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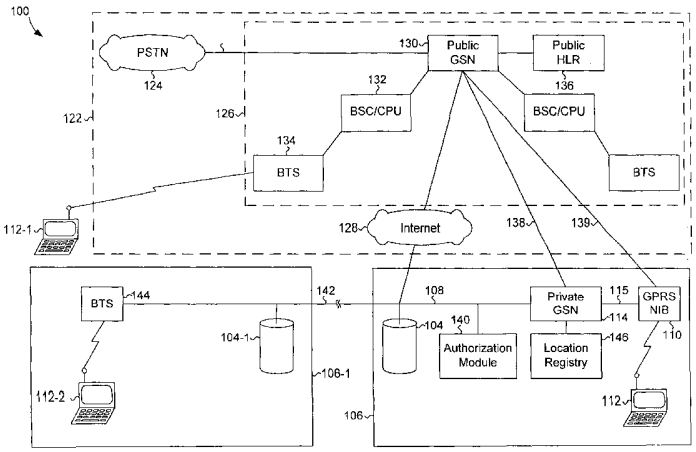
(54) Title: GPRS WIRELESS NETWORK HAVING LOCAL SWITCHING CAPABILITIES AND METHOD OF OPERATING THE SAME




(57) Abstract: A communication system (100) and method for transferring data between user equipment terminals (UEs 112) and a server (104) through a private general packet radio service (GPRS) network (102) linked thereto via a local area network (LAN 100). Generally, the private network (102) includes a GPRS network-in-a-box (GPRS NIB 110) for transmitting to and receiving data from the UEs (112), and a private gateway support node (GSN 114). In one embodiment, the system (100) includes a public network (122), and the private network (100) is adapted to enable the UEs (100) to remotely access the server (100) through the public network. Preferably, the private network (102) includes an authorization module (140) to ensure access to the server (104) is limited to authorized UEs (112) or users. The private network (102) can be coupled to the public network (122) through the GPRS NIB (110) or the GSN (114). Optionally, the private network (102) is adapted to enable the UEs (112) to access data in additional remotely located servers (104-1) linked thereto via a wide area network (142).

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# GPRS WIRELESS NETWORK HAVING LOCAL SWITCHING CAPABILITIES AND METHOD OF OPERATING THE SAME

## REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application Serial No. 60/357,356, entitled *GPRS Wireless Network Having Local Switching Capabilities And Method Of Operating The Same*, filed February 12, 2003.

## FIELD

The present invention relates generally to communication systems, and more particularly to a communication system including general packet radio service (GPRS) wireless network having local switching capabilities and a method for using the same.

## BACKGROUND

There has been a tremendous increase in recent years in the demand for wireless systems or networks capable of handling data communications. User equipment terminals (UEs), such as portable computers, Web Access Appliances (WAPs), Personal Digital Assistants (PDAs) and the like, are widely used to access databases, transfer files and send and receive electronic mail messages. Wireless data communication systems generally rely on packet-switched technologies, such as GPRS (General Packet Radio Service) to provide greater efficiencies. GPRS is a technology integrated into the GSM (Global System for Mobile communications) protocol in order to provide wireless data access.

A conventional data communication system will now be described with reference to FIG. 1. FIG. 1 is a block diagram of a communication system 10 including a public GPRS network 12, and will be used to illustrate routing of data between a number of UEs 14, 16, and a server 18 located at a site 20. Referring to

FIG. 1, the public GPRS network 12 typically includes a public gateway support node (GSN 22) for switching communications or packets between the public GPRS network and other parts of a public network, such as the public switched telephone network (PSTN 24) or the Internet 26. The public GSN 12 is further coupled to a number of base station controllers - central processing units (BSC/CPUs 28), two of which are shown. Each BSC/CPU 28 in turn communicates with one or more base transceiver station (BTS 30), only one of which is shown for each BSC/CPU, that in turn communicate with the UEs 14, 16. A public home location registry (HLR 32) coupled to the public GSN 22 records the location or BTS 30 addresses of where the UEs 14, 16, can be found.

In addition, as shown businesses and enterprises frequently connect servers 18 to the public GPRS network 12 to enable employees, customers and/or vendors to access data and databases maintained on the servers. Ability to access data remotely is desirable, for example, to enable sales persons or service technicians operating off-site to send and receive electronic mail or e-mail, download data and update databases. Generally, the server 18 is coupled to the public GSN 22 through the Internet 26 and a local area network (LAN 34).

While the utility of portable computers and other UEs 14, 16, is greatly enhanced by the availability of wireless communication systems and public GPRS networks 12, the current generation of communication systems 10 has a number of disadvantages or drawbacks. In particular, the conventional communication systems 10 are generally not satisfactory for those situations in which the employee or user of a UE 16 is accessing a server co-located at the same site 18 as the UE. There are any number of reasons why it may not be desirable or even possible for the user to access the server through a terminal 36 hard-wired to the server 18 through the LAN 34. For example, the site 18 can include several separate buildings, some of which are not connected to the LAN 34. The user may need to download or upload data or an application program to or from the sever 18. The site 18 may be a large warehouse or manufacturing facility, such as a refinery, through and about which the user or employee moves in performance of their job.

The communication system 10 described above has a number of problems or shortcomings when used to transfer data between a UE 16 and a co-located server 18. Chief among these is an inability to maintain ownership or control of information/data transferred between the UE 16 and the server. In some situations a

business may choose to make some or all of the information in the server 18 available to on-site UEs 14 only, and therefore transmission through the public GPRS network 12 is undesirable.

Another problem with using the public GPRS network 12 to transfer data between a UE 16 and a co-located server 18 is excessive or unnecessary backhauling of communications through the public communication system 10. Data transfer rates through or over the public communication system 10 are limited by law and by availability of system resources or bandwidth. That is, as the number or users increase, the rate at which data can be transferred decreases. As a result, data transfer rates through the public communication system 10 are generally much lower than the GPRS technology could otherwise provide. Thus, transfer of a large file between the server 18 and UE 16 is generally a time consuming operation, which can restrict the mobility of the user, since the user cannot move out of the service area of the public GPRS network 12 through which the UE 16 is connected to the server 18 without terminating the operation.

Accordingly, there is a need for a communication system and method capable of enabling users to maintain ownership of information transferred between UEs and a server. There is a further need for a communication system and method providing improved efficiency in use of communication system resources through reduction or elimination in backhauling of communications. There is a still further need for a communication system and method providing higher data transfer rates than possible over existing public networks.

The system and method of the present invention provides these and other advantages over the prior art.

## SUMMARY

It is an object of the present invention to provide a communication system having a private general packet radio service (GPRS) network linked to a server via a local or wide area network. It is a further object to provide a method of using the same to transfer data between a number of user equipment terminals (UEs) and the server, thereby optimizing call routing, maintaining ownership of data throughout the transfer, and avoiding toll costs associated with use of a public network.

In one aspect the invention is directed to a private GPRS network coupled to a server co-located therewith via a local area network (LAN), the private GPRS

network adapted to transfer data between the UEs and the server through the LAN. Generally, the private GPRS network includes a GPRS network-in-a-box (GPRS NIB) for transmitting data to and receiving data from the UEs, and a private gateway support node (GSN) for switching communications or packets between the LAN and the GPRS NIB. Preferably, the private GPRS network is adapted to communicate with the number of UEs from about 72.4 kilobits per second (kb/s) to about 171.2 kb/s using channel coding scheme (CS)-1, CS-2, CS-3 or CS-4. More preferably, the private GPRS network is further configured to enable the UEs to access data in a second server remotely located from the private GPRS network and the UEs via a wide area network (WAN). In one version of this embodiment, the LAN is part of the WAN. Optionally, the UEs are further adapted to also communicate with a public wireless network.

In another aspect, the invention is directed to a communication system including a public network, and a private GPRS network coupled to the public network and, via a LAN, to a server. As before, the private GPRS network includes a GPRS NIB and a private GSN to enable UEs to access the server through the private GPRS network and the LAN. Preferably, the public network includes a public wireless network, and the private GPRS network is adapted to enable the UEs to remotely access the server through the public wireless network from areas not served by the private GPRS network. More preferably, the private GPRS network further includes an authorization module to ensure access to the server is limited to the UEs or users authorized to access the server. In one version of this embodiment, the private GPRS network is coupled to the public network through the GPRS NIB. In another version, the private GPRS network is coupled to the public network through the private GSN.

In another embodiment, the public wireless network is coupled to the server through the LAN, and the UEs are adapted to communicate with the public wireless network to remotely access the server directly through the LAN. Optionally, an authorization module coupled to the server through the LAN, or between the LAN and the server prevents unauthorized access to the server.

In yet another aspect, the invention is directed to a method of transferring data between the UEs and the server through the private GPRS network and the LAN. Generally, the method includes the steps of: (i) receiving in the GPRS NIB of the private GPRS network call information from one of the number of UEs; (ii)

coupling the UE to the server through the private GPRS network and the LAN; and (iii) transferring data between the UE and the server through the private GPRS network and the LAN. Preferably, where the communication system includes a public wireless network coupled to the private GPRS network, and the step of coupling the UE to the server, is accomplished by coupling the UE to the server through the public wireless network from areas not served by the private GPRS network. More preferably, the communication system includes an authorization module, and the method further includes the step of determining whether the UE or the user thereof are authorized to access the server.

In one embodiment, where the private GPRS network is coupled via a WAN to additional servers remotely located from the private GPRS network and the UEs, the step of coupling the UE to the server involves coupling the UE to one of the additional servers through the private GPRS network and the WAN.

Advantages of the apparatus and method of the present invention include any or all of the following:

(i) ability to maintain ownership of information/data transfer between UEs and a server;

(ii) improved efficiency in use of communication system resources through reduction or elimination in backhauling of communication path through a public network;

(iii) higher data transfer rates than possible over existing public networks; and

(iv) lower operating costs through avoidance of toll costs associated with use of a public network.

## BRIEF DESCRIPTION OF THE FIGURES

These and various other features and advantages of the present invention will be apparent upon reading of the following detailed description in conjunction with the accompanying drawings, where:

FIG. 1 (prior art) is a block diagram of a conventional communication system including a public general packet radio service (GPRS) network, and showing routing of a communication between a user equipment terminal (UE) and a server co-located at the site;

FIG. 2 is a block diagram of a communication system including a private

GPRS network having local switching capabilities according to an embodiment of the present invention;

FIG. 3 is a block diagram of a communication system having a private GPRS network linked to a public wireless network according to an embodiment of the present invention; and

FIG. 4 is a flowchart showing an embodiment of a process according to the present invention for enabling UEs to access data in a co-located server or a server at a site joined via a local area network (LAN) using the private GPRS network.

**DETAILED DESCRIPTION**

The present invention is directed to a communication system and method for enabling user equipment terminals associated with a private general packet radio service (GPRS) wireless network to directly access data in a co-located sever, or linked to the GPRS wireless network through a local area network, substantially without routing communication over a public network.

A communication system according to the present invention will now be described with reference to FIG. 2. FIG. 2 is an exemplary block diagram of a communication system having a private GPRS wireless network with local switching capabilities according to an embodiment of the present invention. For purposes of clarity, many of the details of communication systems and in particular of Public Switched Telephone Networks, the Internet and GPRS wireless networks that are widely known and are not relevant to the present invention have been omitted.

Referring to FIG. 2, in accordance with the present invention the communication system 100 includes a private GPRS network 102 coupled to a server 104 co-located therewith at a single site 106 via a local area network (LAN 108). Alternatively, the private GPRS network 102 can be coupled to a wide area network or WAN (not shown in this figure) of servers, some or all of which can be remotely located from the private GPRS network. Generally, the private GPRS network 102 includes a GPRS network-in-a-box (GPRS NIB 110) adapted to transfer data between a number of user equipment terminals (UEs 112), only one of which is shown, and the server through the private GPRS network and the LAN 108. A private gateway support node (private GSN 114) connected or coupled to the GPRS NIB 110 and the LAN 108 switches communications or data packets between

the LAN and the GPRS NIB. The private GSN 114 is coupled to the GPRS NIB 110 via a private Iu-PS interface or link 115.

By site it is meant a geographic area capable of being served by the private GPRS network, and which may include one or more buildings or structures.

By UE 112 it is meant any mobile or wireless device or system capable of employing a radio link for accessing information in the server. Information accessed can include voice, multimedia, and/or data. Common UEs include, for example, portable computers, Web Access Appliances (WAPs), Personal Digital Assistants (PDAs), pagers, facsimile machines, and telephones.

By data it is meant any computer readable code capable of conveying numeric, text, graphic, voice or video information. The data stored in the server 104 can be structured as a database, having one or more large sets of persistent data with associated software to organize, access, query and update the data. A complex database can include numerous data files each containing many records each with a number of individual elements. A simple database might consist of a single data file or record.

It will be appreciated that in the communication system 100 of the present invention, ownership of data is maintained throughout the entire transfer, thereby enhancing security, and avoiding toll costs associated with use of a public network (not shown in this figure). Moreover, because the communication system 100 is not constrained by regulatory limitations on data transmission rates, and because it can be designed to accommodate a predetermined number of users, the communication system of the present invention can generally achieve higher data transfer rates than possible over existing public networks. The data transfer rate is a function of the coding scheme used to encode the data being transferred by radio communication. In a GPRS network there are four coding schemes. Channel coding scheme 1, or CS-1, which is capable of providing a maximum data speed of up to about 72.4 kilo bits per second (kb/s) with 8 time GSM time slots, or a data transmission rate of about 9.05 kb/s. CS-2 is capable of providing a maximum data speed of up to about 107.2 kb/s, or a data transmission rate of about 13.4 kb/s, while CS-3is capable of providing a maximum data speed up to about 124.8 kb/s, or a data transmission rate of about 15.6 kb/s, and CS-4 is capable of providing a maximum data speed up to about 171.2 kb/s, or a data transmission rate of about 21.4 kb/s. The choice of coding scheme depends on the quality of the radio link between the UE and the

GPRS NIB 110. If the radio link is very noisy, the private GPRS network may use CS-1 to ensure higher reliability. If the quality of the radio link between the UE and the GPRS NIB 110 is good, the private GPRS network could use CS-3 or CS-4 to obtain optimum data transmission rates.

The GPRS NIB 110 is a complete self-contained radio system which is the basis of the private GPRS network 102. Generally, the GPRS NIB 110 includes a base station controller 116 and base transceiver station 118 integrated with a single micro-cellular platform 120, such the WAVEXpress ® series of micro-cellular platforms, commercially available from Interwave Incorporated of Menlo Park, CA. Preferably, the GPRS NIB 110 is designed for rapid deployment and easy expansion of the private GPRS network 102 as usage and/or coverage requirements increase through the connection of additional GPRS NIBs to the network. More preferably, the GPRS NIB 110 allows expansion of the private GPRS network 102 through the addition of external BTSs 118 connected to and controlled by the GPRS NIB.

In a preferred embodiment the communication system 100 also includes a public network 122 to enable the UEs 112-1 to remotely access the server 104 from areas not served by the private GPRS network. One version of this embodiment will now be described with reference to FIG. 3. Referring to FIG. 3, the public network 122 can include a circuit-switched network, such as the public switched telephone network (PSTN 124), a public wireless network 126, such as the public GPRS network described above, and a packet-switched network, such as the Internet 128. The public wireless network 126 typically includes a public GSN 130 for switching communications or packets between the public wireless network and other parts of the public network 122, such as the PSTN 124, the Internet 128, or additional public GSNs (not shown). The public GSN 130 is further coupled to a number of base station controllers - central processing units (BSC/CPUs 132), only two of which are shown. Each BSC/CPU 132 in turn communicates with one or more base transceiver station (BTS 134), only one of which is shown for each BSC/CPU, that in turn communicate with the UEs 112-1 in the service area of the public wireless network 126. A public home location registry (public HLR 136) coupled to the public GSN 130 records the location or BTS addresses of where the UEs 112-1 can be found in the service area of the public wireless network 126.

In one version of this embodiment, the server 104 is coupled to the public network 122 through a Iu-PS link 138 or interface between the public wireless

network 126 and the private GSN 114. The private GSN 114 can be linked directly to the public GSN 130, as shown, or via the Internet 128, not shown. In another version, the private GPRS network 102 is coupled to the public network 122 through an Iu-PS link 139 or interface between the public wireless network 126 and the GPRS NIB 110. Alternatively, in another embodiment, the server 104 is coupled to the public network 122 through the LAN 108 and the Internet 128, and the UEs 112-1 are adapted to communicate with the public wireless network 126 to remotely access the server directly through the LAN.

In another embodiment, access to the server 104 is controlled by an authorization module 140 to prevent access by unauthorized UEs 112-1 or users. Generally, the authorization module 140 is connected between the LAN 108 and the server 104, not shown, or coupled to the server through the LAN, as shown. Alternatively, where the server 104 is coupled to the public network 122 through the private GPRS network 102, the authorization module 140 can be include within or part of the private GPRS network, coupled to one or both of the private GSN 114 or GPRS NIB 110.

In yet another embodiment, the LAN 108 is part of larger WAN 142 linking additional sites 106-1 within the enterprise at which additional servers 104-1 are located, remote from the private GPRS network 102 and the UEs 112. In one version of this embodiment, additional GPRS NIBs or BTSs 144 are provided at the additional sites 106-1 to expand coverage of the private GPRS network 102 to additional UEs 112-2. Optionally, the private GPRS network 102 may further include a central address table or location registry 146 to record the location or BTS address where the UEs 112 can be found in the service area of the private GPRS network.

A process or method for operating communication system 100 according to an embodiment of the present invention will now be described with reference to FIG. 4. FIG. 4 is a flowchart showing an embodiment of a method for enabling UEs 112 to access data in a co-located server 104, or in a server 104-1 at a site joined via a LAN 108 or a WAN 142, using the private GPRS network 102. In the method, call information from one of the UEs 112 is received in the GPRS NIB 110 of the private GPRS network 102 (step 150). Next, a determination is made whether the UEs 112 or users authorized to access the server 104 (step 152). If the UE 112 or the user is authorized, the UE is coupled to the server 104 through the private GPRS

network 102 and the LAN 108 (step 154), and data transferred between the UE and the server (step 156). Where the communication system 100 includes a public wireless network 126 coupled to the private GPRS network 102, the step of coupling the UE 112 to the server, step 154, is accomplished by coupling the UE 112-1 in areas not served by the private GPRS network 102 to the server through the public wireless network. Where the private GPRS network 102 is coupled via a WAN 142 to additional servers 104-1 remotely located from the private GPRS network and the UEs 112, the step of coupling the UE to the server, step 154, involves coupling the UE to one of the additional servers through the private GPRS network and the WAN 142.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best use the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto and their equivalents.

**WE CLAIM:**

1. A private general packet radio service (GPRS) network coupled to a server co-located therewith via a local area network (LAN), the private GPRS network comprising:

a private gateway support node (GSN); and

a GPRS network-in-a-box (GPRS NIB) adapted to transfer data between a plurality of user equipment terminals (UEs) and the server through the private GPRS network and the LAN,

whereby security is enhanced by maintaining ownership of data throughout the transfer, and toll costs associated with use of a public network are avoided.

2. A private GPRS network according to claim 1, wherein the private GPRS network is adapted to communicate with the plurality of UEs using a coding scheme selected from the group consisting of:

channel coding scheme (CS) 1;

CS-2;

CS-3; and

CS-4.

3. A private GPRS network according to claim 1, wherein the private GPRS network is configured to enable the plurality of UEs to access data in a second server remotely located from the private GPRS network and the plurality of UEs, and coupled to the private GPRS network via a wide area network (WAN).

4. A private GPRS network according to claim 3, wherein the LAN is part of the WAN.

5. A private GPRS network according to claim 1, wherein the UEs are further adapted to also communicate with a public wireless network.

6. A communication system comprising:

a public network; and

a private general packet radio service (GPRS) network coupled to the public network and to a server via a local area network (LAN), the private GPRS network including a private gateway support node (GSN) and a GPRS network-in-a-box (GPRS NIB) to enable a plurality of user equipment terminals (UEs) to access the server through the private GPRS network and the LAN.

7. A communication system according to claim 6, wherein the plurality of UEs include at least one data processing device, and wherein the private GPRS network is adapted to transfer data between the data processing device and the server.

8. A communication system according to claim 6, wherein the private GPRS network is co-located with the server.

9. A communication system according to claim 6, wherein the private GPRS network is adapted to communicate with the plurality of UEs using a coding scheme selected from the group consisting of:

channel coding scheme (CS) 1;

CS-2;

CS-3; and

CS-4.

10. A communication system according to claim 6, wherein the LAN is part of a larger wide area network (WAN) coupling to additional servers remotely located from the private wireless network.

11. A communication system according to claim 10, wherein the private GPRS network is adapted to enable the plurality of UEs to access the additional servers through the WAN.

12. A communication system according to claim 6, wherein the public network comprises a public wireless network, and wherein the private GPRS network is adapted to enable the plurality of UEs to remotely access the server through the public wireless network from areas not served by the private GPRS network.

13. A communication system according to claim 12, wherein the private GPRS network further comprises an authorization module.

14. A communication system according to claim 13, wherein the private GPRS network is coupled to the public network through the GPRS NIB.

15. A communication system according to claim 13, wherein the private GPRS network is coupled to the public network through the private GSN.

16. A communication system according to claim 6, wherein the public network comprises a public wireless network directly coupled to the server through the LAN, and wherein the plurality of UEs are adapted to also communicate with a

public wireless network to remotely access the server through the public wireless network from areas not served by the private GPRS network.

17. A communication system according to claim 16, wherein an authorization module coupled to the server through the LAN prevents unauthorized access to the server.

18. In a communication system having a private general packet radio service (GPRS) network coupled to a server via a local area network (LAN), the private GPRS network including a private gateway support node (GSN), and a GPRS network-in-a-box (GPRS NIB), a method of transferring data between a plurality of user equipment terminals (UEs) and the server through the private GPRS network and the LAN, the method comprising steps of:

receiving in the GPRS NIB of the private GPRS network call information from one of the plurality of UEs;

coupling the UE to the server through the private GPRS network and the LAN; and

transferring data between the UE and the server through the private GPRS network and the LAN.

19. A method according to claim 18, wherein communication system further includes a public wireless network coupled to the private GPRS network, and wherein the step of coupling the UE to the server, includes the step of coupling the UE to the server through the public wireless network from areas not served by the private GPRS network.

20. A method according to claim 19, wherein communication system further includes an authorization module, and wherein the method further includes the step of determining whether the UE or the user thereof are authorized to access the server.

21. A method according to claim 18, wherein the private GPRS network is coupled via a wide area network (WAN) to additional servers remotely located from the private GPRS network and the plurality of UEs, and wherein the step of coupling the UE to the server comprises the step of coupling the UE to one of the additional servers through the private GPRS network and the WAN.

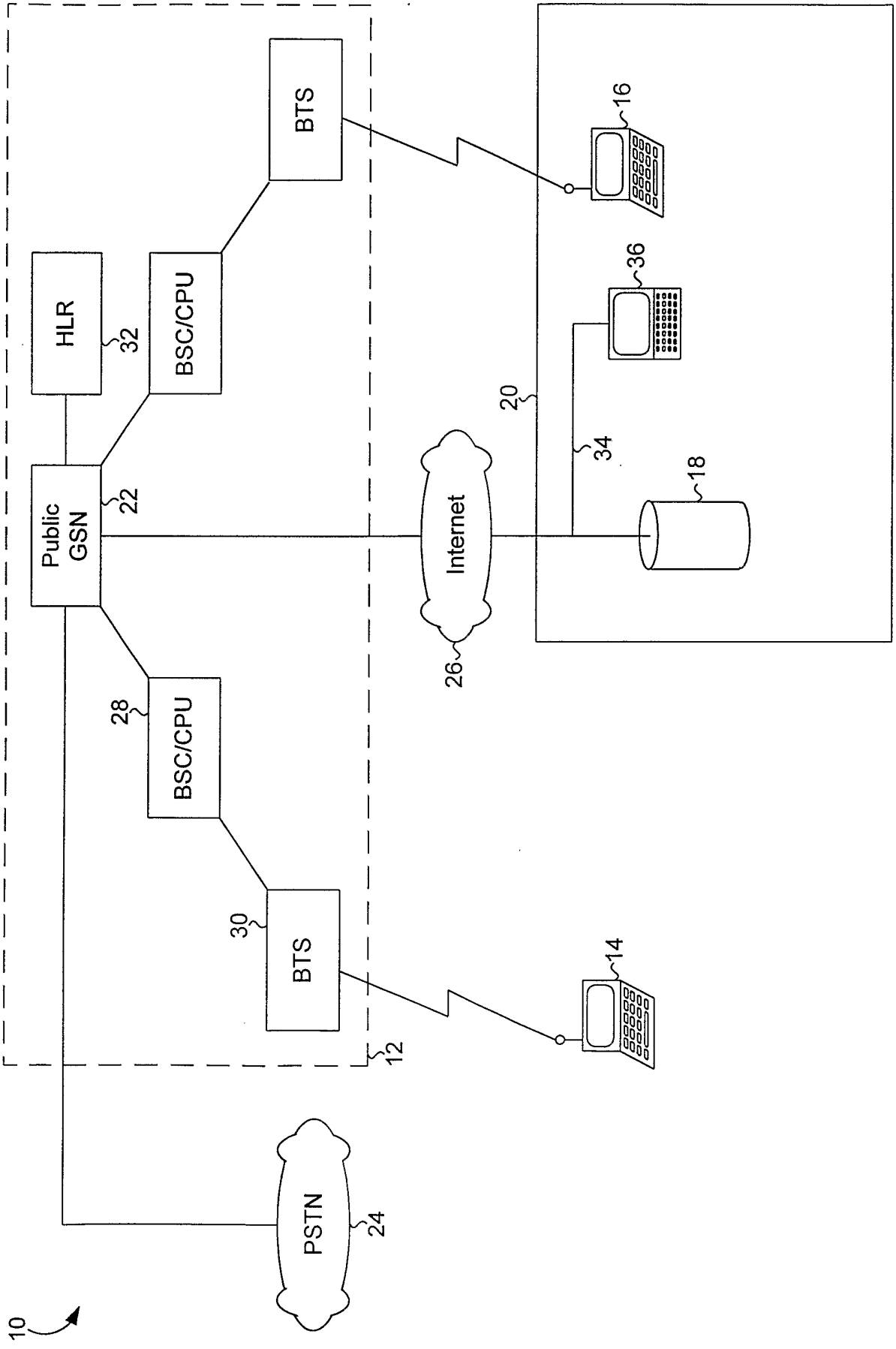



FIG. 1 (Prior Art)

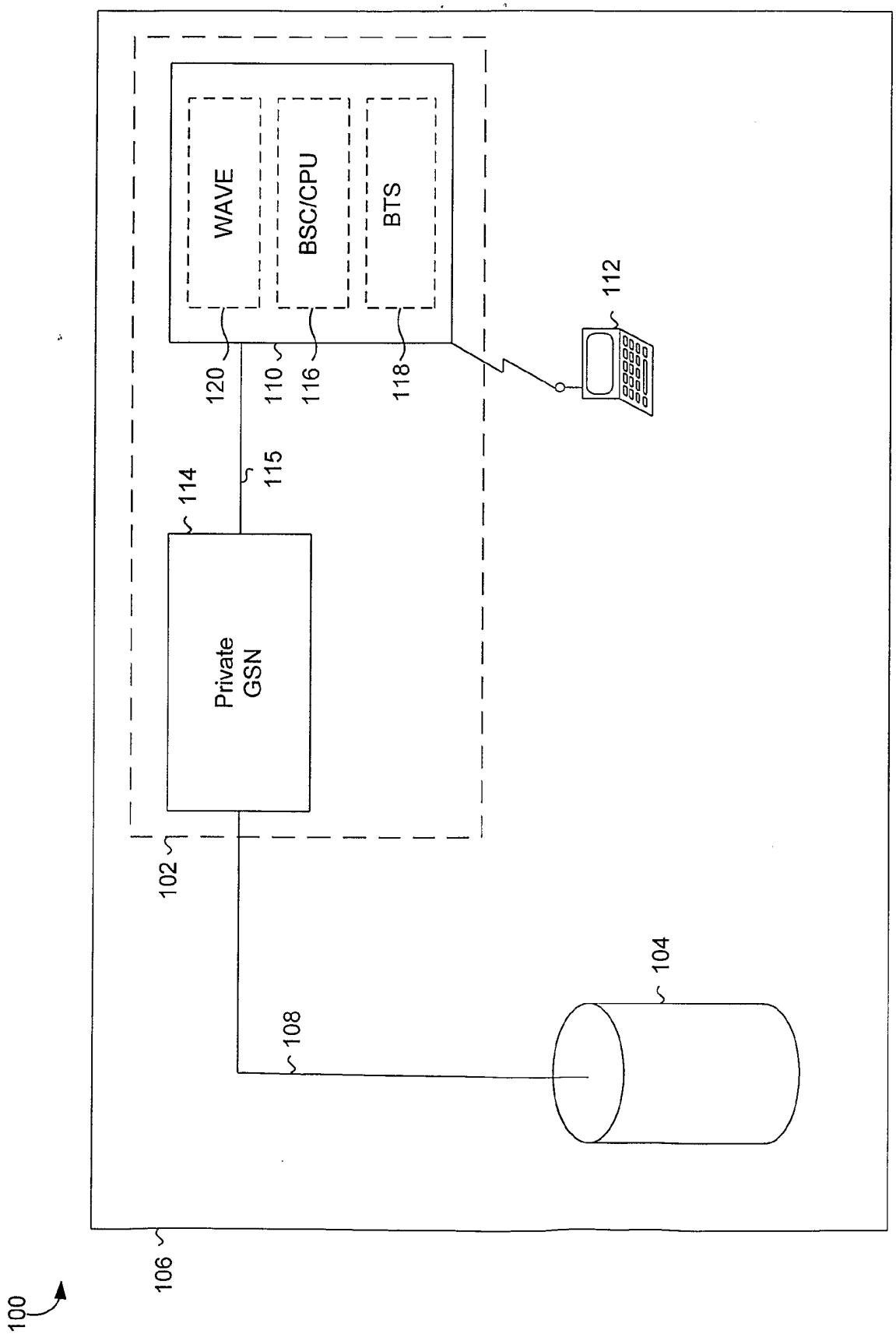
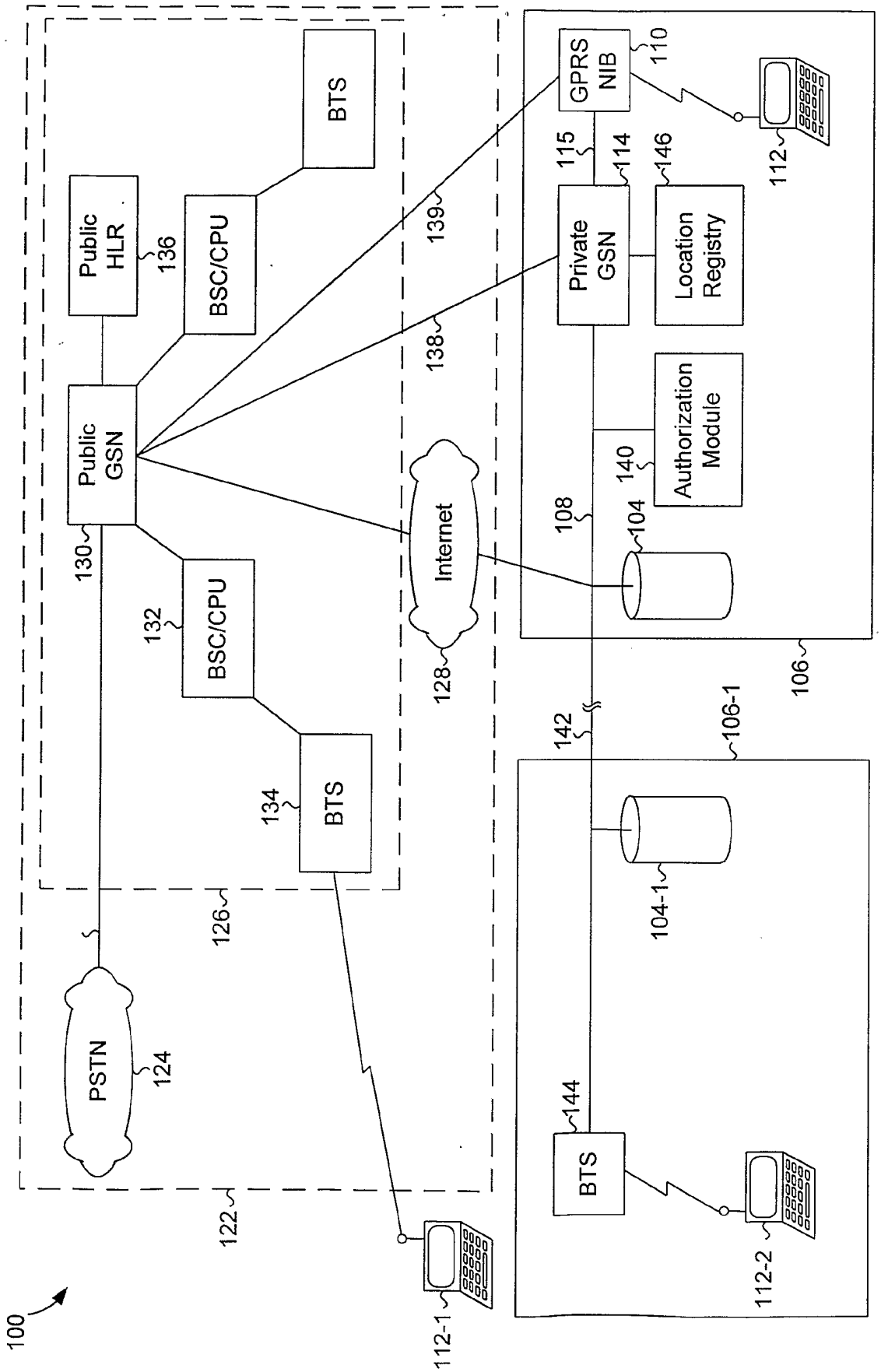

100
106
102
WAVE
BSC/CPU
BTS
120
110
116
118
112
114
115
Private GSN
108
104

FIG. 2


100
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BSC/CPU
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BSC/CPU
BTS
PSTN
124
Internet
128
GPRS NIB
110
115
114
Private GSN
Location Registry
Authorization Module
108
104
106
106-1
104-1
112
112-1
112-2

FIG. 3

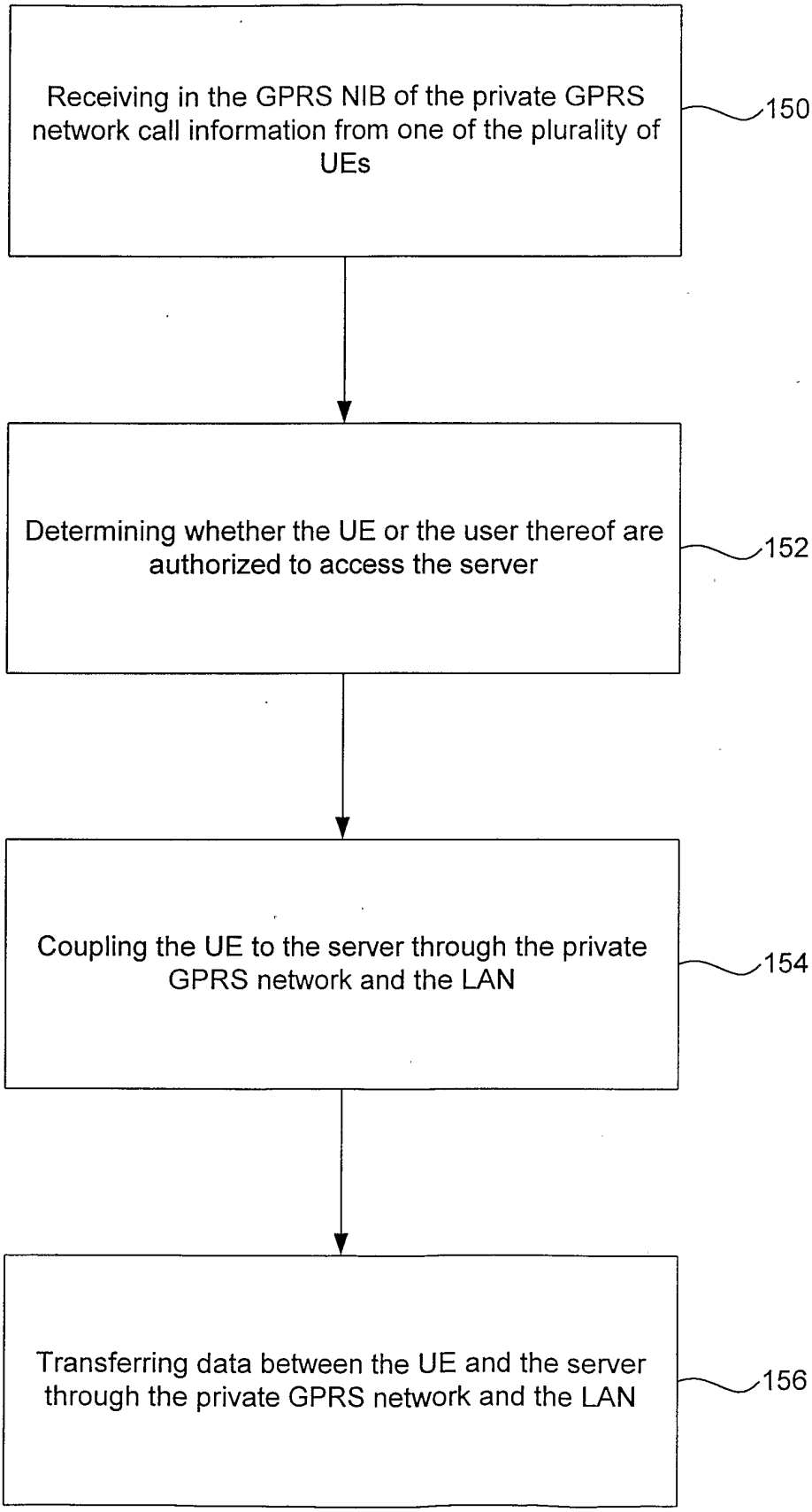
Receiving in the GPRS NIB of the private GPRS network call information from one of the plurality of UEs
150
Determining whether the UE or the user thereof are authorized to access the server
152
Coupling the UE to the server through the private GPRS network and the LAN
154
Transferring data between the UE and the server through the private GPRS network and the LAN
156

FIG. 4