473 753 A (TRU PHON E LTD [GB]) 23 March 2011 (20 11-03-23) page 1, line 4 - line 15 page 1, line 30 - line 51 page 3, line 6 - line 3Q page 4, line 25 - line 46 page 8, line 14 - line 16 page 9, line 4 - line 6 page 11, line 7 - line 29 page 11, line 51 - page 12, line 10 page 12, line 25 - page 13, line 29 page 14, line 13 - line 29 page 15, line 6 - line 22 page 16, line 18 - line 40 page 24, line 29 - line 37 page 28, line 7 - line 17 page 30, line 45 - page 33, line 20 figures 2-4</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

- Special categories of cited documents:
  - "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
  - "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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  - "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

Date of the actual completion of the international search: 6 September 2013

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Authorized officer
Donnini, Carlo Luca

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