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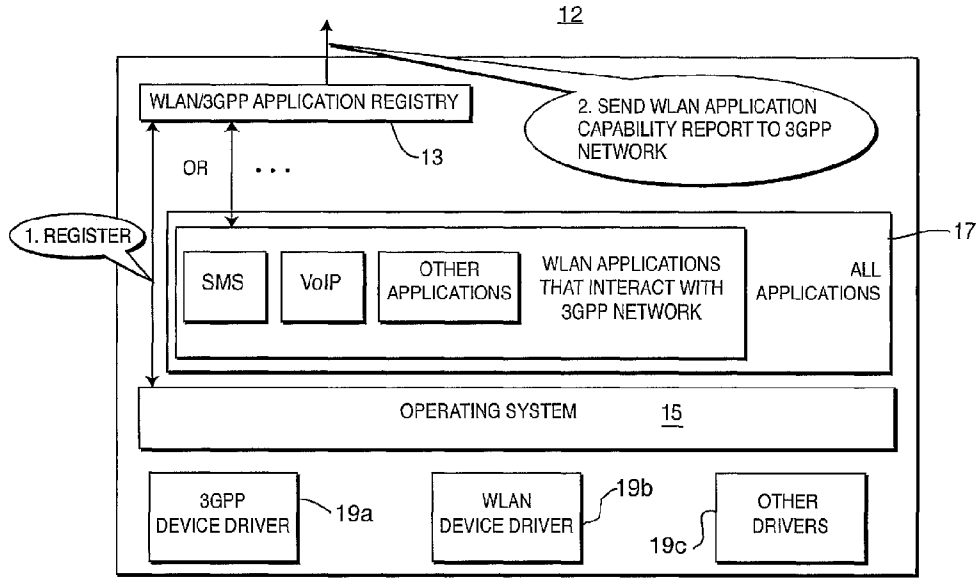
(54) Title: METHOD AND APPARATUS FOR EFFICIENTLY DELIVERING SUPPLEMENTARY SERVICES TO MULTI-TECHNOLOGY CAPABLE WIRELESS TRANSMIT/RECEIVE UNITS




(57) Abstract: A wireless transmit receive unit (WTRU), method and system for efficiently handling various types of wireless services across multiple wireless access technologies for WTRUs that may operate in multiple types of networks is disclosed.

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[0001] METHOD AND APPARATUS FOR EFFICIENTLY DELIVERING SUPPLEMENTARY SERVICES TO MULTI-TECHNOLOGY CAPABLE WIRELESS TRANSMIT/RECEIVE UNITS

[0002] FIELD OF INVENTION

[0003] The present invention relates to wireless communication systems. More particularly, the present invention relates to delivery of services to multi-technology capable wireless transmit/receive units.

[0004] BACKGROUND

[0005] Although the meanings of the following acronyms are well understood by skilled artisans, the following list is deemed to assist in a better understanding of the invention:

[0006]

| | |
|---|---|
| 3GPP | third generation partnership project |
| AAA | authentication, authorization, and accounting |
| AP | access point |
| CCF | charging control function |
| CSCF | call state control function |
| EIR | equipment identity register |
| GGSN | gateway GPRS support node |
| GMSC | gateway MSC |
| GPRS | general packet radio system |
| GSM | global system for mobile communication |
| HLR | home location register |
| HSS | home subscriber server |
| IP | internet protocol |
| IWMSC | interworking MSC for SMS |
| MMS | multi-media services |
| MS | mobile station |
| MSC | mobile switching station |
| PDG | packet data gateway |
| PHY | physical layer |

| | |
|---|---|
| PDA | personal digital assistant |
| SC | service center |
| SIM | subscriber identity module |
| SMS | short messaging service |
| TCP | transmission control protocol |
| UMTS | universal mobile telecommunications system |
| VoIP | voice over internet protocol |
| WAG | wireless application gateway |
| WAT | wireless access technology |
| WLAN | wireless local area network |
| WTRU | wireless transmit/receive unit |

[0007] The trend in the wireless industry is to increasingly support wireless transmit/receive units (WTRUs) that support multiple Wireless Access Technologies (WATs) in heterogeneous networks. Network interworking introduces the possibility of several WATs (e.g., several different types of wireless local area networks) such 802.11a, 802.11b, 802.11g, etc. being connected to a cellular type network (e.g., a Universal Mobile Telecommunications System (UMTS) network). Further, using subscriber identity module (SIM) technology, users may switch their 802.11b card to an 802.11a card, for example, or any other type of multi-mode card using their SIM to access the network while the network is not totally aware of the WAT supported at the WTRU level. Additionally, users may use their 802.11 cards, for example, in different types of WTRUs, such as when they obtain a new laptop or personal digital assistant (PDA), for example.

[0008] In light of the above, it is desirable to efficiently handle various types of wireless services across multiple WATs for WTRUs that may operate in cellular and WLAN type networks.

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**SUMMARY**

The present invention is a method and system for efficiently handling various types of wireless services across multiple wireless access technologies for WTRUs that may operate in different types of networks.

In accordance with an embodiment the present invention provides a method for providing services to a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) including:

sending an application capability report from the WTRU to a wireless local area network (WLAN);

transmitting from the WLAN said report to a cellular network;

storing said report within the cellular network;

acknowledging receipt of said report by the cellular network to the WTRU; and

consulting the stored report in the cellular network to determine if the WTRU supports a service when operating in a WLAN mode prior to attempting to deliver the service.

In accordance with a further embodiment the present invention provides an apparatus for providing services to a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) including:

the WTRU configured to send an application capability report to a wireless local area network (WLAN);

the WLAN configured to transmit said report to a cellular network;

the cellular network configured to store said report and to acknowledge receipt of said report to the WTRU via the WLAN; and

a service source configured to consult the stored report in the cellular network to determine if the WTRU supports a service when operating in a WLAN mode prior to attempting to deliver the service.

In accordance with still a further embodiment the present invention provides a method for providing services to a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) including:

determining a location of the WTRU by obtaining a packet data gateway or wireless application gateway (PDG/WAG) address in a cellular network in response to receiving a short message system (SMS) message for the WTRU by the cellular network;

forwarding the SMS message to a PDG/WAG having the determined address;

sending a request from the PDG/WAG to the WTRU via a wireless local area network (WLAN) to provide SMS capabilities;

responding to the request by the WTRU sending the PDG/WAG via the WLAN a SMS capabilities report; and

delivering the SMS message to said WTRU through said WLAN where the report received by the PDG/WAG reflects that the WTRU supports the SMS message.

In accordance with still a further embodiment the present invention provides a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) including:

an application capability report generator configured to a generate a report identifying services the WTRU can support via a wireless local area network (WLAN) to which it is connected; and

a transmitter configured to send a generated capability report via a WLAN.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is a WTRU logical block diagram embodying the principles of the present invention.

Figure 2 is a block diagram of steps involved in performing a registration-based operation wherein a capability report is provided in accordance with present invention.

Figure 2A is a timeline illustration of the procedure illustrated in Figure 2.

Figure 3 is a block diagram of steps involved in performing a network-solicited operation wherein a capability report is provided in accordance with the present invention.

Figure 3A is a timeline illustration of the procedure illustrated in Figure 3.

[0017] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0018] Hereafter, a WTRU includes, but is not limited to, a user equipment, mobile station, fixed or mobile subscriber unit, pager, PDA or any other type of device capable of operating in a wireless environment. When referred to hereafter, a base station includes but is not limited to a Node B, site controller, access point (AP) or any other type of interfacing device in a wireless environment.

[0019] Figure 1 is a simplified logical block diagram of the layers provided in a WTRU 12, it being understood that a similar layered structure is provided in the network. The objective is to convey the capabilities of the WTRU to the network so that the network can tailor the services provided to the WTRU in accordance with the WTRU's capabilities. As an example, devices such as a PDA, a laptop equipped with a wireless communication card and a cell phone may all be capable of communicating with a WLAN, but each device has different capabilities. A laptop typically has a larger memory and greater processing power than both a PDA and a cell phone. Different laptops may have different capabilities; one laptop being able to conduct video conferencing while another laptop being unable to support such services.

[0020] Referring to Figure 2, a process for WTRU registration that includes the generation and transmittal of a capability report as shown, by combining notification of services supported by the WTRU with a registration process, the network is then able to tailor the services provided to the WTRU communicating with the network. Each time a multi-WATs WTRU, also referred to as a multi-technology WTRU (i.e., a WTRU capable of operating in more than one type of wireless network), successfully registers for service with an authentication, authorization and accounting (AAA) server 16 of a 3GPP network 14 through WLAN access network 22, a WLAN application capability report is sent to the 3GPP network 14 and preferably to the home subscriber server (HSS) 18.

[0021] With reference to Figure 1, initially, the WTRU operating system 15, at step (1), directs the registry application 13 to register the WTRU with the network, for example, the WTRU registers with the 3GPP network through a WLAN. At step (2), the registry application generates and sends a capability report based on either information from the operating system 15 or applications module 17 of the WTRU to include WLAN applications that interact with the 3GPP network, such as short message service (SMS) and voice over IP (VoIP), as well as any other currently supported applications. Drivers, such as a 3GPP driver 19a and WLAN device driver 19b, as well as other drivers 19c, support the services obtained from the network. The layers 13, 17, 15 and associated drivers are also provided in the network to support registry, receipt and storage of the capability report and, subsequent thereto, to provide the services identified in the capability report obtained from the WTRU.

[0022] The WLAN capability report is preferably a list of all supported air interface (PHY) capabilities currently supported by the WTRU 12 (e.g., 802.11a, 802.11b, 802.11x, 802.16, 802.20, UMTS-FDD, UMTS-TDD, TDSCDMA, GPRS, CDMA2000, or any other type of wireless network).

[0023] The WLAN capability report preferably also includes a list of all supported applications/services currently supported by the WTRU (e.g., web browsing, email, SMS, VoIP, or any other type of wireless service). The list of supported services can be associated with certain PHY capabilities (e.g., 802.11b card with MMS service capabilities). The list may also indicate third generation (3G) interworking such as 3GPP and/or 3GPP2 (e.g., GPRS/802.11 dual-mode cards supporting GPRS based SMS services) and/or other services developed in the future for existing or future networks. Optionally, the lists can identify the type and capacity of equipment of the WTRU, i.e. whether the WTRU is a cell phone, lap top computer, etc. with memory and processing speed capacities. The information regarding the device capability may be stored in the device drivers illustrated in Figure 1.

[0024] The SMS message is preferably sent from a 3GPP network to a WTRU on an 802.11 network that is displayed to a user. The lists described above are preferably standardized.

[0025] The WLAN capability report is generated by a "thin" application program for generating the capability report. The "thin" application program can be on top of the operating system (e.g., like a Windows® program) and, being "thin," does not require thousands of lines of code, but requires only several hundred lines of code. For example, the "thin" program is provided in the WLAN/3GPP application registry (AR) 13 in the WTRU 12 shown in Figure 1, wherein the network registry queries the WTRU's operating system 15 or the applications module 17, to determine the list of relevant applications.

[0026] As illustrated in Figure 2, the capability report is preferably sent encrypted from the end user WTRU (currently on a WLAN) through WLAN access network 22 to the 3GPP AAA server 16, which forwards the report to the 3GPP HSS/HLR 18/20. The report is preferably sent encrypted via transmission control protocol/internet protocol (TCP/IP) from the WTRU 12 on the WLAN to the 3GPP AAA server 16, at step (2), and the 3GPP AAA server 16 then preferably forwards the report to the HSS 18 as part of the WLAN registration process, at step (3). The HSS/HLR 18/20 sends an acknowledgement (ACK) to the AAA server 16, at step (4) which sends an ACK to WTRU 12 through WLAN network 22, at step (5).

[0027] Thereafter, whenever the HSS/HLR 18/20 is queried for the location and capability of the user, a relevant check is made to determine if the user's WTRU supports that capability in the WLAN network.

[0028] Referring to the top portion of Figure 2, WLAN access network 22 communicates with 3GPP AAA server 16 through a Wr/Wb interface. HSS 18 and HLR 20 communicate with 3GPP AAA server 16 through interfaces Wx and D'/Gr', respectively.

[0029] As indicated in parentheses in Figure 2, the system components and steps involved in performing a registration based operation are preferably:

1. WTRU 12 generates WLAN application capability report.
2. WTRU 12 transmits report via WLAN 22 to 3GPP AAA server 16.
3. 3GPP AAA server 16 forwards report to HSS/HLR 18/20.
4. HSS/HLR 18/20 acknowledges the report to AAA server 16.
5. 3GPP 14 acknowledges the report to the WTRU 12 via WLAN 22.

Thereafter, any 3GPP node that attempts to deliver service to the WTRU in the WLAN network will check if the WTRU supports the service in WLAN mode.

[0030] The timing of these steps is shown and described in greater detail in Figure 2A, wherein a capability report is created at step S1, the WTRU 12 generating a WLAN application capability report and, at step S2, transmitting the report to the 3GPP AAA server 16 through WLAN 22 (shown in Figure 2). The 3GPP AAA server 16, at step S3, forwards the report to HSS 18 and HSS 18, at step S4, stores the report and, at step S5, acknowledges the report, sending an acknowledgement (ACK) to AAA server 16. AAA server 16, at step S6, sends an ACK to WTRU 12 through WLAN access network 22. Then, any 3GPP node that delivers service to the WTRU 12 in the WLAN network can first determine if the WTRU supports the service when operating in WLAN mode, by accessing HSS 18.

[0031] Referring now to Figure 3, the system components are the same as those shown in Figure 2. The preferred steps involved in performing a network-solicited capability operation, as indicated in parentheses in Figure 3, can be summarized as follows:

1. SMS message is sent from SC 24.
2. GMSC 26 queries HSS 18 about WTRU 12 location.
3. HSS 18 returns PDG/WAG 28 address.
4. GMSC 26 forwards SMS to PDG/WAG 28.

5. PDG/WAG 28 queries the WTRU 12 via WLAN 22 about SMS capabilities.

6. WTRU 12 lists all service capabilities and reports to PDG/WAG 28. If successful, PDG/WAG 28 delivers SMS to WTRU 12 through WLAN 22.

[0032] · Timing of these steps is shown in Figure 3A wherein a capability report has not previously been provided. In this embodiment, a short message system (SMS) message is sent from service center (SC) 24 to a gateway Mobile Switching Center (MSC) or an interworking MSC for SMS (GMSC/IWSMC) 26, at step S1, and responsive thereto, GMSC/IWSMC 26, at step S2, queries HSS 18 about the WTRU location. The HSS 18, at step (3), provides a packet data gateway or a wireless application gateway (PDG/WAG) address to the GMSC/IWSMC 26 and the GMSC/IWSMC 26, at step S4, forwards the SMS message to the PDG/WAG 28. The PDG/WAG 28, at step S5, queries the WTRU 12 (through WLAN access network 22 shown in Figure 3) about its SMS capabilities and WTRU 12, at step S6, and through WLAN access network 22, lists all service capabilities and provides a report to the PDG/WAG 28. Then, if successful, the PDG/WAG 28, at step S7, delivers SMS to WTRU 12. If not successful, the PDG/WAG 28 denies service, at step S7A.

[0033] It should be noted that although the present invention has been described in connection with an interworking 3GPP and WLAN, it is important to note that the present invention may be implemented in all types of wireless communication systems and further in any combination.

* * *

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for providing services to a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) including:

sending an application capability report from the WTRU to a wireless local area network (WLAN);

transmitting from the WLAN said report to a cellular network;

storing said report within the cellular network;

acknowledging receipt of said report by the cellular network to the WTRU; and

consulting the stored report in the cellular network to determine if the WTRU supports a service when operating in a WLAN mode prior to attempting to deliver the service.

2. The method of claim 1 wherein:

the WLAN transmits said report to an authentication, authorization, and accounting (AAA) server in the cellular network;

the storing said report within the cellular network includes forwarding said report within the cellular network to at least one of a home subscriber server (HSS) and home location register (HLR); and

the acknowledging receipt of said report by the cellular network to the WTRU includes acknowledging receipt of said report to the AAA server by the HSS or the HLR and reporting the acknowledgment by the AAA to the WTRU via the WLAN; and

the consulting the stored report in the cellular network includes consulting the acknowledging HLR or HSS to determine if the WTRU supports a service when operating in a WLAN mode prior to attempting to deliver the service.

3. The method of claim 1 further including sending said report during registration by the WTRU with the cellular network via the WLAN.

4. The method of claim 3 wherein the WTRU sends an application capability report identifying services the WTRU can support selected from the group consisting of 802.11a, 802.11b, 802.11c, 802.11g, 802.11h.

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5. The method of claim 1 wherein the WTRU sends an application capability report identifying a type of equipment of the WTRU.

6. The method of claim 2 wherein WTRU transmits said report to the AAA of a cellular network selected from the group consisting of GSM, 3GPP, GPRS and UMTS.

7. Apparatus for providing services to a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) including:

the WTRU configured to send an application capability report to a wireless local area network (WLAN);

the WLAN configured to transmit said report to a cellular network;

the cellular network configured to store said report and to acknowledge receipt of said report to the WTRU via the WLAN; and

a service source configured to consult the stored report in the cellular network to determine if the WTRU supports a service when operating in a WLAN mode prior to attempting to deliver the service.

8. The apparatus of claim 7 wherein:

the WLAN is configured to transmit said report to an authentication, authorization, and accounting (AAA) server in the cellular network;

the cellular network is configured to forward said report within the cellular network to at least one of a home subscriber server (HSS) and home location register (HLR) and to acknowledge receipt of said report to the AAA server by the HSS or the HLR and to report the acknowledgment by the AAA to the WTRU; and

the service source is configured to consult the acknowledging HLR or HSS to determine if the WTRU supports a service when operating in a WLAN mode prior to attempting to deliver the service.

9. The apparatus of claim 7 wherein the WTRU is configured to generate and send said report during registration with the cellular network via the WLAN.

10. The apparatus of claim 7 wherein the WTRU is configured to generate and send said report identifying services the WTRU can support selected from the group consisting of 802.11a, 802.11b, 802.11c, 802.11g, 802.11h.

11. The apparatus of claim 7 wherein the WTRU is configured to generate and send said report identifying the type of equipment of the WTRU.

12. The apparatus of claim 11 wherein the WTRU is of a type taken from a group consisting of a laptop, a personal digital assistant (PDA) and a cell phone.

13. The apparatus of claim 7 wherein the WTRU is configured to generate and send said report during registration with a cellular network selected from the group consisting of GSM, 3GPP, GPRS and UMTS.

14. A method for providing services to a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) including:

determining a location of the WTRU by obtaining a packet data gateway or wireless application gateway (PDG/WAG) address in a cellular network in response to receiving a short message system (SMS) message for the WTRU by the cellular network;

forwarding the SMS message to a PDG/WAG having the determined address;

sending a request from the PDG/WAG to the WTRU via a wireless local area network (WLAN) to provide SMS capabilities;

responding to the request by the WTRU sending the PDG/WAG via the WLAN a SMS capabilities report; and

delivering the SMS message to said WTRU through said WLAN where the report received by the PDG/WAG reflects that the WTRU supports the SMS message.

15. A wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) including:

an application capability report generator configured to a generate a report identifying services the WTRU can support via a wireless local area network (WLAN) to which it is connected; and

a transmitter configured to send a generated capability report via a WLAN.

16. The invention of claim 15 wherein the WTRU is configured to generate and send an application capability report during registration with a cellular network via a WLAN.

17. The invention of claim 15 wherein the WTRU is configured to generate and send an application capability report identifying services the WTRU can support selected from the group consisting of 802.11a, 802.11b, 802.11c, 802.11g, 802.11h.

18. The invention of claim 15 wherein the WTRU is configured to generate and send an application capability report identifying the type of equipment of the WTRU.

19. The invention of claim 18 wherein the WTRU is of a type taken from a group consisting of a laptop, a personal digital assistant (PDA) and a cell phone.

20. The invention of claim 15 wherein the WTRU is configured to generate and send an application capability report during registration with a cellular network selected from the group consisting of GSM, 3GPP, GPRS and UMTS.

21. A method for providing services to a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) according to claim 1 and substantially as hereinbefore described with reference to the drawings.

22. Apparatus for providing services to a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) according to claim 7 and substantially as hereinbefore described with reference to the drawings.

23. A method for providing services to a wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) according to claim 14 and substantially as hereinbefore described with reference to the drawings.

24. A wireless transmit receive unit (WTRU) that is multi-wireless access technology capable (WAT-capable) according to claim 15 and substantially as hereinbefore described with reference to the drawings.

**INTERDIGITAL TECHNOLOGY CORPORATION**

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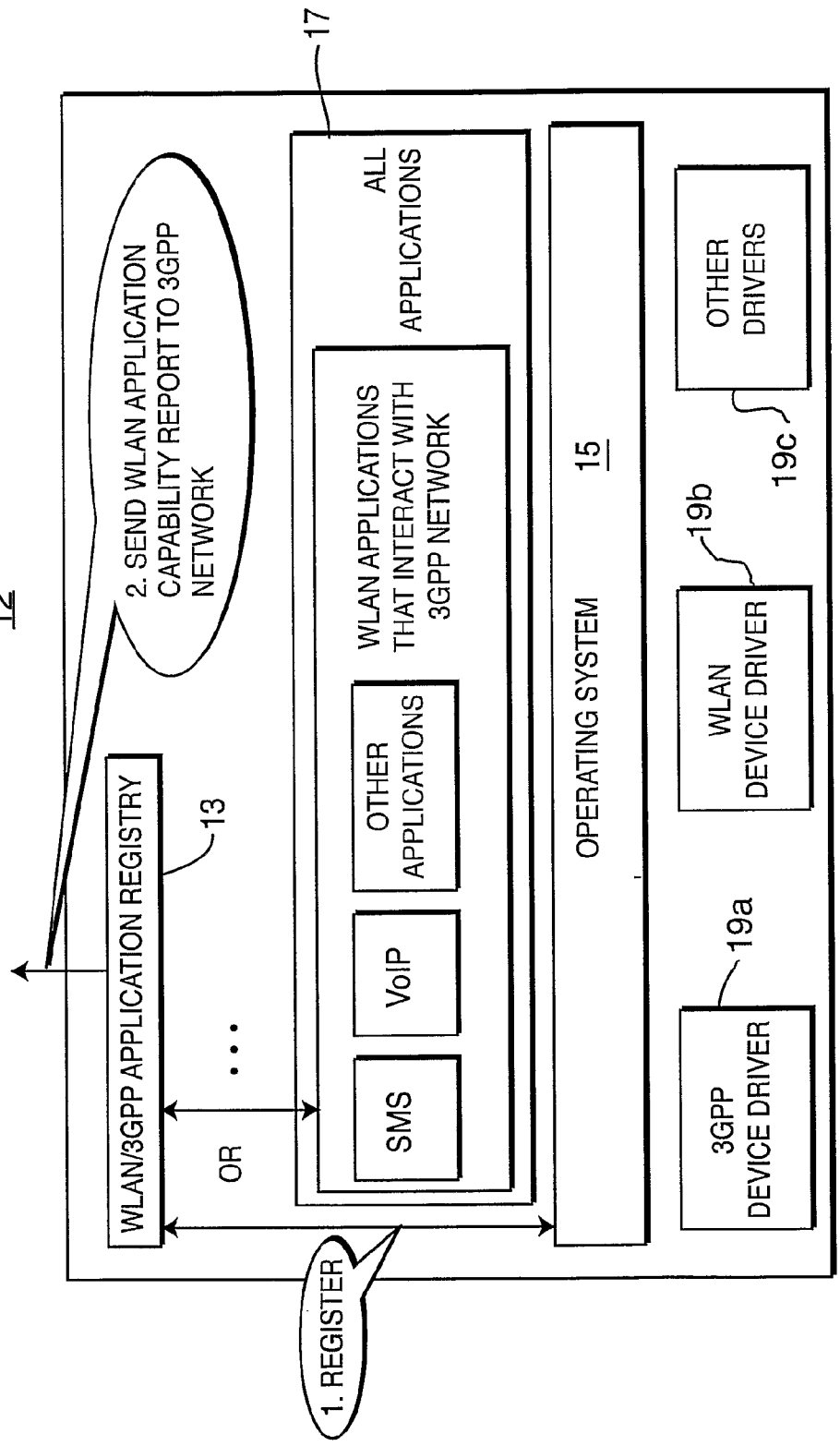
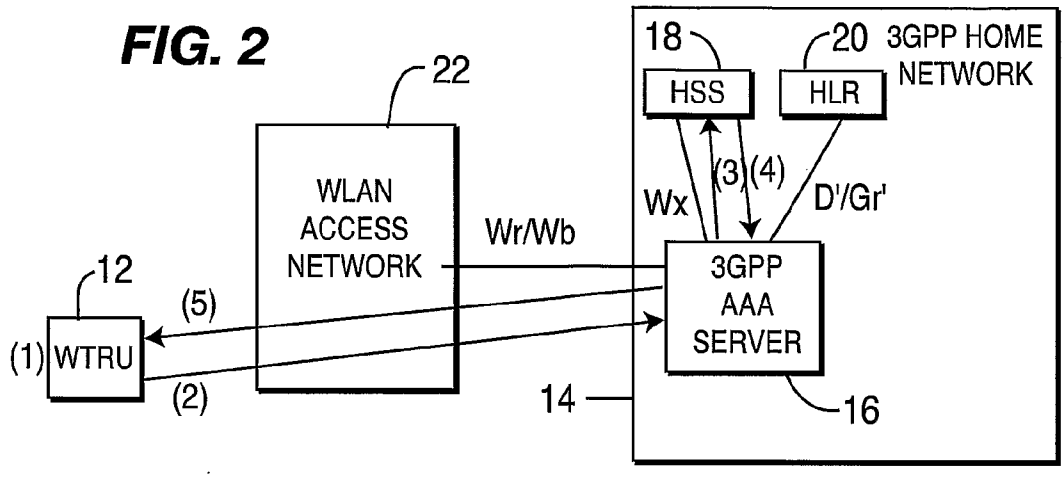

12
17
ALL APPLICATIONS
WLAN APPLICATIONS THAT INTERACT WITH 3GPP NETWORK
OTHER APPLICATIONS
VoIP
SMS
2. SEND WLAN APPLICATION CAPABILITY REPORT TO 3GPP NETWORK
WLAN/3GPP APPLICATION REGISTRY
13
OR
1. REGISTER
OPERATING SYSTEM
15
OTHER DRIVERS
19c
WLAN DEVICE DRIVER
19b
3GPP DEVICE DRIVER
19a

FIG. 1

**FIG. 2**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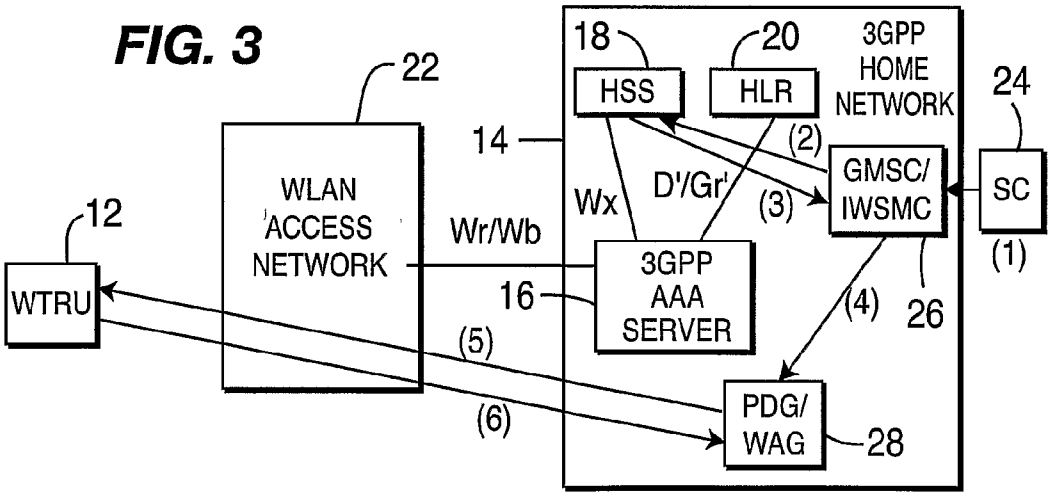
HSS
HLR
22
WLAN ACCESS NETWORK
Wx
(3)
(4)
D'/Gr'
Wr/Wb
12
(5)
(1)
WTRU
3GPP AAA SERVER
(2)
14
16

**FIG. 3**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(3)
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(4)
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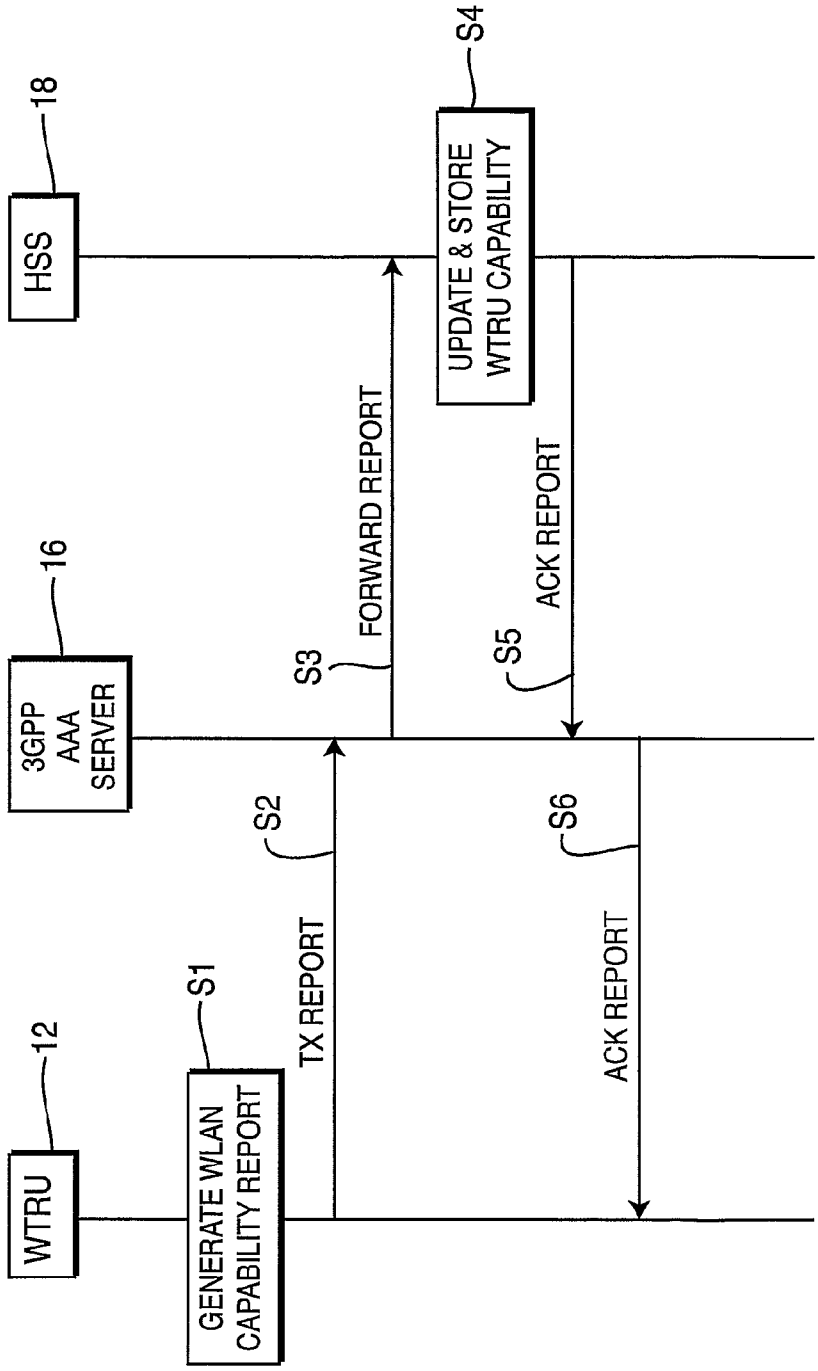
(5)
PDG/ WAG
28
(6)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12
GENERATE WLAN CAPABILITY REPORT
S1
TX REPORT
S2
3GPP AAA SERVER
16
FORWARD REPORT
S3
HSS
18
UPDATE & STORE WTRU CAPABILITY
S4
ACK REPORT
S5
ACK REPORT
S6

FIG. 2A

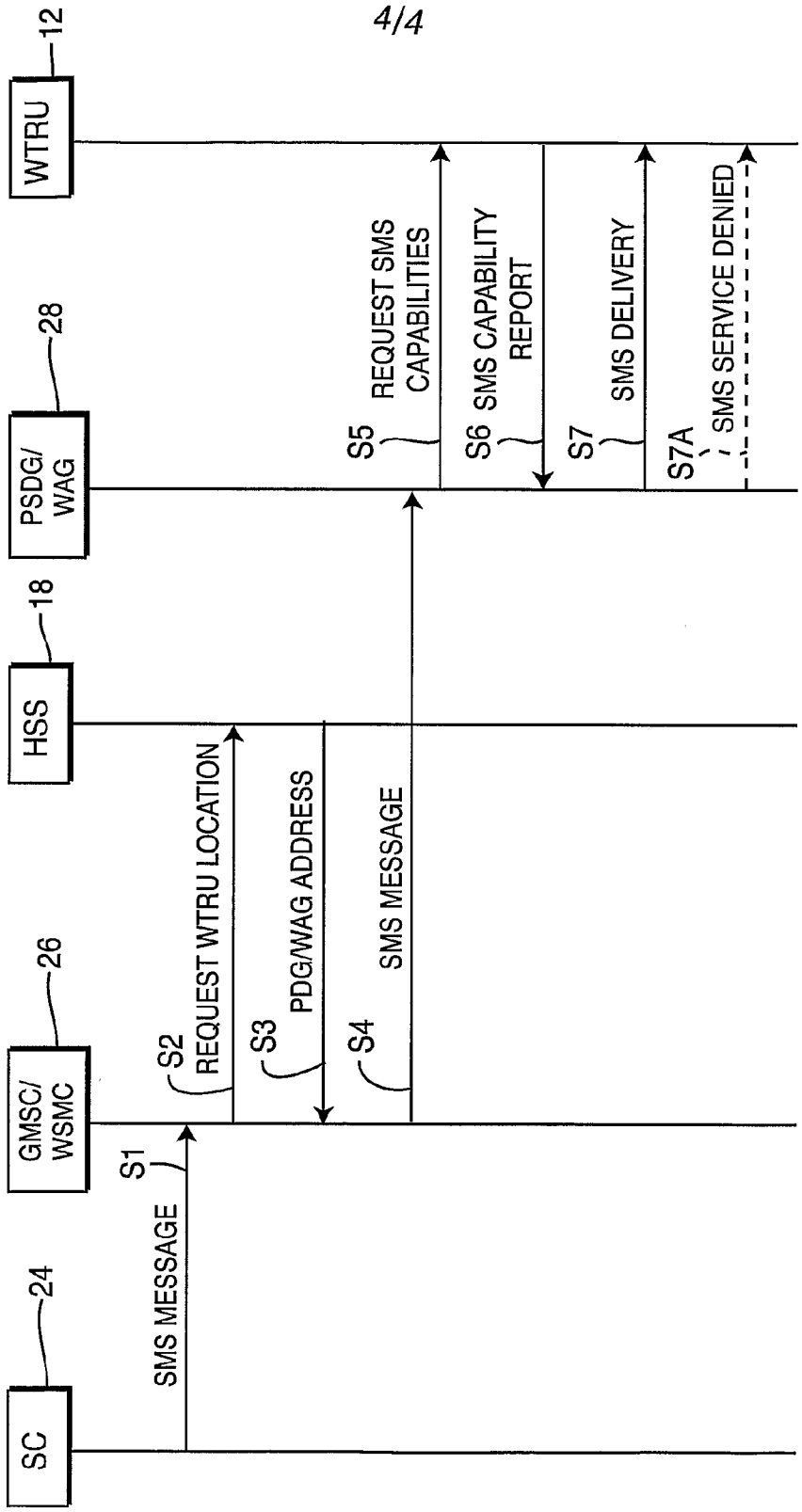
SC
24
GMSC/
WSMC
26
HSS
18
PSDG/
WAG
28
WTRU
12
SMS MESSAGE
S1
S2
REQUEST WTRU LOCATION
S3
PDG/WAG ADDRESS
S4
SMS MESSAGE
S5
REQUEST SMS
CAPABILITIES
S6
SMS CAPABILITY
REPORT
S7
SMS DELIVERY
S7A
SMS SERVICE DENIED

FIG. 3A