Title: CONFIGURING ALTERNATIVE ROAMING PROVIDER ACCESS POINT NAME VIA ACCESS NETWORK DISCOVERY AND SELECTION FUNCTION

(71) Applicant: NOKIA TECHNOLOGIES OY [FEFI]; Karaportti 3, 02610 Espoo (FI).

(71) Applicant (for LC only): NOKIA, INC. [US/US]; 102 Corporate Park Drive, White Plains, NY 10604 (US).

(72) Inventors: BERGIUS, Hannu; Keilalahdentie 2-4, FIN-02150 Espoo (FI). LINDHOLM, Rune; Keilalahdentie 2-4, FIN-02150 Espoo (FI). KAikkonen, Jorma, Joh- hannes; Keilalahdentie 2-4, FIN-02150 Espoo (FI). PIRI_LA, Hannu, Ilmar; Keilalahdentie 2-4, FIN-02150 Espoo (FI).


Declared under Rule 4.17:
- if inventorship (Rule 4.17(iv))
- with international search report (Art. 21(3))

Published:

(54) Title: CONFIGURING ALTERNATIVE ROAMING PROVIDER ACCESS POINT NAME VIA ACCESS NETWORK DISCOVERY AND SELECTION FUNCTION

(57) Abstract: Methods and apparatus, including computer program products, are provided configuring alternative roaming providers. In some example embodiments, there may be provided a method, which may include receiving, at a user equipment, at least one access network discovery and selection function management object, wherein the at least one access network discovery and selection function management object comprises at least one access point name identifying an access network of an alternative roaming provider to be used while roaming in a geographic region allowing use of the alternative roaming provider; discovering, based on at least the at least one access point name, the access network of the alternative roaming provider, when the user equipment is roaming in the geographic region; and accessing, based on at least the at least one access point name, the access network of the alternative roaming provider. Related apparatus, systems, methods, and articles are also described.

FIG. 1
CONFIGURING ALTERNATIVE ROAMING PROVIDER ACCESS POINT NAME VIA ACCESS NETWORK DISCOVERY AND SELECTION FUNCTION

FIELD

[0001] The subject matter disclosed herein relates to wireless communications.

BACKGROUND

[0002] The Access Network Discovery and Selection Function (ANDSF) provides a way for a mobile network operator to use policy-based steering of traffic between cellular access networks, such as Third Generation Partnership Project (3GPP) type access networks, and other types of networks, such as non-3GPP-type access networks (for example, wireless local area networks) and the like.

SUMMARY

[0003] In some example embodiments, there is provided a method for configuring alternative roaming providers.

[0004] In some example embodiments, there may be provided a method, which may include receiving, at a user equipment, at least one access network discovery and selection function management object, wherein the at least one access network discovery and selection function management object comprises at least one access point name identifying an access network of an alternative roaming provider to be used while roaming in a geographic region allowing use of the alternative roaming provider; discovering, based on at least the at least one access point name, the access network of the alternative roaming provider, when the user equipment is roaming in the geographic region; and accessing, based on at least the at least one access point name, the access network of the alternative roaming provider.
In some variations, one or more of the features disclosed herein including the following features can optionally be included in any feasible combination. The access network discovery and selection function management object may further include at least one location information associated with the at least one access point name, wherein the at least one location information determines whether the geographic region authorizes use of the alternative roaming provider while roaming. The discovering may further include discovering the access network of the alternative roaming provider, when the at least one location information matches a current location of the user equipment. The geographic region may include at least one European Union country. The at least one access network discovery and selection function management object may be received from a network node comprising an access network discovery and selection function. The at least one access network discovery and selection function management object may include at least one of a validity area leaf and a location leaf including the at least one location information.

Articles are also described that comprise a tangibly embodied computer-readable medium embodying instructions that, when performed, cause one or more machines (for example, computers) to result in operations described herein. Similarly, apparatus are also described that can include a processor and a memory coupled to the processor. The memory can include one or more programs that cause the processor to perform one or more of the operations described herein.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive. Further features and/or variations may be provided in addition to those set forth herein. For example, the implementations described herein may be
directed to various combinations and subcombinations of the disclosed features and/or combinations and subcombinations of several further features disclosed below in the detailed description.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0008] The accompanying drawings, which are incorporated in and constitute a part of this specification, show certain aspects of the subject matter disclosed herein and, together with the description, help explain some of the principles associated with the subject matter disclosed herein. In the drawings,

[0009] FIG. 1 depicts an example of a system for providing assistance information including an access point name for an alternative roaming provider, in accordance with some example embodiments;

[0010] FIG. 2 depicts an example of a process for evaluating assistance information including an access point name for an alternative roaming provider, in accordance with some example embodiments;

[0011] FIGs. 3A-3F depict examples of ANDSF management objects;

[0012] FIGs. 4 and 5 depict examples of systems including an alternative roaming provider; and

[0013] FIG. 6 depicts an example of a radio, in accordance with some example embodiments.

[0014] Like labels are used to refer to same or similar items in the drawings.

**DETAILED DESCRIPTION**

[0015] Roaming regulations in some jurisdictions may allow increased flexibility with respect to choosing a mobile roaming provider. For example, a user equipment, such as a smartphone, a cell phone, and the like, may be configured to
allow selection (for example, programmatically and/or by a user) of a mobile roaming provider. This selection may be performed via a contract and/or at a given location/destination when roaming. Indeed, the Body of European Regulators for Electronic Communications (BEREC) has written several technical documents that have been used in the preparation of a new roaming regulation. One of these documents compares different technical alternatives and provides recommendations that have been implemented in a regulation titled "ROAMING REGULATION - CHOICE OF DECOUPLING METHOD: A consultation to assist BEREC in preparing advice to the Commission on its forthcoming Implementing Act," June 2012. Similarly, a "REGULATION (EU) No 531/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL" of 13 June 2012, also describes roaming on public mobile communications networks within the European Union.

[0016] A technical solution for choosing a mobile roaming provider may include the use of a Local Break Out (LBO). The LBO may allow the local provisioning of data services and diverting data traffic to the visited network while roaming. Although the LBO was initially designed to optimize data traffic management when roaming, the LBO may also be used by the visited network to act as an Alternative Roaming Provider (ARP) for Internet access and other data services (which may include direct billing to consumers). The ARP thus allows a user equipment to programmatically/automatically discover another provider while roaming. The LBO may also be configured around a "single IMSI" that does not require a user to change a subscriber identity module (SIM) or a universal integrated circuit card (UICC), when accessing the Alternative Roaming Provider's network for data services. A new Access Point Name (APN) called a "EUInternet" may be
configured into a user equipment in order to programmatically/automatically discover and thus access the access network for the Alternative Roaming Provider.

[0017] The subject matter disclosed herein may, in some example embodiments, configure an Alternative Roaming Provider's Access Point Name in a user equipment before the user equipment accesses the LBO. Specifically, an Alternative Roaming Provider (ARP) Access Point Name (APN) may, in some example embodiments, be configured via assistance information provided by the network. For example, assistance information in the form of Access Network Discovery and Selection Function (ANDSF) management objects may provide one or more rules (or policies) that assist a user equipment to discover and select access networks including the Alternative Roaming Provider at a given Access Point Name while roaming. Furthermore, the geographical scope of the Alternative Roaming Provider's Access Point Name may be defined via assistance information, such as an ANDSF management object provided to the user equipment to enable discovery and selection of the Alternative Roaming Provider, while roaming in a visited network.

[0018] FIG. 1 depicts an example of a system 100 including a user equipment 114, a home ANDSF (H-ANDSF) server 199A, and/or a visiting ANDSF (V-ANDSF) server 199B, in accordance with some example embodiments. The ANDSF server may be implemented as a network element in accordance with 3GPP TS 23.402 V12.2.0 (2013-09), 3GPP TS 23.402, 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Architecture enhancements for non-3GPP accesses, (Release 12).

[0019] In some example embodiments, an ANDSF server may provide one or more rules to allow user equipment 114 to select and/or discover access networks
as part of mobility, routing, and the like. Moreover, the ANDSF server may provide one or more rules 118 indicating a certain Access Point Name of an Alternative Roaming Provider to be used when roaming in a certain jurisdiction that allows Alternative Roaming Provider. Moreover, the rule(s) 118 may specify when the APN of the ARP may be used. Furthermore, these rules and relevant parameters may be provided to the user equipment in the form of one or more management objects, such as ANDSF management objects.

[0020] In some example embodiments, user equipment 114 may receive one or more ANDSF management objects including rules from the H-ANDSF 199A and/or V-ANDSF 199B, and the management objects/rules may be related to ARP. Specifically, if the user equipment is using a European SIM or UICC, the user equipment may receive the following ANDSF management object or rule: if the (1) user equipment is roaming and the user equipment is in a country (as indicated by the mobile country code, MCC) where the European roaming regulations allow the ARP, then the user equipment may programmatically/automatically use the APN provided by the ANDSF server via a parameter, such as LocalBreakOutAPN, RoamingAPNInEurope, and the like, to access the ARP while roaming in a jurisdiction that allows use of the ARP.

[0021] FIG. 2 depicts an example of a process 200 for evaluating assistance information including an access point name (APN) for an alternative roaming provider (ARP), in accordance with some example embodiments. The description of process 200 also refers to FIG. 1.

[0022] At 205, user equipment 114 may receive assistance information from an ANDSF server, in accordance with some example embodiments. For example, an ANDSF server may provide rule(s) 118 in the form of one or more ANDSF
management objects. Moreover, the rule(s) 118 may indicate a certain APN for an ARP to be used given certain conditions, as described further below with respect to 207-210.

[0023] In some example embodiments, rule(s) 118 may specify that if user equipment 114 includes a smart card (for example, a subscriber identity module, an electronic UICC, a UICC, and the like) indicating user equipment 114 is in Europe (yes at 207), user equipment 114 is roaming (yes at 208), and a country code/mobile country code indicates a country where roaming to ARP is allowed by regulation (yes at 210), then user equipment 114 may use the APN provided at 205 to access the ARP while roaming in the visited network. Otherwise, the user equipment 114 may not be allowed to use the APN and thus the ARP.

[0024] In some example embodiments, the one or more rules 118 and the relevant policy parameters, such as MCC, APN, and the like, may be provided as in management objects, such as ANDSF management objects. When the user equipment 114 receives the APN while roaming in Europe ("RoamingAPNInEUrope") pointing to the ARP, the user equipment 114 may programmatically discover and select the ARP at the APN provided by RoamingAPNInEUrope.

[0025] As noted above, rule(s) 118 may be provided to user equipment 114 to assist it in discovering and selecting the ARP, and the rules and/or relevant parameters for the rules may be defined by management objects. These management objects may be used by an ANDSF server and/or a user equipment to exchange parameters related to intersystem mobility policy and access network discovery and selection information. In the example of FIGs. 1 and 2, rule(s) 118 may need the relevant parameters including countries (MCC, mobile country code) where the ARP roaming is permitted by regulations and an APN, such as
"EUInternet" APN (or other access point name to be used while roaming in a jurisdiction that allows use of the ARP), to be used by the user equipment. In some example embodiments, these relevant parameters may be structured in accordance with a leaf node of an ANDSF management object.

[0026] FIG. 3A depicts an example of an ANDSF management object. The ANDSF management object may be extended to include relevant parameters to process the rule(s) 118 and handle process 200.

[0027] In some example embodiments, the UEJocation leaf may be extended as shown at FIG. 3A and 3B to include one or more countries, for example a MCC 305, in accordance with the following:

<X>/UE_Location/3GPP_Location/<X>/MCC.

[0028] FIG. 3C depicts the MCC leaf 305 added, in accordance with some example embodiments, to the Discovery Information management object in accordance with the following:

<X>/DiscoveryInformation/<X>/AccessNetworkArea/3GPP_Location/<X>/MCC.

[0029] FIG. 3D depicts the MCC leaf 305 added, in accordance with some example embodiments, to the Validity Area management object in accordance with the following:

<X>/Policy/<X>/ValidityArea/3GPP_Location/<X>/MCC.

[0030] Although FIGs. 3B-C show specific locations for the MCC leaf 305, the MCC leaf may be located in other locations. Moreover, the MCC information may be provided using mechanisms other than ANDSF management objects as well.

[0031] Table 1 below depicts an example formatting for MCC leaf 305, and this MCC leaf may be used to extend the ANDSF management objects as noted above. Moreover, the MCC leaf extensions disclosed herein may be performed in
accordance with extensions to 3GPP TS 24.312, 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Access Network Discovery and Selection Function (ANDSF) Management Object (MO), (Release 12), while the format of the mobile country code (MCC) may also be defined in accordance with 3GPP TS 23.003 V12.0.0 (2013-09), 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Numbering, addressing and identification(Release 12).

[0032] Table 1: MCC leaf

<table>
<thead>
<tr>
<th>.../MCC:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Occurrence: One</td>
</tr>
<tr>
<td>- Format: chr</td>
</tr>
<tr>
<td>- Access Types: Get, Replace</td>
</tr>
<tr>
<td>- Values: &lt;MCC&gt;</td>
</tr>
</tbody>
</table>

[0033] In some example embodiments, the roaming APN information may be added as an ANDSF management object leaf. This Roaming APN in Europe leaf (RoamingAPNInEurope) 310 may configure the location of "EUInternet" APN for the user equipment.

[0034] For roaming in Europe APN, FIG. 3D depicts the roaming in Europe APN leaf added, in accordance with some example embodiments, to an ANDSF management object as RoamingAPNInEurope 310 (which represents a local breakout to be used while roaming in a jurisdiction that allows use of the ARP), in accordance with the following:

<X>/ISRP/<X>/ForFlowBased/<X>/IPFlow/<X>/RoamingAPNInEurope.
FIG. 3E depicts the roaming in Europe APN leaf added, in accordance with some example embodiments, to an ANDSF management object as RoamingAPNInEurope 310, in accordance with the following:

<X>/ISRP/<X>/ForServiceBased/<X>/RoamingAPNInEurope.

FIG. 3F depicts the APN leaf added, in accordance with some example embodiments, to an ANDSF management object as RoamingAPNInEurope 310, in accordance with the following:

<X>/ISRP/<X>/ForNonSeamlessOffload/<X>/IPFlow/<X>/RoamingAPNInEurope.

Although FIGs. 3D-F show specific locations for the RoamingAPNInEurope leaf 310, this leaf may be located in other locations. Moreover, the RoamingAPNInEurope 310 information may be provided using mechanisms other than ANDSF management objects as well.

Table 2 below depicts an example of the format for the RoamingAPNInEurope 310 leaf. This format may be defined in accordance with 3GPP TS 23.003.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RoamingAPNInEurope</strong></td>
<td></td>
</tr>
<tr>
<td>- Occurrence: ZeroOrOne</td>
<td></td>
</tr>
<tr>
<td>- Format: chr</td>
<td></td>
</tr>
<tr>
<td>- Access Types: Get, Replace</td>
<td></td>
</tr>
<tr>
<td>- Values: &lt;EUInternet&gt;</td>
<td></td>
</tr>
</tbody>
</table>

FIG. 4 depicts an example framework 400 for an ARP implementation. In the example of FIG. 4, user equipment 114 may be roaming in a visited network 430 and access the LBO in the visited network. When process 200
allows user equipment 114 to select and discover ARP 410 (via for example process 200), user equipment 114 may access ARP 410 via the APN (for example, RoamingAPNInEurope 310). In a visited access roaming scenario, user equipment 114 may obtain access to the packet data network from the visited public land mobile network 430. As LBO is generally designed for data services, the following services may be billed by the Home Public Land Mobile Network (HPLMN) rather than the Alternative Roaming Provider (ARP): circuit Switched (CS) calls, short message service (SMS) messages, multimedia messaging service (MMS), service level agreement (SLA) based Virtual Private Networks (VPN), home network controlled voice evolution features, such as Voice over LTE (VoLTE) and Rich Communication Services (RCS), and the like.

[0041] Before providing additional examples, the following provides an example of a system framework in which some of the example embodiments described herein may be implemented.

[0042] FIG. 5 depicts a system 500 including a wireless access point, such as a base station 510, in accordance with some example embodiments. In the example of FIG. 5, base station 510 may be implemented as an eNB base station serving a user equipment 114, although base station may be configured as any other type of wireless access point as well including for example, a WiFi wireless access point, a small cell access point, and/or any other radio access technology.

[0043] Base station 510 may, in some exemplary embodiments, be implemented as an evolved Node B (eNB) type base station, as noted above. When this is the case, base station 110A may be configured in accordance with standards, including the Long Term Evolution (LTE) standards, such as 3GPP TS 36.201, Evolved Universal Terrestrial Radio Access (E-UTRA); Long Term Evolution (LTE)
physical layer; General description, 3GPP TS 36.211, Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation, 3GPP TS 36.212, Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding, 3GPP TS 36.213, Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures, 3GPP TS 36.214, Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer - Measurements, and any subsequent additions or revisions to these and other 3GPP series of standards (collectively referred to as LTE standards). In the case base station is a small cell wireless access point, it may, in some exemplary embodiments, be implemented as a WiFi access point, a picocell base station, a femtocell base station, a home base station, and/or a home E-UTRAN node B base station (HeNB), although any other type of access point may be used as well.

[0044] Base station 510 may have wired and/or wireless backhaul links to other network nodes, such as a mobility management entity, other base stations, wireless access points, a radio network controller, a core network, a serving gateway, the Internet, a home network 420, an ARP 410, and/or the like.

[0045] In some exemplary embodiments, system 500 may include wireless access links. The access links may include downlinks for transmitting to user equipment and an uplink for transmitting from user equipment to a base station or wireless access point. The downlink and uplink may each comprise a modulated radio frequency carrying information, such as user data, assistance information, ANDSF management objects, rules/policies, and/or the like.

[0046] In some exemplary embodiments, user equipment 114 may be implemented as a mobile device and/or a stationary device. The user equipment 114 are often referred to as, for example, mobile stations, mobile units, subscriber
stations, wireless terminals, tablets, smart phones, or the like. A user equipment may be implemented as, for example, a wireless handheld device, a wireless plug-in accessory, or the like. In some cases, user equipment may include a processor, a computer-readable storage medium (for example, memory, storage, and/or the like), a radio access mechanism, and/or a user interface.

[0047] Although FIG. 1 depicts single base station 510, a single user equipment 114, and the like, system 500 may include other quantities and types of devices as well.

[0048] FIG. 6 illustrates a block diagram of an apparatus 10, in accordance with some example embodiments. For example, apparatus 10 may comprise a radio, such as a user equipment, a smart phone, mobile station, a mobile unit, a subscriber station, a wireless terminal, a tablet, a wireless plug-in accessory, a wireless access point, a base station, and/or or any other device with device having a transceiver.

[0049] The apparatus 10 may include at least one antenna 12 in communication with a transmitter 14 and a receiver 16. Alternatively transmit and receive antennas may be separate.

[0050] The apparatus 10 may also include a processor 20 configured to provide signals to and receive signals from the transmitter and receiver, respectively, and to control the functioning of the apparatus. Processor 20 may be configured to control the functioning of the transmitter and receiver by effecting control signaling via electrical leads to the transmitter and receiver. Likewise, processor 20 may be configured to control other elements of apparatus 10 by effecting control signaling via electrical leads connecting processor 20 to the other elements, such as a display or a memory. The processor 20 may, for example, be embodied in a variety of ways
including circuitry, at least one processing core, one or more microprocessors with accompanying digital signal processor(s), one or more processor(s) without an accompanying digital signal processor, one or more coprocessors, one or more multi-core processors, one or more controllers, processing circuitry, one or more computers, various other processing elements including integrated circuits (for example, an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), and/or the like), or some combination thereof. Accordingly, although illustrated in FIG. 6 as a single processor, in some example embodiments the processor 20 may comprise a plurality of processors or processing cores.

[0051] Signals sent and received by the processor 20 may include signaling information in accordance with an air interface standard of an applicable cellular system, and/or any number of different wireline or wireless networking techniques, comprising but not limited to Wi-Fi, wireless local access network (WLAN) techniques, such as Institute of Electrical and Electronics Engineers (IEEE) 802.11, 802.16, and/or the like. In addition, these signals may include speech data, user generated data, user requested data, and/or the like.

[0052] The apparatus 10 may be capable of operating with one or more air interface standards, communication protocols, modulation types, access types, and/or the like. For example, the apparatus 10 and/or a cellular modem therein may be capable of operating in accordance with various first generation (1G) communication protocols, second generation (2G or 2.5G) communication protocols, third-generation (3G) communication protocols, fourth-generation (4G) communication protocols, Internet Protocol Multimedia Subsystem (IMS) communication protocols (for example, session initiation protocol (SIP) and/or the like. For example, the apparatus 10 may be capable of operating in accordance with
2G wireless communication protocols IS-136, Time Division Multiple Access TDMA, Global System for Mobile communications, GSM, IS-95, Code Division Multiple Access, CDMA, and/or the like. In addition, for example, the apparatus 10 may be capable of operating in accordance with 2.5G wireless communication protocols General Packet Radio Service (GPRS), Enhanced Data GSM Environment (EDGE), and/or the like. Further, for example, the apparatus 10 may be capable of operating in accordance with 3G wireless communication protocols, such as Universal Mobile Telecommunications System (UMTS), Code Division Multiple Access 2000 (CDMA2000), Wideband Code Division Multiple Access (WCDMA), Time Division-Synchronous Code Division Multiple Access (TD-SCDMA), and/or the like. The apparatus 10 may be additionally capable of operating in accordance with 3.9G wireless communication protocols, such as Long Term Evolution (LTE), Evolved Universal Terrestrial Radio Access Network (E-UTRAN), and/or the like. Additionally, for example, the apparatus 10 may be capable of operating in accordance with 4G wireless communication protocols, such as LTE Advanced and/or the like as well as similar wireless communication protocols that may be subsequently developed.

[0053] It is understood that the processor 20 may include circuitry for implementing audio/video and logic functions of apparatus 10. For example, the processor 20 may comprise a digital signal processor device, a microprocessor device, an analog-to-digital converter, a digital-to-analog converter, and/or the like. Control and signal processing functions of the apparatus 10 may be allocated between these devices according to their respective capabilities. The processor 20 may additionally comprise an internal voice coder (VC) 20a, an internal data modem (DM) 20b, and/or the like. Further, the processor 20 may include functionality to
operate one or more software programs, which may be stored in memory. In general, processor 20 and stored software instructions may be configured to cause apparatus 10 to perform actions. For example, processor 20 may be capable of operating a connectivity program, such as a web browser. The connectivity program may allow the apparatus 10 to transmit and receive web content, such as location-based content, according to a protocol, such as wireless application protocol, WAP, hypertext transfer protocol, HTTP, and/or the like.

[0054] Apparatus 10 may also comprise a user interface including, for example, an earphone or speaker 24, a ringer 22, a microphone 26, a display 28, a user input interface, and/or the like, which may be operationally coupled to the processor 20. The display 28 may, as noted above, include a touch sensitive display, where a user may touch and/or gesture to make selections, enter values, and/or the like. The processor 20 may also include user interface circuitry configured to control at least some functions of one or more elements of the user interface, such as the speaker 24, the ringer 22, the microphone 26, the display 28, and/or the like. The processor 20 and/or user interface circuitry comprising the processor 20 may be configured to control one or more functions of one or more elements of the user interface through computer program instructions, for example, software and/or firmware, stored on a memory accessible to the processor 20, for example, volatile memory 40, non-volatile memory 42, and/or the like. The apparatus 10 may include a battery for powering various circuits related to the mobile terminal, for example, a circuit to provide mechanical vibration as a detectable output. The user input interface may comprise devices allowing the apparatus 20 to receive data, such as a keypad 30 (which can be a virtual keyboard
presented on display 28 or an externally coupled keyboard) and/or other input devices.

[0055] As shown in FIG. 6, apparatus 10 may also include one or more mechanisms for sharing and/or obtaining data. For example, the apparatus 10 may include a short-range radio frequency (RF) transceiver and/or interrogator 64, so data may be shared with and/or obtained from electronic devices in accordance with RF techniques. The apparatus 10 may include other short-range transceivers, such as an infrared (IR) transceiver 66, a Bluetooth (BT) transceiver 68 operating using Bluetooth wireless technology, a wireless universal serial bus (USB) transceiver 70, a Bluetooth Low Energy transceiver, a ZigBee transceiver, an ANT transceiver, a cellular device-to-device transceiver, a wireless local area link transceiver, and/or any other short-range radio technology. Apparatus 10 and, in particular, the short-range transceiver may be capable of transmitting data to and/or receiving data from electronic devices within the proximity of the apparatus, such as within 10 meters, for example. The apparatus 10 including the WiFi or wireless local area networking modem may also be capable of transmitting and/or receiving data from electronic devices according to various wireless networking techniques, including 6LoWPan, Wi-Fi, Wi-Fi low power, WLAN techniques such as IEEE 802.11 techniques, IEEE 802.15 techniques, IEEE 802.16 techniques, and/or the like.

[0056] The apparatus 10 may comprise memory, such as a subscriber identity module (SIM) 38, a removable user identity module (R-UIM), an eUICC, an UICC, and/or the like, which may store information elements related to a mobile subscriber. In addition to the SIM, the apparatus 10 may include other removable and/or fixed memory. The apparatus 10 may include volatile memory 40 and/or non-volatile memory 42. For example, volatile memory 40 may include Random Access
Memory (RAM) including dynamic and/or static RAM, on-chip or off-chip cache memory, and/or the like. Non-volatile memory 42, which may be embedded and/or removable, may include, for example, read-only memory, flash memory, magnetic storage devices, for example, hard disks, floppy disk drives, magnetic tape, optical disc drives and/or media, non-volatile random access memory (NVRAM), and/or the like. Like volatile memory 40, non-volatile memory 42 may include a cache area for temporary storage of data. At least part of the volatile and/or non-volatile memory may be embedded in processor 20. The memories may store one or more software programs, instructions, pieces of information, data, and/or the like which may be used by the apparatus for performing the functions of the apparatus including process assistance information, ANDSF rules and management objects, selection of ARPs, process 200, and the like. The memories may comprise an identifier, such as an international mobile equipment identification (IMEI) code, capable of uniquely identifying apparatus 10. The functions may include one or more of the operations disclosed herein with respect to user equipment 114 and the like. The memories may comprise an identifier, such as an international mobile equipment identification (IMEI) code, capable of uniquely identifying apparatus 10. In the example embodiment, the processor 20 may be configured using computer code stored at memory 40 and/or 42 to provide operations disclosed herein with respect to user equipment 114 (for example, process 200 and the like).

[0057] Some of the embodiments disclosed herein may be implemented in software, hardware, application logic, or a combination of software, hardware, and application logic. The software, application logic, and/or hardware may reside on memory 40, the control apparatus 20, or electronic components, for example. In some example embodiment, the application logic, software or an instruction set is
maintained on any one of various conventional computer-readable media. In the context of this document, a "computer-readable medium" may be any non-transitory media that can contain, store, communicate, propagate or transport the instructions for use by or in connection with an instruction execution system, apparatus, or device, such as a computer or data processor circuitry, with examples depicted at FIG. 6, computer-readable medium may comprise a non-transitory computer-readable storage medium that may be any media that can contain or store the instructions for use by or in connection with an instruction execution system, apparatus, or device, such as a computer. For example, the computer-readable medium may include computer program code which when executed by processor circuitry provides operations disclosed herein with respect to the user equipment (for example, process 200 and the like).

[0001] Without in any way limiting the scope, interpretation, or application of the claims appearing herein, a technical effect of one or more of the example embodiments disclosed herein may, in some example implementations, include facilitating roaming to alternative providers in certain jurisdictions.

[0002] The subject matter described herein may be embodied in systems, apparatus, methods, and/or articles depending on the desired configuration. For example, the base stations and user equipment (or one or more components therein) and/or the processes described herein can be implemented using one or more of the following: a processor executing program code, an application-specific integrated circuit (ASIC), a digital signal processor (DSP), an embedded processor, a field programmable gate array (FPGA), and/or combinations thereof. These various implementations may include implementation in one or more computer programs that are executable and/or interpretable on a programmable system including at least one
programmable processor, which may be special or general purpose, coupled to receive data and instructions from, and to transmit data and instructions to, a storage system, at least one input device, and at least one output device. These computer programs (also known as programs, software, software applications, applications, components, program code, or code) include machine instructions for a programmable processor, and may be implemented in a high-level procedural and/or object-oriented programming language, and/or in assembly/machine language. As used herein, the term "computer-readable medium" refers to any non-transitory computer program product, machine-readable medium, computer-readable storage medium, apparatus and/or device (for example, magnetic discs, optical disks, memory, Programmable Logic Devices (PLDs)) used to provide machine instructions and/or data to a programmable processor, including a non-transitory machine-readable medium that receives machine instructions. Similarly, systems are also described herein that may include a processor and a memory coupled to the processor. The memory may include one or more programs that cause the processor to perform one or more of the operations described herein.

[0003] Although a few variations have been described in detail above, other modifications or additions are possible. In particular, further features and/or variations may be provided in addition to those set forth herein. Moreover, the implementations described above may be directed to various combinations and subcombinations of the disclosed features and/or combinations and subcombinations of several further features disclosed above. Other embodiments may be within the scope of the following claims.

[0004] The different functions discussed herein may be performed in a different order and/or concurrently with each other. Furthermore, one or more of the
above-described functions may be optional or may be combined. Although various aspects of the invention are set out in the independent claims, other aspects of the invention comprise other combinations of features from the described embodiments and/or the dependent claims with the features of the independent claims, and not solely the combinations explicitly set out in the claims. It is also noted herein that while the above describes example embodiments of the invention, these descriptions should not be viewed in a limiting sense. Rather, there are several variations and modifications, which may be made without departing from the scope of the present invention as, defined in the appended claims. The term "based on" includes "based on at least."
WHAT IS CLAIMED:
1. A method comprising:
   receiving, at a user equipment, at least one access network discovery and selection function management object, wherein the at least one access network discovery and selection function management object comprises at least one access point name identifying an access network of an alternative roaming provider to be used while roaming in a geographic region allowing use of the alternative roaming provider;
   discovering, based on at least the at least one access point name, the access network of the alternative roaming provider, when the user equipment is roaming in the geographic region; and
   accessing, based on at least the at least one access point name, the access network of the alternative roaming provider.
2. The method of claim 1, wherein the access network discovery and selection function management object further comprises at least one location information associated with the at least one access point name, and wherein the at least one location information determines whether the geographic region authorizes use of the alternative roaming provider while roaming.
3. A method as in claims 1-2, wherein the discovering further comprises:
   discovering the access network of the alternative roaming provider, when the at least one location information matches a current location of the user equipment.
4. A method as in claims 1-3, wherein the geographic region comprises at least one European Union country.
5. A method as in claims 1-4, wherein the least one access network discovery and selection function management object is received from a network node comprising an access network discovery and selection function.

6. A method as in claims 1-5, wherein the at least one access network discovery and selection function management object includes at least one of a validity area leaf and a location leaf including the at least one location information.

7. An apparatus, comprising:

   at least one processor; and

   at least one memory including computer program code,

   the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to perform at least the following:

   receive, at the apparatus, at least one access network discovery and selection function management object, wherein the at least one access network discovery and selection function management object comprises at least one access point name identifying an access network of an alternative roaming provider to be used while roaming in a geographic region allowing use of the alternative roaming provider;

   discover, based on at least the at least one access point name, the access network of the alternative roaming provider, when the apparatus is roaming in the geographic region; and

   access, based on at least the at least one access point name, the access network of the alternative roaming provider.
8. The apparatus of claim 7, wherein the access network discovery and selection function management object further comprises at least one location information associated with the at least one access point name, and wherein the at least one location information determines whether the geographic region authorizes use of the alternative roaming provider while roaming.

9. An apparatus as in claims 7-8, wherein the access network of the alternative roaming provider is discovered, when the at least one location information matches a current location of the apparatus.

10. An apparatus as in claims 7-9, wherein the geographic region comprises at least one European Union country.

11. An apparatus as in claims 7-10, wherein the least one access network discovery and selection function management object is received from a network node comprising an access network discovery and selection function.

12. An apparatus as in claims 7-11, wherein the at least one access network discovery and selection function management object includes at least one of a validity area leaf and a location leaf including the at least one location information.

13. A non-transitory computer-readable medium including computer program code, which when executed by at least processor circuitry causes operations comprising:

   receiving, at a user equipment, at least one access network discovery and selection function management object, wherein the at least one access network discovery and selection function management object comprises at least one access point name identifying an access network of an
alternative roaming provider to be used while roaming in a geographic region allowing use of the alternative roaming provider;

discovering, based on at least the at least one access point name, the access network of the alternative roaming provider, when the user equipment is roaming in the geographic region; and

accessing, based on at least the at least one access point name, the access network of the alternative roaming provider.

14. An apparatus comprising:

means for receiving at least one access network discovery and selection function management object, wherein the at least one access network discovery and selection function management object comprises at least one access point name identifying an access network of an alternative roaming provider to be used while roaming in a geographic region allowing use of the alternative roaming provider;

means for discovering, based on at least the at least one access point name, the access network of the alternative roaming provider, when the apparatus is roaming in the geographic region; and

means for accessing, based on at least the at least one access point name, the access network of the alternative roaming provider.

15. The apparatus of claim 14, wherein the access network discovery and selection function management object further comprises at least one location information associated with the at least one access point name, and wherein the at least one location information determines whether the geographic region authorizes use of the alternative roaming provider while roaming.
16. An apparatus as in claims 14-15, wherein the means for discovering further comprises:

means for discovering the access network of the alternative roaming provider, when the at least one location information matches a current location of the apparatus.

17. An apparatus as in claims 14-16, wherein the geographic region comprises at least one European Union country.

18. An apparatus as in claims 14-17, wherein the least one access network discovery and selection function management object is received from a network node comprising an access network discovery and selection function.

19. An apparatus as in claims 14-18, wherein the at least one access network discovery and selection function management object includes at least one of a validity area leaf and a location leaf including the at least one location information.
UE receives assistance information including rule regarding ARP APN

European (U)SIM?

YES

ROAMING?

YES

MCC Code where roaming rules apply?

YES

UE uses the APN provided at 205 (RoamingAPNInEurope)

FIG. 2
FIG. 4
A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W8/18
ADD.

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, COMPENDEX, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
</table>

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:
  * "A" document defining the general state of the art which is not considered to be of particular relevance
  * "E" earlier application or patent but published on or after the international filing date
  * "L" document which may throw doubts on priority claim(s) one of which is cited in the text of the document under consideration
  * "C" 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: 22 October 2014

Date of mailing of the international search report: 29/10/2014

Name and mailing address of the ISA:
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040
Fax: (+31-70) 340-3016

Authorized officer: Rosenauer, Hubert
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>wo 2012/092935 AI (NOKIA SIEMENS NETWORKS 0Y [FI]; MUSTAJARVI JARI PEKKA [FI]; TERVONEN J) 12 July 2012 (2012-07-12) page 1, line 4 - line 6 page 1, line 16 - line 22 page 5, line 30 - page 8, line 32 page 9, line 34 - page 10, line 3 page 19, line 15 - line 37 page 20, line 26 - line 35 figures 2, 3, 8</td>
<td>1-19</td>
</tr>
<tr>
<td>A</td>
<td>wo 2014/005654 AI (NOKIA SIEMENS NETWORKS 0Y [FI]; FORSSELL MIKA [FI]; MUSTAJARVI JARI PE) 9 January 2014 (2014-01-09) page 1, line 2 - line 4 page 7, line 9 - page 8, line 11 page 10, line 10 - line 18 page 15, line 19 - line 30 page 18, line 14 - page 19, line 6 page 23, line 6 - line 14 figures 1, 4,</td>
<td>1-19</td>
</tr>
<tr>
<td>Category</td>
<td>Citation of document, with indication, where appropriate, of the relevant passages</td>
<td>Relevant to claim No.</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>A</td>
<td>WO 2011/038771 A1 (NOKIA SIEMENS NETWORKS OY [FI] ; TERVONEN JANNE PETTERI [FI] ; MUSTAJARV) 7 April 1 2011 (2011-04-07) page 1, line 5 - line 7 page 1, line 26 - line 334 page 4, line 31 - page 5, line 27 page 9, line 28 - page 18, line 9 page 16, line 26 - line 32 page 17, line 31 - page 18, line 2 page 19, line 31 - page 20, line 26 page 2233, line 8 - page 24, line 8 page 25, line 24 - page 26, line 2 figures 3, 5, 6</td>
<td>1-19</td>
</tr>
</tbody>
</table>

Form PCT/ISA/210 (continuation of second sheet) (April 2008)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>WO 2012092935 A1</td>
<td>12-07-2012</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>WO 2014005654 A1</td>
<td>09-01-2014</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>WO 2011038771 A1</td>
<td>07-04-2011</td>
<td>CN 102668642 A</td>
<td>12-09-2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2484153 A1</td>
<td>08-08-2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2012264412 A1</td>
<td>18-10-2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2011038771 A1</td>
<td>07-04-2011</td>
</tr>
</tbody>
</table>