the PSTN operators. In the case of a network with many roaming partners, different IMSI number ranges for different purposes, customer agreements and so forth, the risk for misconfiguration of the IMSI number conversion at one or several of the local roaming partners is non-negligible.

The present invention solves the above described problems of high roaming costs in an automatic way which requires minimum network and mobile device modification. It also solves the problem of creating a large, possibly complicated roaming network in which a method according to the said international application is used while keeping the exposure to misconfiguration by external partners to a minimum.

Thus, the invention relates to a method for use when a mobile communication device roams between a mobile communication home network in a home country and one or several mobile communication networks in one or several visited countries, which home network and networks in said visited countries are interconnected by a PSTN (Public Switched Telephone Network) operated by one or several PSTN operators, via which PSTN telephone signaling can be performed during roaming using a telephony signaling protocol, which mobile communication device comprises a Subscriber Identity Module (SIM) card identifying itself to each network using an International Mobile Subscriber Identity (IMSI), wherein the method comprises the steps of

a) storing on the SIM card a first visited country IMSI which is associated with a first collaborating mobile communication network in the first visited country, and using it for network identification of the SIM card;

b) when the mobile device is located within the coverage area of the first collaborating network, causing the

mobile device to initiate a location update procedure using the first visited country IMSI;

characterized in that the method further comprises the subsequent steps of

c) triggered by the said location update procedure and based on the first visited country IMSI used therein, causing the first collaborating network to investigate the contents of the said first IMSI, and, depending on the contents of said first IMSI, either causing a first STP (Signal Transfer Point) of the first collaborating network to send a location update message to a first ITP (Internet Transfer Point) without using the PSTN or to send the location update message to the PSTN;

d) in case the location update message was sent to the first ITP, causing the first ITP to simply forward the location update message to a home ITP via the internet and not using the PSTN, and in turn causing the home ITP to forward the location update message to a home STP of the home network; and

causing a subsequent signaling message addressed to the mobile device and using the first visited country IMSI to be sent by the home STP to the home ITP, which uses the first visited country IMSI to identify the first ITP and then forwards the subsequent message to the first ITP, over the internet and without using the PSTN, whereupon the first IPT forwards the subsequent message to the first STP for distribution to the mobile device.

Also disclosed herein is a method for use when a mobile communication device roams between a mobile communication home network in a home country and one or several mobile communication networks in one or several visited countries, which home network and networks in said visited countries are in-

terconnected by a PSTN (Public Switched Telephone Network) operated by one or several PSTN operators, via which PSTN telephone signaling can be performed during roaming using a telephony signaling protocol, which mobile communication device comprises a Subscriber Identity Module (SIM) card identifying itself to each network using an International Mobile Subscriber Identity (IMSI), which method is characterized in that the method comprises the steps of a) storing on the SIM card a first visited country IMSI which is associated with a first collaborating mobile communication network in the first visited country, and using it for network identification of the SIM card; b) when the mobile device is located within the coverage area of the first collaborating network, causing the mobile device to initiate a location update procedure using the first visited country IMSI; c) triggered by

the said location update procedure and based on the first visited country IMSI used therein, causing an STP (Signal Transfer Point) of the first collaborating network to send a location update message to a first ITP (Internet Transfer Point); and d) causing the first ITP to forward the location update message to an STP of the home network via a wide area network and not using the PSTN.

Further, the present invention relates to system for providing mobile communication signaling connection to a mobile communication device within the coverage area of a home network in a home country and one or several mobile communication networks in one or several visited countries, between which networks the mobile device can roam and which networks are interconnected by a PSTN (Public Switched Telephone Network) operated by one or several PSTN operators , via which PSTN telephone signaling can be performed during roaming using a telephony signaling protocol, which mobile communication device comprises a Subscriber Identity Module (SIM) card arranged to identify itself to a network using an International Mobile Subscriber Identity (IMSI), c h a r a c t e r - i z e d i n that the system comprises a first ITP (Internet Transfer Point) as well as functionality in a first collaborating mobile communication network in a first visited country, which functionality is arranged to investigate the contents in a first IMSI, which first IMSI is used in a location update procedure initiated by the mobile device when it is present within the coverage area of the first collaborating network, and, based upon the said first IMSI which is used therein and depending on the contents in the said first IMSI, either to cause an STP (Signal Transfer Point) in the first collaborating network to send a first location update message, comprising the first IMSI, to the first ITP, without using the PSTN, or to send the location update message to the

PSTN, in that the system further comprises a home ITP, in that the first ITP is arranged to receive the said first location update message from the STP, and in that the first ITP is further arranged to simply forward the first location update message, via the internet and not using the PSTN, to the home ITP, and the home ITP in turn being arranged to forward the location update message to a home STP of the home network, in that the home ITP is arranged to receive a subsequent signaling message, addressed to the mobile device and using the said first IMSI, from the home STP, and to use the said first IMSI to identify the first ITP and then to forward the subsequent message to the first ITP, over the internet and without using the PSTN, whereupon the first IPT is arranged to forward the subsequent message to the first STP for distribution to the mobile device.

Also disclosed herein is a system for providing mobile communication signaling connection to a mobile communication device within the coverage area of a home network in a home country and one or several mobile communication networks in one or several visited countries, between which networks the mobile device can roam and which networks are interconnected by a PSTN (Public Switched Telephone Network) operated by one or several PSTN operators, via which PSTN telephone signaling can be performed during roaming using a telephony signaling protocol, which mobile communication device comprises a Subscriber Identity Module (SIM) card arranged to identify itself to a network using an International Mobile Subscriber Identity (IMSI), which system is characterized in that the system comprises a first ITP (Internet Transfer Point), arranged to receive a first location update message comprising a first visited country IMSI, asso-ciated with a first collaborating network, from an STP (Signal Transfer Point) of the first collaborating network, and in that the first ITP is

further arranged to forward the location update message to an STP of the home network via a wide area network and not using the PSTN.

In the following, the invention will be described in detail, with reference to the appended drawings, where:

C L A I M S

1. Method for use when a mobile communication device (40) roams between a mobile communication home network (10) in a home country (3) and one or several mobile communication networks (20,26,30,36) in one or several visited countries (4,5), which home network (10) and networks (20,26,30,36) in said visited countries are interconnected by a PSTN (Public Switched Telephone Network) (1) operated by one or several PSTN operators (7,8,9), via which PSTN (1) telephone signaling can be performed during roaming using a telephony signaling protocol, which mobile communication device comprises a Subscriber Identity Module (SIM) card (41) identifying itself to each network using an International Mobile Subscriber Identity (IMSI), wherein the method comprises the steps of

a) storing on the SIM card (41) a first visited country IMSI which is associated with a first collaborating mobile communication network (20) in the first visited country (4), and using it for network identification of the SIM card (41);

b) when the mobile device (40) is located within the coverage area of the first collaborating network (20), causing the mobile device (40) to initiate a location update procedure using the first visited country IMSI;

c h a r a c t e r i z e d i n that the method further comprises the subsequent steps of

c) triggered by the said location update procedure and based on the first visited country IMSI used therein, causing the first collaborating network (20) to investigate the contents of the said first IMSI, and, depending on the contents of said first IMSI, causing a first STP (Signal Transfer Point) (25) of the first collaborating network (20) to send a location update

The Swedish Patent and Registration Office
PCT International Application

message to a first ITP (Internet Transfer Point) (29) without using the PSTN (1);

d) in case the location update message was sent to the first ITP (29), causing the first ITP (29) to simply forward the location update message to a home ITP (17) via the internet (6) and not using the PSTN (1), and in turn causing the home ITP (17) to forward the location update message to a home STP (16) of the home network (10); and

e) causing a subsequent signaling message addressed to the mobile device (40) and using the first visited country IMSI to be sent by the home STP (16) to the home ITP (17), which uses the first visited country IMSI to identify the first ITP (29) and then forwards the subsequent message to the first ITP (29), over the internet and without using the PSTN (1), whereupon the first IPT (29) forwards the subsequent message to the first STP (25) for distribution to the mobile device (40).

2. Method according to claim 1, **characterized in** that, in an initial step, the SIM card (41) is provided with a home IMSI associated with the home network (10), and in that step a) comprises the substeps

a1) initiating a location update procedure after or in connection to the mobile device (40) moving from the coverage area of the home network (10) to the coverage area of a first visited network (26) in the first visited country (4);

a2) triggered by the location update message, sending an instruction message over the air to the mobile device (40) to change, to the first visited country IMSI, the IMSI used for network identification of the SIM card (41); and

The Swedish ... PCT International Application

a3) causing the mobile device (40) to store the first visited country IMSI on the SIM card (41) and to use it for network identification of the SIM card (41).

3. Method according to any one of the preceding claims, **characterized in** that the method comprises the additional steps of

f) causing the mobile device (40) to store an APN (Access Point Name) identifying a GGSN (Gateway GPRS Support Node) (13) in the home network (10); and

g) upon a data connection attempt by the mobile device (40) using the APN, setting up an Internet data connection to the mobile device (40) via the GGSN (13) and an SGSN (Serving GPRS Support Node) (23) in the first collaborating network (20).

4. Method according to any one of the preceding claims, **characterized in** that, upon roaming from the coverage area of the first collaborating network (20) to the coverage area of a second visited network (36) in a second visited country (5) after step d) has been performed, the method comprises the additional steps

h) causing the mobile device (40) to change the IMSI used for network identification of the SIM card (41) back to the home IMSI and then to perform a device network refresh;

i) triggered by a location update message resulting from the change of IMSI used for network identification and received by the home network (10), sending an instruction message over the air to the mobile device (40) to change, to a second visited country IMSI which is associated with a second collaborating mobile communication network (30) in the second visited

The Swedish Patent Office
PCT International Application

country (5), the IMSI used for network identification of the SIM card (41); and

j) resuming the method from step b), but with the second visited country (5), second collaborating network (30), second visited country IMSI and a second ITP (39) instead of first visited country (4), first collaborating network (20), first visited country IMSI and first ITP (29), respectively.

5. Method according to any one of the preceding claims, **characterized in** that, in steps c) and d), the first visited country IMSI is not modified.

6. Method according to any one of the preceding claims, **characterized in** that the first ITP (29) is located in the first visited country (4), and in that the home ITP (17) is arranged in the home country (3).

7. Method according to any one of the preceding claims, **characterized in** that a server comprising a HLR (Home Location Registry) (18) is connected to, but arranged externally to, the home network (10), and that, in step d), the home network (10) forwards the location update message to the HLR (18) based upon the IMSI contained in the location update message.

8. Method according to any one of the preceding claims, **characterized in** that all of the said IMSI codes except possibly the home IMSI are caused to be associated with a setting in the respective HLR (12,22,32) with which the IMSI in question is associated making available data communication but not voice communication when roaming of the mobile device (40).

The Swedish Patent Office
PCT International Application

9. Method according to claim 8, **characterized in** that the data communication to and from the mobile device (40) when being served by a collaborating network (20,30) is in the form of Internet access, and is passed on to the home network (10) using a roaming exchange (2) or an Internet tunnel.

10. Method according to any one of the preceding claims, **characterized in** that the first and/or second visited country IMSI codes are caused to belong to a respective plurality of IMSI codes, which plurality is associated with a respective visited country (4,5) and caused to contain less individual IMSI codes than the total number of users of the method, and in that all IMSI codes in said plurality are caused to be associated with a HLR (22,32) of the respective collaborating network (20,30) in the respective visited country (4,5).

11. Method according to any one of the preceding claims, **characterized in** that the SIM card (41) is caused to be provided with a software application (42) arranged to monitor in which country the mobile device (40) is currently located, arranged to perform the said changes of the IMSI used for network identification and arranged to perform the said device network refresh performances.

12. Method according to claim 11, **characterized in** that the software application (42) is caused to monitor in which country the mobile device (40) is currently located by reading the country codes present in available networks at the current location of the mobile device, and in that a change of such country codes is interpreted as roaming of the mobile device (40).

13. System for providing mobile communication signaling connection to a mobile communication device (40) within the coverage area of a home network (10) in a home country (3) and one or several mobile communication networks (20,30) in one or several visited countries (4,5), between which networks (10,20,30) the mobile device (40) can roam and which networks (10,20,30) are interconnected by a PSTN (Public Switched Telephone Network) (1) operated by one or several PSTN operators (7,8,9), via which PSTN (1) telephone signaling can be performed during roaming using a telephony signaling protocol, which mobile communication device (40) comprises a Subscriber Identity Module (SIM) card (41) arranged to identify itself to a network using an International Mobile Subscriber Identity (IMSI), **characterized in** that the system comprises a first ITP (Internet Transfer Point) (29) as well as functionality in a first collaborating mobile communication network (20) in a first visited country (4), which functionality is arranged to investigate the contents in a first IMSI, which first IMSI is used in a location update procedure initiated by the mobile device (40) when it is present within the coverage area of the first collaborating network (20), and, based upon the said first IMSI which is used therein and depending on the contents in the said first IMSI, to cause an STP (Signal Transfer Point) (25) in the first collaborating network (20) to send a first location update message, comprising the first IMSI, to the first ITP (29), without using the PSTN (1), in that the system further comprises a home ITP (17), in that the first ITP (29) is arranged to receive the said first location update message from the STP (25), and in that the first ITP (29) is further arranged to simply forward the first location update message, via the internet (6) and not using the PSTN (1), to the home ITP (17), and the home ITP (17) in turn being arranged to forward the location update message to a home STP (16) of the

The Swedish Patent
PCT International Application

home network (10), in that the home ITP (17) is arranged to receive a subsequent signaling message, addressed to the mobile device (40) and using the said first IMSI, from the home STP (16), and to use the said first IMSI to identify the first ITP (29) and then to forward the subsequent message to the first ITP (29), over the internet and without using the PSTN (1), whereupon the first IPT (29) is arranged to forward the subsequent message to the first STP (25) for distribution to the mobile device (40).

14. System according to claim 13, **characterized in** that the system further comprises a second ITP (39), arranged to receive a second location update message comprising a second visited country IMSI, associated with a second collaborating network (30), from an STP (35) of the second collaborating network (30), in that the second ITP (39) is further arranged to forward the location update message to the STP (16) of the home network (10) via the internet (6) and not using the PSTN (1), and in that the home ITP (17) is also arranged to route signaling messages comprising an IMSI from the home STP (16) to either of the first (29) and second (39) ITP:s based upon the IMSI comprised in each signaling message.

15. System according to claim 13 or 14, **characterized in** that the system further comprises a HLR (Home Location Register) (18), arranged to communicate with the home STP (16) and comprising or being associated with a set of IMSI codes which are associated with the first collaborating network (20).

C L A I M S

1. Method for use when a mobile communication device roams between a mobile communication home network in a home country and one or several mobile communication networks in one or several visited countries, which home network and networks in said visited countries are interconnected by a PSTN (Public Switched Telephone Network) operated by one or several PSTN operators, via which PSTN telephone signaling can be performed during roaming using a telephony signaling protocol, which mobile communication device comprises a Subscriber Identity Module (SIM) card identifying itself to each network using an International Mobile Subscriber Identity (IMSI), wherein the method comprises the steps of

a) storing on the SIM card a first visited country IMSI which is associated with a first collaborating mobile communication network in the first visited country, and using it for network identification of the SIM card;

b) when the mobile device is located within the coverage area of the first collaborating network, causing the mobile device to initiate a location update procedure using the first visited country IMSI;

c h a r a c t e r i z e d i n that the method further comprises the subsequent steps of

c) triggered by the said location update procedure and based on the first visited country IMSI used therein, causing the first collaborating network to investigate the contents of the said first IMSI, and, depending on the contents of said first IMSI, either causing a first STP (Signal Transfer Point) of the first collaborating network to send a location update message to a first ITP (Internet Transfer Point)

without using the PSTN or to send the location update message to the PSTN;

d) in case the location update message was sent to the first ITP, causing the first ITP to simply forward the location update message to a home ITP via the internet and not using the PSTN, and in turn causing the home ITP to forward the location update message to a home STP of the home network; and

e) causing a subsequent signaling message addressed to the mobile device and using the first visited country IMSI to be sent by the home STP to the home ITP, which uses the first visited country IMSI to identify the first ITP and then forwards the subsequent message to the first ITP, over the internet and without using the PSTN, whereupon the first IPT forwards the subsequent message to the first STP for distribution to the mobile device.

2. Method according to claim 1, **characterized in** that, in an initial step, the SIM card is provided with a home IMSI associated with the home network, and in that step a) comprises the substeps

a1) initiating a location update procedure after or in connection to the mobile device moving from the coverage area of the home network to the coverage area of a first visited network in the first visited country;

a2) triggered by the location update message, sending an instruction message over the air to the mobile device to change, to the first visited country IMSI, the IMSI used for network identification of the SIM card; and

a3) causing the mobile device to store the first visited country IMSI on the SIM card and to use it for network identification of the SIM card.

3. Method according to any one of the preceding claims, **characterized in** that the method comprises the additional steps of

f) causing the mobile device to store an APN (Access Point Name) identifying a GGSN (Gateway GPRS Support Node) in the home network; and

g) upon a data connection attempt by the mobile device using the APN, setting up an Internet data connection to the mobile device via the GGSN and an SGSN (Serving GPRS Support Node) in the first collaborating network.

4. Method according to any one of the preceding claims, **characterized in** that, upon roaming from the coverage area of the first collaborating network to the coverage area of a second visited network in a second visited country after step d) has been performed, the method comprises the additional steps

h) causing the mobile device to change the IMSI used for network identification of the SIM card back to the home IMSI and then to perform a device network refresh;

i) triggered by a location update message resulting from the change of IMSI used for network identification and received by the home network, sending an instruction message over the air to the mobile device to change, to a second visited country IMSI which is associated with a second collaborating mobile communication network in the second visited country, the

IMSI used for network identification of the SIM card; and

j) resuming the method from step b), but with the second visited country, second collaborating network, second visited country IMSI and a second ITP instead of first visited country, first collaborating network, first visited country IMSI and first ITP, respectively.

5. Method according to any one of the preceding claims, **characterized in** that, in steps c) and d), the first visited country IMSI is not modified.

6. Method according to any one of the preceding claims, **characterized in** that the first ITP is located in the first visited country, and in that the home ITP is arranged in the home country.

7. Method according to any one of the preceding claims, **characterized in** that a server comprising a HLR (Home Location Registry) is connected to, but arranged externally to, the home network, and that, in step d), the home network forwards the location update message to the HLR based upon the IMSI contained in the location update message.

8. Method according to any one of the preceding claims, **characterized in** that all of the said IMSI codes except possibly the home IMSI are caused to be associated with a setting in the respective HLR with which the IMSI in question is associated making available data communication but not voice communication when roaming of the mobile device.

9. Method according to claim 8, **characterized in** that the data communication to and from the mobile de-

vice when being served by a collaborating network is in the form of Internet access, and is passed on to the home network using a roaming exchange or an Internet tunnel.

10. Method according to any one of the preceding claims, **characterized in** that the first and/or second visited country IMSI codes are caused to belong to a respective plurality of IMSI codes, which plurality is associated with a respective visited country and caused to contain less individual IMSI codes than the total number of users of the method, and in that all IMSI codes in said plurality are caused to be associated with a HLR of the respective collaborating network in the respective visited country.

11. Method according to any one of the preceding claims, **characterized in** that the SIM card is caused to be provided with a software application arranged to monitor in which country the mobile device is currently located, arranged to perform the said changes of the IMSI used for network identification and arranged to perform the said device network refresh performances.

12. Method according to claim 11, **characterized in** that the software application is caused to monitor in which country the mobile device is currently located by reading the country codes present in available networks at the current location of the mobile device, and in that a change of such country codes is interpreted as roaming of the mobile device.

13. System for providing mobile communication signaling connection to a mobile communication device within the coverage area of a home network in a home country and one or several mobile communication networks in one or several visited countries, between which networks the mobile device can roam and which networks are interconnected by a PSTN (Public Switched

Telephone Network) operated by one or several PSTN operators , via which PSTN telephone signaling can be performed during roaming using a telephony signaling protocol, which mobile communication device comprises a Subscriber Identity Module (SIM) card arranged to identify itself to a network using an International Mobile Subscriber Identity (IMSI), **characterized in** that the system comprises a first ITP (Internet Transfer Point) as well as functionality in a first collaborating mobile communication network in a first visited country, which functionality is arranged to investigate the contents in a first IMSI, which first IMSI is used in a location update procedure initiated by the mobile device when it is present within the coverage area of the first collaborating network, and, based upon the said first IMSI which is used therein and depending on the contents in the said first IMSI, either to cause an STP (Signal Transfer Point) in the first collaborating network to send a first location update message, comprising the first IMSI, to the first ITP, without using the PSTN, or to send the location update message to the PSTN, in that the system further comprises a home ITP, in that the first ITP is arranged to receive the said first location update message from the STP, and in that the first ITP is further arranged to simply forward the first location update message, via the internet and not using the PSTN, to the home ITP, and the home ITP in turn being arranged to forward the location update message to a home STP of the home network, in that the home ITP is arranged to receive a subsequent signaling message, addressed to the mobile device and using the said first IMSI, from the home STP, and to use the said first IMSI to identify the first ITP and then to forward the subsequent message to the first ITP, over the internet and without using the PSTN, whereupon the first IPT is arranged to forward the subsequent message to the first STP for distribution to the mobile device.

14. System according to claim 13, **characterized in** that the system further comprises a second ITP, arranged to receive a second location update message comprising a second visited country IMSI, associated with a second collaborating network, from an STP of the second collaborating network, in that the second ITP is further arranged to forward the location update message to the STP of the home network via the internet and not using the PSTN, and in that the home ITP is also arranged to route signaling messages comprising an IMSI from the home STP to either of the first and second ITP:s based upon the IMSI comprised in each signaling message.

15. System according to claim 13 or 14, **characterized in** that the system further comprises a HLR (Home Location Register), arranged to communicate with the home STP and comprising or being associated with a set of IMSI codes which are associated with the first collaborating network.