US009271313B2

(12) **United States Patent**
Qu et al.

(10) **Patent No.:** **US 9,271,313 B2**
(45) **Date of Patent:** **Feb. 23, 2016**

(54) **SERVICE FREQUENCY BASED 3GDT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/130,462**

(22) PCT Filed: **Jul. 1, 2011**

(86) PCT No.: **PCT/EP2011/061123**
§ 371 (c)(1), (2), (4) Date: **Dec. 31, 2013**

(87) PCT Pub. No.: **WO2013/004272**
PCT Pub. Date: **Jan. 10, 2013**

(65) **Prior Publication Data**
US 2014/0133431 A1 May 15, 2014

(51) **Int. Cl.**
H04W 76/02 (2009.01)
H04W 28/02 (2009.01)
H04W 8/08 (2009.01)
H04L 12/46 (2006.01)

(52) **U.S. Cl.**
CPC ***H04W 76/02*** (2013.01); ***H04W 76/022*** (2013.01); *H04L 12/4633* (2013.01); *H04W 8/082* (2013.01); *H04W 28/0289* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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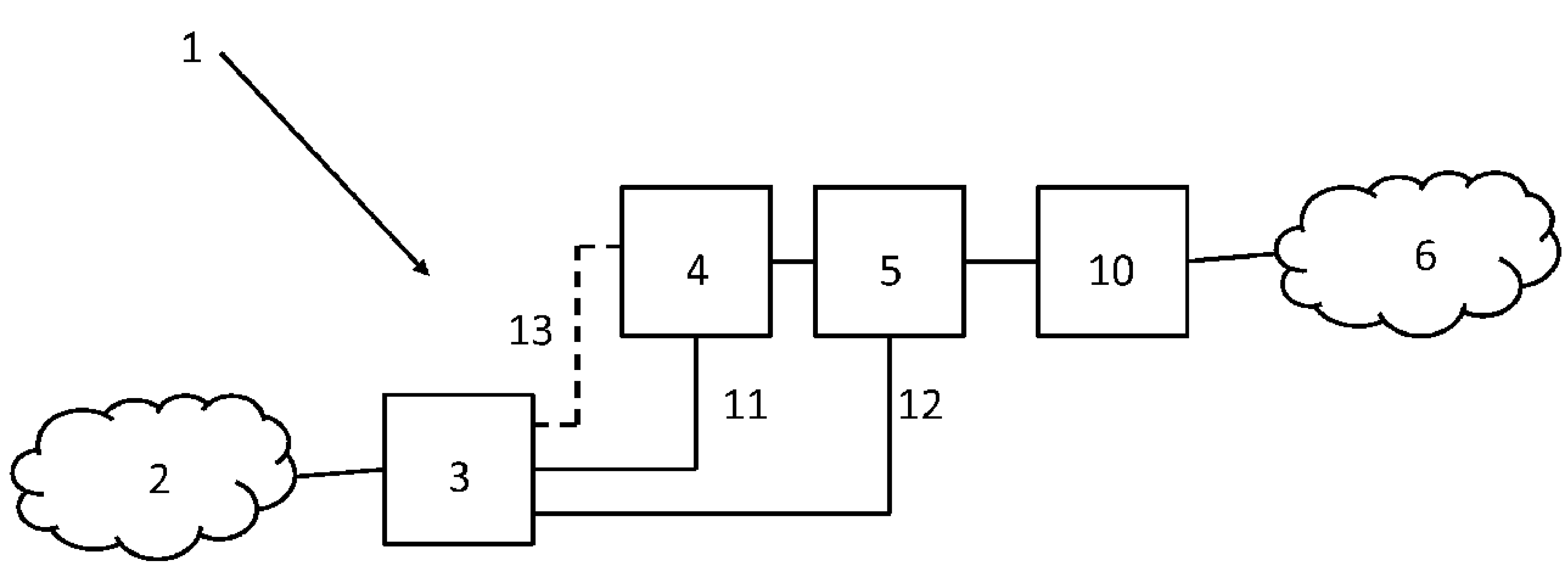
(57) **ABSTRACT**

A method for reducing the signaling load of a GPRS core network system is provided. The GPRS core network system comprises a first UE, a first RNC, a first SGSN, a first core network node, and a first IP network, where the first UE is arranged to be in communication with the first RNC, where the first RNC is arranged to be in communication with the SGSN for non-3GDT communication of the GPRS core network system or the core network node for 3GDT communication of the GPRS core network system, where the first SGSN is arranged to be in communication with the first core network node, where the first core network node is arranged to be in contact with the first IP network, where one or more service requests originates from the first UE to the SGSN, where the number of service requests to the SGSN is measured.

3 Claims, 3 Drawing Sheets



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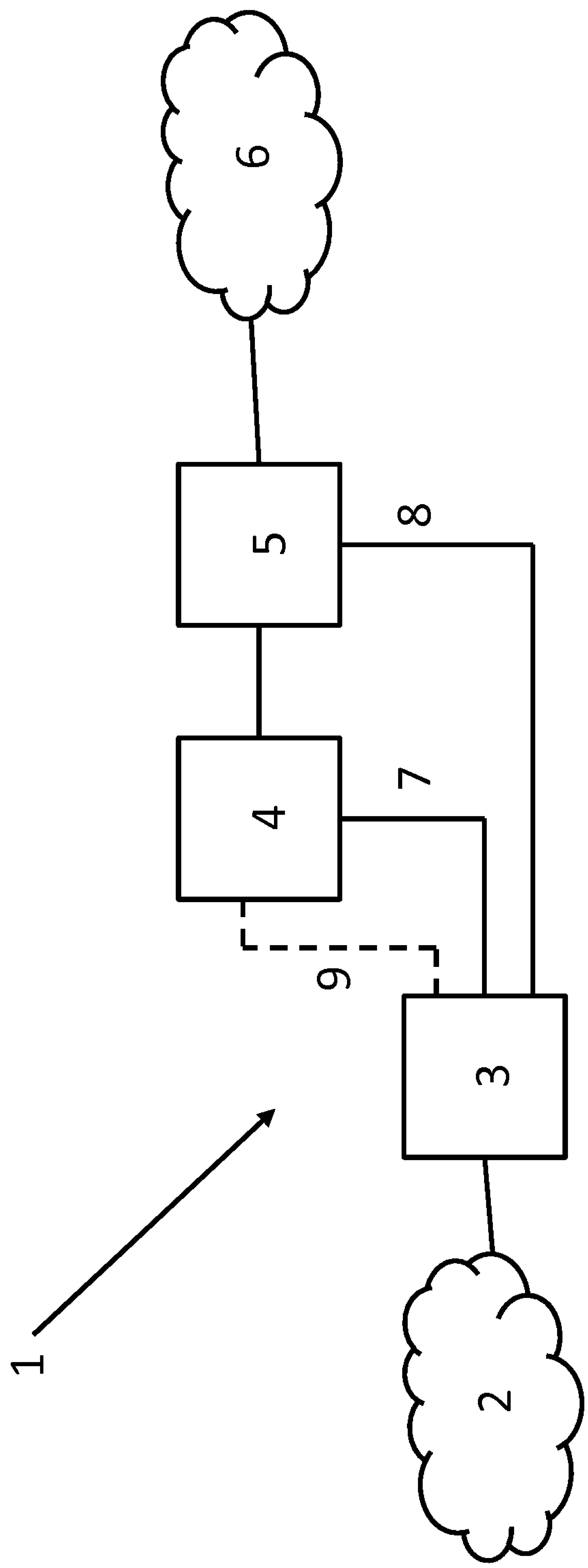

Figure 1

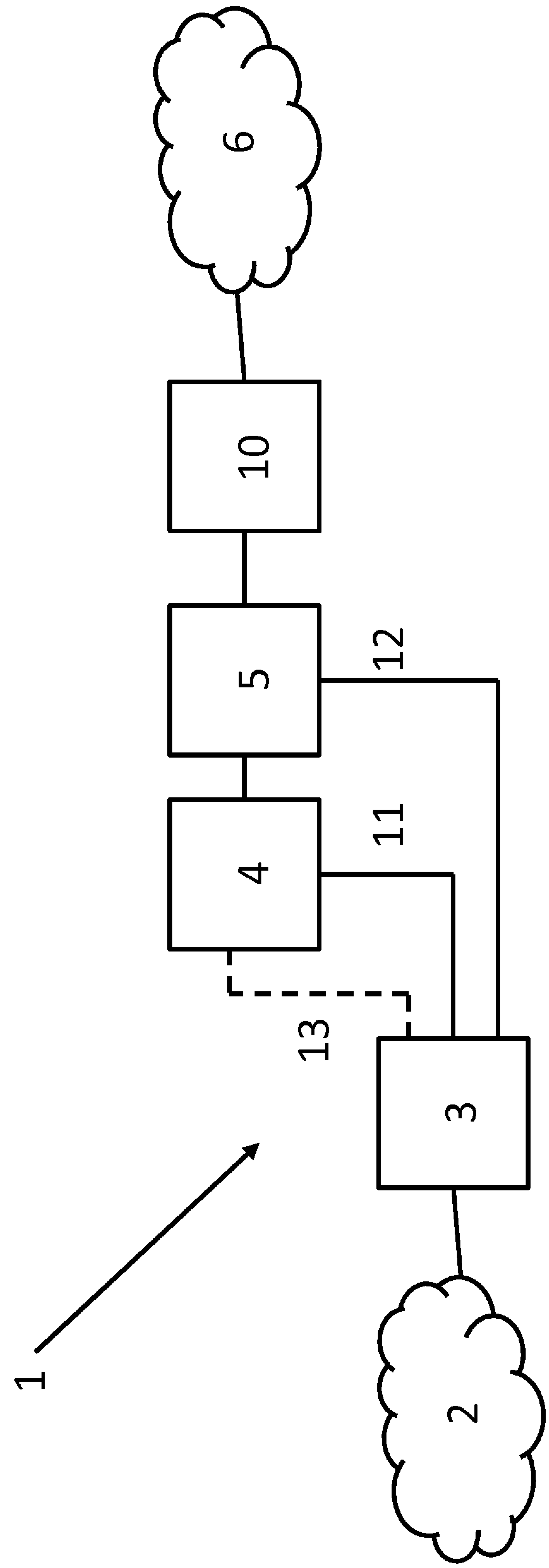

Figure 2

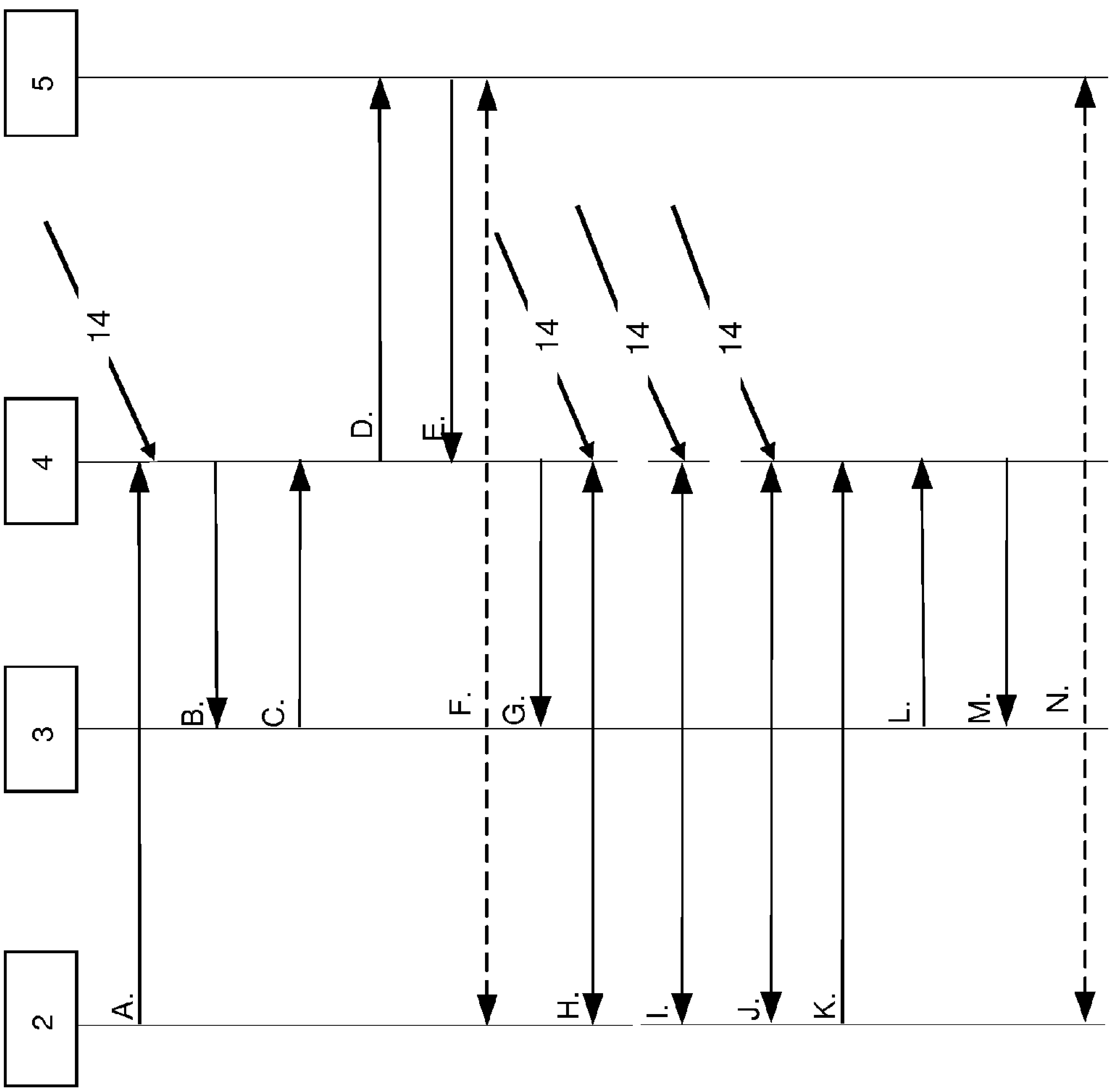

Figure 3

SERVICE FREQUENCY BASED 3GDT

CROSS REFERENCE TO RELATED APPLICATION(S)

This application is a 35 U.S.C. § 371 National Phase Entry Application from PCT/EP2011/061123, filed Jul. 1, 2011, designating the United States, the disclosure of which is incorporated herein in its entirety by reference.

TECHNICAL FIELD

The present invention relates to a method for reducing the signalling load of a GPRS core network system. The GPRS core network system comprises a first UE, a first RNC, a first SGSN, a first core network node, and a first IP network. The first UE is arranged to be in communication with the first RNC. The first RNC is arranged to be in communication with the SGSN for non-**3**GDT communication of the GPRS core network system or the core network node for 3GDT communication of the GPRS core network system. The first SGSN is arranged to be in communication with the first core network node, where the first core network node is arranged to be in contact with the first IP network. One or more service requests originate from the first UE to the SGSN.

BACKGROUND ART

Abbreviations:

3GDT 3G Direct Tunnel
3GPP 3rd Generation Partnership Project
APN Access Point Name
BSC Base Station Controller
CN Core Network
DNS Domain Name System
ECM EPS Connection Management
EMM EPS Mobility Management
EPC Evolved Packet Core
EPS Evolved Packet System
E-RAB E-UTRAN Radio Access Bearer
E-UTRAN Evolved Universal Terrestrial Radio Access Network
GGSN Gateway GPRS Support Node
GTP GPRS Tunnelling Protocol
GTP-U GTP user data tunnelling
GUMMEI Globally Unique MME Identifier
GUTI Globally Unique Temporary Identity
GW Gateway
HLR Home location register
IE Information Element
IM Instant Message
IMSI International Mobile Subscriber Identity
IP Internet Protocol
ISD Insert Subscriber Data
ISRAU Inter SGSN Routing Area Update
MM Mobility Management
MME Serving GPRS Support Node
MME Mobility Management Entity
MS Mobile Station
MT Mobile Terminating
NRI Network Resource Identifier
P GW PDN Gateway
PDP Packet Data Protocol
PDU Packet Data Unit
PLMN Public Land Mobile Network
PS Packet Switched
P-TMSI Packet Temporary Mobile Subscriber Identity

RAB Radio Access Bearer
RAI Routing Area Identity
RAN Radio Access Network
RAT Radio Access Technology
RAU Routing Area Update
RNC Radio Network Controller
S GW Serving Gateway
SRNS Serving Radio Network Subsystem, the change of lu instance and transfer of the SRNS role to another RNS.
TAI Tracking Area Identity
TAU Tracking Area Update
TEID Tunnel Endpoint Identifier
UE User Equipment
UMTS Universal Mobile Telecommunications System
UP User Plane

References:

3GPP TS 23.060
3GPP TS 23.401
3GPP TS 29.060
3GPP TS 29.274
3GPP TS 29.272

3GDT is very popular to the operator and the end user. 3GDT enables setup of a GPRS Tunnelling Protocol (GTP) tunnel for transporting payload traffic between a GGSN/PGW or a SGW and an RNC directly, thus bypassing the SGSN. GPRS Tunnelling Protocol (GTP) is a group of IP-based communications protocols used to carry General Packet Radio Service (GPRS) within GSM, UMTS and EPS within LTE networks. The tunnel separates the user traffic from the control traffic and reduces the payload traffic through the SGSN. However, even though the tunnel has many advantages, some complaints from the operators occurs because they found the 3GDT to be consuming a lot of signalling load to the GGSN/PGW or the SGW especially for some IM (Instant Message) applications. The IM applications send very short length of PDU and release the radio connection and reconnect again which gives a lot of signalling load.

In the present existing solution, the SGSN has to handle a high number of (frequent) service requests, which may exhaust the node capacity due to the frequent service request triggered, here called "Update PDP Context Request/Response" between Gn-SGSN and GGSN/PGW or "Modify Bearer Request/Response" between S4-SGSN and SGW.

There is thus a need for an improved and more effective system.

DISCLOSURE OF INVENTION

The object of the present invention is to provide a method for reducing the signalling load of a GPRS core network system where the previously mentioned problems are avoided. This object is achieved by the features of the characterising portion of claim **1**, wherein the number of service requests from the UE to the SGSN is measured.

The purpose of the solution of the present invention is to prevent a core network node, for instance the GGSN/PGW or SGW, from frequent "Update PDP Request" or "Modify Bearer Request" from SGSN due to frequent 3GDT update.

According to the present invention a 3GDT will not be set up for certain services. The UE requires to setup RAB by service request, but soon to release the RAB. According to the invention the services are detected and measured more smartly based on the configuration by the operator. Based on the request type, the SGSN can detect if the message type is a Service Request or not.

The present invention relates to a method for reducing the signalling load of a GPRS core network system, the GPRS core network system comprising a first UE, a first RNC, a first SGSN, a first core network node, the first core network node being either a GGSN/PGW or a SGW, and a first IP network, where the first UE is arranged to be in communication with the first RNC, where the first RNC is arranged to be in communication with the SGSN for non-3GDT communication of the GPRS core network system or the first core network node for 3GDT communication of the GPRS core network system, where the first SGSN is arranged to be in communication with the first core network node, where the first core network node is arranged to be in contact with the first IP network, where one or more service requests originates from the first UE to the SGSN, where the number of service requests from the UE to the SGSN is measured.

The method may also allow for that a 3GDT communication is set up if the configuration of the SGSN allows the setup of a 3GDT communication and the number of service requests from the first UE to the SGSN does not exceed a threshold value.

The method may also allow for that a non-3GDT communication for the GPRS core network system is set up instead of the GPRS core network communication if the number of service requests from the first UE to the SGSN has exceeded a threshold value.

One advantage of the invention is that it will decrease the signalling load for the core network. This will not introduce extra signalling or message to the existing network but effectively make full use of the legacy message and improve the network quality. Additionally the need for SGSN-MME payload capacity expansion is greatly reduced. Costly hardware upgrades can be avoided and the number of SGSN-MMES can be reduced even with many mobile broadband and payload intensive subscribers in the network.

BRIEF DESCRIPTION OF DRAWINGS

The invention will below be described in connection to a number of drawings where;

FIG. **1** schematically shows a GPRS core network system using Gn/Gp architecture according to the invention, and;

FIG. **2** schematically shows a GPRS core network system using S3/S4 architecture according to the invention, and;

FIG. **3** schematically shows a block diagram over the method according to the invention.

DETAILED DESCRIPTION OF DRAWINGS

FIG. **1** schematically illustrates a GPRS core network system **1** setup for 3GDT using Gn/Gp architecture. The system comprises a first UE **2**, a first RNC **3**, a first SGSN **4**, a first core network node **5** being a GGSN/PGW and a first IP network **6**. Additional units (not shown) may connect to the GPRS core network system such as a first NodeB connected to a first WCDMA UE or one or more PLMN's.

The RNC **3** is arranged to be connected to the SGSN **4** for non-3GDT communication via a non-3GDT connection **7**. The RNC **3** is further arranged to be connected to the first core network node **5** for 3GDT communication via a 3GDT connection **8**. The RNC **3** is further arranged to be connected to the SGSN **4** via a control connection **9**. The connections **7**, **8**, **9** are lu connections. The control connection **9** is an lu-C connection; the user plane connections, i.e. the non-3GDT connection **7** and the 3GDT connection, are lu-U connections.

The RNC **3** is connected either to the SGSN **4** or the first core network node **5** depending on whether 3GDT is enabled or not. The first SGSN **4** is arranged to be in communication with the first core network node **5**, and the first core network node **5** is arranged to be in contact with the first IP network **6**.

FIG. **2** schematically illustrates a GPRS core network system **1** setup for 3GDT using S3/S4 architecture. The system comprises a first UE **2**, a first RNC **3**, a first SGSN **4**, a first core network node being a SGW **5**, a PGW **10** and a first IP network **6**. Additional units (not shown) may connect to the GPRS core network system such as a first NodeB connected to a first WCDMA UE or one or more PLMN's.

The RNC **3** is arranged to be connected to the SGSN **4** for non-3GDT communication via a non-3GDT connection **11**. The RNC **3** is further arranged to be connected to the first core network node **5** for 3GDT communication via a 3GDT connection **12**. The RNC **3** is further arranged to be connected to the SGSN **4** via a control connection **13**. The connections **11** and **13** are lu connections. The control connection **13** is an lu-C connection; the user plane connection, i.e. the non-3GDT connection **7** is a lu-U connections. The 3GDT connection **12** is a S**12** connection

The RNC **3** is connected either to the SGSN **4** or the first core network node **5** depending on whether 3GDT is enabled or not. The first SGSN **4** is arranged to be in communication with the first core network node **5**, the first core network node **5** is arranged to be in contact with the PGW **10** and the PGW **10** is arranged to be in connection with the first IP network **6**.

The below description describes the setup of the 3GDT in a GPRS core network system using Gn/Gp architecture. The description is valid for the S3/S4 architecture having a SGW instead of GGSN/PGW except where specifically stated.

3GDT enables the setup of a GPRS Tunnelling Protocol (GTP) tunnel for transporting the payload traffic between the GGSN/PGW **5** and RNC **3** directly, thus bypassing the SGSN **4**. This separates the user traffic from the control traffic and reduces the payload traffic through the SGSN **4**.

A GTP-U tunnel for transporting traffic between the GGSN/PGW **5** and RNC **3** directly is referred to as the direct tunnel. The configuration where 3GDT is not activated and the SGSN **4** is not bypassed is referred to as the two-tunnel solution.

The SGSN **4** decides on a RNC **3**, GGSN/PGW **5**, APN, and optionally on subscriber basis if 3GDT should be used. The RNC configuration in the SGSN **4** specifies if an RNC **3** supports a direct user-plane connection. Whether to allow 3GDT on GGSN/PGW, APN (APN-based 3GDT configuration), and optionally subscriber basis is specified through the configuration in the SGSN **4**, HLR and DNS.

If the SGSN **4** uses 3GDT, a direct tunnel between the GGSN/PGW **5** and RNC **3** replaces the two-tunnel solution in the user plane and the SGSN **4** then continuously updates both the GGSN/PGW **5** and RNC **3** with information regarding the user-plane TEID values and IP addresses. The control traffic is routed as in the two-tunnel solution.

Configuring 3GDT on a GGSN/PGW **5**, APN, and subscriber basis enables the use of 3GDT, for example, for payload extensive and stationary MSs, by bypassing the SGSN **4** for the user plane while mitigating the capacity impact of continuously keeping the RNC **3** and GGSN/PGW **5** updated.

The SGSN **4** checks if 3GDT should be used each time a PDP context is activated, either as MS activated or by means of an Inter SGSN Routing Area Update (ISRAU), an Inter SGSN Inter-Radio Access Technology (IRAT) PS Handover from GSM to WCDMA Systems, or an Inter SGSN Serving

Radio Network Subsystem (SRNS) relocation. Also, each time a new serving RNC is selected the use of 3GDT for a PDP context is checked.

If 3GDT is used, the set-up of the Radio Access Bearers (RABs) includes information necessary for the transport of user data between the

GGSN/PGW **5** and RNC **3** directly, using a direct tunnel, illustrated by connection **9** in FIG. **1**. The direct tunnel uses one user-plane IP address and TEID value for each of its tunnel endpoints. The IP address and TEID value are configured in each node. If the user-plane IP address and TEID value are updated at the RNC **3** tunnel endpoint, the opposite node must be updated also. A RAB is updated if the corresponding PDP context is modified.

The SGSN **4** is responsible for providing the following information to the GGSN/PGW **5**:

The RNC IP address

The RNC user-plane TEID value

The SGSN **4** is responsible for providing the following information to the RNC **3**:

The GGSN/PGW user-plane IP address

The GGSN/PGW user-plane TEID value

If a RAB assigned for a PDP context is released, a GTP-U tunnel is established between the SGSN **4** and GGSN/PGW **5** for handling the downlink packets. This until the direct tunnel is re-established between the GGSN/PGW **5** and the RNC **3**.

If a MS with an already established PDP context moves between compliant and non-3GDT compliant RNCs, the SGSN **4** switches between using the direct tunnel and the two-tunnel solution.

For a Gn-SGSN, 3GDT will not be set-up for non-roaming traffic. But for an S**4**-SGSN, 3GDT can be set-up for both roaming and non-roaming traffic depending on the configuration.

The PDP Context is always updated in the GGSN/PGW or SGW when the MS moves to another RNC during all types of Routing Area Updates (RAUs). The roaming transport, Gp, remains in the SGSN-MME.

During RAB release and reestablishment and some mobility procedures that require bicasting of packets, the SGSN-MME might disconnect the tunnel between the RNC and the GGSN/PGW or SGW. For a Gn-SGSN, the SGSN-MME sets up the classic two tunnel solution between the RNC and the SGSN-MME, as well as between the SGSN-MME and the GGSN/PGW. But for an S**4**-SGSN, the SGSN-MME releases the direct tunnel between the RNC and the SGW. When using S**4**-SGSN, this feature also supports the S**12** interface.

FIG. **3** schematically illustrates a block diagram showing an implementation of the method according to the invention. The method may comprise the steps of

A. The SGSN **4** receiving a Service Request **14** could due to either a Service Request (Service type=Data) from the MS due to Uplink payload or Downlink payload from GGSN/PGW **5** resulting in a Service Request (Service type=paging response) from RNC **3**.

B. The SGSN **4** sends RAB Assignment Request towards RNC **3** with GGSN/PGW **5** User Plane IP-address and TEID. (RAB Assignment Request)

C. The SGSN **4** receives RAB Assignment Response from RNC **3**. (RAB Assignment Response)

D. If the requirements for 3GDT are fulfilled an Update PDP Context

Request is sent to the GGSN/PGW **5** with RNC **3** UP IP-address and TEID. (Update PDP Context Request)

E. An Update PDP Context Response is sent from the GGSN/PGW **5**. (Update PDP Context Response)

F. PDU is transferred between UE **2** and PDN network. (PDU)

G. lu is released if the PDU transferring finished. (lu Release)

H-J. Several Service Requests **14** are triggered in the SGSN **4** due to frequent data transferring request from the UE **2**. (Service Request)

When the rate of Service Requests for this event has reached a predetermined threshold in a predetermined measurement interval a two tunnel solution starts to set up from now on. The two tunnel solution may be set up for a predetermined period of time or indefinitely, depending on the operator's configuration.

K. If the predetermined threshold is reached, SGSN **4** decides not to setup a direct tunnel for this subscriber. (Service request)

L-N. The two tunnel solution will be kept for this subscriber. (RAB Assignment Request, RAB Assignment Response, PDU) The two tunnel solution will be kept as long as Service Requests are received by the SGSN **4** from the UE **2** with a high enough frequency during a period configured by an operator, i.e. as long as the number of Service Requests exceeds a predetermined threshold in a predetermined measurement interval.

One example of the above may be that the predetermined threshold is **5**, the predetermined measurement interval may be one minute and the predetermined period of time is 10 minutes. This would mean that the SGSN **4** receives a service request from the same UE **2** five times in one minute. The SGSN **4** may then choose the two-tunnel solution for 10 minutes. The two tunnel solution may in addition to the 10 minutes be active indefinitely depending on configuration conditions set by the operator. Other suitable predetermined values of threshold, measurement interval and period of are of course conceivable.

Since 3GDT impacts both payload and signalling, on network as well as on node level, it is strongly recommended to perform a network analysis of the specific operator traffic case. This is done in order to determine optional configurations and node sizes. Here follows payload and signalling sums that affect dimensioning.

The total payload through the SGSN-MME is the sum of the following:

Roaming WCDMA traffic payload in Gn-SGSN.

GSM payload, for dual and triple-access SGSN-MME.

Non-roaming WCDMA payload for WCDMA users configured for 3GDT OFF.

The total signalling in the SGSN-MME consists of the following:

Initial SGSN-MME signalling.

Additional 3GDT signalling for WCDMA users configured for 3GDT ON.

The invention claimed is:

1. A method for reducing a signaling load of a General Packet Radio Service (GPRS) core network system, wherein the GPRS core network system comprises a first User Equipment (UE); a first Radio Network Controller (RNC); a first Serving GPRS Support Node (SGSN); a first core network node, the first core network node being either a Gateway GPRS Support Node/Packet Data Network Gateway (GGSN/PGW), or a Serving Gateway (SGW); and a first Internet Protocol (IP) network, the method comprising:

receiving by the first SGSN one or more service requests from the first UE;

measuring by the first SGSN the number of service requests from the first UE to the first SGSN in a predetermined measurement interval of time;

determining by the first SGSN whether the measured number of service requests in the predetermined measurement interval of time exceeds a threshold value;

setting up a 3rd Generation Direct Tunnel (3GDT) communication if a configuration of the first SGSN allows the setup of the 3GDT communication and the number of service requests from the first UE to the first SGSN does not exceed the threshold value; and

setting up a non-3GDT communication for the GPRS core network system if the number of service requests from the first UE to the first SGSN exceeds the threshold value,

wherein the first UE is arranged to be in communication with the first RNC,

wherein the first RNC is arranged to be in communication with the first SGSN for non-3GDT communication of the GPRS core network system or the first core network node for 3GDT communication of the GPRS core network system,

wherein the first SGSN is arranged to be in communication with the first core network node, and

wherein the first core network node is arranged to be in contact with the first IP network.

2. A network system in communication with a first User Equipment (UE) comprising:

a first Radio Network Controller (RNC);

a first Serving GPRS Support Node (SGSN);

a first core network node, the first core network node being either a Gateway GPRS Support Node/Packet Data Network Gateway (GGSN/PGW), or a Serving Gateway (SGW); and

a first Internet Protocol (IP) network,

wherein the first RNC is arranged to be in communication with the first SGSN for non-3rd Generation Direct Tunnel (3GDT) communication of the network system or the first core network node for 3GDT communication of the network system,

wherein the first SGSN is arranged to be in communication with the first core network node,

wherein the first core network node is arranged to be in contact with the first IP network, and

wherein the first SGSN is configured to:

receive one or more service requests from the first UE;

measure the number of service requests from the first UE to the first SGSN in a predetermined measurement interval of time;

determine whether the measured number of service requests in the predetermined measurement interval of time exceeds a threshold value;

set up a 3GDT communication if a configuration of the first SGSN allows the set up of the 3GDT communication and the number of service requests from the first UE to the first SGSN does not exceed the threshold value; and

set up a non-3GDT communication for the network system if the number of service requests from the first UE to the first SGSN exceeds the threshold value.

3. A method performed by a Serving GPRS Support Node (SGSN) of a network, the method comprising:

receiving by the SGSN one or more service requests from a user equipment (UE);

measuring by the SGSN a number of the one or more service requests from the UE in a predetermined measurement interval of time;

determining by the SGSN whether the measured number of the one or more service requests in the predetermined measurement interval of time exceeds a threshold value;

setting up by the SGSN a 3rd Generation Direction Tunnel (3GDT) communication if a configuration of the SGSN allows the setup of the 3GDT communication and the number of the one or more service requests from the UE does not exceed the threshold value;

setting up by the SGSN a non-3GDT communication for a GPRS core network system if the number of the one or more service requests from the UE exceeds the threshold value; and

wherein the network further comprises a Radio Network Controller (RNC), a core network node, and an Internet Protocol (IP) network, the RNC being arranged to be in communication with the SGSN for non-3GDT communication or the core network node for 3GDT communication, the SGSN being arranged to be in communication with the core network node, and the core network node being arranged to be in contact with the IP network.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,271,313 B2
APPLICATION NO. : 14/130462
DATED : February 23, 2016
INVENTOR(S) : Qu et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the specification,

In Column 1, Line 57, delete "MME" and insert -- SGSN --, therefor.

In Column 3, Line 34, delete "SGSN-MMES" and insert -- SGSN-MMEs --, therefor.

In the claims,

In Column 8, Line 26, in Claim 3, delete "Direction" and insert -- Direct --, therefor.

Signed and Sealed this
Twenty-fourth Day of May, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office