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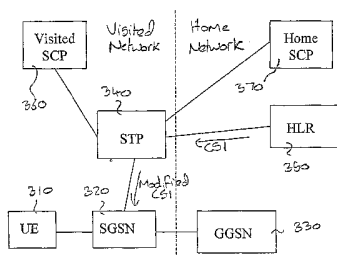
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(54) Title: TELECOMMUNICATIONS SYSTEM AND METHOD



(57) Abstract: A telecommunications system for providing internet protocol multi-media services in accordance with a service level agreement specifying conditions for a communications session in which internet protocol data is communicated to and from a mobile user equipment is provided. The system comprises an internet protocol multi-media sub-system operable to provide the internet protocol multi-media communications session to the mobile user equipment, a mobile access network for providing a mobile communications facility to the mobile user equipment for the internet protocol multi-media communications session, and a signal transfer point. The signal transfer point is operable to receive signalling data messages communicated to and from the mobile access network for providing the internet protocol multi-media communications session, to receive subscriber data of the mobile user equipment communicated to the mobile access network from the home location register of the mobile user equipment as part of a communications session establishment procedure, the subscriber data including data representing the service level agreement for providing the multi-media communications session, and to set triggering conditions, based on the subscriber data, in the mobile access network in accordance with the service level agreement. The system also comprises a local access control function operable in response to reporting messages received from the mobile access network generated by the mobile access network when the triggering conditions are satisfied to determine whether the mobile user equipment is communicating in accordance with the service level agreement, and to control the multimedia communications session in accordance with the service level agreement. By setting the triggering conditions in the mobile access network in this way, a local access control function associated with the mobile access network can assume control over communications to and from the user equipment.

WO 2006/134313 A2

TELECOMMUNICATIONS SYSTEM AND METHOD

Field of the Invention

The present invention relates to telecommunications systems and methods for providing internet protocol multi-media services to mobile user equipment. The present invention also relates to a computer program for providing internet protocol multi-media services to mobile user equipment.

Background of the Invention

Mobile communications systems such as those provide by mobile radio networks allow a mobile communications device such as, for example, a mobile telephone or portal personal computer (herein after referred to generally as a mobile user equipment) to move within a coverage area of the mobile radio network whilst still supporting a communications service to the mobile user equipment. Sometimes the mobile user equipment can roam between different mobile access networks. For example the mobile user equipment may roam from a home mobile access network, via which the mobile user equipment usually communicates to a visited mobile access network. Typically the user of the mobile user equipment subscribes to an operator of its home mobile access network.

Communications sessions can be controlled by control functions which are associated with the mobile user equipment's home mobile access network or with a visited mobile access network. The controlling function in the home mobile access network provides the home mobile access network with the capability to monitor and control media sessions in a visited network, and in particular to apply charges to a user, and to allocate and control bandwidth and Quality of Service. However, the controlling function typically does not allow the visited mobile access network to monitor and control the media sessions in this way. Furthermore, it may be appropriate in some circumstances to provide an arrangement for controlling a communications session, which operates separately from the mobile user equipment's home mobile access network, even when the mobile user equipment is currently attached to its home mobile access network.

Summary of Invention

According to an aspect of the present invention, there is provided a telecommunications system for providing internet protocol multi-media services in accordance with a service level agreement specifying conditions for a communications session in which internet protocol data is communicated to and from a mobile user equipment. The system comprises an internet protocol multi-media sub-system operable to provide the internet protocol multi-media communications session to the mobile user equipment, a mobile access network for providing a mobile communications facility to the mobile user equipment for the internet protocol multi-media communications session, and a signal transfer point. The signal transfer point is operable to receive signalling data messages communicated to and from the mobile access network for providing the internet protocol multi-media communications session, to receive subscriber data of the mobile user equipment from the home location register of the mobile user equipment as part of a communications session establishment procedure, the subscriber data including data representing the service level agreement for providing the multi-media communications session, and to set triggering conditions, based on the subscriber data, in the mobile access network in accordance with the service level agreement. The system also comprises a local access control function operable in response to reporting messages received from the mobile access network generated by the mobile access network when the triggering conditions are satisfied to determine whether the mobile user equipment is communicating in accordance with the service level agreement, and to control the multimedia communications session in accordance with the service level agreement.

For example the triggering conditions may be set by adapting the subscriber data, which may be communicated to the mobile access network from the home location register during a communications session establishment procedure.

Accordingly, by setting the triggering conditions in the mobile access network in this way, a local access control function associated with the mobile access network can assume control over a communications session to and from the user equipment. The mobile network may include a service support node and a gateway support node, and the triggering conditions may be set either in the service support node or,

assuming it has the required functionality, the gateway support node. In either case, little or no change to the service support node or gateway support node may be required, because these nodes traditionally perform the monitoring and policy enforcement functions in response to home network policy decisions. Moreover, neither the mobile access network (the serving support node and/or the gateway support node) nor the users HLR or any Service Control Functions (SCFs) in the home network need to be aware that additional triggering is being added. This enables the technique to be transparent to these network functions, and means little or no change to these network functions may be required. One, or more than one triggering condition may be set in the mobile access network, so that control of the session by the local access control function can be enabled for a plurality of parameters.

In one example, the mobile access network is the mobile user equipment's home network, in which case the signal transfer point and the local access function are part of the home mobile access network of the user equipment. Inserting triggering information into subscriber data from the home location register may in some cases be preferable to the conventional approach of storing the triggering information in the home location register (HLR). For instance, if there are a large number of subscribers with triggering information stored in the HLR, but it is necessary to migrate subscribers to start running a new version of an application, say on a different local access control function, then providing for alteration of the routing will allow for a smooth change over of services. It also becomes possible to monitor a total amount of traffic communicated using a mobile access network. For example, by inserting extra trigger information and instructing a service support node of a GPRS network to report to the application plane an amount of data being sent, a total amount of data communicated on that GPRS network can be determined. This could be done for all subscribers and could be done regardless of whether other Intelligent Network (IN) services were running. Another example application of the present technique is to amend the triggering information for all users, so that all users are awarded free data calls at predetermined times, for instance as a free promotion to offer free late night data when the network is quiet.

Alternatively, the user equipment may be currently attached to a visited network, in which case the mobile access network, the signal transfer point and the

local access control function are part of the visited network to which the user equipment is currently roaming from its home network. The home location register will in this case be in the home network of the user equipment. Usually in such a situation, where a user is roaming to a visited network, it is the user's home network which provides session control functions. In contrast, in an advantageous implementation of this embodiment, it is the visited mobile access network which provides session control, regardless of whether the user's home mobile access network has determined that it wishes to trigger service control.

The subscriber data may or may not include triggering information prior to being received by the signal transfer point in a visited mobile access network. If triggering information was not previously present, it is inserted by the signal transfer point to set triggering conditions in the mobile access network to enable message reporting to a local access control function within the visited network. Alternatively, if triggering information already existed in the subscriber data received by the signal transfer point, the triggering information will be modified to set triggering conditions in the mobile access network to enable message reporting to a local access control function within the visited network in addition to message reporting to a home access control function within the home network of the user equipment. The STP may be a function integrated into another physical network node, such as an MSC, or a physical entity in its own right.

IP (Internet Protocol) Multimedia Subsystems (IMS) are an example of a telecommunications system, which can be used to control multi-media sessions between parties for applications such as voice, video, messaging, presence and games. The 3GPP (3rd Generation Partnership Project) has defined an IMS, which is described in detail in 3GPP specifications such as 24.228 – 3GPP. For the example of IMS, media sessions can be controlled by CAMEL (Customized Applications for Mobile network Enhanced Logic) which is a mobile network architecture providing IN (Intelligent Network) services. The CAMEL architecture provides remote control functions and switching functions and supports roaming into a visited mobile access network. To support these services, a controlling function, referred to as a service control point (SCP), in a home mobile access network interacts with a switching function, referred to as a signal transfer point (STP), in a visited network. The use of

CAMEL to control media sessions is defined in specification 22.078 – 3GPP. In one example therefore, the triggering information may be CAMEL subscription information comprising a Global Title and a Service Key. In this case, one or both of the Global Title and the Service Key can be adapted by the signal transfer point to route reporting messages from the mobile access network to the local access control function. The triggering conditions may include the expiry of a predetermined session duration or the transfer of a predetermined volume of data. It is also possible to set triggering conditions to monitor the quality of service experienced by the user equipment, and to apply charges to the user equipment in respect of multi-media services used.

Embodiments of the invention are arranged to be separate to the SIP session control that can be carried out in a CAMEL Service Control Function (SCF) as defined in 23.228 – 3GPP and may apply to the control of data flow associated with IMS across various access solutions defined by 3GPP, such as UMTS (Universal Mobile Telecommunications System) and GPRS (General Packet Radio Service).

Various further aspects and features of the present inventions are defined in the appended claims. Other aspects of the invention include a local access control function, a signal transfer point, a communications method and a computer program.

Brief Description of the Drawings

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings where like parts are provided with corresponding reference numerals and in which:

Figure 1 is a schematic illustration of a network architecture providing IMS services;

Figure 2 is a schematic illustration of a CAMEL attachment and data control procedure for a subscriber in their home network according to a first embodiment of the invention;

Figure 3 is a schematic illustration of a first CAMEL attachment and data control procedure for a subscriber roaming from their home network to a visited network according to a second embodiment of the invention;

Figure 4 is a schematic illustration of Global Title and Service Key adaptation for the attachment and data control procedure of Figure 3;

Figure 5 is a schematic illustration of a second CAMEL attachment and data control procedure for a subscriber roaming from their home network to a visited network according to a third embodiment of the invention;

Figure 6 is a schematic illustration of the steps involved in setting and triggering CAMEL conditions in the procedure of Figures 3 and 4;

Figure 7 is a schematic illustration of illustrates an example message flow between the SGSN, the STP, a home SCP and a visited SCP for the second embodiment of the invention;

Figure 8 is a schematic illustration of a bandwidth monitoring and allocation procedure according to an embodiment of the invention.

Description of the Example Embodiments

Example home and visited mobile radio networks which conform to the GPRS/UMTS standard are illustrated in Figure 1 and provide mobile radio communication of data via a radio access interface in accordance with the Universal Terrestrial Radio Access Network (UTRAN). The terminology and architecture used in Figure 1 corresponds to that used for the UMTS and that proposed for 3G as administered by the 3GPP. A home mobile radio network includes a Gateway Support Node (GGSN) 100 which provides an interface between an external network 120 and the home mobile radio network for communicating data to and from external networks for mobile user equipment which are attached to the GPRS/UMTS network. The home mobile radio network shown in Figure 1 includes a plurality of base transceiver stations which are referred to in the UMTS standard as Node Bs. The Node Bs 112, 114 are connected by a Radio Network Controller 110 (RNC) to a Serving GPRS Support Node (SGSN) 106 which is connected to the GGSN 100. As shown in Figure 1, mobile user equipment 116 communicates radio signals in accordance with the UTRAN standard within a radio coverage area provided by the Node Bs. Alternatively, a similar network architecture, which exists for 2G and 2.5G networks may be provided, in which a Base Transceiver Stations (BTS) will replace the role of a Node B and a Base Station Controller (BSC) will replace the role of an RNC.

The GGSN 100 acts as the gateway between the external network 120 and the mobile network, which supports GPRS. The GGSN 100 routes incoming IP data packets to an SGSN that is serving a particular mobile User Equipment (UE) receiving data via a radio access facility provided by the mobile packet radio network. The radio access facility may be provided in accordance with the Universal Terrestrial Radio Access Network (UTRAN) system which is specified in accordance with the 3GPP standard. The SGSN 100 is connected to the GGSN 106 via a Gn interface if the SGSN is within the same Public Land Mobile Network (PLMN), and connected via the Gp interface to GGSNs belonging to other PLMNs.

An SGSN provides mobility management of UEs, which are moving within an area supported by the mobile radio network. Specifically, the SGSN is responsible for the delivery of data packets from and to the mobile terminal 116 and other mobile

terminals within its service area. Its tasks include packet routing and transfer, mobility management, logical link management, and authentication and charging. The SGSN includes a location register which stores location information and user profiles of all users registered with this SGSN. To this end, the SGSN 106 is provided with access to a Home Location Register (HLR) 130 from which this user information can be extracted. The SGSN 106 is arranged to route data packets to Radio Network Controllers (RNC) 112, 114 for communication via the UTRAN radio access facility to mobile user UE 116. The UTRAN radio access facility is provided using Node B apparatus 112, 114, which effectively form base transceiver stations providing radio coverage for the area served by the mobile telecommunications network.

Figure 1 further illustrates a visited mobile network VPLMN into which the user equipment 116 may roam. The visited mobile network has a similar architecture to the home mobile network, and as such includes a GGSN 150 which acts as the gateway between the external network 120 and the visited mobile network, an SGSN 156, an RNC 160 and a Node B apparatus 162. The user equipment 116 roaming from the home network to the visited network is illustrated as a user equipment 116'. The user equipment 116' is thus currently affiliated to the visited network at a node B 162. Profile and other information regarding the user equipment 116' continues to be stored at the HLR 130 in the home network.

The home mobile network can provide the user equipment 116 with access to IMS services using an IMS 170. The IMS includes a Session Initiation Protocol (SIP) server (S-CSCF) 172, a Home Subscriber Server (HSS) 174, a CAMEL server 176 and an IMS application server 178. The IMS can be used to provide IP multimedia services to the user equipment 116 using the SIP which can be used to register and control IMS sessions. The SIP server 172 is the serving CSCF server and performs the functions of controlling sessions, acting as registrar and triggering and executing services, in the present case IMS services. The S-CSCF will access the user's profile from the HSS 174 to determine which services are available to the user equipment and to configure a session, and controls the application server 178 using SIP commands.

The CAMEL server 176 provides a CAMEL state machine which is defined by conditions (states) and messages resulting from those conditions. CAMEL messages to the CAMEL server update the state machine, and CAMEL messages from the

CAMEL server specify commands to be carried out by the mobile network. For instance, the CAMEL server is able to control the allocation of data volume, call duration and quality of service available to the user equipment 116. Specifically, the CAMEL server will be informed of session initiation, data usage, quality of service and session termination, and can allocate blocks of data and terminate sessions in response to these incoming reports. The visited mobile network is able to provide the user equipment 116' with access to IMS services using the IMS 170, through the GGSN 150.

Figure 2 schematically illustrates an attachment and data control procedure for a subscriber in its home mobile network. Specifically, the subscriber is represented by a user equipment 210 attaching itself to the home mobile network via an SGSN 220. The network elements of the home mobile network shown in Figure 2 include a GGSN 230 for providing a gateway to an external network, a Signalling Transfer Point (STP) 240 for routing data packets between network elements, a Home Location Register (HLR) 250 storing subscriber data relating to the user equipment 210, and a Service Control Point (SCP) 260 which is an Intelligent Network (IN) entity which controls the duration, data volume and quality of service available to the user equipment 210.

When the user equipment 210 attaches itself to the mobile network via the SGSN 220, it communicates the International Mobile Subscriber Identity (IMSI) associated with the user equipment 210 to the SGSN 220. The IMSI includes a Mobile Country Code (MCC), a Mobile Network Code (MNC) and a Mobile Station Identification Number (MSIN). This information enables the SGSN 220 to identify the HLR 250 associated with the user equipment 220 and to route a location update message to that HLR 250. The location update message is routed to the HLR 250 via the STP 240.

The HLR, on receipt of the location update message, registers the location update, and communicates the users subscriber data to the SGSN 220 via the STP 240. In the present example, the subscriber data corresponding to the user equipment does not include CAMEL Subscription Information (CSI), and so CAMEL services would not usually be available to the user equipment 220. However, the STP 240, upon receiving the subscriber data without CSI, modifies the subscriber data to include CAMEL triggers before passing it on to the SGSN 220. The CAMEL triggers instruct

the SGSN 220 and STP 240 to perform special handling for this user equipment 210. As a result of this, all data the user sends via the GGSN 230 is then controlled by the SCP 260. The SCP 260 may, in doing so, examine Access Point Names (APN's) to separate out traffic flow by routing destination.

Figure 3 schematically illustrates an attachment and data control procedure for a subscriber roaming from its home mobile network to a visited mobile network. Specifically, the subscriber is represented by a user equipment 310 attaching itself to the visited mobile network via an SGSN 320. The network elements of the visited mobile network shown in Figure 3 also include a Signalling Transfer Point (STP) 340 for routing data packets between network elements and a visited Service Control Point (SCP) 360 for controlling the duration, data volume and quality of service available to the user equipment 310. The home network of the user equipment 310 includes a Home Location Register (HLR) 350 storing subscriber data relating to the user equipment 310, and a home Service Control Point (SCP) 370 which, in combination with the visited SCP 360, controls the duration, data volume and quality of service available to the user equipment 310. The home network also includes a GGSN 330 for providing a gateway to an external network. When the user equipment 310 attaches itself to the visited mobile network via the SGSN 320, it communicates the International Mobile Subscriber Identity (IMSI) associated with the user equipment 310 to the SGSN 320. As with the arrangement of Figure 2, this enables the SGSN 320 to identify the HLR 350 associated with the user equipment 320 and to route a location update message to that HLR 350 via the STP 340.

The HLR 350, on receipt of the location update message, registers the location update, and communicates the user's subscriber data to the SGSN 320 via the STP 340. In the present case, the subscriber data corresponding to the user equipment includes CAMEL Subscription Information (CSI) which enables control of the user equipment 310 by the home SCP 370. The STP 340, upon receiving the subscriber data in which the CSI is embedded, modifies the CAMEL Subscription Information before passing it on to the SGSN 320. The CAMEL Subscription Information includes a Global Title (GT) and a Service Key. The Global Title indicates the identity of the Camel Service Environment (CSE) to be used in respect of CAMEL functions. In particular, it will identify the SCP to be used when a CAMEL triggering condition is

met at the SGSN 320 and provides an address at which the SCP can be reached. The Service Key specifies the service logic, or application, to be used by the SCP. When modifying the CAMEL Subscription Information, the STP 340 modifies the Global Title, and may also modify the Service Key. The modification of the Global Title and Service Key for the Figure 3 situation will now be described with reference to Figure 4.

Figure 4 illustrates the flow of subscriber data and CAMEL messages between the network elements of Figure 3, in which like elements are provided with like reference numerals. The HLR 350 communicates subscriber data including CSI to the SGSN 320 via the STP 340. The CSI within the subscriber data includes a Global Title of 33777123000 and a Service Key of 2000. The first two digits of the Global Title represent the country code of the network in which the HLR 350 and the Home SCP 370 are located. In this case the country code is 33. The STP 340, upon receipt of the CSI, stores the initial Global Title and Service Key and then adapts the Global Title to 447980011001 and the Service Key to 5000 before passing the CSI on to the SGSN 320. In the adapted Global Title, a different country code 44 is used, indicating that the visited network in the present example is in a different country than the home network of the user. Then, when a CAMEL message is generated in response to a triggering condition being met within the SGSN 320, it will use the adapted Global Title of 447980011001 and the adapted Service Key of 5000 in communicating the CAMEL message to the STP 340. The STP 340, upon receipt of CAMEL messages from the SGSN 320, is able to communicate the CAMEL messages on to either or both of the visited SCP 360 and the home SCP 370. In particular, when a CAMEL message is to be sent to the home SCP 370, the STP 340 correlates the received CAMEL message with the stored Global Title and Service Key and sends a CAMEL message using the original Global Title and Service Key identified by the HLR 350. When a CAMEL message is to be sent to the visited SCP 360, the STP 340 again adapts the Global Title and the Service Key, this time to 447980011002 and 4000 respectively, in order to route the CAMEL message to the visited SCP 360. It will be recognised that the STP 340 can also send CAMEL messages to both the visited SCP 370 and the home SCP 360 in response to the same CAMEL message from the SGSN 320.

Figure 5 schematically illustrates an attachment and data control procedure for a subscriber roaming from its home mobile network to a visited mobile network. Specifically, the subscriber is represented by a user equipment 510 attaching itself to the visited mobile network via an SGSN 520. The network elements of the visited mobile network shown in Figure 5 also include a Signalling Transfer Point (STP) 540 for routing data packets between network elements and a visited Service Control Point (SCP) 560 for controlling the duration, data volume and quality of service available to the user equipment 510. The home network of the user equipment 510 includes a Home Location Register (HLR) 550 storing subscriber data relating to the user equipment 510 and a GGSN 530 for providing a gateway to an external network. When the user equipment 510 attaches itself to the visited mobile network via the SGSN 520, it communicates the International Mobile Subscriber Identity (IMSI) associated with the user equipment 510 to the SGSN 520. As with the arrangement of Figures 2 and 3, this enables the SGSN 520 to identify the HLR 550 associated with the user equipment 520 and to route a location update message to that HLR 550 via the STP 540.

The HLR 550, on receipt of the location update message, registers the location update, and communicates the users subscriber data to the SGSN 520 via the STP 540. In the present case, the subscriber data corresponding to the user equipment does not include any CAMEL Subscription Information (CSI). The STP 540, upon receiving the subscriber data in which the CSI is embedded, inserts CAMEL Subscription Information into the subscriber data before passing it on to the SGSN 520. This CAMEL Subscription Information operates in a similar way to the CAMEL Subscription Information described in Figures 2 and 3. In the example embodiment of Figure 5, no CAMEL messages are communicated to a home network SCP, because no CAMEL services have been specified by the HLR of the home network for the user equipment 510.

Figure 6 is a flow diagram schematically illustrating the steps involved in setting up and processing CAMEL triggers in a mobile network such as that shown in the preceding Figures. The process commences at a step S1, where a user equipment attaches to a network at an SGSN. At a step S2, the SGSN determines the identity and HLR of the user equipment from the IMSI of the user equipment and sends a location

update message to the HLR via an STP. At a step S3, on receipt of the location update message, the HLR registers the updated location of the user equipment and sends the subscriber data relating to the user equipment back to the SGSN, again via the STP. At a step S4, the STP intercepts the subscriber data determines whether CAMEL Subscription Information is present. If no CAMEL Subscription Information is found, the STP inserts new CAMEL Subscription information to set CAMEL in the SGSN. If existing CAMEL Subscription Information is found, the STP modifies the CAMEL Subscription Information to adapt the CAMEL triggers in the SGSN.

At a step S5, either the user of the network initiates a PDP context. This process uses the SGSN and sets up a PDP Context defining a bearer for data packets between the User Equipment and a third party. The set-up of the PDP context includes the communication of CAMEL messages from the SGSN to the SCP's via the STP in order to set up CAMEL state logic for controlling a communications session if appropriate triggers have been set. When the PDP context is set up, the SGSN monitors subscriber data, such as the bandwidth used, the duration of a call and the Quality of Service (QoS), with respect to the CAMEL triggering conditions set in the SGSN. At a step S7, if no triggering condition is met, processing returns to the step S6, where monitoring by the SGSN continues. However, if at the step S7 a triggering condition is met, then at a step S8, the SGSN sends a CAMEL message to the STP. Upon receipt of the CAMEL message, the STP, at a step S9 passes the CAMEL message on to the relevant SCP. The SCP, at a step S10, makes decisions in response to the CAMEL message and based on service policy and subscriber data.

An example implementation of steps S5 to S10 will now be explained with reference to Figure 7, which illustrates a message flow between the SGSN, the STP, a home SCP and a visited SCP. This example message flow relates to a situation where the VPLMN is monitoring the volume of data which is being sent, however, other services could be provided, such as a service to count all PDP context activations which take place within the VPLMN. When the SGSN sets up a session using a PDP Context, a CAMEL trigger occurs and an INITDP CAMEL message is sent by the SGSN to the STP at a step C1. The CAMEL message is passed on from the STP to both the visited SCP at a step C2 and the home SCP at a step C3 to configure CAMEL services within the PDP context. Steps C2 and C3 may be carried out using Global

Title adaptation as described above. At a step C4, the home SCP sends an Apply Charge message to the STP which enables the STP to set CAMEL triggers for when the user equipment reaches predetermined data volume or call duration limits in accordance with a policy governed by the home SCP. Specifically, the home SCP sets a volume V_{home} and a duration T_{home} . Similarly, at a step C5, the visited SCP sends an Apply Charge message to the STP which enables the STP to set CAMEL triggers for when the user equipment reaches predetermined data volume or call duration limits in accordance with a policy governed by the visited SCP. Specifically, the visited SCP sets a volume V_{visited} and a duration T_{visited} . The STP, at a step C6, processes the two received Apply Charge messages and sets CAMEL triggering conditions in the SGSN in accordance with the smallest data volume V_{smallest} , that is the smallest of V_{home} and V_{visited} , and the shortest call duration T_{smallest} , that is the shortest of T_{home} and T_{visited} . Once the CAMEL triggering conditions are set at the SGSN, data packets can be sent between the user equipment and a third party, and the SGSN will monitor the data usage. If the data usage exceeds V_{smallest} or T_{smallest} , the CAMEL triggering conditions will have been met and the SGSN will send an Apply Charge Report to the STP at a step C7. Accordingly, it will be understood that the values set in the Apply Charge message are effectively constraints dictating the duration and volume of data transfer permitted before the SCP wishes to be consulted. It will be understood that the triggering of the Apply Charge message does not prevent further data transfer from taking place between the user equipment and a third party. The STP, on receipt of the Apply Charge Report message, will determine which SCP the activated trigger relates to, and will communicate the Apply Charge Report message to that SCP. In the present case, the activated trigger relates to the home SCP, and so the Apply Charge Report is sent there at a step C8. The home SCP, on receipt of the Apply Charge Report, can either allocate additional bandwidth and/or duration, or can terminate the session. In the present case, the home SCP sends another Apply Charge message to the STP at a step C9, which enables the STP to set further CAMEL triggering conditions for a new predetermined data volume or call duration at a step C10.

Steps C7 to C10 can be continued, with CAMEL messages being sent to both the home and visited SCP's, many times, until either the user equipment, or one of the SCP's elects to terminate the session. In the Figure 7 example, the home SCP elects,

at a step C27, to terminate the session with an Entity Released message which is communicated to the STP. The STP passes the Entity Released message on to the SGSN at a step C28. The STP also communicates, at a step C29, the Entity Released message, and any outstanding Apply Charge message, to the visited SCP.

An example bandwidth allocation and monitoring procedure using the messaging of Figure 7 is schematically illustrated in Figure 8. In this example, the visited SCP allocates bandwidth V_{visited} in blocks of 300kbits at a time and the home SCP allocates bandwidth V_{home} in blocks of 500kbits at a time. The STP, when setting the first bandwidth trigger condition in the SGSN, will compare V_{visited} and V_{home} against the current bandwidth usage to determine V_{smallest} . The current bandwidth usage at the start of the call will be 0kbits. It can be seen from Figure 8 that the first value of V_{smallest} will be 300kbits, and that this will therefore be the first trigger condition A1. When the bandwidth used reaches 300kbits, the trigger condition will be met and the SGSN will report this back to the STP, which will in turn pass on the report to the SCP which set that particular trigger condition, in this case the visited SCP. Assuming the session continues, the STP will determine the next value of V_{smallest} , again by comparing V_{visited} and V_{home} against the current bandwidth usage of 300kbits. This will result in the trigger condition A2 being set, at a bandwidth of 500kbits.

When the bandwidth used reaches 500kbits, the second trigger condition A2 will be met and the SGSN will report this back to the STP, which again will in turn pass on the report to the SCP that set the trigger condition A2, which in this case was the home SCP. Following this, the next trigger condition will be determined. It can be seen that the third and fourth trigger conditions A3 and A4 respectively are set by the visited SCP, that the fifth trigger condition A5 is set by the home SCP and that the sixth trigger condition A6 is set by the visited SCP. It can also be seen that the seventh trigger condition A7 is set by both the home and visited SCPs. Accordingly, when this trigger condition is met, the resulting report will be sent to both SCPs, which will each have the opportunity to allocate additional bandwidth or terminate the session.

While the above examples relate to CAMEL triggering by the SGSN, it is also possible, if the GGSN is in the HPLMN, to use CAMEL triggering at the GGSN, because there will be sufficient information available at the GGSN to enable triggering

to be performed. The SCP will be unaware that a trigger has come from the GGSN rather than the SGSN, and so no changes to the message flow are required.

It is also possible to provide a separate policy enforcement module, such as a firewall, behind the GGSN to control the data packets sent to and from the user equipment. The role of the policy enforcement module is simply to monitor bandwidth usage and routing in real time and report the data volume and third party locations used.

Embodiments of the present invention can also handle cases where the visited network VPLMN and the home network HPLMN service request different default call handling. As indicated in 3GPP 23.078 'The Default GPRS Handling indicates whether the GPRS session or PDP context shall be released or continued as requested in case of error in the gprsSSF to gsmSCF dialogue.' Thus if either the VPLMN service or the HPLMN service profile which they wish to enforce release, then the STP can inform of the SGSN to use the release method. An STP which uses the present technique in the visited network VPLMN can also allow for cases where one of the local access control functions SCP is set to continue whilst the other is set to request. For example, if the home network HPLMN local access control function is set to continue, whereas the visited network VPLMN local access control function service is set to release. then:

- The STP would set the SGSN to a release mode
- The SGSN would then expect the SCF plane (ie the STP) to respond
- If the VPLMN local access control function SCP fails to respond, then the session should be released – either SGSN can releases or the STP can send a release (skip the next step)
- If the HPLMN local access control function SCP fails to respond then the STP can simply base the service control on dialogue messages from the VPLMN local access control function to allow the dialogue to continue.
- If both network nodes respond, then default call handling is not relevant.

Various modifications may be made to the embodiments herein before described without departing from the scope of the present invention. For instance, the GGSN may be in the HPLMN while the SGSN is in the VPLMN, the SGSN and the

GGSN may both be in the VPLMN, or the SGSN and the GGSN may both be in the HPLMN.

CLAIMS

1. A telecommunications system for providing internet protocol multi-media services in accordance with a service level agreement specifying conditions for a communications session in which internet protocol data is communicated to and from a mobile user equipment, the system comprising

an internet protocol multi-media sub-system operable to provide the internet protocol multi-media communications session to the mobile user equipment,

a mobile access network for providing a mobile communications facility to the mobile user equipment for the internet protocol multi-media communications session,

a signal transfer point operable

to receive signalling data messages communicated to and from the mobile access network for providing the internet protocol multi-media communications session,

to receive subscriber data of the mobile user equipment from the home location register of the mobile user equipment as part of a communications session establishment procedure, the subscriber data including data representing the service level agreement for providing the multi-media communications session,

to set triggering conditions, based on the subscriber data, in the mobile access network in accordance with the service level agreement, and

a local access control function operable in response to reporting messages received from the mobile access network generated by the mobile access network when the triggering conditions are satisfied to determine whether the mobile user equipment is communicating in accordance with the service level agreement, and to control the multimedia communications session in accordance with the service level agreement.

2. A telecommunications system according to claim 1, wherein the triggering conditions include an expiry of a predetermined session duration or the transfer of a predetermined volume of data.

3. A telecommunications system according to claim 1 or claim 2, wherein the signal transfer point is operable to set a plurality of triggering conditions in the mobile access network to establish different triggers for different parameters.

4. A telecommunications system according to any preceding claim, wherein the local access control function is operable to control the internet protocol multi-media session by applying charges to the user for internet protocol multi-media services in response to predetermined reporting messages received from the mobile access network.

5. A telecommunications system according to any preceding claim, wherein, in response to the triggering conditions being met, the mobile access network is operable to communicate the reporting messages to the local access control function via the signal transfer point, wherein the triggering conditions are set by adding or adapting CAMEL subscription information in the subscriber data, the CAMEL subscription information comprising a Global Title and a Service Key, one or both of the Global title and the Service Key being adapted by the signal transfer point to route reporting messages from the mobile access network to the local access control function.

6. A telecommunications system according to any preceding claim, in which the mobile access network includes a gateway support node providing a gateway for internet protocol packets to and from the mobile access network and a serving support node for routing the internet protocol packets to and or from the mobile user equipment, wherein the triggering conditions are set in, and the reporting messages are communicated from, one of the serving support node or the gateway support node.

7. A telecommunications system according to claim 6, comprising a policy enforcement subsystem arranged between the gateway support node and an external network with which the user equipment is communicating, the policy

enforcement subsystem being operable to control the bandwidth used by the user equipment in real time.

8. A telecommunications system according to any preceding claim, wherein the mobile access network, the signal transfer point, the local access function and the home location register are part of the home network of the user equipment.

9. A telecommunications system according to any one of claims 1 to 7, wherein the mobile access network, the signal transfer point and the local access control function are part of a visited network to which the user equipment has roamed from a home mobile access network of the user equipment, the home mobile access network including the home location register.

10. A telecommunications system according to claim 9, wherein the home mobile access network of the user equipment includes a home access control function operable in response to the reporting messages to determine whether the mobile user equipment is communicating in accordance with the service level agreement, and to control the multimedia communications session in accordance with the service level agreement, and wherein the subscriber data received from the home location register comprises triggering information to set triggering conditions in the mobile access network in accordance with the service level agreement, the signal transfer point being operable to adapt the subscriber data to modify the triggering conditions to communicate selectively reporting messages to one or both of the local access control function and the home access control function.

11. A telecommunications system as claimed in any preceding Claim, wherein the mobile access network operates in accordance with the General Packet Radio System (GPRS) standard, the GPRS mobile access network requiring substantially no adaptation in order to co-operate with the signal transfer point and the local access control function.

12. A signal transfer point for communicating signalling data messages within a telecommunications system, the telecommunications system providing internet protocol multi-media services in accordance with a service level agreement specifying conditions for a communications session in which internet protocol data is communicated to and from a mobile user equipment, the system comprising an internet protocol multi-media sub-system operable to provide the internet protocol multi-media communications session to the mobile user equipment and a mobile access network for providing a mobile communications facility to the mobile user equipment for the internet protocol multi-media communications session,

the signal transfer point being operable

to receive signalling data messages communicated to and from the mobile access network for providing the internet protocol multi-media communications session,

to receive subscriber data of the mobile user equipment communicated from the home location register of the mobile user equipment as part of a communications session establishment procedure, the subscriber data including data representing the service level agreement for providing the multi-media communications session,

to set triggering conditions, based on the subscriber data, in the mobile access network in accordance with the service level agreement,

to receive from the mobile access network reporting messages generated by the mobile access network when the triggering conditions are satisfied, and

to communicate the reporting messages to a local access control function, the local access control function being operable in response to the reporting message to determine whether the mobile user equipment is communicating in accordance with the service level agreement and to control the multi-media communications session in accordance with the service level agreement.

13. A local access control function for monitoring and controlling internet protocol multi-media services being provided to a user of a telecommunications system in accordance with a service level agreement specifying conditions for a communications session in which internet protocol data is communicated to an from a mobile user equipment, the telecommunications system comprising an internet

protocol multi-media sub-system operable to provide the internet protocol multi-media communications session to the mobile user equipment, a mobile access network for providing a mobile communications facility to the mobile user equipment for the internet protocol multi-media communications session, and a signal transfer point operable

to receive signalling data messages communicated to and from the mobile access network for providing the internet protocol multi-media communications session,

to receive subscriber data of the mobile user equipment communicated from the home location register of the mobile user equipment as part of a communications session establishment procedure, the subscriber data including data representing the service level agreement for providing the multi-media communications session, and

to set triggering conditions, based on the subscriber data, in the mobile access network in accordance with the service level agreement,

the local access control function being operable in response to reporting messages received from the mobile access network generated by the mobile access network when the triggering conditions are satisfied to determine whether the mobile user equipment is communicating in accordance with the service level agreement, and to control the multi-media communications session in accordance with the service level agreement.

14. A method for providing internet protocol multi-media services in accordance with a service level agreement specifying conditions for a communications session in which internet protocol data is communicated to and from a mobile user equipment, the method comprising the steps of

providing, using an internet protocol multi-media sub-system, the internet protocol multi-media communications session to the mobile user equipment,

providing, via a mobile access network, a mobile communications facility to the mobile user equipment for the internet protocol multi-media communications session,

receiving, at a signal transfer point, signalling data messages communicated to and from the mobile access network for providing the internet protocol multi-media communications session,

receiving, at the signal transfer point, subscriber data of the mobile user equipment communicated from the home location register of the mobile user equipment as part of a communications session establishment procedure, the subscriber data including data representing the service level agreement for providing the multi-media communications session,

setting triggering conditions, based on the subscriber data, in the mobile access network in accordance with the service level agreement,

determining, in response to reporting messages received from the mobile access network generated by the mobile access network when the triggering conditions are satisfied, at the local access control function, whether the mobile user equipment is communicating in accordance with the service level agreement, and controlling the multi-media communications session in accordance with the service level agreement.

15. A method according to claim 14, wherein the triggering conditions include an expiry of a predetermined session duration or the transfer of a predetermined volume of data.

16. A method according to claim 14 or claim 15, comprising the step of setting a plurality of triggering conditions in the mobile access network to establish different triggers for different parameters.

17. A method according to any of claims 14 to 16, comprising the step of controlling the internet protocol communications session by applying charges to the user for internet protocol multi-media services in response to predetermined reporting messages received from the mobile access network.

18. A method according to any of claims 14 to 17, comprising the step of communicating, in response to the triggering conditions being met, the reporting messages from the mobile access network to the local access control function via the

signal transfer point, and wherein the triggering conditions are set by adding or adapting CAMEL subscription information in the subscriber data, the CAMEL subscription information comprising a Global Title and a Service Key, one or both of the Global title and the Service Key being adapted by the signal transfer point to route reporting messages from the mobile access network to the local access control function.

19. A computer program providing computer executable instructions, which when loaded on to a data processor causes the data processor to perform the method according to any of Claims 14 to 18.

20. A medium bearing information representing the computer program as claimed in Claim 19.

21. A telecommunications apparatus for providing internet protocol multi-media services in accordance with a service level agreement specifying conditions for a communications session in which internet protocol data is communicated to and from a mobile user equipment, the telecommunications apparatus comprising

means for providing the internet protocol multi-media communications session to the mobile user equipment, using an internet protocol multi-media sub-system,

means for providing a mobile communications facility to the mobile user equipment for the internet protocol multi-media communications session, via a mobile access network,

means for receiving, at a signal transfer point, signalling data messages communicated to and from the mobile access network for providing the internet protocol multi-media communications session,

means for receiving, at the signal transfer point, subscriber data of the mobile user equipment communicated from the home location register of the mobile user equipment as part of a communications session establishment procedure, the subscriber data including data representing the service level agreement for providing the multi-media communications session,

means for setting triggering conditions, based on the subscriber data, in the mobile access network in accordance with the service level agreement,

means for determining, in response to reporting messages received from the mobile access network generated by the mobile access network when the triggering conditions are satisfied, at the local access control function, whether the mobile user equipment is communicating in accordance with the service level agreement, and

means for controlling the multi-media communications session in accordance with the service level agreement.

22. A telecommunications system substantially as herein before described with reference to the accompanying drawings.

23. A method substantially as herein before described with reference to the accompanying drawings.

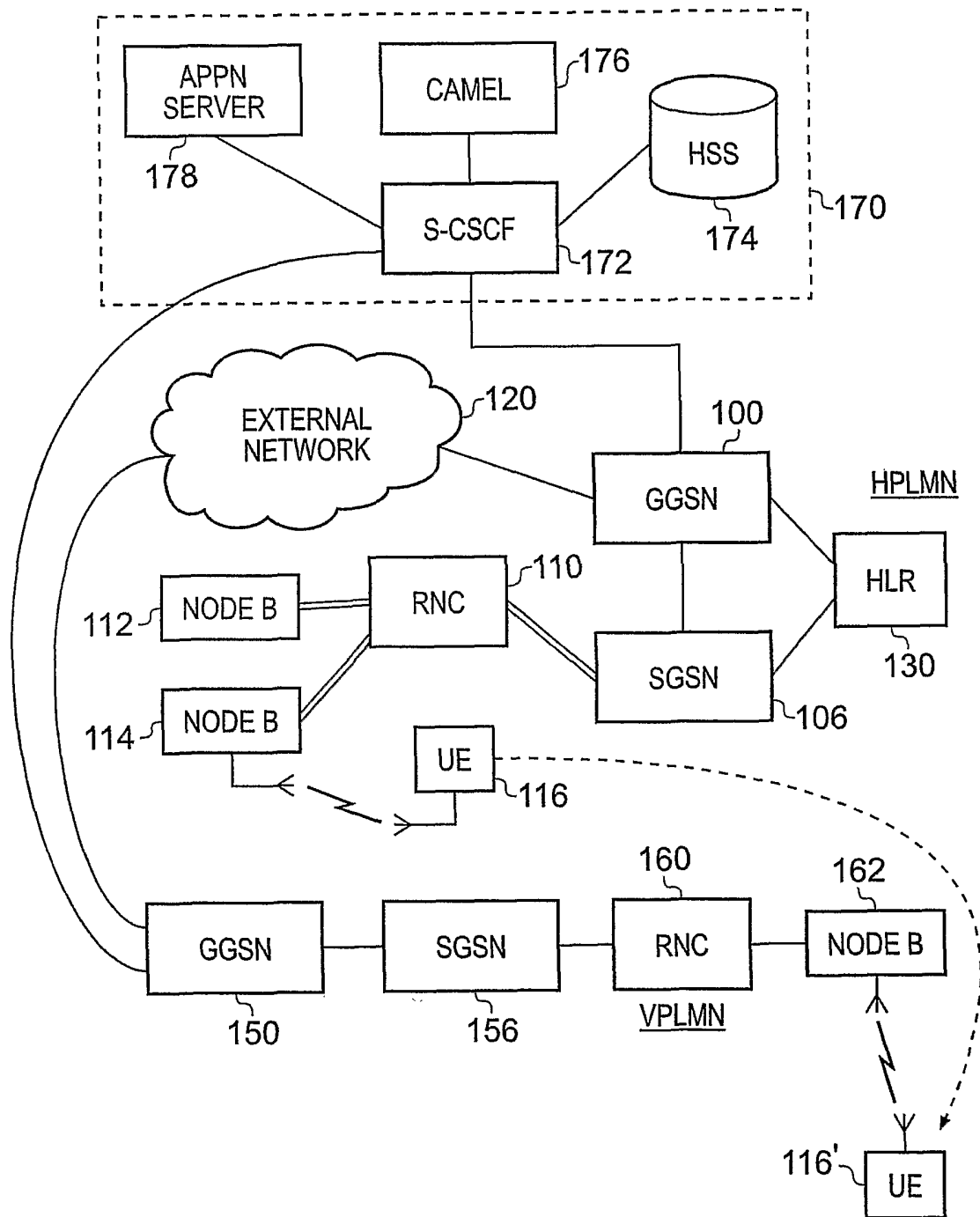


Fig. 1

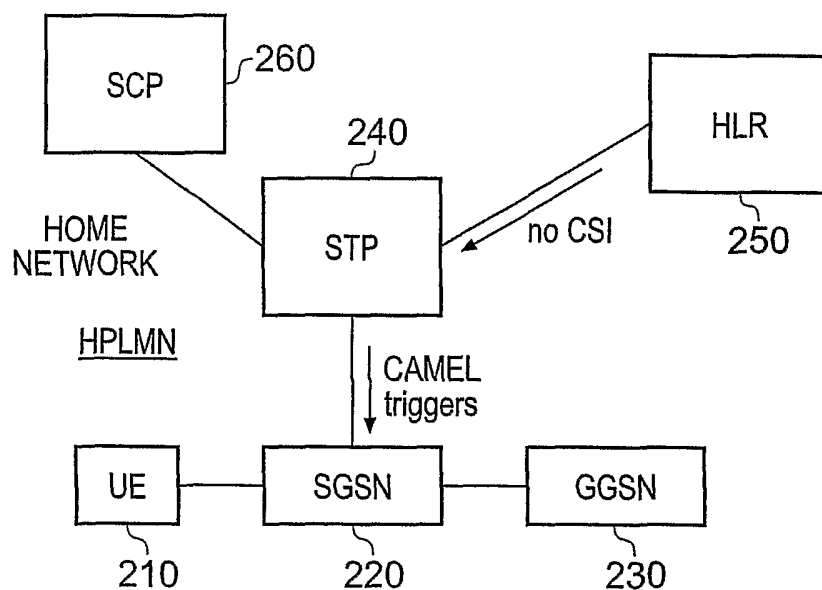


Fig. 2

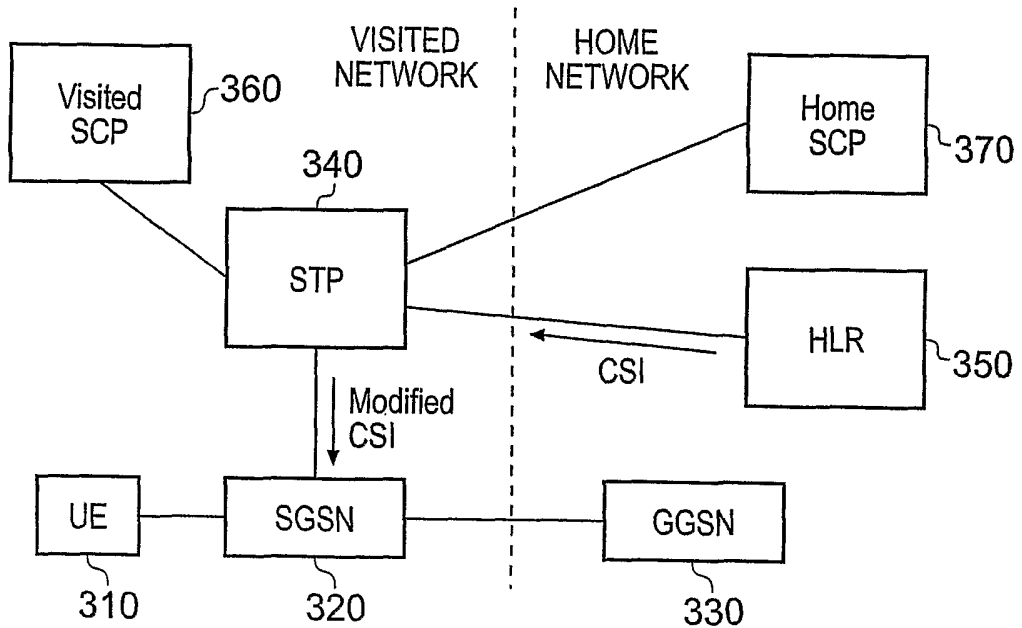


Fig. 3

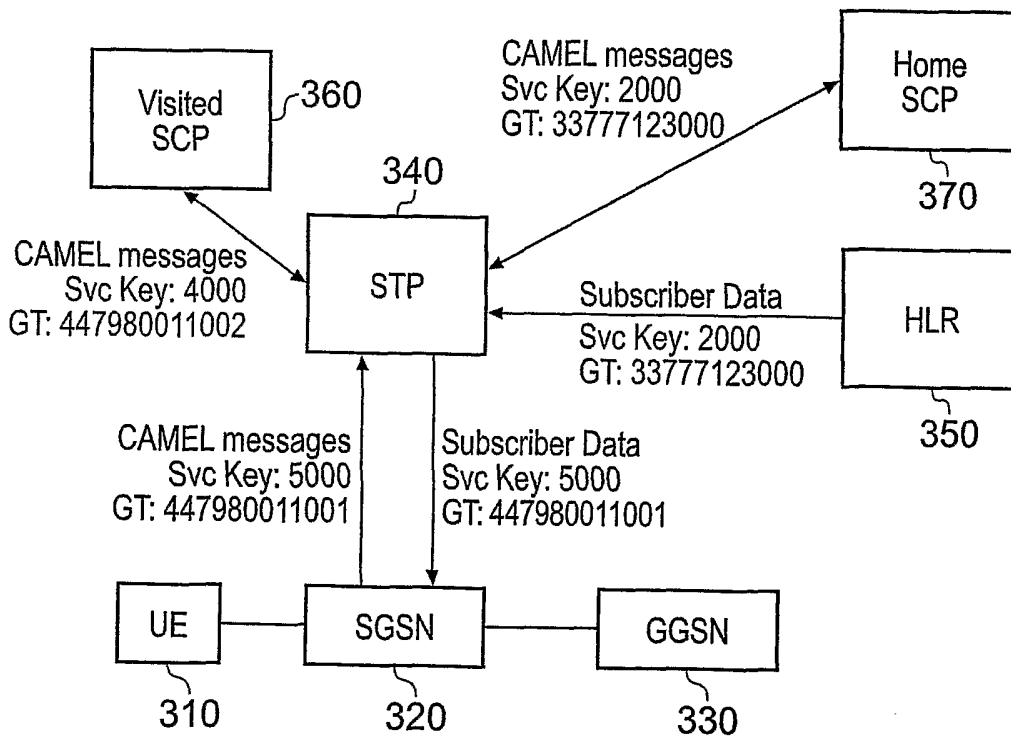


Fig. 4

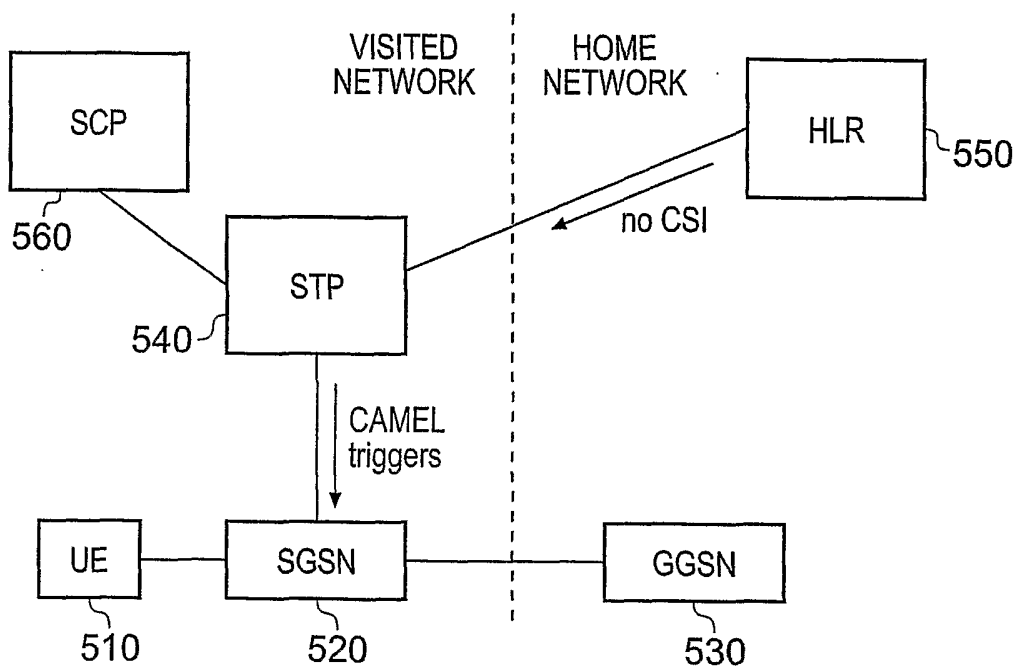


Fig. 5

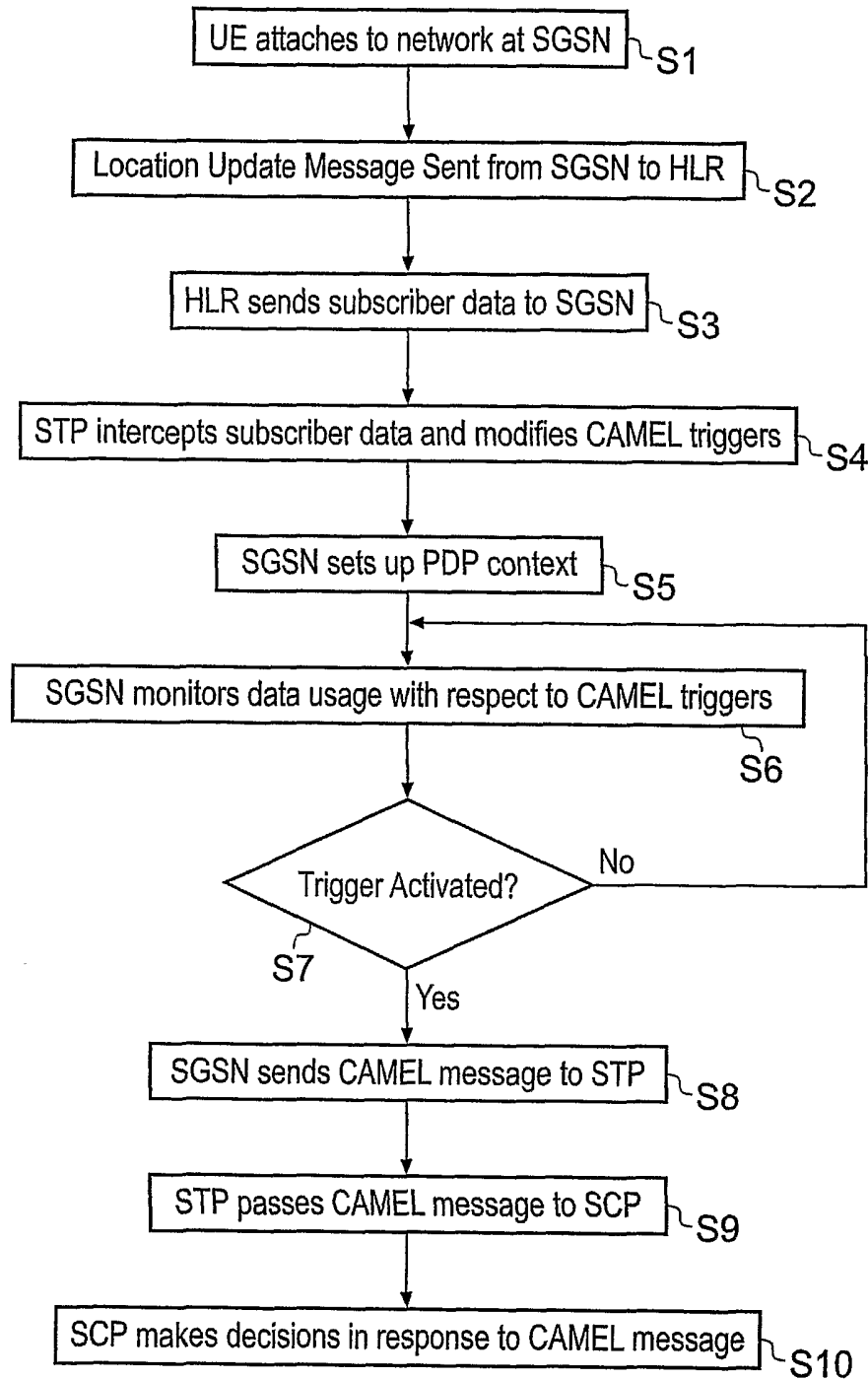


Fig. 6

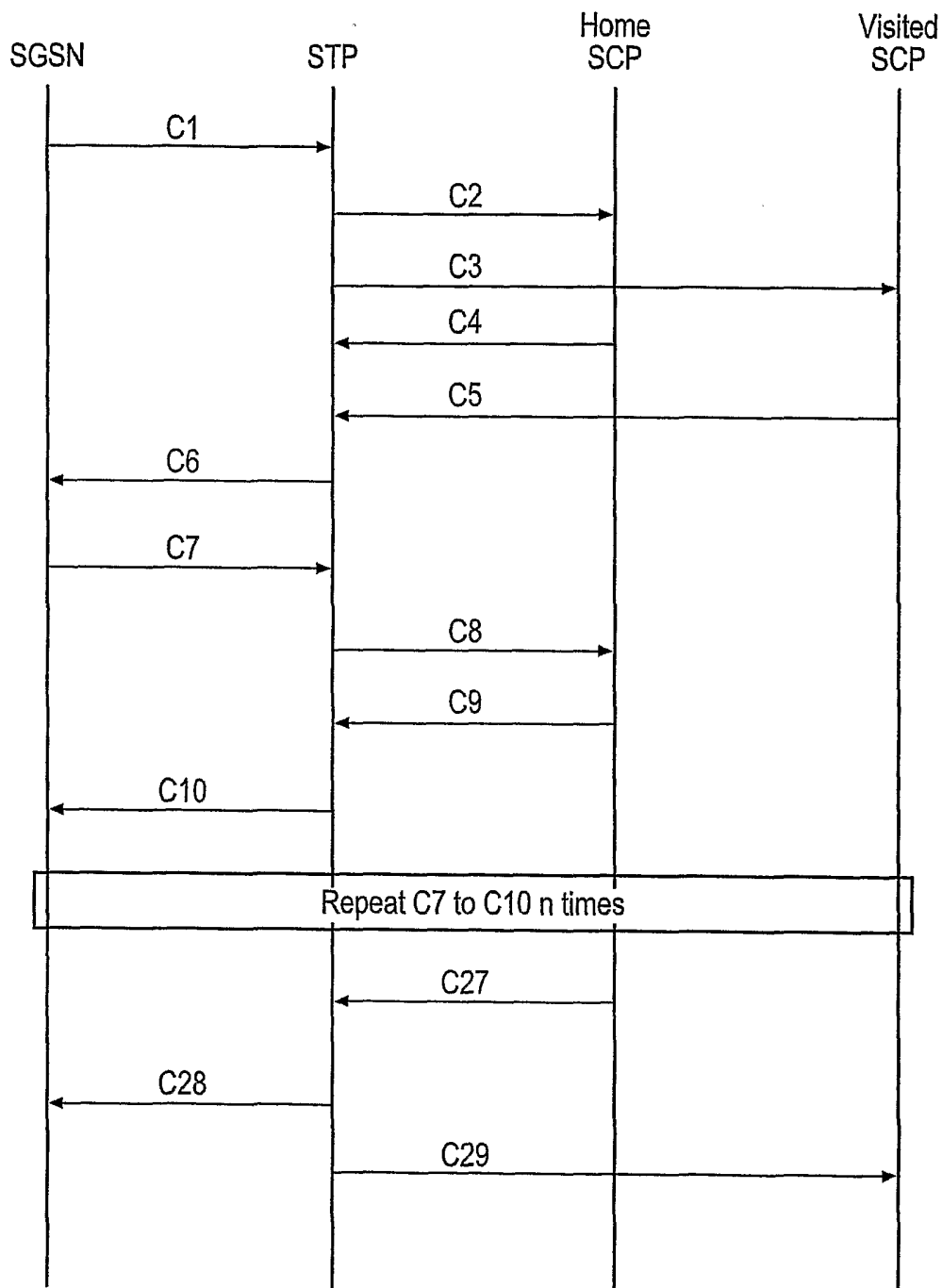


Fig. 7

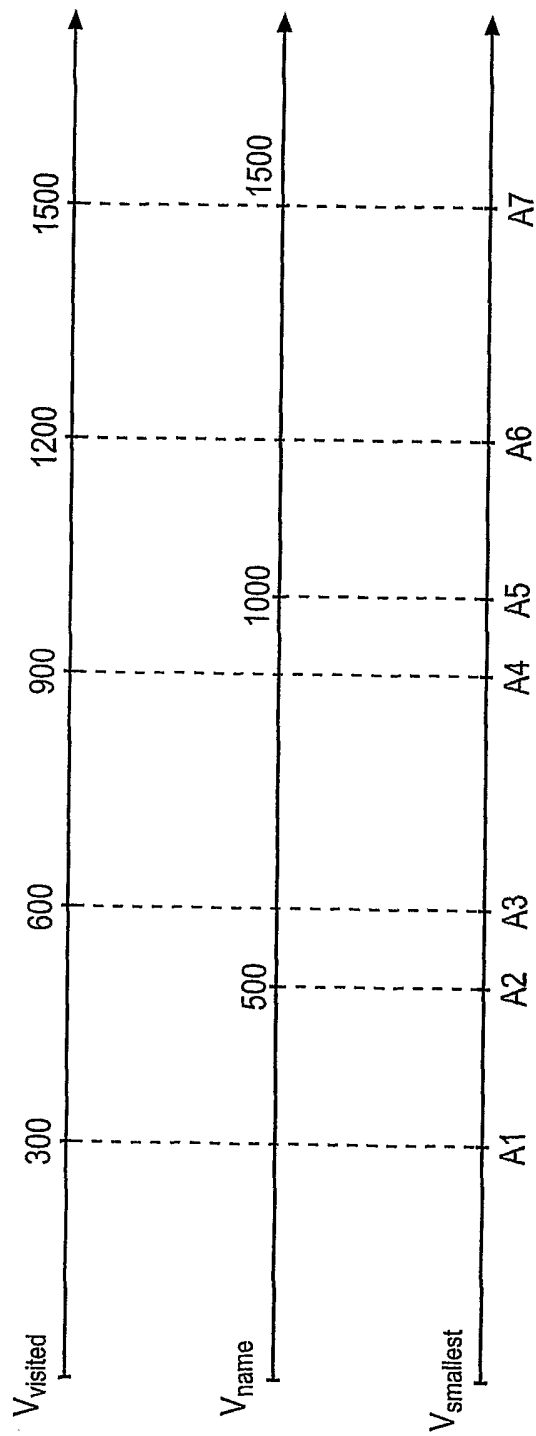


Fig. 8