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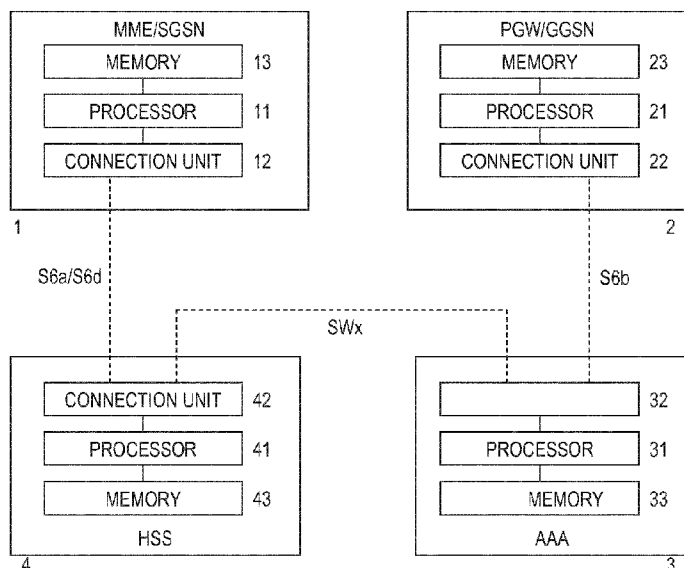


Fig. 1

(57) Abstract: Apparatuses and methods are provided by which a group control device for controlling a group of user equipments is selected. When a packet data connection for a first user equipment of the group is created, the group control device for the group is selected based on information related to the group. Information regarding the group control device and the information related to the group are stored in a subscription management device. When a next user equipment requests creation of a packet data connection, information regarding the group control device is obtained from the subscription management device.

DESCRIPTION**TITLE****Bearer management for groups**5 Field of the Invention

The present invention relates to an apparatus, a method and a computer program product for carrying out bearer management for groups.

10 Related background Art

The following meanings for the abbreviations used in this specification apply:

	AAA	Authentication, authorization and accounting
15	APN	Access point name
	AMBR	Aggregate maximum bit-rate
	CDMA	Code division multiple access
	ePDG	evolved packet data gateway
	GGSN	Gateway GPRS support node
20	GPRS	General packet radio service
	HRPD	High rate packet data
	HSGW	HRPD serving gateway
	HSS	Home subscriber server
	LTE	Long term evolution
25	LTE-A	LTE-Advanced

	MME	Mobility management entity
	M2M	Machine to machine
	PCRF	Policy control and charging rules function
	PDN	Packet data network
5	PDP	Packet data protocol
	PGW	Packet data network gateway
	QoS	Quality of service
	SGSN	Serving GPRS support node
	SGW	Serving gateway
10	UE	User equipment
	WLAN	Wireless local area network

Embodiments of the present invention relate to 3GPP accesses (e.g. LTE, LTE-A, WCDMA and GSM accesses) and to non-3GPP accesses (e.g. WLAN, CDMA and WiMAX accesses) and in more detail to handling of groups. Group specific features are currently under standardization in 3GPP R12. 3GPP is currently working on standardisation of group policing / usage monitoring and other group features may be standardized later (e.g. group charging, group messaging, etc.). Users belong to a group or multiple groups and functionalities such as policing, charging and/or messaging are performed in the network per group. Grouping is relevant e.g. for M2M devices and for family members.

One potential option is that group members are served by the same PGW/GGSN. Each group member is assumed to perform attach (and PDP context activation in 3G) but should be served by the same PGW/GGSN. PDN connections / PDP contexts of the group members are assumed to be managed in the same PGW/GGSN.

At PDN connection / PDP context creation, a PGW/GGSN is selected for the PDN connection / PDP context.

Thus, for each member of a group it is necessary to perform bearer management such as PDN connection/PDP context creation etc. separately, which leads to a high amount of signalling and process load in the network. With current solutions, PGW/GGSN selection is done separately for each member of a group and thus group members may be served by different PGW/GGSNs.

10 Summary of the Invention

Embodiments of the present invention address this situation and aim to overcome the above-described problem and to reduce the amount of signaling in connection with PDN connection / PDP context creation.

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According to a first aspect of the present invention, an apparatus is provided which comprises a connection unit configured to provide a connection to a network, and a processor configured to receive, via the connection unit, a request to create a packet data connection from a user equipment of a group, and to select a group control device for the group based on information related to the group.

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According to a second aspect of the present invention, an apparatus is provided which comprises a memory configured to store subscription-related information, a connection unit configured to provide a connection to a network, and a processor configured to handle subscriber-related information for a group by referring to an address of a group control device stored for the group in the memory.

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According to a third aspect of the present invention, an apparatus is provided which comprises a connection unit configured to provide a connection to a network, and a

processor configured to handle control of a group of user equipments, and to forward information regarding the group together with the address of the apparatus to an authentication, authorization and accounting entity.

- 5 According to a fourth aspect of the present invention, an apparatus is provided which comprises a memory, a connection unit configured to provide a connection to a network, and a processor configured to control authentication, authorization and accounting in a network, and to handle authentication, authorization and accounting for a packet data connection related to a group by referring to an address of a group control device stored
10 for the group in the memory.

According to a fifth aspect of the present invention, a method is provided which comprises

- receiving a request to create a packet data connection from a user equipment of a group, and
15 selecting a group control device for the group based on information related to the group.

According to a sixth aspect of the present invention, a method is provided which comprises

- 20 storing subscription-related information in a memory, and
handling subscriber-related information for a group by referring to an address of a group control device stored for the group in the memory.

- According to a seventh aspect of the present invention, a method is provided which
25 comprises

handling control of a group of user equipments, and
forwarding information regarding the group together with the address of an apparatus carrying out the method to an authentication, authorization and accounting

entity.

According to a eighth aspect of the present invention, a method is provided which comprises

5 controlling authentication, authorization and accounting in a network, and

 handling authentication, authorization and accounting for a packet data connection related to a group by referring to an address of a group control device stored for the group in the memory.

10 The first to eighth aspects of the present invention may be modified as defined in the dependent claims, for example.

 According to a ninth aspect of the present invention, a computer program product is provided which comprises code means for performing a method according to any one of
15 the fifth to eighth aspects and/or their modifications when run on a processing means or module. The computer program product may be embodied on a computer-readable medium.

 Thus, according to embodiments of the present invention, bearer management for a group
20 is performed on a group basis. That is, for example PGW/GGSN selection can be performed per group. Thus, when the appropriate PGW/GGSN is known, there is no need to carry out further procedures and signaling in order to determine the appropriate PGW/GGSN.

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Brief Description of the Drawings

These and other objects, features, details and advantages will become more fully apparent from the following detailed description of embodiments of the present invention which is to be taken in conjunction with the appended drawings, in which:

- 5 Fig. 1 shows simplified structures of network elements involved in a bearer management for groups of according to an embodiment of the present invention,

Fig. 2 shows a signal flow illustrating example for PDN connection / PDP context creation for a first member of a group according to an embodiment of the present invention,

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Fig. 3 shows a signal flow illustrating example for PDN connection / PDP context creation for a next member of a group according to an embodiment of the present invention.

- 15 Figs. 4 and 5 show signal flows illustrating examples for group control according to an embodiment of the present invention,

Fig. 6 shows a PCRF as a group control device according to a further embodiment of the present invention, and

- 20 Fig. 7 shows a signal flow illustrating example for PDN connection / PDP context creation for a first member of a group according to the further embodiment of the present invention.

Detailed Description of embodiments

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In the following, description will be made to embodiments of the present invention. It is to be understood, however, that the description is given by way of example only, and that the

described embodiments are by no means to be understood as limiting the present invention thereto.

5 However, before explaining embodiments of the present invention in detail, the problem to be solved by the invention is summarized again. In particular, currently for each UE, PGW/GGSN selection happens separately when a PDN connection / primary PDP context for the UE is created. Commonly, operators deploy multiple PGWs and/or GGSNs and then UEs are served by those. Group members are not served by the same PGW/GGSN. Some group features become too complicated or even impossible if group members are
10 not in the same PGW/GGSN. For example, group bandwidth management becomes far too complicated if there is one bandwidth limit (e.g. Group APN-AMBR) which is enforced in many PGW/GGSNs.

15 Thus, embodiments of the present invention are directed to overcome the problems mentioned above.

In the following, a general embodiment of the present invention is described by referring to Fig. 1. In particular, Fig. 1 shows several elements involved in the procedure according to embodiments of the present invention. In more detail, Fig. 1 shows a MME/SGSN 1, a
20 PGW/GGSN 2, a AAA 3 and a HSS 4.

The MME/SGSN 1 is an example for an apparatus, e.g., a network access apparatus, applying an embodiment of the present invention. Other examples may include MME and SGSN separately, an Access GW (e.g. Trusted WiFi Access GW or HSGW) or ePDG.
25 Moreover, the apparatus may also be only a part of the corresponding network element (i.e., SGSN, MME, Access GW, ePDG etc.).

The MME/SGSN 1 comprises a processor 11 and a connection unit 12. The connection unit 12 is configured to provide a connection to a network, e.g., a (mobile) communication
30 network. The processor 11 is configured to receive, via the connection unit, a request to

create a packet data connection (e.g. PDN connection / PDP context) from a user equipment of a group, and to select a group control device (such as a packet data network gateway device (e.g., PGW 2) for the group, or a PCRF) based on information related to the group.

5

The PGW/GGSN 2 is an example for an apparatus, e.g., a group control device, applying an embodiment of the present invention. Other examples may include a GGSN or PGW separately, for example. Moreover, the apparatus may also be only a part of the PGW/GGSN.

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The PGW/GGSN 2 comprises a connection unit 22 configured to provide a connection to a network and a processor 21. The processor 21 is configured to handle control of a group of user equipments, and to forward information regarding the group together with the address of the apparatus (of the PGW/GGSN in this example) to an authentication, authorization and accounting entity (e.g., AAA 3).

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In the example shown in Fig. 1, the apparatus described above is a packet data network gateway device (PGW/GGSN). In this case, the processor is further configured to receive, via the connection unit, a request to create a packet data connection (e.g. PDN connection / PDP context) for a user equipment related to the group, and to create the packet data connection (e.g., PDN connection / PDP context). Thus, the processor will then forward information regarding the group together with the address of the packet data network gateway device to the authentication, authorization and accounting entity (e.g., AAA 3).

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Optionally, the MME/SGSN 1 and the PGW/GGSN 2 respectively may further comprise memories 13 and 23 for storing data and programs, by means of which the respective processors 11 and 21 may carry out their corresponding functions.

The AAA 3 is an example for an apparatus, e.g., an authentication, authorization and accounting entity, applying an embodiment of the present invention. Moreover, the apparatus may also be only a part of the AAA.

- 5 The AAA 3 comprises a memory 23, a connection unit 22 configured to provide a connection to a network, and a processor 21. The processor 21 is configured to control authentication, authorization and accounting in a network, and to handle authentication, authorization and accounting for a packet data connection related to a group by referring to an address of a group control device stored for the group in the memory 32.

10

The HSS 4 is an example for an apparatus, e.g., a subscription management device, or a home subscriber server, applying an embodiment of the present invention. Other examples may include HLR (home location register). Moreover, the apparatus may also be only a part of the HSS.

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The HSS 4 comprises a memory 43 configured to store subscription-related information, a connection unit 42 configured to provide a connection to a network, and a processor 41. The processor 31 is configured to handle subscriber-related information for a group by referring to an address of a group control device stored for the group in the memory 43.

20

Optionally, the AAA 3 and the HSS 4 respectively may further comprise additional memories for storing data and programs (or store these in the memories 33 and 43), by means of which the respective processors 31 and 41 may carry out their corresponding functions.

25

Thus, handling of packet data network connections of user equipments of a group, i.e., bearer management can be handled on a group basis.

In the following, a more detailed embodiment of the present invention is described.

According to this embodiment, a new option for PGW/GGSN selection is described, namely PGW/GGSN selection per group. According to this embodiment, group specific PGW/GGSN selection for LTE/3G/2G access but also for non-3GPP accesses (e.g. WiFi, CDMA, WiMAX) is possible. In addition, bearer management for groups can be optimized.

The embodiment relates in particular to a network architecture as indicated in Fig. 1 described above. It is noted that between the HSS 4 and the AAA 3, an interface SWx is defined, and between the PGW 2 and the AAA 3, an interface S6b is defined. Between the MME/SGSN and the HSS, an interface S6a/S6d is defined. In more detail, the interface between MME and HSS is defined as S6a, and the interface between SGSN and HSS is defined as S6d.

The S6b interface standardized in 3GPP is standardized for mobility between 3GPP and non-3GPP accesses. On S6b, the PGW address is sent from the PGW to the AAA. From the AAA, the PGW address is sent to the HSS on the SWx interface. In this way, the PGW address is stored in the HSS and is available from the HSS for PGW selection when the user moves from one access to another access. There is currently no group support on S6b/SWx.

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According to the present embodiment, it is proposed to re-use the S6b/SWx interfaces for group based bearer management, e.g. to select the PGW/GGSN for a group or release PDN connections / PDP contexts of a group.

When a PDN connection / PDP context for the first group member (which is assumed to be identified with group Id) is created, it is possible to select a PGW/GGSN supporting the requested APN dynamically e.g. based on APN and/or group Id. Dynamic PGW/GGSN is commonly seen important by operators because it allows load sharing between multiple PGW/GGSNs supporting the requested APN. In 3GPP access, PGW/GGSN selection happens in the MME or SGSN. In non-3GPP access, PGW/GGSN selection happens e.g. in the Access GW (e.g. Trusted WiFi Access GW or HSGW) or ePDG. When signalling for

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PDN connection / PDP context creation is received by the PGW/GGSN, the PGW/GGSN signals with the AAA in order to store the PGW/GGSN Address per group. The group Id is added to S6b signalling. The AAA forwards the PGW/GGSN Address and group Id in SWx signalling to the HSS.

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This procedure is illustrated in the signaling flow shown in Fig. 2, wherein Fig. 2 shows an example for 3GPP access, that is, a PDN connection is requested by the UE by sending a PDP context creation.

- 10 In A1, a UE1 (the UE of the first group member) performs an attach procedure with a MME/SGSN. During the attach procedure, the MME/SGSN also contacts the HSS in order to obtain subscriber information, as indicated in A11 and A12. The MME/SGSN includes the group Id into the inquiry in A11. Since in the present case it is assumed that the UE1 is of the first group member, no association between group Id and a PGW/GGSN is stored
- 15 yet, so that no PGW address will be returned in the response in A12. It is noted that in the following, the address of the PGW/GGSN is referred to as PGW address.

Thereafter, in A2 the UE sends a PDP context creation request to the MME/SGSN. This request contains the group Id. In A3, the MME/SGSN selects an appropriate PGW/GGSN.

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- In A4, the MME/SGSN forwards the PDP context creation request including the group Id to the selected PGW/GGSN. The PGW/GGSN creates the PDP context in A5 and forwards the group Id (via the S6b interface) to the AAA entity in A6. It is noted that at this point the PGW/GGSN knows that this is the first PDN connection / PDP context for a
- 25 group as no other PDN connection / PDP context exists in the PGW/GGSN with the same Group Id. In A7, the AAA entity stores the PGW address per group (i.e., together with the group Id), and in A8, it forwards the PGW address and the group Id to the HSS. The HSS stores the PGW address together with the group Id in A9.

When a PDP context for the next group member (i.e., a group member which is not the first group member) is created, the PGW address per group Id is available in the HSS and can be sent to the node performing PGW/GGSN selection (e.g. MME, SGSN, Access GW, ePDG). The correct PGW/GGSN gets selected for the next group member. At this time,
5 there is no need to signal on S6b/SWx because the PGW address was sent to the HSS already earlier (when the PDN connection / PDP context of the first group member was created).

This is illustrated in Fig. 3. In B1, a UE2 (the UE of the next group member) performs an
10 attach procedure with a MME/SGSN (which is not necessarily the same as the MME/SGSN shown in Fig. 2), including the group Id. During the attach procedure, the MME/SGSN contacts the HSS in order to obtain subscriber information, as indicated in B11 and B12. The MME/SGSN includes the group Id into the inquiry in B11. Since in the present case it is assumed that the UE1 is of the next group member, an association
15 between group Id and the PGW/GGSN is stored in the HSS. Thus, the PGW address of the PGW/GGSN will be returned in the response in B12.

Thereafter, in B2 the UE sends a PDP context creation request to the MME/SGSN. This request contains the group Id. In B3, the MME/SGSN selects an appropriate PGW/GGSN.

20

In B4, the MME/SGSN forwards the PDP context creation request including the group Id to the selected PGW/GGSN, and the PGW/GGSN creates the PDP context in B4. Since the PGW address and the Group Id are already stored together in the HSS, there is no need to forward the information to the AAA and the HSS, so that A6 to A9 of Fig. 2 can be
25 omitted.

It is noted that Figs. 2 and 3 show a simplified procedure, and only the main signaling is illustrated. For example, the actual signaling path between MME/SGSN and PGW is carried out via a serving gateway (SGW). That is, the messages in A4 and B4 are always
30 conveyed via the SGW. In Figs. 2 and 3, however, the SGW is omitted for simplifying the illustration.

The above procedure was described for GSM/WCDMA access. The procedure in LTE is similar, however, then a PDN connection is created. This is already done during the attach procedure (i.e., during A1 and B1). Thus, there is not need for the UE to send a separate
5 PDN connection request. Hence, the procedure shown in Figs. 2 and 3 for LTE access differs in that step A2/B2 would be omitted, and that in A4 and A5 or in B4 and B5 a PDN connection instead of a PDP context is request and created, respectively.

At some point, PDN connections / PDP contexts of group members get released. When
10 the last PDN connection / PDP context per group is released, the PGW/GGSN signals with the AAA to remove the PGW/GGSN Address. The AAA forwards this signalling to the HSS. Group Id is added to S6b/SWx signalling. This allows selecting the PGW/GGSN dynamically when at some point a PDN connection / PDP context is again created for the first group member.

15

The HSS/AAA may trigger release of PDN connections / PDP contexts per group e.g. in case of subscription changes (e.g. if the group subscription is removed). In order to perform this signalling once per group, group Id needs to be added in S6b/SWx signalling. Without this enhancement, the relevant PDN connections / PDP contexts have to be
20 released one by one and this means more signalling on S6b/SWx.

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Examples for such a group control are described in the following by referring to Figs. 4 and 5. In these examples, subscription changes are considered, which are notified from the HSS.

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Fig. 4 shows an example regarding a subscription change. In C1, the HSS sends a notification on subscription information change including the group Id to the AAA. The AAA forwards in C2 a re-authorization request including the group Id and updated parameters etc. to the PGW/GGSN. In C3, the PGW/GGSN sends a response to the AAA
in order to confirm receipt, and in C4 the PGW/GGSN performs the relevant actions per group / PDP context(s) / PDN connection(s) / bearer(s).

Fig. 5 shows an example in which the subscription is removed, i.e., the group is to be canceled. In D1, the HSS sends a notification on subscription information removal including the group Id to the AAA. In D2, the AAA forwards an abort request including the group Id to the PGW/GGSN, to which the PGW/GGSN responds in C3 in order to confirm the request. In D4, the PGW/GGSN performs the relevant actions per group / PDP context(s) / PDN connection(s) / bearer(s), which include in this case triggering removal of bearer(s) etc.

Thus, group related actions can easily be coordinated since a single network device (such as the PGW/GGSN) is designated as the group control device for the particular group.

In the above embodiment as described in connection with Figs. 2 to 5, the group control device was described as the PGW/GGSN. However, the invention is not limited to this, and, for example, the group control device may also be a PCRF. This is described in the following by referring to Fig. 6.

When the group control device is an PCRF, then the PGW/GGSN selection may happen as currently (resulting in serving group members by different PGW/GGSNs), but there is a common element in the network serving the group members, namely the PCRF per group.

Fig. 6 shows an example thereof. The PCRF 5 comprises a connection unit 52 configured to provide a connection to a network and a processor 51. The processor 51 is configured to configured to handle control of a group of user equipments, and to forward information regarding the group together with the address of the apparatus (of the PCRF in this example) to an authentication, authorization and accounting entity (e.g., AAA 3 shown in Fig. 1). Similar as described for the PGW/GGSN 2 in Fig. 1, the PCRF 5 may further comprise a memory 53 for storing data and programs, by means of which the processor 51 may carry out its corresponding functions.

Thus, the PCRF 5 carries out the group control similar as the PGW/GGSN 2 shown in Fig. 1. That is, instead of the PGW/GGSN, the PCRF 5 is associated to the group, so that the address of the PCRF 5 is stored together with the group Id in the HSS and AAA.

- 5 As mentioned above, in the present case a plurality of PGW/GGSN may serve the group members, as indicated in Fig. 6 by PGW1 and PGW2. Thus, when performing controls such as described above in connection with Figs. 4 and 5, the PCRF will receive corresponding subscription change/removal notifications from the HSS and will forward them to the corresponding PGW/GGSNs.

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Thus, the PGW/GGSN commonly selects the PCRF. In order to select the same PCRF for all group members, the PCRF may be selected dynamically for the first group member. Group Id and PCRF Address should be stored e.g. to the HSS so that it is available from the HSS when PCRF selection happens for the next group member. In this case, the
15 PGW/GGSN could send Group Id and PCRF Address to the AAA which forwards these parameters to the HSS.

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This selection of the PCRF is illustrated in Fig. 7, which shows the procedure for the first group member. The procedure is similar to that as shown in Fig. 2, so that in the following only the main differences are described. The attach procedure in E1 is similar to A1, wherein, however, no group related inquiry is sent to the HSS. Nevertheless, an inquiry may sent to the HSS in order to obtain subscription information related to the particular user. When the UE1 issues a PDP context creation request (E2), the MME/SGSN selects a PGW in E3, but not commonly for the group but only for the particular UE1, e.g., based
25 on subscription information received from the HSS. The PDP context creation request including the group Id is then forwarded to the PGW/GGSN, which creates the PDP context in E5, but also selects the PCRF for the group. It is noted that at this point the PGW/GGSN knows that this is the first PDN connection / PDP context for a group as no other PDN connection / PDP context exists in the PGW/GGSN with the same Group Id.

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The address of this selected PCRF together with the group Id is forwarded to the AAA (E6), which stores the PCRF address per group (E7). Moreover, the AAA forwards the PCRF address with the group Id to the HSS (E8), which also stores the PCRF address per group (E9).

When the next group member joins the group, the procedure is similar to that of Fig. 3, wherein, however, no PCRF is selected for the group by the PGW/GGSN, since this already was effected for the first group member. The PGW/GGSN knows that this, since a
5 PDN connection / PDP context exists in the PGW/GGSN with the same Group Id.

For obtaining the address of the PCRF which is selected/associated to the group, the PGW/GGSN sends a signaling message (with Group Id) to the AAA which forwards a signaling message (with Group Id) to the HSS to retrieve PCRF Address of the group. The
10 HSS replies to the AAA by sending PCRF Address and the AAA forwards PCRF Address to the PGW/GGSN.

It is noted that the above signaling is needed if the PCRF address is not stored by the PGW/GGSN, e.g., when all group members are not served by the same PGW/GGSN. If
15 all group members are served by the same PGW/GGSN, this signaling is not needed because PCRF address can be stored to the PGW/GGSN.

That is, when a PDN connection / PDP context is created for the next group member, the PCRF address is sent from the HSS to the AAA which forwards the PCRF address to the
20 PGW/GGSN serving the next group member.

When a PDP context / PDN connection of any group member is released, information on the release is sent from the PGW/GGSN to the AAA, which forwards the information on the release to the HSS.

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When the PDP context / PDN connection of the last group member is released, the PGW/GGSN can inform the AAA which informs the HSS. That is, when all PDP contexts / PDN connections of the group have been released, the HSS can remove PCRF Address of the relevant group.

In the following, some considerations are given with respect to the use of the S6b/SWx interfaces for sending control signaling.

- 5 On S6b/SWx, there are also other functionalities, e.g. sending a QoS Profile and/or APN-AMBR for the PDN connection / PDP context or trigger tracing. These S6b/SWx functionalities are not commonly used because there are other ways to achieve the same functionality. If an operator decides to use S6b/SWx for these functionalities, It is possible to enhance these functionalities to provide the QoS Profile and/or APN-AMBR per group
10 or trigger tracing per group by sending relevant parameters per group.

It should be noted that also the MME or SGSN can send the PGW address to the HSS (S6a, S6d). In non-3GPP accesses, the Access GW or ePDG can not send the PGW address to the HSS via the AAA but enhancements to the STa and SWm interfaces would
15 be needed (group Id and PGW address on STa/SWm). Sending these parameters from the PGW as described above makes the overall solution simpler as there is only one node in the architecture for the functionality (i.e. no need to update e.g. the SGSN, Access GW or ePDG in the operator network).

- 20 Commonly, the PGW is the node releasing bearers. Thus the solution described above is aligned with this and in addition, optimizes signalling on S6b/SWx. It would be possible to enhance also the MME - HSS and SGSN – HSS interfaces for optimized bearer release per group in the same way as described above but this is not preferred. The same applies to the Access GW – AAA and ePDG – AAA interfaces.

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Signalling flows are as standardised in 3GPP. Additional parameters and functionality to the nodes are introduced as described above. That is, the solution is easy to implement, since basically only the additional parameters have to be signaled within already existing messages.

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Thus, according to the procedures according to embodiments of the present invention, the following advantages can be achieved:

- Dynamic selection of PGW/GGSN is possible. This allows load sharing between PGW/GGSNs supporting the requested APN.
- 5 - PGW/GGSN selection works in LTE/3G/2G accesses but also in non-3GPP accesses. Especially for WiFi, there is currently very much operator interest. This solution allows group based functionalities also when WiFi is used as the access.
- Signalling on S6b/SWx is optimized e.g. when there is a need to release PDN connections / PDP contexts of all group members.
- 10 - Functionalities are done in one node and there is no need to update many nodes in the operator network.

It is noted that the embodiments and the present invention in general is not limited to the specific examples given above.

15

For example, in the embodiment described above the interfaces between PGW and AAA and AAA and HSS were denoted as S6b and SWx, respectively. However, these are denotations as currently used in the standard, and may change.

- 20 Moreover, according to the embodiments described above by referring to Figs. 1 to 6, the group control device was described as a PGW/GGSN or a PCRF. However, also other suitable network elements can be applied as a group control device, as long as they can provide the corresponding control signaling. For example, a dedicated stand-alone group network control element could be used.

25

Hence, according to several aspects of embodiments of the present invention, apparatuses and methods are provided by which a group control device for controlling a group of user equipments is selected. When a packet data connection for a first user equipment of the group is created, the group control device for the group is selected

based on information related to the group. Information regarding the group control device and the information related to the group are stored in a subscription management device. When a next user equipment requests creation of a packet data connection, information regarding the group control device is obtained from the subscription management device.

5

According to a another aspect of embodiments of the present invention, an apparatus is provided which comprises means for receiving a request to create a packet data connection from a user equipment of a group, and means for selecting a group control device for the group based on information related to the group.

10

According to a further aspect of embodiments of the present invention, an apparatus is provided which comprises means for storing subscription-related information in a memory, and means for handling subscriber-related information for a group by referring to an address of a group control device stored for the group in the memory.

15

According to a still further aspect of embodiments of the present invention an apparatus is provided which comprises means for handling control of a group of user equipments, and means for forwarding information regarding the group together with the address of an apparatus carrying out the method to an authentication, authorization and accounting entity.

20

According to a still further aspect of embodiments of the present invention, an apparatus is provided which comprises means for controlling authentication, authorization and accounting in a network, and means for handling authentication, authorization and accounting for a packet data connection related to a group by referring to an address of a group control device stored for the group in the memory.

25

It is to be understood that any of the above modifications can be applied singly or in combination to the respective aspects and/or embodiments to which they refer, unless they are explicitly stated as excluding alternatives.

30

For the purpose of the present invention as described herein above, it should be noted that

- 5 - an access technology via which signaling is transferred to and from a network element may be any technology by means of which a network element or sensor node can access another network element or node (e.g. via a base station or generally an access node). Any present or future technology, such as WLAN (Wireless Local Access Network), WiMAX (Worldwide Interoperability for Microwave Access), LTE, LTE-A, Bluetooth, Infrared, and the like may be used; although the above technologies are mostly wireless
- 10 access technologies, e.g. in different radio spectra, access technology in the sense of the present invention implies also wired technologies, e.g. IP based access technologies like cable networks or fixed lines but also circuit switched access technologies; access technologies may be distinguishable in at least two categories or access domains such as packet switched and circuit switched, but the existence of more than two access domains
- 15 does not impede the invention being applied thereto,
 - usable communication networks, stations and transmission nodes may be or comprise any device, apparatus, unit or means by which a station, entity or other user equipment may connect to and/or utilize services offered by the access network; such services include, among others, data and/or (audio-) visual communication, data download etc.;
- 20 - a user equipment or communication network element (station) may be any device, apparatus, unit or means by which a system user or subscriber may experience services from an access network, such as a mobile phone or smart phone, a personal digital assistant PDA, or computer, or a device having a corresponding functionality, such as a modem chipset, a chip, a module etc., which can also be part of a UE or attached as a
- 25 separate element to a UE, or the like;
 - method steps likely to be implemented as software code portions and being run using a processor at a network element or terminal (as examples of devices, apparatuses and/or modules thereof, or as examples of entities including apparatuses and/or modules therefore), are software code independent and can be specified using any known or future
 - 30 developed programming language as long as the functionality defined by the method steps is preserved;
 - generally, any method step is suitable to be implemented as software or by hardware without changing the idea of the invention in terms of the functionality implemented;
 - method steps and/or devices, units or means likely to be implemented as hardware
 - 35 components at the above-defined apparatuses, or any module(s) thereof, (e.g., devices

carrying out the functions of the apparatuses according to the embodiments as described above, eNode-B etc. as described above) are hardware independent and can be implemented using any known or future developed hardware technology or any hybrids of these, such as MOS (Metal Oxide Semiconductor), CMOS (Complementary MOS),
5 BiMOS (Bipolar MOS), BiCMOS (Bipolar CMOS), ECL (Emitter Coupled Logic), TTL (Transistor-Transistor Logic), etc., using for example ASIC (Application Specific IC (Integrated Circuit)) components, FPGA (Field-programmable Gate Arrays) components, CPLD (Complex Programmable Logic Device) components or DSP (Digital Signal Processor) components;

- 10 - devices, units or means (e.g. the above-defined apparatuses, or any one of their respective means) can be implemented as individual devices, units or means, but this does not exclude that they are implemented in a distributed fashion throughout the system, as long as the functionality of the device, unit or means is preserved;
- an apparatus may be represented by a semiconductor chip, a chipset, or a (hardware)
15 module comprising such chip or chipset; this, however, does not exclude the possibility that a functionality of an apparatus or module, instead of being hardware implemented, be implemented as software in a (software) module such as a computer program or a computer program product comprising executable software code portions for execution/being run on a processor;
- 20 - a device may be regarded as an apparatus or as an assembly of more than one apparatus, whether functionally in cooperation with each other or functionally independently of each other but in a same device housing, for example.

It is noted that the embodiments and examples described above are provided for
25 illustrative purposes only and are in no way intended that the present invention is restricted thereto. Rather, it is the intention that all variations and modifications be included which fall within the spirit and scope of the appended claims.

CLAIMS

1. An apparatus comprising
a connection unit configured to provide a connection to a network, and
5 a processor configured
to receive, via the connection unit, a request to create a packet data connection
from a user equipment of a group, and
to select a group control device for the group based on information related to the
group.
10
2. The apparatus according to claim 1, wherein
the processor is configured to access a subscription management device in order
to determine, based on the information related to the group, whether a group control
device is assigned to the group, and to select this group control device for the group.
15
3. The apparatus according to claim 1 or 2, wherein the processor is configured
to forward information regarding the group together to the selected group control
device.
- 20 4. The apparatus according to any one of the claims 1 to 3, wherein
the group control device is a packet data network gateway device or a policy
control and charging rules function.
5. An apparatus comprising
25 a memory configured to store subscription-related information,
a connection unit configured to provide a connection to a network, and

a processor configured

to handle subscriber-related information for a group by referring to an address of a group control device stored for the group in the memory.

- 5 6. The apparatus according to claim 5,
 wherein the processor is configured

to receive, via the connection unit, an address of the group control device together with group identification information from an authentication, authorization and accounting entity, and

- 10 to store the address of the group control device with the group identification information.

7. The apparatus according to claim 5 or 6, wherein the processor is configured

- 15 to receive, via the connection unit, information to remove the address of the group control device stored for the group, and

to remove the address of the group control device with the group identification information.

- 20 8. The apparatus according to any one of the claims 5 to 7, wherein the group control device is a packet data network gateway device.

9. The apparatus according to claim 8, wherein the processor is configured

to send control signaling related to the group to the packet data network gateway device.

25

10. The apparatus according to claim 9, wherein the control signaling comprises a command to release the packet data connection of the group.

11. An apparatus comprising
a connection unit configured to provide a connection to a network, and
a processor configured
5 to handle control of a group of user equipments, and
to forward information regarding the group together with the address of the
apparatus to an authentication, authorization and accounting entity.
12. The apparatus according to claim 11, wherein
10 the apparatus is or is part of a packet data network gateway device, and the
processor is configured
to receive, via the connection unit, a request to create a packet data connection for
a user equipment related to group, and
to create the packet data connection.
15
13. The apparatus according to claim 12, wherein the processor is configured to
release the packet data network connection for the group, and,
when the packet data connection of the last group member has been released, to
signal to remove the address of the apparatus to the authentication, authorization and
20 accounting entity.
14. The apparatus according to claim 12 or 13, wherein the processor is configured
to receive control signaling related to the group from the authentication,
authorization and accounting entity, and
25 to perform control according to the received control signaling.

15. The apparatus according to claim 14, wherein the control signaling comprises a command to release the packet data connection of the group.
16. The apparatus according to claim 11, wherein
5 the apparatus is or is part of a policy control and charging rules function.
17. An apparatus comprising
a memory,
a connection unit configured to provide a connection to a network, and
10 a processor configured
to control authentication, authorization and accounting in a network, and
to handle authentication, authorization and accounting for a packet data
connection related to a group by referring to an address of a group control device stored
for the group in the memory.
15
18. The apparatus according to claim 17, wherein the processor is configured
to receive, via the connection unit, group identification information from the group
control device during creation of the packet data network connection for a member of the
group,
20 to store the address of the group control device with the group identification
information and
to forward the address of the group network control device with the group
identification information to a subscription management device.
- 25 19. The apparatus according to claim 17 or 18, wherein the processor is configured
to receive, via the connection unit, information to remove the address of the group

control device stored for the group,

to remove the address of the group control device with the group identification information, and

5 to forward the information to a subscription management device storing the address of the group control device for the group.

20. The apparatus according to any one of the claims 17 to 19, wherein the group control device is a packet data network gateway device.

10 21. The apparatus according to claim 20, wherein the processor is configured to send control signaling related to the group to the packet data network gateway device.

15 22. The apparatus according to claim 21, wherein the control signaling comprises a command to release the packet data connection of the group.

23. A method comprising
receiving a request to create a packet data connection from a user equipment of a group, and
20 selecting a group control device for the group based on information related to the group.

24. The method according to claim 23, further comprising
accessing a subscription management device in order to determine, based on the
25 information related to the group, whether a group control device is assigned to the group, and to select this group control device for the group.

25. The method according to claim 23 or 24, further comprising forwarding information regarding the group together to the selected group control device.
- 5 26. The method according to any one of the claims 23 to 25, wherein the group control device is a packet data network gateway device or a policy control and charging rules function.
27. A method comprising
- 10 storing subscription-related information in a memory, and handling subscriber-related information for a group by referring to an address of a group control device stored for the group in the memory.
28. The method according to claim 27, further comprising
- 15 receiving an address of the group control device together with group identification information from an authentication, authorization and accounting entity, and storing the address of the group control device with the group identification information.
- 20 29. The method according to claim 27 or 28, further comprising receiving information to remove the address of the group control device stored for the group, and removing the address of the group control device with the group identification information.
- 25 30. The method according to any one of the claims 27 to 29, wherein the group control

device is a packet data network gateway device.

31. The method according to claim 30, further comprising

5 sending control signaling related to the group to the packet data network gateway device.

32. The method according to claim 31, wherein the control signaling comprises a command to release the packet data connection of the group.

10 33. A method comprising

handling control of a group of user equipments, and

forwarding information regarding the group together with the address of an apparatus carrying out the method to an authentication, authorization and accounting entity.

15

34. The method according to claim 33, wherein

the apparatus carrying out the method is or is part of a packet data network gateway device, the method further comprising

20 receiving a request to create a packet data connection for a user equipment related to group, and

creating the packet data connection.

35. The method according to claim 34, further comprising

releasing the packet data network connection for the group, and,

25 when the packet data connection of the last group member has been released, signaling to remove the address of the apparatus carrying out the method to the

authentication, authorization and accounting entity.

36. The method according to claim 34 or 35, further comprising

5 receiving control signaling related to the group from the authentication, authorization and accounting entity, and

performing control according to the received control signaling.

37. The method according to claim 36, wherein the control signaling comprises a command to release the packet data connection of the group.

10

38. The method according to claim 33, wherein

the apparatus carrying out the method is or is part of a policy control and charging rules function.

15 39. A method comprising

controlling authentication, authorization and accounting in a network, and

handling authentication, authorization and accounting for a packet data connection related to a group by referring to an address of a group control device stored for the group in the memory.

20

40. The method according to claim 39, further comprising

receiving group identification information from the group control device during creation of the packet data network connection for a member of the group,

25 storing the address of the group control device with the group identification information, and

forwarding the address of the group network control device with the group

identification information to a subscription management device.

41. The method according to claim 39 or 40, further comprising

5 receiving information to remove the address of the group control device stored for the group,

removing the address of the group control device with the group identification information, and

forwarding the information to a subscription management device storing the address of the group control device for the group.

10

42. The method according to any one of the claims 39 to 41, wherein the group control device is a packet data network gateway device.

43. The method according to claim 42, further comprising

15 sending control signaling related to the group to the packet data network gateway device.

44. The method according to claim 43, wherein the control signaling comprises a command to release the packet data connection of the group.

20

45. A computer program product comprising code means for performing a method according to any one of claims 23 to 44 when run on a processing means or module.

25 46. The computer program product according to claim 45, wherein the computer program product is embodied on a computer-readable medium.

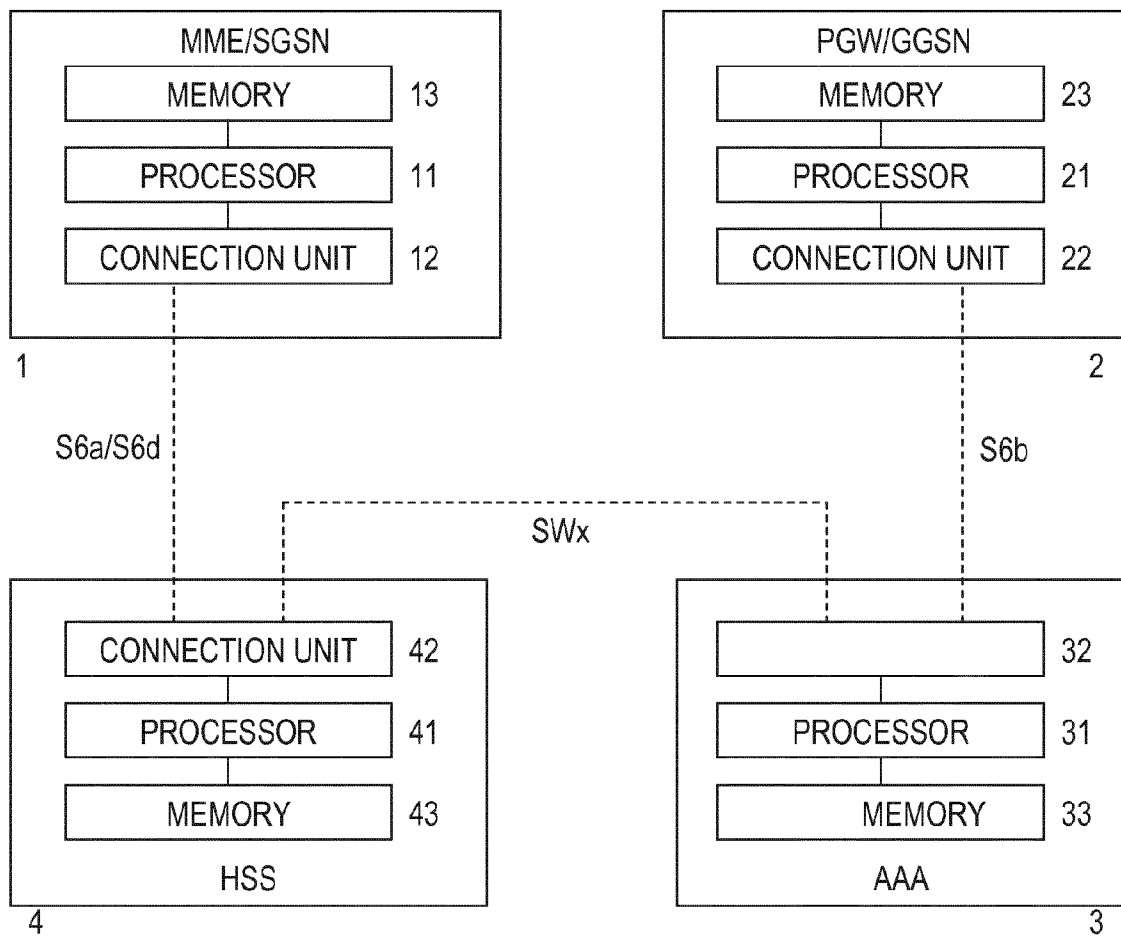


Fig. 1

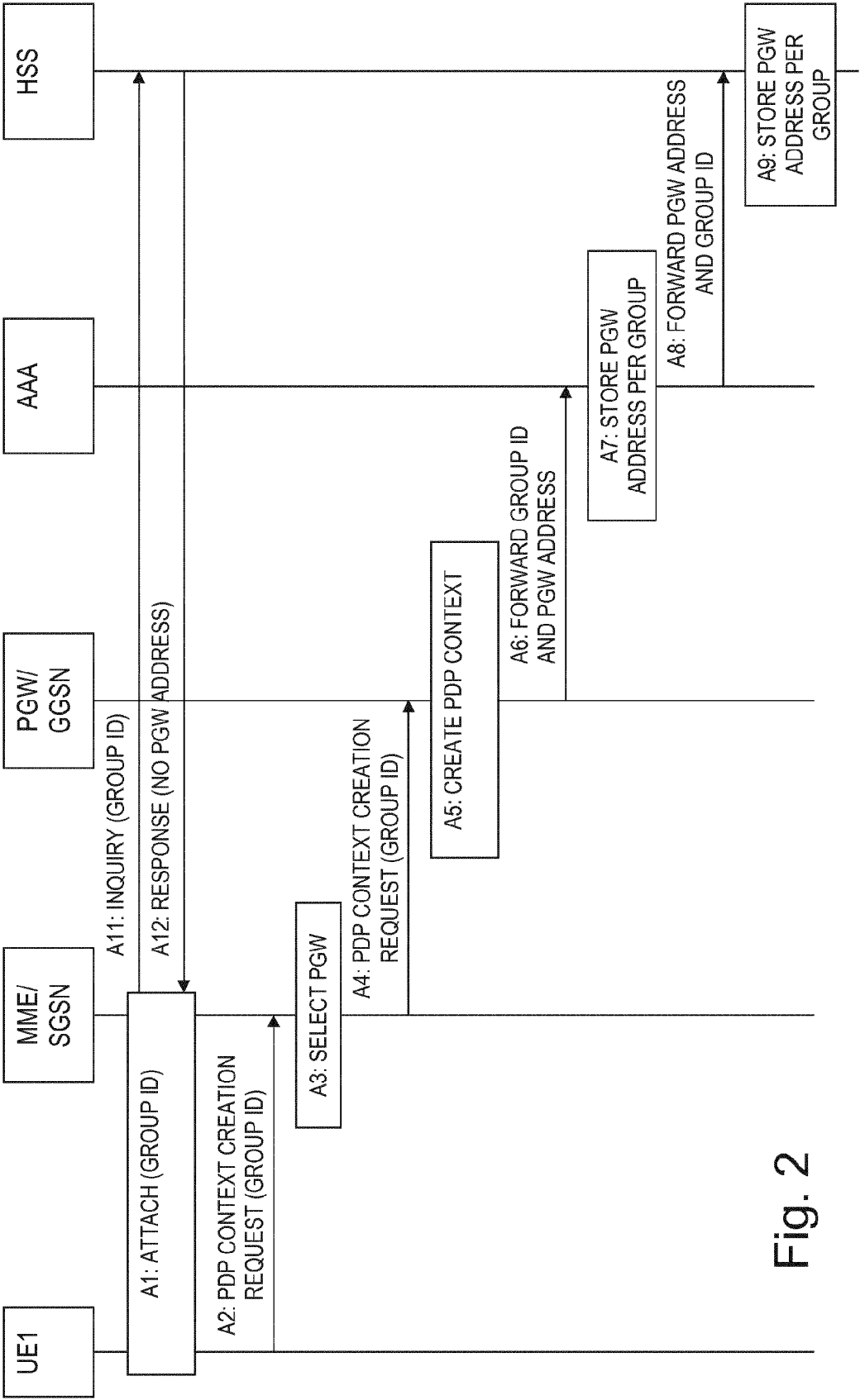


Fig. 2

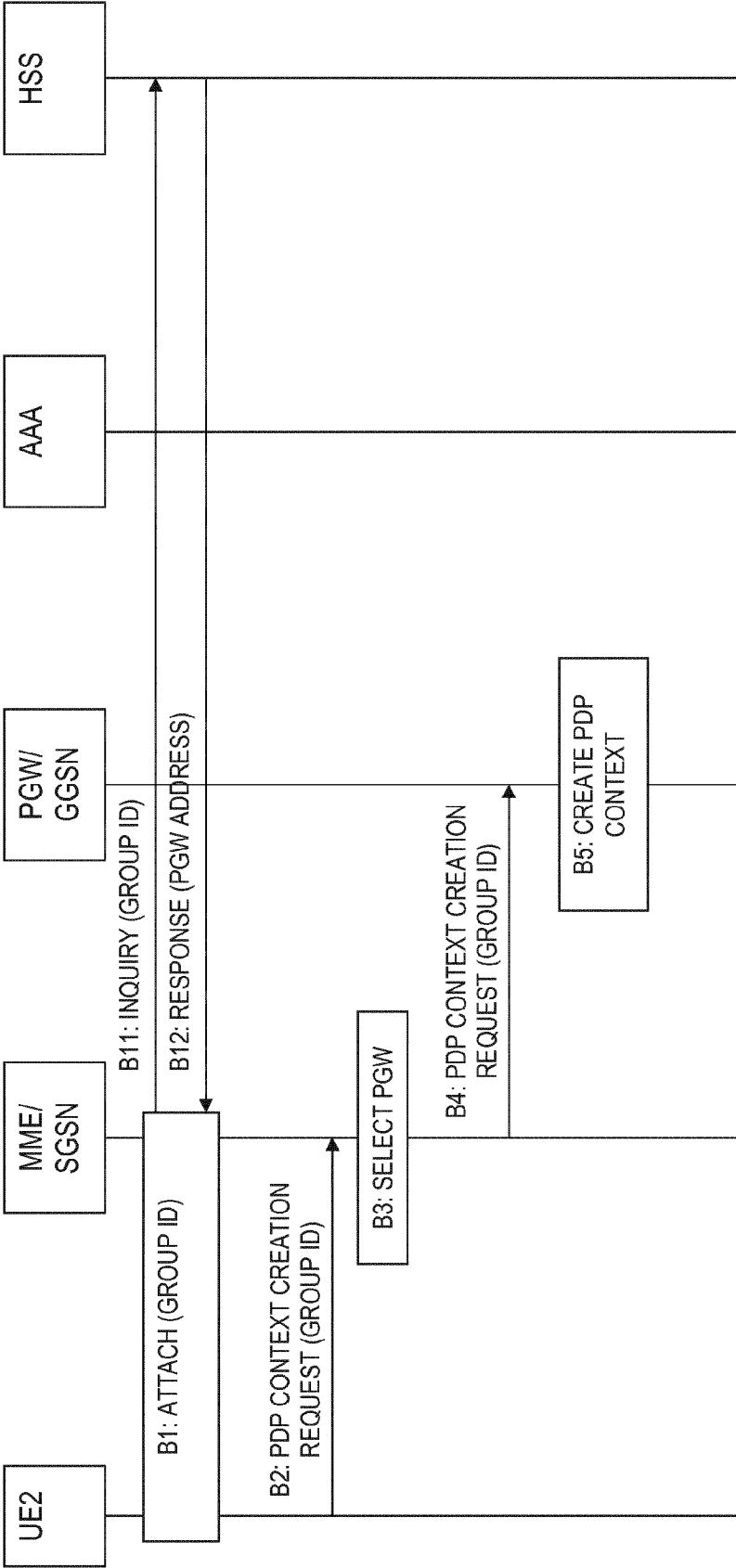


Fig. 3

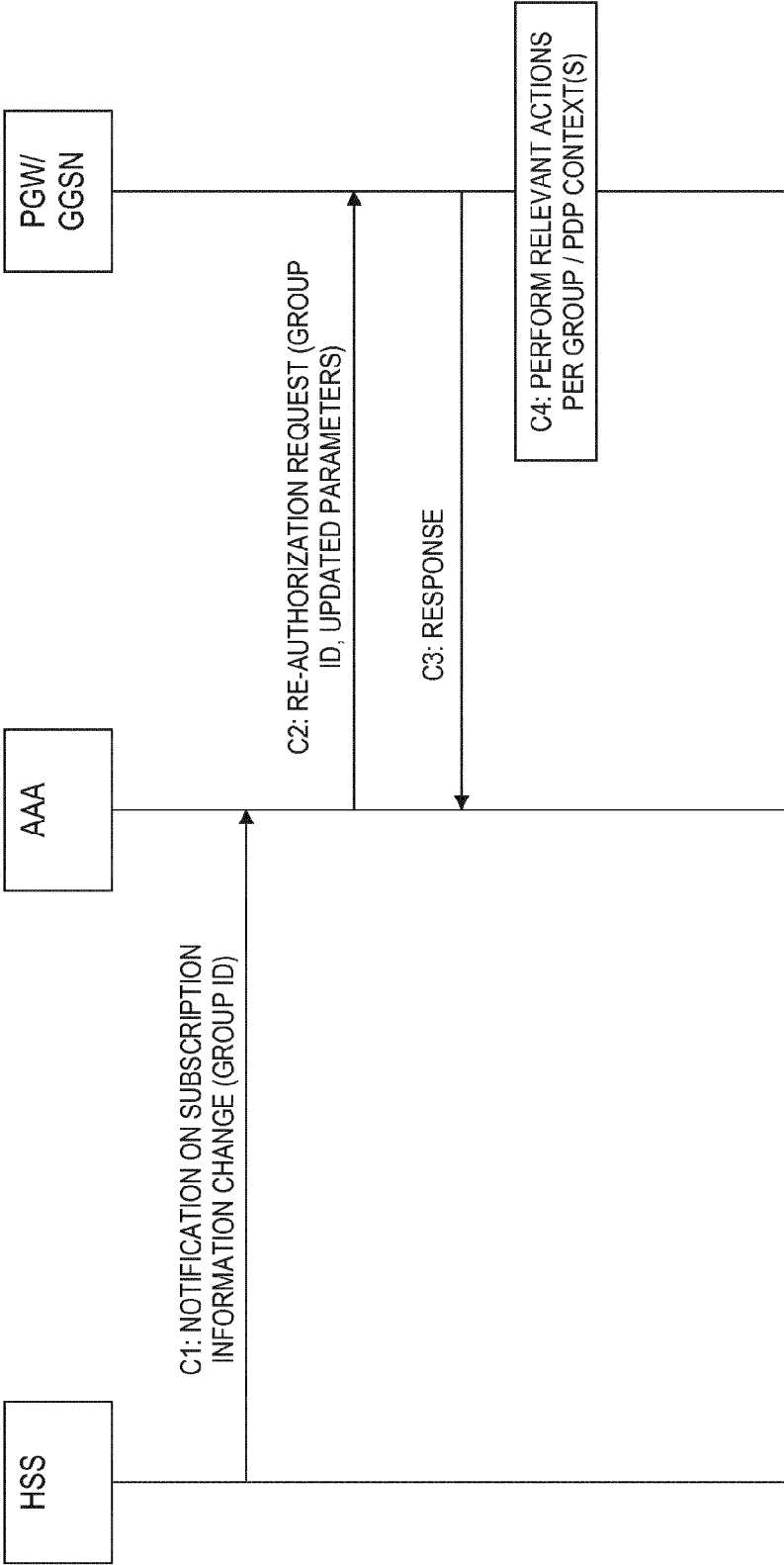


Fig. 4

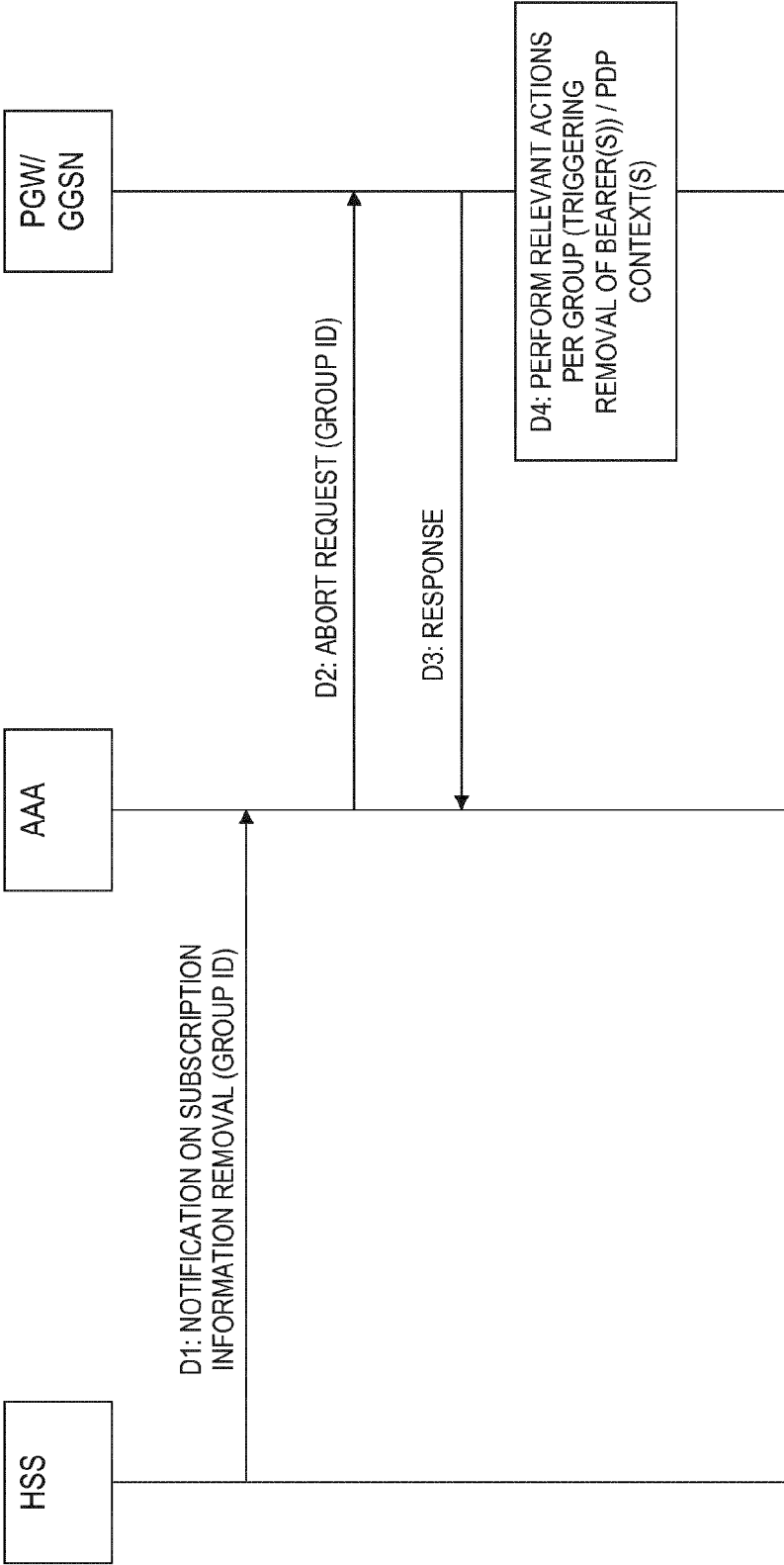


Fig. 5

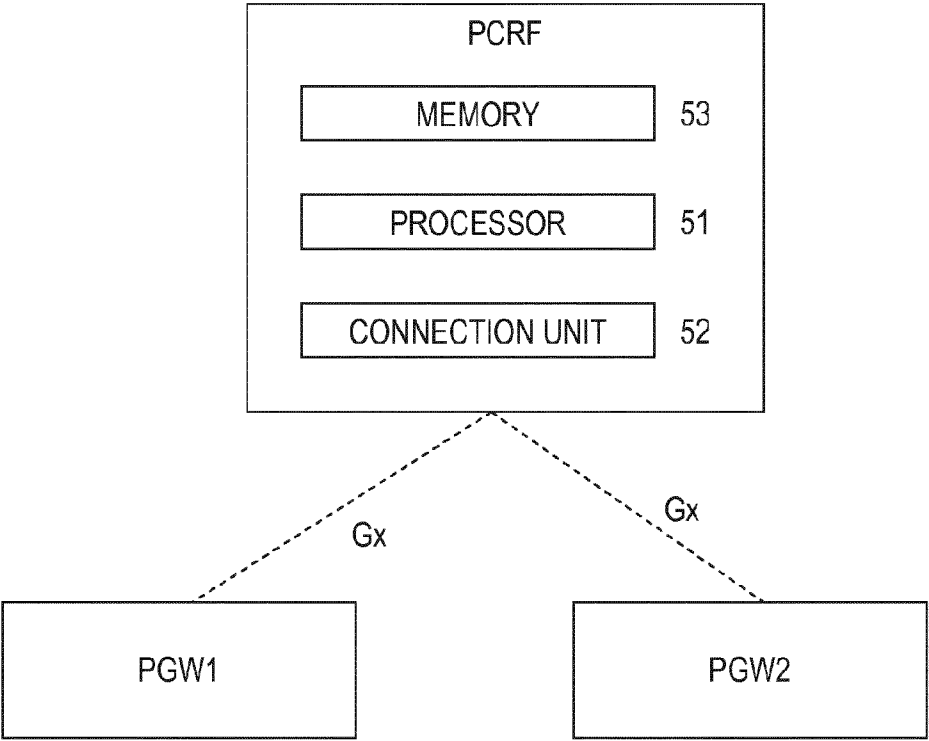


Fig. 6

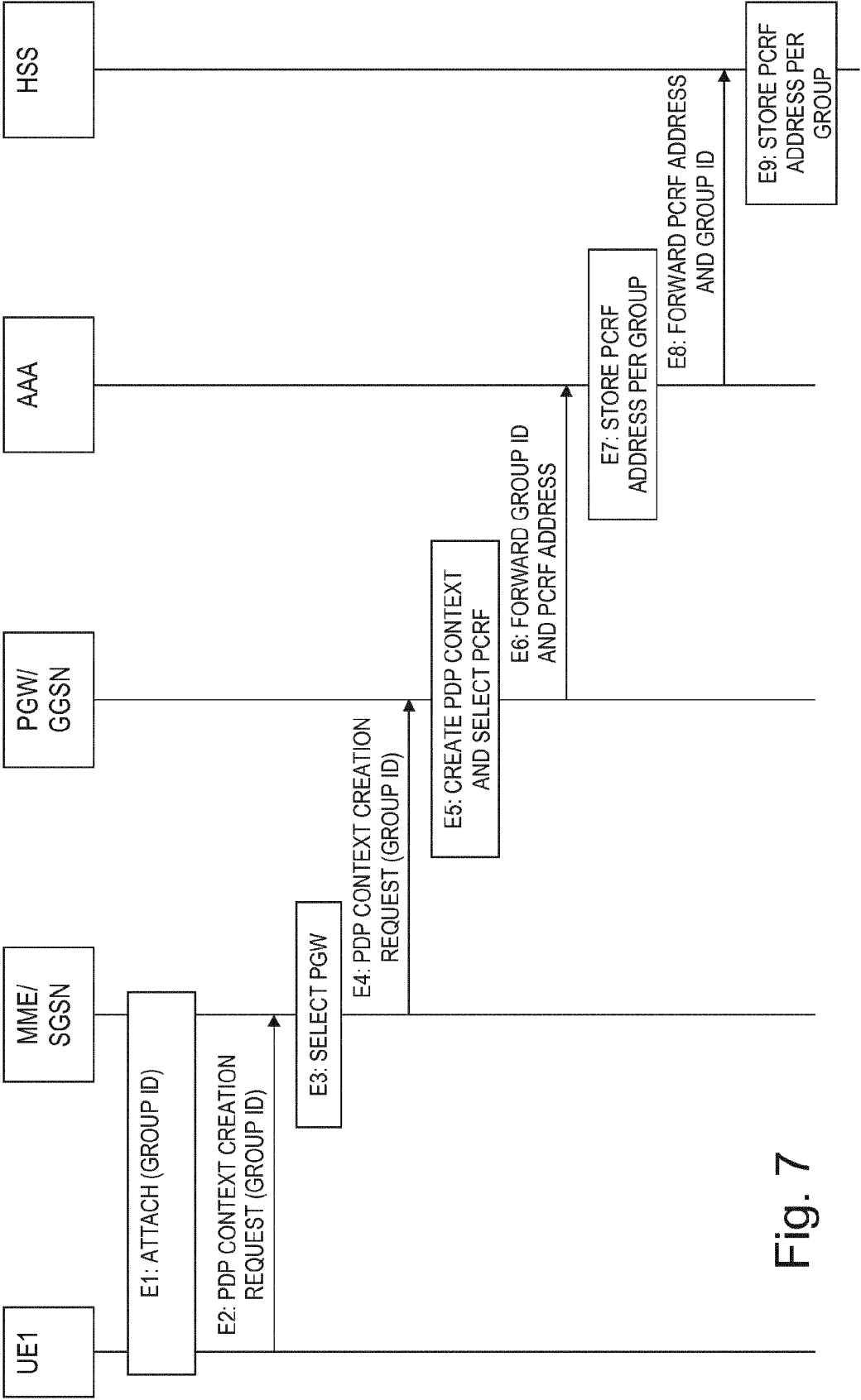


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2013/052871

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/052871

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W76/02 H04W8/18
ADD. H04W4/08

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)
H04W

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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SAMSUNG: "The solution for key issue 5", 3GPP DRAFT; S2-124289 KEY ISSUE 5, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. SA WG2, no. New Orleans, USA; 20121112 - 20121116 6 November 2012 (2012-11-06), XP050683957, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_94_New_Orleans/Docs/[retrieved_on_2012-11-06]the whole document ----- -/-	1-10, 23-32, 45,46

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

16 January 2014

Date of mailing of the international search report

23/01/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Fax: (+31-70) 340-3016

Authorized officer

Megalou-Nash, M

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2013/052871

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HUAWEI ET AL: "Enforcing group level policy", 3GPP DRAFT; S2-124308 ENFORCING GROUP LEVEL POLICY, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. SA WG2, no. New Orleans, USA; 20121112 - 20121116 6 November 2012 (2012-11-06), XP050683975, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_94_New_Orleans/Docs/[retrieved on 2012-11-06] the whole document	1-10, 23-32, 45,46
A	----- 3GPP: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Study on S2a Mobility based On GTP & WLAN access to EPC (SaMOG); Stage 2 (Release 12)", 3GPP DRAFT; 23852-110 RM, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, 1 June 2012 (2012-06-01), XP050625467, [retrieved on 2012-06-01] figures 6.1.1-1, 6.1.1-2 -----	1-46
X	----- JP 2011 019125 A (NIPPON TELEGRAPH & TELEPHONE) 27 January 2011 (2011-01-27) paragraphs [0028] - [0035] paragraph [0028] - paragraph [0031] paragraph [0019] paragraph [0020] paragraph [0028] - paragraph [0035] -----	11-22, 33-46

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/052871

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2011019125	A	27-01-2011	NONE

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4, 23-26, 45, 46

Apparatus, method and computer program product for receiving a request to create a packet data connection from a user equipment of a group, and selecting a group control device for the group based on information related to the group.

2. claims: 5-10, 27-32, 45, 46

Apparatus, method and computer program product for storing subscription-related information in a memory, and handling subscriber-related information for a group by referring to an address of a group control device stored for the group in the memory.

3. claims: 11-16, 33-38, 45, 46

Apparatus, method and computer program product for handling control of a group of user equipments, and forwarding information regarding the group together with the address of an apparatus carrying out the method to an authentication, authorization and accounting entity.

4. claims: 17-22, 39-46

Apparatus, method and computer program product for controlling authentication, authorization and accounting in a network, and handling authentication, authorization and accounting for a packet data connection related to a group by referring to an address of a group control device stored for the group in the memory.
