

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
17 August 2006 (17.08.2006)

PCT

(10) International Publication Number
WO 2006/085222 A1

(51) International Patent Classification:
H04Q 7/38 (2006.01) *H04Q* 7/22 (2006.01)
H04L 12/28 (2006.01)

(21) International Application Number:
PCT/IB2006/000556

(22) International Filing Date:
13 February 2006 (13.02.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0503040.8 14 February 2005 (14.02.2005) GB

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

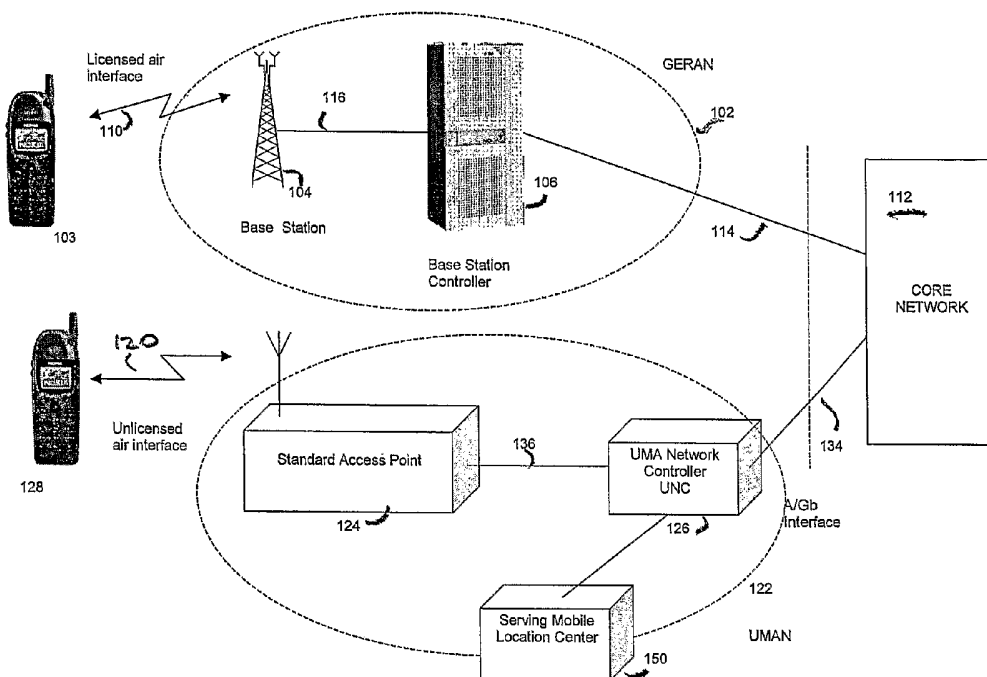
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: LOCATION SERVICES FOR UNLICENSED MOBILE ACCESS



(57) Abstract: There is disclosed a method of supporting location services in an unlicensed mobile access network, comprising transferring location related information between one or more mobile stations and a network control element.

LOCATION SERVICES FOR UNLICENSED MOBILE ACCESS

BACKGROUND TO THE INVENTION:

Field of the Invention:

The present invention relates to unlicensed mobile access
5 networks, and more particularly to the support of
location services in such networks.

Description of the Related Art:

"Unlicensed Mobile Access" (UMA) is a proposal to create
a BSS (base station sub-system) look-alike access system
10 architecture for "tunneled GSM" over two existing
unlicensed-band radio interfaces: Bluetooth and WiFi
(802.11). It is proposed that UMA may be used, for
example, for coverage extensions in indoor applications
(such as home or office applications) to capture
15 otherwise fixed line traffic for cellular operators. In
the US, UMA is perceived as a cheaper way to provide
missing coverage to domestic users at home than via a
macro network.

There is a current European proposal to use UMA
20 architectures in combination with a GSM (global system
for mobile communication) RAN (radio access network),
known as a GERAN. The unlicensed mobile access network
(UMAN) is proposed to consist of UMA network controllers
(UNCs), and access points (APs), which APs conform to a
25 BlueTooth or WiFi standard as appropriate.

The UMA signaling protocol architecture for circuit
switched domain (between a mobile station, an access
point, and an UNC) is shown in Figure 1.

A consortium of companies (reference can be made to <http://www.umatechnology.org/>) have drafted specifications for UMANs. Location Services in UMA

At least some of these UMAN specifications include some
5 discussion of location services (LCS).

The published document "UMA Architecture (Stage 2) R1.0.2" discusses LCS support. Specifically discussed is emergency service support for United States Federal Communications Code (FCC) E911 Phase 2 requirements. A
10 number of ways in which the location of a terminal performing an emergency call may be obtained are discussed (in chapter 9.17.2.1). In one way the UNC may maintain a database of AP locations. The AP location is provided from a terminal via a known URR REGISTER
15 REQUEST/URR REGISTER UPDATE message or via some management interface. In another way the terminal may provide its current location (e.g. obtained via the A-GPS interface) in a URR REGISTER/UPDATE message. In another way the UNC can look up a location database based on a
20 public IP address and/or MAC address of a terminal.

Location services are discussed in chapter 9.18 of the published document "UMA Architecture (Stage 2) R1.0.2". Cell information (of possibly available GSM coverage) may be used by the UNC to determine the location of a
25 terminal. As another possibility, the AP identity is mentioned. Cell and AP information can be provided from the terminal to the UNC using URR-REGISTER and URR-REGISTER UPDATE messages.

Likewise, the document "UMA Protocols (Stage 3) R1.0.2"
30 discusses LCS support. URR REGISTER REQUEST and URR REGISTER UPDATE UPLINK messages are identified as including the following information elements (IE) useful for location purposes: AP radio identity; cell identity;

Geographic Location; and AP location. AP radio identity IE is used for transmission of Bluetooth Device address (BD_ADDR) or WLAN MAC Address of AP. There is a field called "Type of Identity" which contains only a value
5 "IEEE MAC-address format". Other values are for future use. A cell identity IE identifies the cellular cell. A geographic location IE can be used to deliver, for example, an A-GPS location estimate from the terminal. An AP location IE is for indicating the location of a
10 terminal or an AP to the network.

T-Mobile USA has proposed in the UMA Forum that the Lb interface should be used between a UMA network controller (UNC) and a serving mobile location centre (SMLC). The Lb interface is the 3GPP GERAN standardized interface
15 between a base station controller (BSC) and the SMLC. The Lb interface and the protocol stack between a SMLC, BSC, and Mobile Station (MS) (as described in 3GPP TS 43.059 v6.4.0) is shown in Figure 3.

The RRLP (Radio Resource LCS Protocol) is a protocol that
20 defines the location related information exchanged directly between a MS and the SMLC. Currently the RRLP supports Enhanced Observed Time Difference (E-OTD), Global Positioning System (GPS), and Assisted GPS (A-GPS) location methods.

25 The proposal from T-Mobile USA to use the 3GPP standardized Lb interface between an UNC and a SMLC provides for the possibility to reuse existing GERAN SMLCs in the UMAN. However a problem with UMA specifications, as can be seen from the document "UMA
30 Protocols (Stage3) R1.0.2, is that there is no mechanism to deliver E-OTD, GPS, or A-GPS related information from the UNC towards mobile stations. There are no messages or

information elements available that could include such information.

While E-OTD, which requires that the mobile station can receive signals from at least three separate base station sites, may not usually be a feasible location method with
5 UMA, A-GPS can be expected to be an important solution for UMA.

SUMMARY OF THE INVENTION:

A method of supporting location services in an unlicensed
10 mobile access network, comprising transferring location related information between one or more mobile stations and a network control element.

The location related information may include one or more of: enhanced observed time difference information; global
15 positioning system, GPS, information; or assisted GPS location information.

The location information may be transferred by inclusion in a unlicensed mobile access message. The location information may be transferred in an information element
20 in a unlicensed mobile access message.

The location related information may be transferred in a new unlicensed radio resource, URR, message. The location related information may be transferred in a modified existing unlicensed radio resource, URR, message. The
25 location related information may be transferred in a modified existing unlicensed radio resource, URR, message enhanced to contain one or more new information elements.

An unlicensed radio resource message including a measure position request may be transmitted from the network
30 control element to a mobile station. An unlicensed radio resource message including a measure position response

may be transmitted from a mobile station to a network control element.

An unlicensed radio resource message including assistance data may be transmitted from the network control element to a mobile station. An unlicensed radio resource message including an assistance data acknowledgement may be transmitted from a mobile station to a network control element.

There may be provided an unlicensed mobile access network including a network control element and a network access point, in which there is supported location services, in which one or more mobile stations and a network control element are adapted to transfer location related information therebetween.

15

The transfer of location information may comprise inclusion of location information in an unlicensed mobile access message. The transfer of location information may comprise inclusion of location information in an information element of an unlicensed mobile access message.

The invention may provide a mobile station for connection in an unlicensed mobile access network, the mobile station being adapted to communicate location related information between with a network control element of the unlicensed mobile access network.

The location information may be received and transmitted by the mobile station in an unlicensed mobile access message, such as in an information element in a unlicensed mobile access message.

The location related information may be received and transmitted by the mobile station in a new unlicensed radio resource, URR, message. The location related information may be received and transmitted by the mobile station in a modified existing unlicensed radio resource, URR, message. The location related information may be received and transmitted in a modified existing unlicensed radio resource, URR, message enhanced to contain one or more new information elements.

10 An unlicensed radio resource message including a measure position request may be received by the mobile station from the network control element. An unlicensed radio resource message including a measure position response may be transmitted from the mobile station to a network control element.

An unlicensed radio resource message including assistance data may be received by the mobile station from the network control element. An unlicensed radio resource message including an assistance data acknowledgement may be transmitted from the mobile station to a network control element.

The invention may provide a network access point for an unlicensed mobile access network, the network access point being adapted to communicate location related information with one or mobile stations of the unlicensed mobile access network.

The location related information may be received and transmitted by the access point in a new unlicensed radio resource, URR, message. The location related information may be received and transmitted by the access point in a modified existing unlicensed radio resource, URR, message. The location related information may be received

and transmitted in a modified existing unlicensed radio resource, URR, message enhanced to contain one or more new information elements.

5 An unlicensed radio resource message including a measure position request may be transmitted by the network access point to the mobile station. An unlicensed radio resource message including a measure position response may be received by the access point from the mobile station.

10 An unlicensed radio resource message including assistance data may be transmitted by the network control element to the mobile station. An unlicensed radio resource message including an assistance data acknowledgement may be received by the access point from the mobile station.

BRIEF DESCRIPTION OF THE FIGURES:

15 The invention is described by way of example with reference to the accompanying figure in which:

Figure 1 illustrates a UMA signaling protocol architecture for circuit switched domain;

20 Figure 2 illustrates signaling between a serving mobile location centre and a target mobile station in the circuit switched domain in a GERAN;

Figure 3 illustrates a proposed unlicensed mobile access architecture in which the invention and embodiments thereof may be implemented;

25 Figure 4 illustrates RRLP over UMA-RR signaling protocol architecture for a circuit switched domain;

Figure 5 illustrates RRLP measure position procedure with new RRLP carrying URR message; and

30 Figure 6 illustrates RRLP assistance data procedure with new RRLP carrying URR message.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

The invention is described herein by way of example with reference to a number of embodiments. The invention is described in the context of an unlicensed mobile access system operating in conjunction with a licensed mobile access system, and specifically, in exemplary embodiments, a GERAN system.

With reference to Figure 3, there is shown a GERAN 102 including at least one base station 104 and at least one base station controller 106. A mobile station 108 is connected, via a licensed air interface 110, to the base station 104 of the GERAN 102. The base station 104 is connected to the base station controller 106 via a communication link 116. The base station controller 106 is connected to a core network 112 via an A/Gb interface connection 114.

With further reference to Figure 3, there is shown a UMA 122 including at least one standard access point 124, or network access point, and at least one UMA network controller (UNC) 126, or network control element. A mobile station 128, being a UMA terminal, is connected, via an unlicensed air interface 120, to the standard access point 124 of the UMAN 122. The standard access point 124 is connected to the UNC 126 via a communication link 136. The UNC 126 is connected to the core network 112 via an A/Gb interface connection 134.

The architecture of network arrangements as illustrated in Figure 3 is known to those skilled in the art. It should be noted that the mobile stations 108 and 128 are preferably configured to connect in either a GERAN or a UMAN, in accordance with available network coverage and implementation requirements.

A SMLC 150 is provided as part of the UMAN 122.

The invention and embodiments thereof provides for an enhancement to unlicensed mobile access so that it is possible to transfer E-OTD, GPS, and A-GPS related information between mobile stations and UNC's.

- 5 In embodiments this is preferably done either by: including in UMA messages specific information elements; or by allowing RRLP messages to be transported in UMA signaling, i.e providing containers for RRLP messages.

Referring to the Figure 1, the preferred layer for this is the UMA-RR layer. There are two alternatives for this. In
10 a first possibility a new Unlicensed Radio Resources (URR) message is created that contains A-GPS and other information. In a second possibility some existing URR messages are enhanced to contain new information
15 elements.

By way of an implementation example, a case may be considered with new URR messages that contain RRLP messages. The protocol stack would then be as shown in Figure 4.

- 20 One possible signaling scenario is as shown in Figure 5, for an RRLP measure position procedure.

As represented by message 502, the SMLC 150 sends a RRLP Measure Position Request to the UNC 126 over the Lb interface. This RRLP message may, for example, carry a
25 request for location information, and it may also contain GPS assistance data.

The UNC 126 packs the RRLP Measure Position Request into a new "URR RRLP" message 504 that it sends to the MS 128. URR RRLP is a specific URR message intended to carry RRLP
30 messages between the UNC and MSs.

The MS 128 responds with a RRLP Measure Position Response message, that may contain for example an A-GPS location estimate, embedded in a URR RRLP message 506.

5 The UNC 126 forwards the RRLP Measure Position Response 508 to the SMLC 150.

In a similar fashion, the RRLP Assistance data procedure according to an embodiment of the invention is described with reference to Figure 6.

10 The SMLC 150 sends a RRLP Assistance Data message 602 to the UNC 126 over the Lb interface. This RRLP message may for example carry GPS assistance data.

The UNC 126 packs the RRLP Assistance Data into a URR RRLP message 604 that it sends to the MS 128.

15 The MS 128 responds with a RRLP Assistance Data Ack. message embedded in a URR RRLP message 606.

The UNC 126 forwards the RRLP Assistance Data Ack. Message 608 to the SMLC 150.

20 The above discussion of the problem addresses by embodiments of the invention, and discussion of the embodiments themselves, has been given assuming usage of the Lb interface between an UNC and a SMLC.

However, the problem and the embodiments of the invention are also valid with other possible interfaces between the UNC and the SMLC. For example the Iu-PC interface, that
25 is defined for UTRAN between a SMLC and a RNC, may be adapted with RRC messages corresponding to RRLP messages.

The problem and embodiments of the invention are also valid even in the case where there is no interface, i.e. where there is provided a combined UNC and SMLC.

The invention, and embodiments thereof, advantageously provide an A-GPS and E-OTD location method which can be used with UMA; without needing new hardware.

5 As A-GPS is the main location method in 3G and 2G mobile communication standards, a mechanism to carry A-GPS assistance data from the UNC to the mobile is advantageous.

10 The invention, and embodiments thereof, provide for various advantages and improvements to the art. These advantages include improved location information. The uncertainty of location information can be estimated. Potential large location estimation errors due to invalid assumption of proximity of a terminal to an access point are avoided. Easy implementation is allowed for. No new
15 hardware is needed.

Various modifications to the described embodiments will be understood by one skilled in the art. The scope of protection afforded by the invention is defined by the appended claims.

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CLAIMS:

1. A method of supporting location services in an
unlicensed mobile access network, comprising
transferring location related information between one
5 or more mobile stations and a network control element.
2. The method according to claim 1 wherein the location
related information includes one or more of: enhanced
observed time difference information; global
positioning system, GPS, information; or assisted GPS
10 location information.
3. The method of claim 1 or claim 2 further comprising
transferring location information by inclusion in a
unlicensed mobile access message.
4. The method of any one of claims 1 to 3 further
15 comprising transferring location information by
inclusion in an information element in a unlicensed
mobile access message.
5. The method of any one of claims 1 to 4 further
comprising transferring location information by
20 inclusion in a new unlicensed radio resource, URR,
message.
6. The method of any one of claims 1 to 5 further
comprising transferring location information by
inclusion in a modified existing unlicensed radio
25 resource, URR, message.
7. The method of any one of claims 1 to 6 further
comprising transferring location information by
inclusion in a modified existing unlicensed radio
resource, URR, message enhanced to contain one or more
30 new information elements.
8. The method of any one of claims 1 to 7 further
comprising an unlicensed radio resource message

including a measure position request transmitted from the network control element to a mobile station.

9. The method of any one of claims 1 to 8 further comprising a measure position response transmitted from
5 a mobile station to a network control element.

10. The method of any one of claims 1 to 9 further comprising an unlicensed radio resource message including assistance data transmitted from the network control element to a mobile station.

10 11. The method of any one of claims 1 to 10 further comprising an unlicensed radio resource message including an assistance data acknowledgement transmitted from a mobile station to a network control element.

15 12. An unlicensed mobile access network including a network control element and a network access point, in which there is supported location services, in which one or more mobile stations and a network control element are adapted to transfer location related
20 information therebetween.

13. The unlicensed mobile network according to claim 12 wherein the location related information includes one or more of: enhanced observed time difference information; global positioning system, GPS,
25 information; or assisted GPS location information.

14. The unlicensed mobile network according to claim 12 or claim 13 wherein the transfer of location information comprises inclusion of location information in an unlicensed mobile access message.

30 15. The unlicensed mobile network according to claim 12 or claim 13 wherein the transfer of location information comprises inclusion of location information

in an information element of an unlicensed mobile access message.

16. The unlicensed mobile network according to any one of claims 12 to 15 wherein the location related information may be transferred in a new unlicensed radio resource, URR, message.

17. The unlicensed mobile network according to any one of claims 12 to 16 wherein the location related information may be transferred in a modified existing unlicensed radio resource, URR, message.

18. The unlicensed mobile network according to any one of claims 12 to 15 wherein the location related information may be transferred in a modified existing unlicensed radio resource, URR, message enhanced to contain one or more new information elements.

19. The unlicensed mobile network according to any one of claims 12 to 18 wherein an unlicensed radio resource message including a measure position request is transmitted from the network control element to a mobile station.

20. The unlicensed mobile network according to any one of claims 12 to 19 wherein an unlicensed radio resource message including a measure position response is transmitted from a mobile station to a network control element.

21. The unlicensed mobile network according to any one of claims 12 to 20 wherein unlicensed radio resource message including assistance data is transmitted from the network control element to a mobile station.

22. The unlicensed mobile network according to any one of claims 12 to 21 wherein unlicensed radio

resource message including an assistance data acknowledgement is transmitted from a mobile station to a network control element.

23. A mobile station for connection in an unlicensed mobile access network, the mobile station being adapted to communicate location related information between with a network control element of the unlicensed mobile access network.

24. A mobile station according to claim 23 wherein the location related information may include one or more of: enhanced observed time difference information; global positioning system, GPS, information; or assisted GPS location information.

25. A mobile station according to claim 23 or claim 24 wherein location information is received and transmitted in an unlicensed mobile access message, such as in an information element in a unlicensed mobile access message.

26. A mobile station according to any one of claims 23 to 25 wherein location related information is received and transmitted by the mobile station in a new unlicensed radio resource, URR, message.

27. A mobile station according to any one of claims to 23 to 26 wherein location related information is received and transmitted by the mobile station in a modified existing unlicensed radio resource, URR, message.

28. A mobile station according to any one of claims to 23 to 27 wherein the location related information is received and transmitted in a modified existing unlicensed radio resource, URR, message enhanced to contain one or more new information elements.

29. A mobile station according to any one of claims to 23 to 28 wherein an unlicensed radio resource message including a measure position request is received by the mobile station from the network control element.
30. A mobile station according to any one of claims to 23 to 29 wherein an unlicensed radio resource message including a measure position response is transmitted from the mobile station to a network control element.
31. A mobile station according to any one of claims to 23 to 30 wherein unlicensed radio resource message including assistance data is received by the mobile station from the network control element.
32. A mobile station according to any one of claims to 23 to 31 wherein unlicensed radio resource message including an assistance data acknowledgement is transmitted from the mobile station to a network control element.
33. A network access point for an unlicensed mobile access network, the network access point being adapted to communicate location related information with one or more mobile stations of the unlicensed mobile access network.
34. A network access point according to claim 33 wherein the location related information may include one or more of: enhanced observed time difference information; global positioning system, GPS, information; or assisted GPS location information.
35. A network access point according to claim 33 or claim 34 wherein the location information may be received and transmitted by the access point in an

unlicensed mobile access message, such as in an information element in a unlicensed mobile access message.

36. A network access point according to anyone of
5 claims 33 to 35 wherein the location related information is received and transmitted by the access point in a new unlicensed radio resource, URR, message.

37. A network access point according to anyone of
10 claims 33 to 36 wherein location related information is received and transmitted by the access point in a modified existing unlicensed radio resource, URR, message.

38. A network access point according to anyone of
15 claims 33 to 37 wherein location related information is received and transmitted in a modified existing unlicensed radio resource, URR, message enhanced to contain one or more new information elements.

39. A network access point according to anyone of
20 claims 33 to 38 wherein unlicensed radio resource message including a measure position request is transmitted by the network access point to the mobile station.

40. A network access point according to anyone of
25 claims 33 to 39 wherein an unlicensed radio resource message including a measure position response is received by the access point from the mobile station.

41. A network access point according to anyone of
30 claims 33 to 40 wherein unlicensed radio resource message including assistance data is transmitted by the network control element to the mobile station.

42. A network access point according to anyone of
claims 33 to 41 wherein unlicensed radio resource

message including an assistance data acknowledgement is received by the access point from the mobile station.

43. A network control element for an unlicensed mobile access network, the network control element
5 being adapted to communicate location related information with one or mobile stations of the unlicensed mobile access network.

44. A network control element according to claim 43
10 wherein the location related information may include one or more of: enhanced observed time difference information; global positioning system, GPS, information; or assisted GPS location information.

45. A network control element according to claim 43
15 or claim 44 wherein the location information may be received and transmitted by the network control element in an unlicensed mobile access message, such as in an information element in a unlicensed mobile access message.

46. A network control element according to anyone of
20 claims 43 to 45 wherein the location related information is received and transmitted by the network control element in a new unlicensed radio resource, URR, message.

47. A network control element according to any one
25 of claims 43 to 46 wherein location related information is received and transmitted by the network control element in a modified existing unlicensed radio resource, URR, message.

48. A network control element according to any one
30 of claims 43 to 47 wherein location related information is received and transmitted in a modified existing

unlicensed radio resource, URR, message enhanced to contain one or more new information elements.

49. A network control element according to any one of claims 43 to 48 wherein unlicensed radio resource
5 message including a measure position request is transmitted by the network control element to the mobile station.

50. A network control element according to any one of claims 43 to 49 wherein an unlicensed radio resource
10 message including a measure position response is received by the network control element from the mobile station.

51. A network control element according to any one of claims 43 to 50 wherein unlicensed radio resource
15 message including assistance data is transmitted by the network control element to the mobile station.

52. A network control element according to anyone of claims 43 to 51 wherein unlicensed radio resource
20 message including an assistance data acknowledgement is received by the network control element from the mobile station.

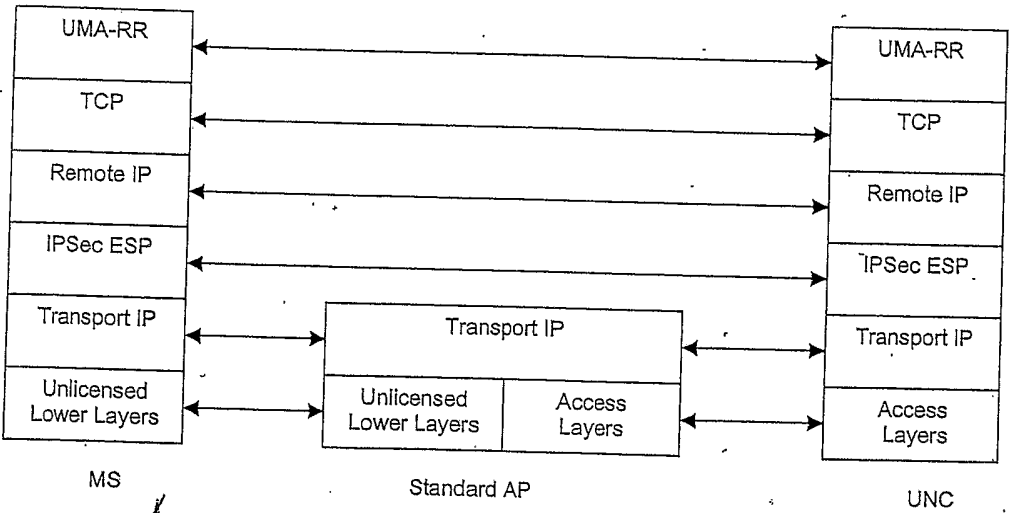
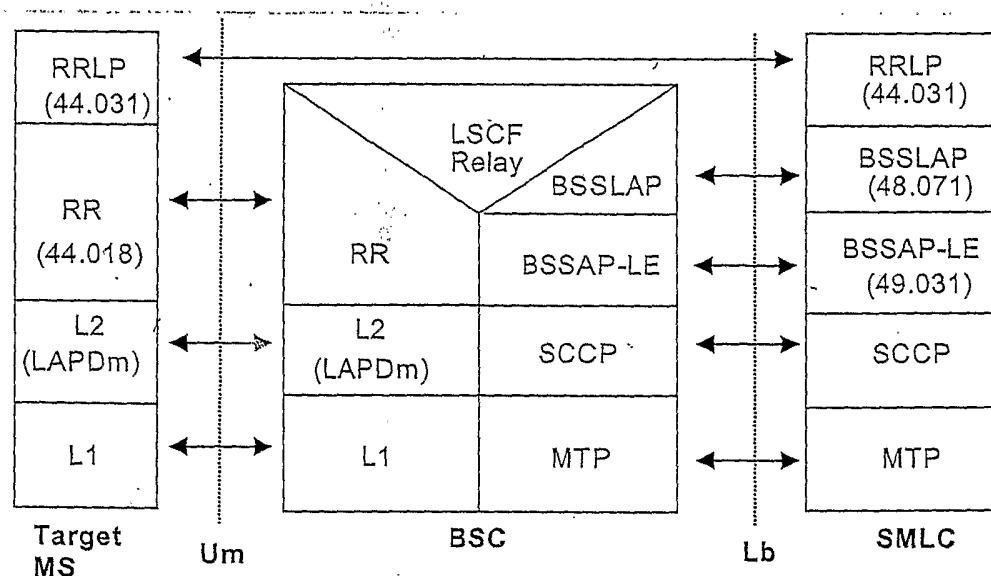


Figure 21

Figure 2²

TypeUnitOrDepartmentHere
TypeYourNameHere

TypeDateHere

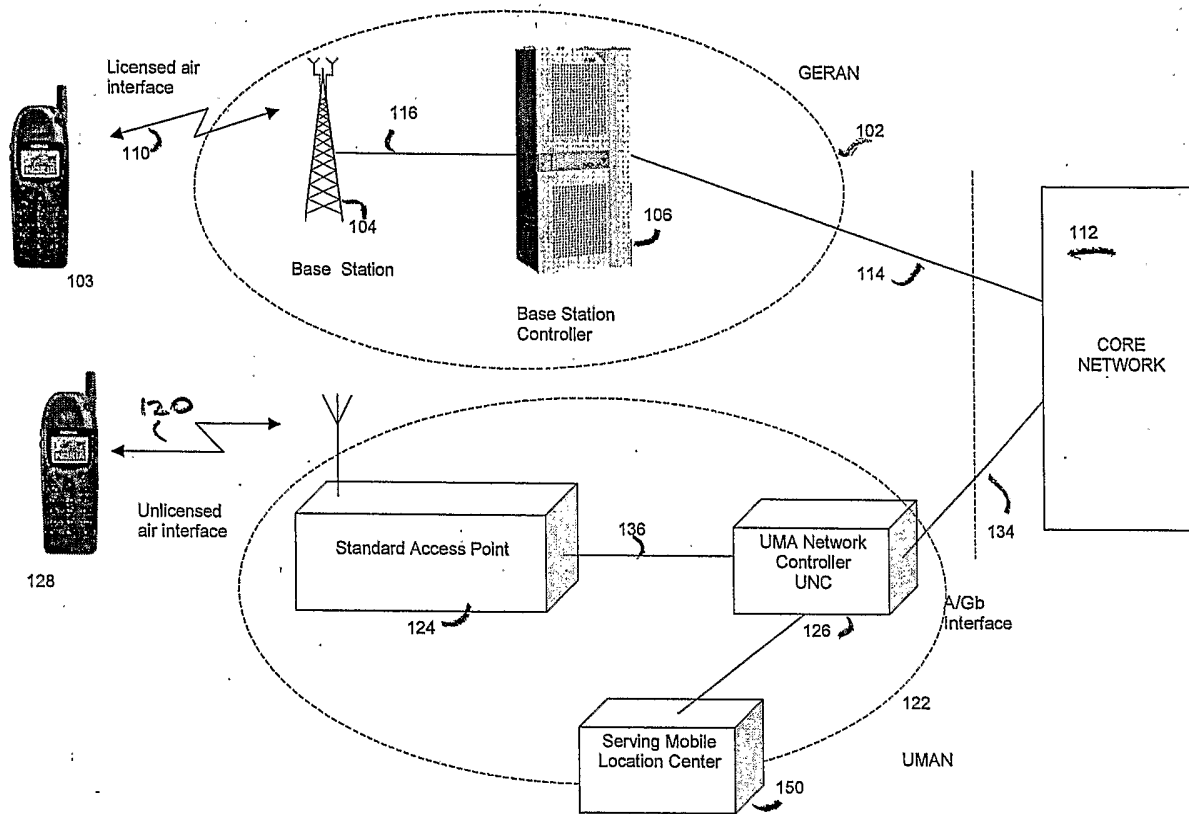


FIG 3

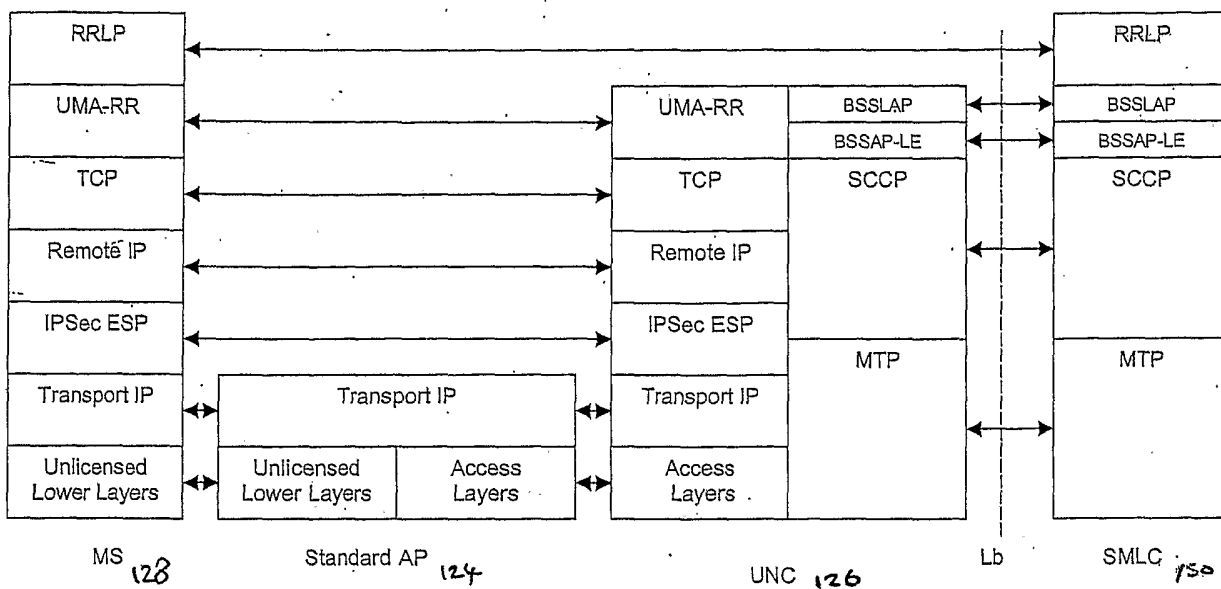


Figure 4.

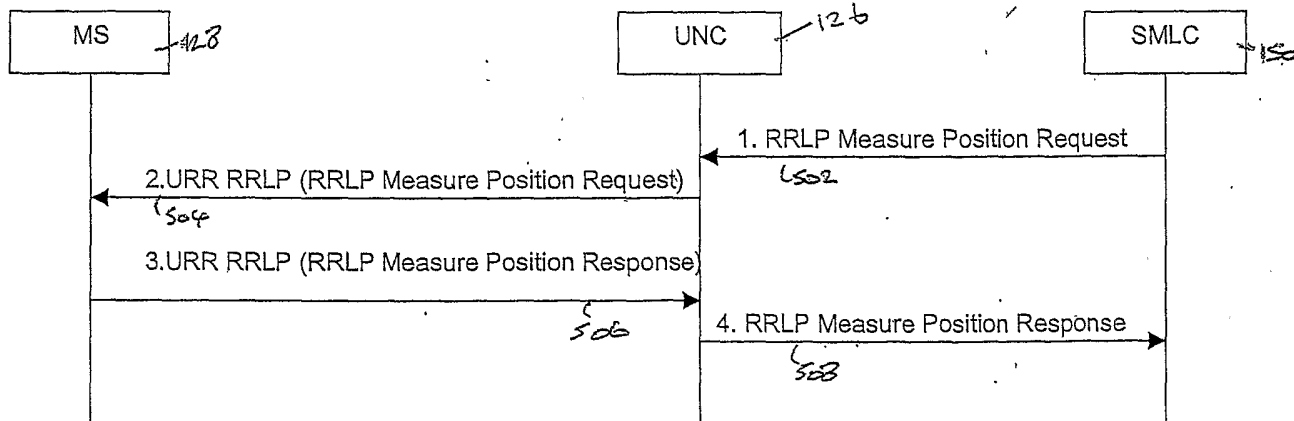
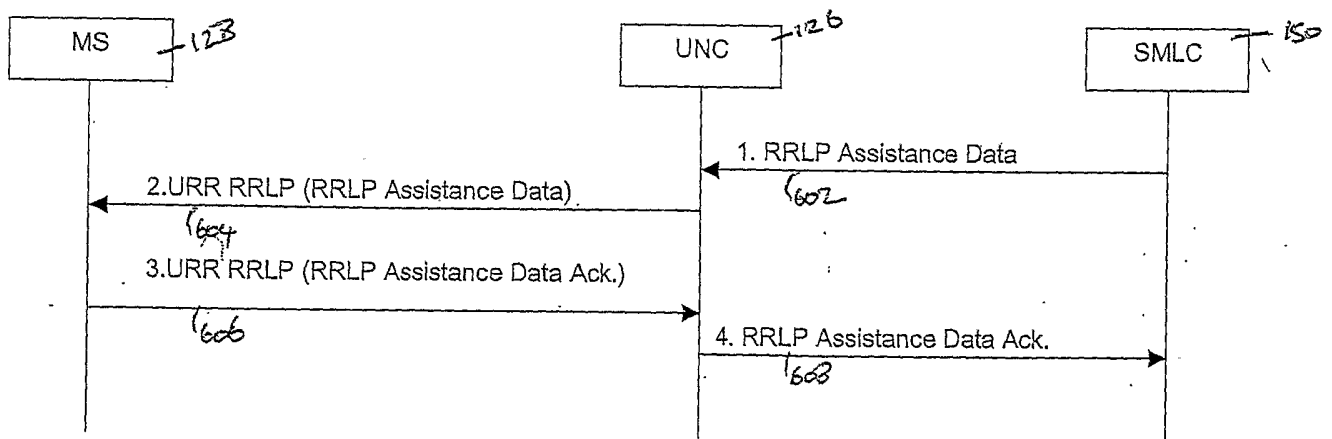


Figure 5.

FIG 6

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2006/000556

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04Q7/38 H04L12/28
ADD. H04Q7/22

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)
H04Q H04L

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2004/032540 A (INTERDIGITAL TECHNOLOGY CORPORATION) 15 April 2004 (2004-04-15) paragraph [0019] paragraph [0040] - paragraph [0047]	1-52
A	"3rd Generation Partnership Project; Technical Specification Group GSM EDGE Radio Access Network; Location Services (LCS); Broadcast Network Assistance for Enhanced Observed Time Difference (E-OTD) and Global Positioning System (gps) Positioning Methods (Release 1999)" 3GPP TS 04.35 V8.3.0, January 2001 (2001-01), pages 1-35, XP002280213 paragraph [0004]	1-52



Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

19 April 2006

Date of mailing of the international search report

03/05/2006

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International application No

PCT/IB2006/000556

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