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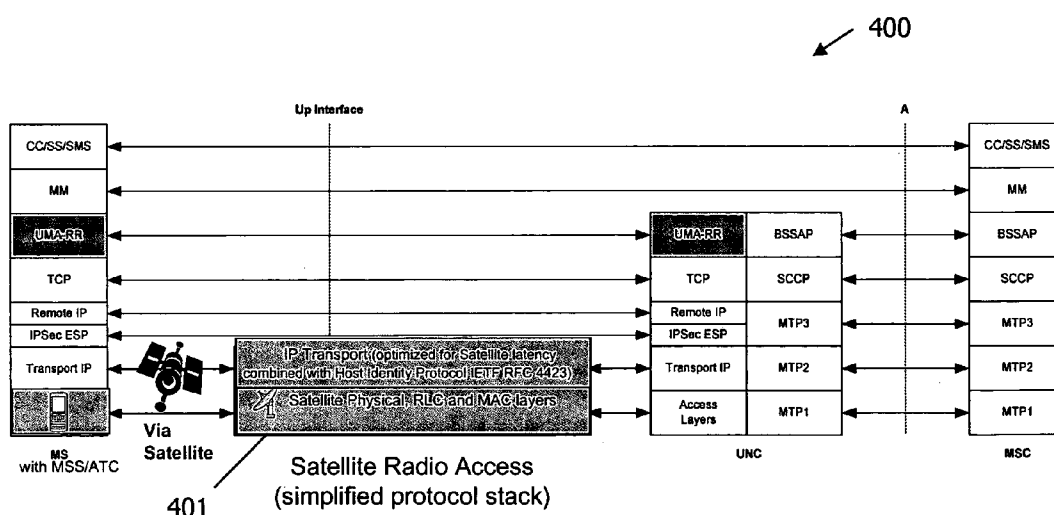
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(54) Title: MOBILE SATELLITE SERVICE VIA 3GPP GENERIC RADIO ACCESS NETWORK



(57) Abstract: A system and method adapted to support a satellite component as generic access in the terrestrial mobile networks. The present invention uses the Third Generation Partnership Project (3GPP) baseline standard, 3GPP Generic Access Network (GAN) to support a Mobile Satellite Service (MSS) satellite component at the physical, Radio Link Control (RLC) and Medium Access Control (MAC) layers, with the terrestrial standards based in the Generic Access Protocol architecture framework.

MOBILE SATELLITE SERVICE VIA 3GPP GENERIC RADIO ACCESS NETWORK

5 BACKGROUND OF THE INVENTION

The present invention relates to satellite communications. More particularly, and not by way of limitation, the present invention is directed to a system and method for facilitating mobile satellite service via a Third Generation Partnership Project (3GPP) generic radio access network. As used

10 herein, the abbreviations used herein shall have the following meanings:

	AAA	Authentication, Authorization and Accounting
	AP	Access Point
	ATC	Ancillary Terrestrial Component
	BER	Bit Error Rate
15	BSC	Base Station Controller
	BTS	Base Transceiver Station
	CC	Call Control
	CS	Circuit Switched
	EGPRS	Enhanced General Packet Radio Service
20	FCC	Federal Communications Commission
	GAN	Generic Access Network
	GANC	Generic Access Network Controller
	GMR	Geo Mobile Radio
	GMR 3G	Geo Mobile Radio with 3G (evolution of GMR1 or GMR2
25	protocols to support packet access support)	
	Gb	Interface between BSC and SGSN
	GPRS	General Packet Radio Service
	GSM	Global System for Mobile Communication
	HBS	Home Base Station
30	HBSC	Home Base Station Controller
	HLR	Home Location Register
	HSPA	High Speed Packet Access

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	IGW	IP Gateway
	IP	Internet Protocol
	IETF	Internet Engineering Task Force
	LTE	Long Term Evolution
5	MAC	Medium Access Control
	MIPv6	Mobile IP version 6
	MM	Mobility Management
	MME	Mobility Management Entity
	MMS	Multimedia Messaging Services
10	MS	Mobile Station
	MSS	Mobile Satellite Service
	PCU	Packet Channel Unit
	RLC	Radio Link Control
	RFC	Request for Comments
15	RTP	Real Time Protocol
	SAE	System Architecture Evolution
	SGSN	Serving GPRS Support Node
	SGW	Security Gateway
	SMS	Short Messaging Services
20	UT	User Terminal
	UMA	Unlicensed Mobile Access
	WCDMA	Wideband Code Division Multiple Access
	XCP	Explicit Control Protocol

25 The US Federal Communications Commission (FCC) permits MSS spectrum to be used nationwide on the ground for terrestrial networks (under the ATC), provided that Satellite services are also offered. MSS operators are thus able to offer terrestrial mobile telecommunication services using a hybrid satellite/terrestrial UT.

30 In order to be successful, MSS/ATC operators must be able to leverage the economies of scale of the existing UTs and also the existing mobile communication network infrastructure. While it is possible to implement a system using ETSI GMR1 or GMR2 standards, as derivative of mainstream

3GPP GSM/EGPRS standards, it will likely be cost prohibitive to sustain the satellite component in an integrated UT or mobile communication infrastructure when terrestrial standards continue evolve to later generations.

The 3GPP GAN enables end users to use alternative air interface technologies, such as Bluetooth and WiFi, to access mobile services that otherwise are commonly accessed using WCDMA/GSM/EGPRS networks. One system that illustrates the 3GPP GAN reference architecture is Ericsson's Mobile@Home system as seen in Figure 1. A 3GPP GAN system enables GSM and GPRS services over the IP backbone and short-range unlicensed radio access technology, such as Bluetooth or WiFi. The end user hence will be able to use the "public" cellular network or the UMA Bluetooth/WiFi pico-cell to access the same voice, GPRS, MMS and/or SMS services.

Figure 1 illustrates a conventional 3GPP GAN system 100. The protocol stacks in the 3GPP GAN standards support end user applications and services transparently across the underlying radio access 101 which are unlicensed lower layers between the MS 102 and AP 103, shown here as a HBS.

Figure 2 illustrates the 3GPP GAN Protocol Stack 200 for a CS domain. The unlicensed lower layers 201 supported by 3GPP GAN are Bluetooth and WiFi. Figure 3 further illustrates the 3GPP GAN unlicensed lower layers for Bluetooth 301 and an 802.11 based wireless network 302.

Conventional MSS systems are based on several air interface standards, including: GMR1, GMR2, Globalstar air interface, Iridium air interface and Inmarsat I4 air interface. Each of these standards is unique, and hence they are non-interoperable. As a result, the MSS is fragmented, making it difficult to leverage economies of scale in the MSS market for UT and the network infrastructure. As a result, the MSS has seen limited market success.

It would thus be advantageous to have a system and method for simpler reference network architecture to support a satellite component as generic access in the terrestrial mobile networks and UTs that overcomes the disadvantages of the prior art. The present invention provides such a system and method.

BRIEF SUMMARY OF THE INVENTION

The present invention comprises a system and method for simpler reference network architecture to support a satellite component as generic access in the terrestrial mobile networks. The present invention uses the 3GPP baseline standard, 3GPP GAN, to support a MSS satellite component at the physical, RLC and MAC layers, with the terrestrial standards based in the Generic Access Protocol architecture framework. The present invention seamlessly incorporates satellite component lower layers into the GAN protocol architecture, leveraging the flexibility of the IP transport protocols between the UT or MS and the GAN Radio Access Network to slide in satellite protocol lower layers in the GAN protocol architecture framework. To support this mobility management system across the IP domain, the present invention uses the IETF RFC 4423 protocol for Host Identity protocol and multi-homing support. These additions are transparent to the GAN infrastructure, particularly the UMA GANC.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

In the following section, the invention will be described with reference to exemplary embodiments illustrated in the Figures, in which:

Figure 1 illustrates a conventional 3GPP GAN system;

Figure 2 illustrates the conventional 3GPP GAN protocol stack for the CS domain;

Figure 3 illustrates the 3GPP GAN – unlicensed lower layers;

Figure 4 illustrates the 3GPP GAN CS domain protocol layers with satellite access; and

Figures 5A and 5B illustrate the 3GPP GAN protocol architecture operable to support satellite enabled handsets with a GAN/MSS inter-working unit.

DETAILED DESCRIPTION OF THE INVENTION

In the present invention, the 3GPP GAN protocol stack is used to provide access by satellite instead of by Bluetooth or WiFi. This enables the

MSS component to be incorporated into the existing terrestrial UT or MS and network that supports the 3GPP GAN reference architecture. This is seen in Figure 4. As seen therein, the 3GPP GAN CS domain protocol layers with satellite access 400 of the present invention is shown. This provides an example of a protocol instance illustrating how the satellite protocol layers 401 can be introduced in the 3GPP GAN protocol architecture. Figure 4 can be generalized to include other GAN protocol architectures, such as Up interface CS Voice bearer protocol, Up interface GPRS signaling and user plane protocols. In addition, other mechanisms existing in the 3GPP GAN for roving, GAN cell identification and the like can be leveraged for the satellite access as well

Referring now to the satellite protocol lower layers, the present invention provides that the satellite protocol architecture in the 3GPP GAN framework will be comprised of the physical, RLC, MAC and IP transport layers. These will comprise peer to peer protocol layers between the UT or MS and a satellite RBS. The satellite physical, RLC and MAC layers comprise an adaptation of the terrestrial EGPRS standards for physical, RLC and MAC layers. The adaptation of the physical, RLC and MAC layers are based on the Ericsson satellite cellular backhaul solutions for Abis over satellite.

Adapting the EGPRS satellite variants for the physical, RLC and MAC layers enables the reuse of the UT or MS EGPRS baseband and radio frequency electronics with minimal modification. Alternatively, the satellite physical, RLC, MAC layers can be based on proprietary VSAT IP modems technologies.

In one embodiment of the present invention, the satellite link can be optimized for voice calls using a low data rate codec over the GAN user plane without IP overhead. The encapsulation of the codec payload into IP packets with RTP headers can be performed in the satellite BTS as transparent connectivity to the BSC, either the Home BSC or GAN.

The satellite IP transport layer is an important aspect of the satellite RBS protocol stack of the present invention. The satellite IP transport layer contains performance enhancing proxies to combat satellite latencies and also provide a

mechanism to appropriately map user locations, Identities to IP addresses and carrier frequencies in the lower layers for UT or MS mobility.

Mobility refers to the ability of the network to provide support for handover to mobile devices such as UTs and MSs as they change point of access. Device mobility can either be addressed at layer 3 of the protocol stack, which means that the IP forwarding mechanism, which is based on IP addresses with implicit location information, either needs to be changed or the addressing scheme has be modified. In this way, mobility is hidden from higher layer protocols, and the host's IP address remains unchanged.

10 This present invention is adapted to use the IETF RFC 4423, Host Identity Protocol, as an MME to implicitly map the end users locations for example to spot beam id and/or GPS positions and/or identities that are operable to determine end user locations. Alternatively MIPv6 can be used for mobility management to achieve similar results.

15 The IP stack could also optionally support multi homing (using TCP or SCTP protocol) for the user to enable mobility management to ensure device mobility of the UTs or MSs.

Several methods can be employed in concert with the present invention to determine the physical location of the UT or MS. These methods use information configured in the GAN and information received from the UT during location update typically via a GPS location. It is conventionally known that GANC is operable to allow an external database to map this data to the exact geographical location of the end user in relation to the spot beam id and/or GPS position. The UT or MS can also be adapted to report the geographic location to the GANC.

25 There are several known techniques to improve transmission efficiency in the presence of long propagation delay. The present invention can be adapted to use such known techniques such as those available via commonly known TCP/IP accelerator products such as performance enhancing proxies and/or using XCP. In this manner, the present invention leverages the principles of 3GPP GAN network, is based on open standard interfaces, such as Up protocol stack, IP transport layers, and IETF RFC 4423 concerning Host

Identity Protocol and uses conventional performance enhancing techniques to combat long propagation delay. In this manner, a BSC, either a Home BSC or GANC, can be used with minimum modifications or no changes.

As seen in Figures 5A and 5B, the MS platform 501 of a UT or MS 500
5 can be leveraged to incorporate satellite access in 3GPP GAN protocol domain. As seen in Figure 5B, the 3GPP GAN protocol architecture makes it feasible to support satellite enabled UTs or MSs with GAN/MSS internetworking unit 502. The present invention comprises an MSS/ATC
10 solution as an ancillary satellite component in WCDMA/HSPA/GSM/EGPRS mobile networks with minimal impact to these networks. The impacts are minimized due to the use of IP protocol stack at the lowest level of protocol stack granularity.

As will be recognized by those skilled in the art, the innovative concepts described in the present application can be modified and varied over a wide
15 range of applications. Accordingly, the scope of patented subject matter should not be limited to any of the specific exemplary teachings discussed above, but is instead defined by the following claims.

WHAT IS CLAIMED IS:

1. A method of interfacing a User Terminal (UT) or Mobile Station (MS) to a mobile telecommunications system, comprising the step of:
 - 5 using a baseline standard to support a mobile satellite service (MSS) satellite component at the physical, Radio Link Control (RLC) and Medium Access Control (MAC) layers with a conventional terrestrial standard to support Voice and packet Data services and applications.
- 10 2. The method of claim 1, wherein the baseline standard is the Third Generation Partnership Project (3GPP) Generic Access Network (GAN).
3. The method of claim 2, wherein the GAN protocol architecture is one selected from the group consisting of Up interface CS Voice bearer protocol,
 - 15 Up interface GPRS signaling and user plane protocol.
4. The method of claim 2, further comprising using the 3GPP GAN for roving and GAN cell identification using satellite access.
- 20 5. The method of claim 2, wherein the conventional terrestrial standards are based on the Generic Access Protocol architecture framework.
6. The method of claim 1, further comprising the steps of:
 - incorporating satellite component lower layers into a Generic Access
 - 25 Network (GAN) protocol architecture; and
 - leveraging the flexibility of the IP transport protocols between the UT or MS and the GAN Radio Access Network (RAN) to slide in satellite protocol lower layers in the GAN protocol architecture framework.
- 30 7. The method of claim 6, further comprising the step of using the IETF RFC 4423 protocol for Host Identity protocol and multi-homing support.

8. The method of claim 7, wherein using the IETF RFC 4423 protocol for Host Identity protocol and multi-homing support are transparent to the GAN infrastructure.

5 9. The method of claim 8, further comprising the step of using the IETF RFC 4423 Host Identity Protocol as a mobility management entity (MME) to implicitly map the end users locations to one from the group consisting of a spot beam id, Global Positioning Satellite (GPS) position and an identity that is operable to determine end user locations.

10

10. The method of claim 1, wherein the conventional terrestrial standard is one selected from the group consisting of Wideband Code Division Multiple Access (WCDMA), High Speed Packet Access (HSPA), Global System for Mobile Communication (GSM) and General Packet Radio Service (GPRS).

15

11. The method of claim 1, wherein the baseline standard is the Third Generation Partnership Project (3GPP) Generic Access Network (GAN); and
the satellite link is optimized for voice calls using a low data rate codec over the GAN user plane without Internet Protocol (IP) overhead.

20

12. The method of claim 11, further comprising the step of performing an encapsulation of a codec payload into Internet Protocol (IP) packets with Real Time Protocol (RTP) headers in the satellite Base Station Transceiver (BTS) as transparent connectivity to a base station controller (BSC).

25

13. A mobile telecommunications system, comprising:
a means in a User Terminal (UT) or Mobile Station (MS) for using a baseline standard to support a mobile satellite service (MSS) satellite component at the physical, Radio Link Control (RLC) and Medium Access Control (MAC) layers with a conventional terrestrial standard.

30

14. The system of claim 13, wherein the baseline standard is the Third Generation Partnership Project (3GPP) Generic Access Network (GAN).
15. The system of claim 14, wherein the GAN protocol architecture is one
5 selected from the group consisting of a Up interface CS Voice bearer protocol, a Up interface GPRS signaling and user plane protocol.
16. The system of claim 14, further comprising a means for using the 3GPP GAN for roving and GAN cell identification using satellite access.
- 10 17. The system of claim 14, wherein the conventional terrestrial standards are based on the Generic Access Protocol architecture framework.
18. The system of claim 13, further comprising:
15 a means for incorporating satellite component lower layers into a Generic Access Network (GAN) protocol architecture; and
a means for leveraging the flexibility of the Internet Protocol (IP) transport protocols between the UT or MS and the GAN Radio Access Network (RAN) to slide in satellite protocol lower layers in the GAN protocol architecture
20 framework.
19. The system of claim 18, further comprising a means for using the IETF RFC 4423 protocol for Host Identity protocol and multi-homing support.
- 25 20. The system of claim 18, wherein using the IETF RFC 4423 protocol for Host Identity protocol and multi-homing support is transparent to the GAN infrastructure.
21. The system of claim 20, further comprising means of using the IETF
30 RFC 4423 Host Identity Protocol as a mobility management entity (MME) to implicitly map the end users locations to one from the group consisting of a

spot beam id, a Global Positioning Satellite (GPS) position and an identity that is operable to determine end user locations.

22. The system of claim 13, wherein the conventional terrestrial standard is one selected from the group consisting of Wideband Code Division Multiple Access (WCDMA), High Speed Packet Access (HSPA), Global System for Mobile Communication (GSM) and General Packet Radio Service (GPRS).

23. The system of claim 13, wherein the baseline standard is the Third Generation Partnership Project (3GPP) Generic Access Network (GAN); and the satellite link is optimized for voice calls using a low data rate codec over the GAN user plane without IP overhead.

24. The system of claim 23, further comprising means for performing an encapsulation of a codec payload into Internet Protocol (IP) packets with Real Time Protocol (RTP) headers in the satellite Base Station Transceiver (BTS) as transparent connectivity to a base station controller (BSC).

25. A User Terminal (UT) for use in a mobile communications system, comprising a means for using a baseline standard to support a mobile satellite service (MSS) satellite component at the physical, Radio Link Control (RLC) and Medium Access Control (MAC) layers with a conventional terrestrial standard.

26. The UT of claim 25, wherein the baseline standard is the Third Generation Partnership Project (3GPP) Generic Access Network (GAN).

27. The UT of claim 25, wherein the conventional terrestrial standards are based on the Generic Access Protocol architecture framework.

28. The UT of claim 27, wherein the conventional terrestrial standard is one selected from the group consisting of Wideband Code Division Multiple Access

(WCDMA), High Speed Packet Access (HSPA), Global System for Mobile Communication (GSM) and General Packet Radio Service (GPRS).

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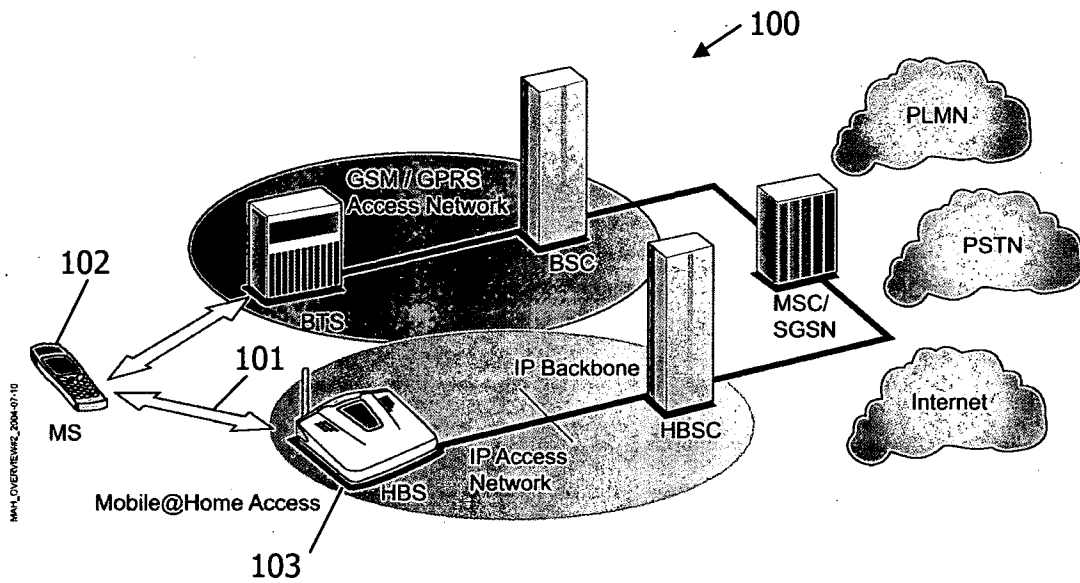


FIG. 1 (Prior Art)

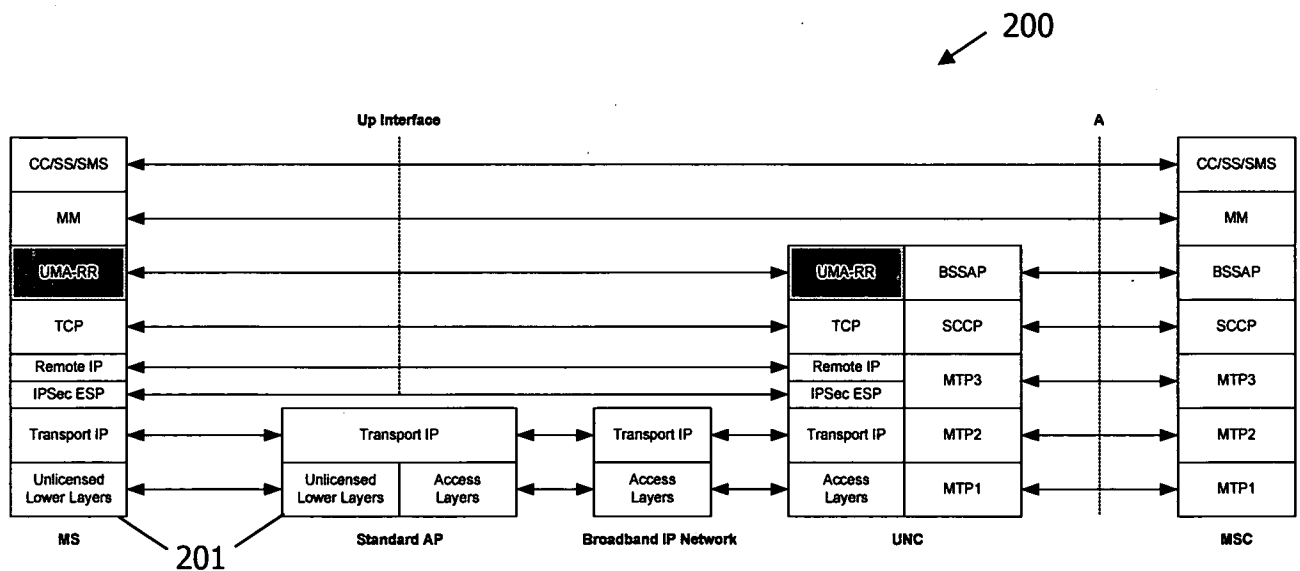
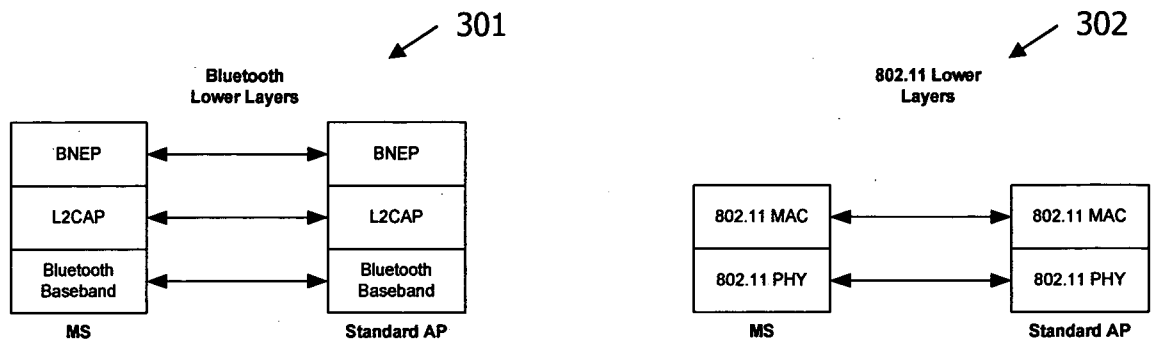
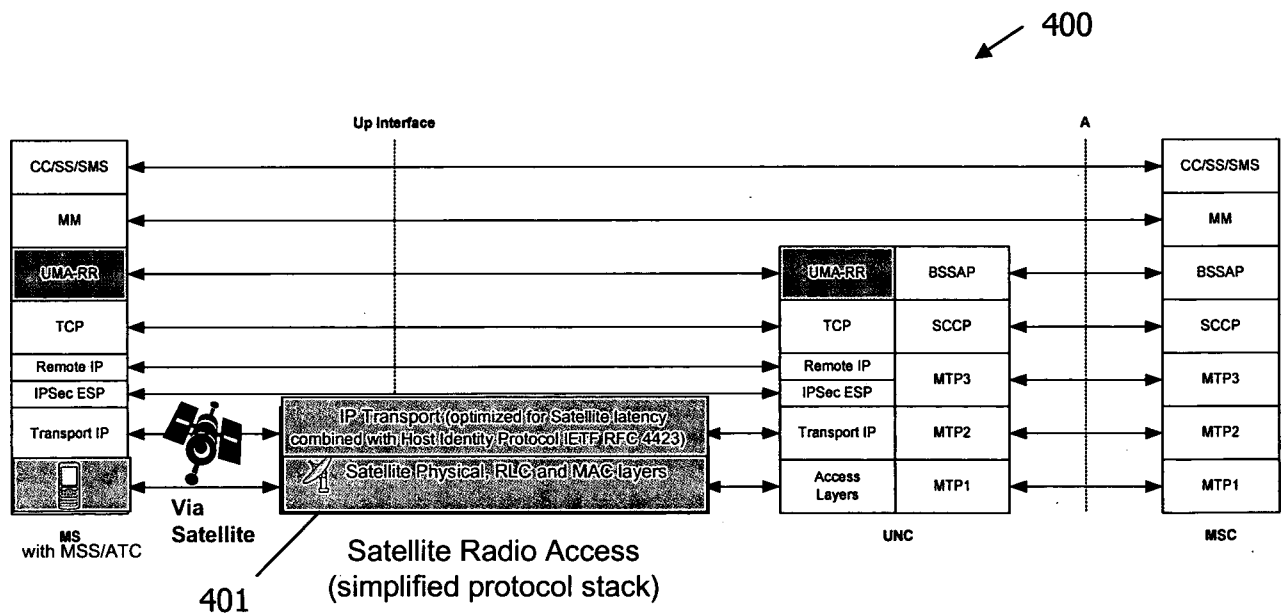
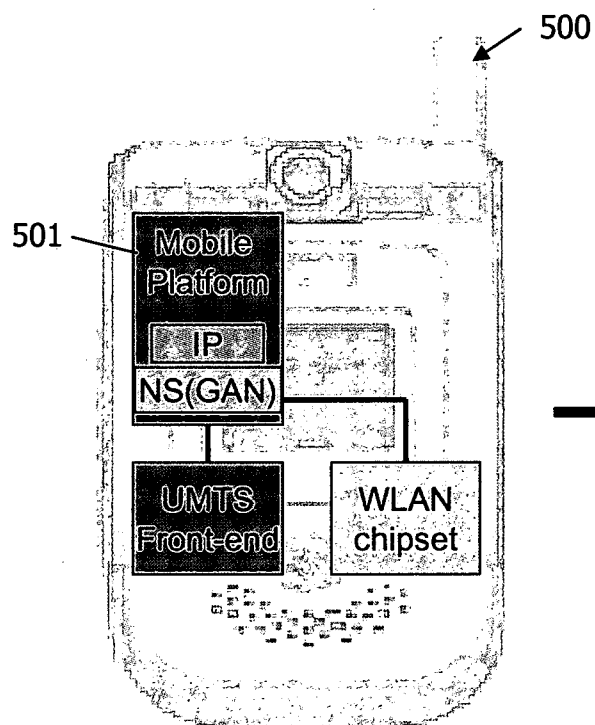


FIG. 2 (Prior Art)

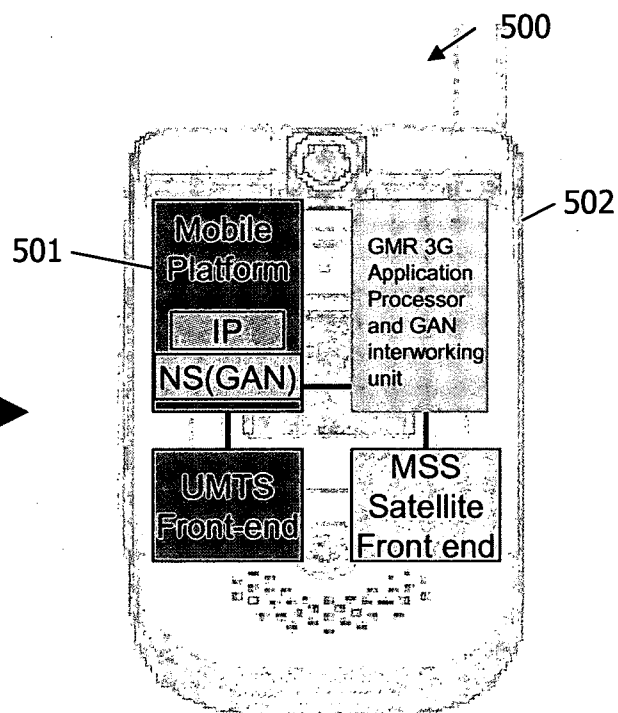
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**FIG. 3 (Prior Art)****FIG. 4**

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Baseline Mobile Platform
integrated fully
compliant GAN solution

FIG. 5A

Mobile Platform
integrated with MSS solution
Using GAN framework

FIG. 5B