Title: A METHOD AND APPARATUS FOR PROVIDING LOCAL BREAKOUT IN A MOBILE NETWORK

Abstract: A method of providing local breakout from a local network for a user equipment associated with a home network, which is located at the local network; wherein communication between the home and local networks includes information signalling between the home and local networks characterised in that the method comprises the steps of: • identifying a possibility of carrying out a first local breakout in relation to the communication of a specific type; • communicating the rules for the local breakout at the local network from the home network by means of an extension of the information signalling; • effecting local breakout from the local network for the user equipment based on the rules defined by the home network.
Title: A method and apparatus for providing local breakout in a mobile network.

Description

Field of the invention

This invention relates to a method and apparatus for providing local breakout in a mobile network, particularly but not exclusively a network which also includes an IP multimedia system (IMS).

Background of the invention

In a mobile network it is not uncommon for a user to wish to operate at a home location and maybe one or more other locations. That is to say a user may be roaming to another operator's network. Generally in this situation the media routing occurs as is shown in figure 1. Figure 1 shows a home domain 100 and a visited domain 102. If the user equipment 104 is located in a visited domain any media is routed through the visited domain gateway 106 to the home domain gateway 108 before it is passed to the network node 110 for onward transmission or as the ultimate destination.

The provision of local breakout is not typically deployed in most mobile networks, although a number of proposals of how this may be carried out, have been made with respect to the 3GPP standards. Figure 2 shows a proposal of approaching local breakout using the network address translator (NAT) function 200 in the visited network gateway 106. This NAT would be applied to any local breakout traffic and map the home address of the user to and/or from a local address in the visited public land mobile network (VPLMN). The NAT would be placed at an anchor node in the visited network and be under the control of the home operator such that the home public land mobile network (HPLMN) remains in control of which traffic flows are allowed to go locally or otherwise. The result of this is the requirement to have a control interface between the HPLMN and VPLMN which can specify the traffic which should go through the home gateway 108 and that which should not go through the home network gateway 108.
The type of control interface for controlling the decision in the VPLMN is not specified, however the 3GPP standards suggest one possible solution: the use of a policy and charging rules function (PCRF) by specifying a PCRF to PCRF roaming interface. This type of implementation is not yet specified and would require complex development to achieve a workable system, although a proposed example of such a system is shown schematically in figure 3.

One object of the present invention is to provide a means of local breakout, which overcomes at least some of the problems associated with the prior art.

Summary of the invention

According to one aspect of the present invention there is provided a method of providing local breakout from a local network for a user equipment associated with a home network, which is located at the local network; wherein communication between the home and local networks includes information signalling between the home and local networks characterised in that the method comprises the steps of: identifying a possibility of carrying out a first local breakout in relation to the communication of a specific type; communicating the rules for the local breakout at the local network from the home network by means of an extension of the information signalling; and effecting local breakout from the local network for the user equipment based on the rules defined by the home network.

According to a second aspect of the present invention, there is provided a local gateway for allowing local break out for a user equipment associated with home network, the local gateway comprising a control module for recognising the possibility of carrying out a local breakout in relation to a communication of a specific type; and communicating this possibility to the home network; a receiver for receiving rules for local breakout form the home network in the form of information signalling and a switch for switching traffic to local breakout in accordance with the rules.

According to a third aspect of the present invention, there is provided a home gateway for generating rules by which a local network can effect local break out or a user equipment associated with a home network, the home gateway comprising:
a control module for receiving a communication indicating the ability to effect local breakout from the local network in information signalling between the home and local gateway, wherein the control module generates a set of rules for local breakout and communicates the same with the local network, so as to permit local breakout at the local network.

This invention has the advantage that it is possible to adopt a system and network which permits local breakout and that overcomes many of the problems of the prior art. The invention requires very little changes to currently existing systems, which ensures that the invention can be adopted with minimal expense.

**Brief description of the drawings**

Reference will now be made by way of example, to the accompanying drawings, in which:

Figure 1 is a schematic diagram of the basic concept of roaming associated with the prior art;

Figure 2 is a schematic diagram of a prior art NAT-based local breakout;

Figure 3 is a schematic diagram of NAT controlled system using a PCRF to PCRF interface;

Figure 4 is a schematic diagram of the basic concept of local breakout according to the present invention;

Figure 5 is a more detailed diagram of NAT control as an extension of the PDP context signalling in accordance with the present invention;

Figure 6 is the signalling diagram of a primary PDP context activation in accordance with the present invention;

Figure 7 is the signalling diagram of a terminal initiated secondary PDP context activation in accordance with the present invention;

Figure 8 is a signalling diagram of a network initiated secondary PDP first context activation in accordance with the present invention;

Figure 9 is a signalling diagram of a network initiated secondary PDP second context activation in accordance with the present invention;
Figure 10 is a signalling diagram of a VPLMN initiated secondary first alternative PDP context set up in accordance with the present invention;

Figure 11 is a signalling diagram of a VPLMN initiated secondary second alternative PDP context to set up in accordance with the present invention.

**Detailed description of the preferred embodiments**

Referring to figure 4 the basic concept of local breakout in accordance with the present invention is demonstrated. Figure 4 shows a home network 400, a visited (or local) network 402 at which a user equipment (UE) 404 is located. The home network and the local network include gateways 408 and 406 respectively. The UE 404 communicates with node 410, which can be located anywhere. In accordance with the present invention any media to or from the user 404 may be routed to the node 410 directly as shown by line 412 (local breakout, IP@local), rather than the home tunnelling route shown by line 414 (home tunnelling, IP@home). The user is said to be roaming when not located at the home network of the user. IP@local and IP@home are abbreviations for indicating that an IP address would be allocated at the local or home gateway, respectively.

It should be noted that the invention is described with respect to uplink traffic, but the invention may equally apply to downlink traffic as will be clear to the person skilled in the art.

The invention relates to a mobile network, for example a GPRS core network or any other type of network where roaming and/or local breakout are envisaged. Local breakout is used in this specification to refer to traffic which is not routed through the home network, but instead is routed in a different way. The control and management of this different routing will remain with the home network.

The manner in which the invention is achieved is explained in greater detail with respect to figure 5. This shows a home network 500 and visited (or local) network 502. The home network includes a gateway 504 connected to the packet data network 506. The local network includes a gateway 508 connected to a packet data network 510. A user terminal 512 is shown located at the current time at the local network. Depending on the nature of the terminal media from the terminal, data is passed to the local gateway 508 via any appropriate means. For
example this may be via a GSM/EDGE radio access network (GERAN) 514 or a UMTS terrestrial radio access network (UTRAN) 516. For either of these radio access networks traffic is passed through a serving GPRS support node (SGSN) 518. In an alternative e.g., an Evolved UTRAN 520 may be connected to the local gateway 508 without passing through an SGSN. The local core gateway 508 includes NAT control 522 for facilitating local breakout using an extension of a PDP context signalling without requiring a PCRF to PCRF interface. This has the effect of reducing the complexity of realising local breakout as will be described below.

There are a number of considerations that need to be made in order to implement the present invention and implement local breakout. The considerations include the following:

- Indication of the local breakout capability between gateways, terminals and networks;
- Determination of which traffic should go locally and which should not;
- Determining whether mixed traffic is allowed or not in a single PDP context
- Determining whether the VPLMN or the HPLMN select the local address required;
- Determination of the PDP context activation procedures;
- Determination of the PDP context setup by VPLMN request;
- The provision of a policy and charging rules function to the VPLMN gateway depending on the type of control previously determined.

For ease of understanding each of the above considerations will be considered in turn.

**Indication of the local breakout capability between gateways, terminals and networks.**

When a user is located within a local network (also known as the visited public land mobile network (VPLMN)), determination is necessary to indicate whether the local network is capable of providing local breakout to the home
network (also known as the home public land mobile network (HPLMN)). This
determination can be made in a number of different ways. The local breakout
capability can be agreed as part of roaming agreement between the local and
home operators or networks. In this circumstance, the identification of the operator
of the user will be used to determine whether there is an agreement for the
provision of local breakout. The identification may be made by means of a list of
home operators with which the local operator has an agreement, for example.

The local breakout capability can be signalled as part of the attachment or
authentication procedure from the local network to the home network when the
user terminal attaches to the local network. The local breakout capability will be
signalled, possibly along with other capabilities, as a bit or bits in a predetermined
part of the attachment signalling. For example, in the existing GPRS attachment
procedure, the Update Location signal may be used to signal local breakout
capability.

The local breakout capability can be signalled in the packet data protocol
(PDP) context request message that is sent from the VPLMN to the HPLMN by
adding a new field to a possibly evolved/extended Create PDP Context Request
message. The packet data protocol context will depend on the format of the data
packet in question. If any other interfaces exist between the local and home
networks the local breakout capability can be indicated in any of these types of
communication. For example once PCRF-PCRF roaming interface is
implemented the local breakout capability may be indicated therein although this is
not necessary for realisation of the invention.

The indication of local breakout capability need not be merely yes or no, but
could be dependent on other criteria, for example, on the subscriptions of the user
or users packet data type or whatever. In other words, for certain types of packets
local breakout may be permitted but for others it may not. In the event that the
HPLMN does not receive any indication of local breakout capability from the
VPLMN the HPLMN can assume that there is no such capability at the VPLMN
and operate in an appropriate manner.
The examples of determination of local breakout capability are just examples and other means of communicating the capability from the VPLMN to the HPLMN are equally as relevant to the present invention as those described above.

**Determination of which traffic should go locally and which should not**

As indicated above not all traffic should always be part of local breakout traffic. This decision should come from the home network, taking into account e.g. whether policy and charging control is preferred in the home network or not.

A local breakout selection criterion is used by the VPLMN gateway for a given PDP context. If there is no local breakout selection criteria available then all traffic would be transported as defined by existing GPRS (General Packet Radio Service) protocols, e.g., all the traffic will be processed via the home network in accordance with currently accepted techniques.

The PDP context may contain a single bit which may be read at the gateway to determine whether the gateway should break out the traffic locally or should transmit the traffic to the home network. This single bit may be referred to as the home/local breakout selector bit and will be part of the PDP context in the local gateway.

In a further embodiment a set of packet filters (not shown) may be provided to determine which media should be broken out locally and which should be transmitted via the home network. The TFT (Traffic Flow Template) format used for PDP context can be reused for specifying local breakout filters. The home network will construct the filtering rules for determining which packets are broken out locally and which are not. It should be noted that the home network may not know the local address used by the NAT at this stage. If this is the case the home network can use e.g., a predetermined character in the filtering rules which gives the local networks a possibility to replace this predetermined character with the correct local IP address which can be generated by the local network.

In this situation where a secondary PDP context activation occurs with the same user, i.e. another call or communication using the same IP address by the same user in the local network, the local network may use the rules already
defined for the first PDP context activation. That is to say the IP address of the same user has been activated for a local breakout under a specific PDP context.

The local gateway can use any combination of the various different selection rules indicated above, either individually or by using more than one of the rules. This provides a very flexible means of determining the type of traffic, which can be enabled for local breakout for individual users. It is possible to specify local breakout filters for each primary PDP context activation and then use the same filters, without needing to specify them again at any subsequent secondary PDP context activation. It is possible to specify at a primary PDP context activation that all traffic should be transmitted via the home network. This can be updated at a later time by specifying a different local breakout filter for each secondary PDP context activation. A further possibility is to specify the local breakout filters at primary PDP context activation and to activate a secondary PDP context for all traffic which is local, overriding the filter for the primary PDP context.

Determining whether mixed traffic is allowed or not in a single PDP context

Another consideration that must be taken into account is whether or not both home tunnelling and local breakout traffic can occur in a single PDP context. The idea of allowing both home tunnelling and local breakout traffic is referred to as "mixed traffic". Basically there are two possibilities in respect of mixed traffic: allowing it or not allowing it.

One embodiment of the present invention provides that mixed traffic is disallowed. Traffic in a single PDP context can be either tunnelled to the home network or be subject to local breakout, but cannot be subject to both. If no mixed traffic is to be allowed a single bit is sufficient to indicate to the gateway how the specific PDP context should be handled. In this case it is not necessary to use local breakout filters as described above. The single bit indicates to the gateway that the traffic must be either tunnelled to the home network or broken out locally. The bit could be part of the PDP context, stored in the gateway. In the case of uplink traffic, home traffic is tunnelled to the home gateway, and in the case of local traffic this may be for example ,,NAT-ed". There are a number of advantages in disallowing mixed traffic in a single PDP context, including the fact that there is
a requirement for less additional parameters (i.e. no local breakout filters are required) and less modification to the existing PDP context signalling is required. On the other hand, this may lead to a greater number of PDP contexts being required, which may impact resources in the terminal and network nodes.

If a terminal is not adapted to handle secondary PDP context activations it would not be possible for these terminals to take advantage, in this embodiment, of local breakout. In this embodiment there is no mixed traffic in one PDP context, but there is traffic into different secondary PDP context depending on whether it is local or home traffic. So it is important that the terminal supports secondary PDP context activation.

In another embodiment of the invention mixed traffic may be allowed. In this situation, both tunnelling to the home network and local breakout is possible for a single PDP context. This is a more general approach than disallowing mixed traffic but requires additional functionality. In the first instance it is necessary to specify the local breakout filters mentioned above. In addition, separate quality of service (QoS) parameters may be applied to tunnelling to the home network than would be the case for the local breakout traffic. The individual quality of service parameters for each may not be completely independent, as generally the media has to be transmitted by the wireless operator irrespective of which route is chosen. However, the bit rate parameters of each may be different.

From a Quality of Service point of view, the sum of the tunnelling to the home network and local breakout traffic is what is relevant to both the terminal and the gateway in the local network. As a consequence of this if a network initiated PDP context setup is started, the home network gateway should not only specify the overall quality of service parameters for the PDP context but also the bit rate parameters that apply to the local breakout traffic or the tunnelling to the home network. This is due to the fact that the total bit rate is equal to the sum of the home tunnelling bit rate and the local breakout bit rate. Accordingly it is only necessary for the home gateway to specify one of the individual bit rates, either home tunnelling or local breakout. As the total bit rate is known, the other one of the two individual bit rates can be calculated.
In the case of a terminal initiated PDP context setup it is the terminal which will specify the quality of service parameters. The home gateway determines the bit rate for the local breakout traffic and supplies it to the local gateway.

**Determining whether the VPLMN or HPLMN select the local address required**

In order for a local breakout to occur a local address has to be selected so that the NAT in the local network can map the PDP address of the terminal (or terminals) to and from the local address (or addresses). This local address can be selected either by the local network or by the home network. In each case a different functionality is required. It is expected that the typical way in which the local address will be selected is by local network rather than the home network although the invention is not limited to this.

In the case where the home network selects the local address, additional configuration parameters are required to indicate the available local addresses which may be used. This could form part of a roaming agreement or may be implemented in other ways. Address selection by the home network could be based on an alignment with fixed network architectures, where master slave relationship exists between the SIP server and the media server. In fixed networks, a SIP server node assigns the address and notifies the media gateway about the selection. This may result in address allocation in the home network. In one embodiment of the invention the home network selects the local address by means of signalling in the PDP context signalling from the home to local network.

If the local network selects the local address, this will be determined based on local rules. The local network may notify the home network of the chosen address, although this is optional.

In a further embodiment of the present invention, there are circumstances where the NAT carries out port translation functions (NAPT). If this is the case port translation parameters need to be provided as part of the PDP context activation procedures.
PDP context activation procedures

A number of different scenarios for PDP context activation procedure are described with respect to the signal diagrams in figures 6, 7, 8 and 9. In these diagrams the text in italics indicates the additional PDP context signalling provided by the present invention. It should be noted that not all the signalling between the user equipment, the local gateway and the home gateway are shown in the signalling diagrams, instead only those relevant to the explanations at that time are shown. Where an action is activated from the user equipment, the user equipment is making a call or trying to send something to a third party. Where the action is activated by a network (generally the home network) a third party is making a call or trying to send something to the user equipment.

Figure 6 shows the primary PDP context activation initiated by the user equipment (UE) 600 via the local and home networks 602 and 604 respectively. Primary PDP context activation is generally terminal initiated, although the network initiated primary PDP context activation may occur. The user equipment generates and activates a PDP context request, which is transmitted to the local gateway 606. It will be appreciated that at other means of local breakout indication may alternatively be used, as discussed above. The local gateway generates a create PDP context request that includes an indication that local breakout capability is permitted (illustrated by signal 608) in the local network. The indication may include details relating to the type of traffic which can become local breakout traffic, details of address selection, information relating to mixed traffic, packet filters, NAT configuration data or any other appropriate or relevant information. The home gateway responds to the create PDP contexts with a local breakout request 610. The local gateway can then activate the PDP context accept signal which is transmitted to the user equipment 612. If either network is unable to respond to any message an error message or failure message may be sent between the gateways by means of the local breakout error handling box 614. An error may result in a resend of the request or reply, or any other type of request depending on the error type that is recognized by the appropriate gateway.

If a network initiated primary PDP context activation occurs, the signalling diagram of figures 6 would be modified as follows. The activate PDP context
request would e.g., be preceded by a network initiated signal to the terminal requesting the transmission of the activate PDP context request. The primary PDP context activation signal may be combined with attachment signalling. Attachment is a separate procedure that is performed before primary PDP context activation, however attachment and primary PDP context activation may be combined.

Figure 7 shows the signal diagram for a terminal initiated secondary PDP context activation. In figure 7, like elements are given the same reference numerals as in figure 6. The secondary PDP context activation is very similar to the primary PDP context activation with the exception that the request 608 and the response 610 may not include local breakout capability requests or responses, as these may have already been provided in the primary PDP context activation. Thus in this case the user equipment activates a secondary PDP context request 616, which causes the local network to generate a create PDP context request without necessarily indicating local breakout capability. The home gateway similarly responds by it providing a permission to create a PDP context response either with or without the local breakout permission as the case may be. The local gateway then activates the user equipment by means of a secondary PDP context response 618.

Figures 8 and 9 show two possible alternatives for the network initiated secondary PDP context activation.

The first alternative, as shown in figure 8, and is in accordance with the network initiated secondary PDP context activation in GPRS release 7. This is similar to the terminal initiated secondary PDP context activation and differs there from by the inclusion of an initiation of a PDP context activation 800 from the home gateway to the local gateway, which generates a request for PDP context activation 802 from the local gateway to the user equipment. In figure 8, like elements are shown by the same reference numerals as figure 6 and 7. As in figure 7, since this is a secondary activation, local breakout requests and responses may not be included if that is the chosen setup by the home and local networks.
The second alternative, shown in figure 9 is in accordance with the network initiated set up in the system architecture evolution (SAE) as disclosed in the 3GPP technical report 23.882. The signalling is started by the home gateway sending a create bearer request 900. It is transmitted to the local gateway and may include a local breakout request. The home gateway relies on the fact that an earlier primary PDP context activation message has indicated local breakout capability in the local network. The local gateway sends an activate bearer request 902 to the user equipment and the users equipment generates and activate bearer response 904 which is sent back the local gateway. The local gateway can then communicate a create bearer response 906 to the home gateway. The PDP context modification and the deactivation procedures may also be defined based on the activation procedures.

**Determination of the PDP context set up by VPLMN request**

It is generally the case, for a home IP address, the home gateway or the user terminal sets up a new PDP context. However for local breakout, the local gateway may wish to setup new local breakout traffic that would require a new PDP context set up or modification. This may be the case in a situation where the local network takes part of the service provisioning for example service specific nodes, such as P-CSCF, media gateway, etc. In order to achieve the network requested PDP context setup the local network may send a request to the home gateway asking for a secondary PDP context activation. In this way it is possible to start a new local breakout initiated by the local network but about which the home network is fully informed and in full control.

Signalling diagrams 10 and 11 show two alternatives of network initiated PDP context activations in this scenario. Referring to figure 10, the local gateway 602 generates a VPLMN requested PDP context activation 1000 to the home gateway. The home gateway initiates a PDP context activation 1002 which is sent back to the local network 602. The local network then requests PDP context activation 1004 from the user equipment. The user equipment can then activate a secondary PDP control request 1006 which causes the local gateway to generate a create PDP context request which may indicate local breakout capability 1008. The home gateway replies with a create PDP context response including a local
breakout request 1010. This causes the local gateway to send an activate
secondary PDP context response 1012 to the user equipment. In this way the
control of local breakout remains at the home network as the home network is not
required to accept the initial request of the local gateway. If this is the case and
the home network does not wish local breakout to occur a negative response may
also be sent to the local gateway.

Referring to figure 11 a second alternative of how the local network may
initiate secondary PDP context setup is shown. Again the local gateway
generates a VPLMN requested PDP context activation 1000 this causes the home
gateway to generate a create bearer request including the local breakout request
1002. The local gateway then generates an activate bearer request 1100 to the
user equipment which then responds with an activate bearer response 1102. The
local gateway then generates a create bearer response 1104 which is sent back to
the home gateway. Once again the home gateway is in control of any
determination as to whether or not a local breakout should be allowed.

The provision of policy and charging rules to the VPLMN gateway
depending on the type of control previously determined.

In the case of home tunnelling traffic it is clear that the home operator or
network via the home gateway is in a position to apply policy and charging
functions e.g., according to 3GPP TS 23.203. However local breakout traffic may
bypass the policy and charging enforcement point in the home gateway. For this
reason the home network may require that policy and/or charging rules are applied
to the local breakout traffic as would be the case for the home tunnelling traffic. To
achieve this policy and charging rules could be provided as further optional
extensions to the PDP context setup signalling from their home network to the
local network. In other words, policy and charging rules could be communicated
alongside local breakout filters that specify which traffic is permitted to go locally.
One example of a simple policy rule would be to perform bandwidth policing of the
traffic in the local gateway. Alternatively marking or remarking packets based on
packet filtering and bandwidth parameters may also be used. The policy and
charging rules can be based on a subset of those specified over the Gx interface
and could be attached to the PDP context messages.
PDP is a term which indicates the type of packet data protocol which applies for a specific type of communication that may be instigated by a terminal or gateway. In other words this is an indication of the various protocols supported by the terminal, the network or both. PDP context signalling refers to the control signalling that is present between the two gateways.

The example shown in this invention is in relation to IMS, although it will be appreciated that this invention may apply also to I-WLAN. In this case a TTG node is used to achieve the dynamic configuration of a NAT function to achieve local breakout. In this case the PDP context signalling is extended such that the signalling goes between the TTG and a gateway in the network of the operator.

It should be noted that the invention described above may be utilised in a number of environments, for example for a large operator in the country for example or between national companies of the same operator that have a close relationship. Although, these are merely examples and many other possibilities may arise. It should also be noted that while this invention has been described with respect to 3GPP, it may also apply to other wireless communications standards. The present invention allows local breakout to be realised without the extra complexity of standardisation, implementation or the deployment of special interfaces. The PCRF-PCRF type of interface is not required for the present invention. This will have a great advantage in providing local breakout in a simple, cost-effective and instantly available manner.
Claims

1. A method of providing local breakout from a local network for a user equipment associated with a home network, which is located at the local network; wherein communication between the home and local networks includes information signalling between the home and local networks characterised in that the method comprises the steps of:
   - identifying a possibility of carrying out a first local breakout in relation to the communication of a specific type;
   - communicating the rules for the local breakout at the local network from the home network by means of an extension of the information signalling;
   - effecting local breakout from the local network for the user equipment based on the rules defined by the home network.

2. The method as claimed in claim 1, further comprising communicating packet data protocol (PDP) context signalling as the information signalling.

3. A method as claimed in claim 1 or 2, further comprising using the previously established rules associated with the local breakout in relation to a subsequent local breakout of the same specific type.

4. A method as claimed in any preceding claim, wherein the step of identifying further comprises identifying a possibility of carrying out a first local breakout in relation to the communication of a specific PDP context.

5. A method as claimed in any preceding claim, further comprising processing at least some of the information by means of a network address translator (NAT) at the local gateway.

6. A method as claimed in any preceding claim, further comprising assigning a local breakout address at the local network for any local breakout traffic.
7. A method as claimed in any preceding claim, further comprising defining the rules for any local breakout at the local network.

8. A method as claimed in claim 7, wherein the step of defining the rules comprises indicating the local breakout capability at the local network.

9. A method as claimed in claim 7 or claim 8, wherein the step of defining the rules comprises determining which traffic should be subjected to local breakout and which should not.

10. A method as claimed in any of claims 7 to 9, wherein the step of defining the rules comprises determining which type of traffic can be subjected to both local breakout and home network tunnelling.

11. A method as claimed in any one of claims 7 to 10, wherein the step of defining the rules comprises determining the local address for the user equipment during local breakout.

12. A method as claimed in any one of claims 7 to 11, wherein the step of defining the rules comprises determining policy and charging rules for the local gateway.

13. A local gateway for allowing local breakout for a user equipment associated with home network, the local gateway comprising

   - a control module for recognising the possibility of carrying out a local breakout in relation to a communication of a specific type; and communicating this possibility to the home network;

   - a receiver for receiving rules for local breakout form the home network in the form of information signalling

   - a switch for switching traffic to local breakout in accordance with the rules

14. A home gateway for generating rules by which a local network can effect local breakout or a user equipment associated with a home network, the home gateway comprising: a control module for receiving a communication indicating
the ability to effect local breakout from the local network in information signalling between the home and local gateway, wherein the control module generates a set of rules for local breakout and communicates the same with the local network, so as to permit local breakout at the local network.

15. The gateway of claim 13 or claim 14, wherein the information signalling comprises PDP context signalling.

16. A network including a gateway as claimed in any one of claims 13 to 15.

17. A system including one or more networks as claimed in claim 16.

18. A computer program comprising instructions for carrying out the steps of the method according to any one of claims 1 to 12 when said computer program is executed on a computer.
Local breakout, IP @ at visited

Home tunneling, IP @ at home

Can be located anywhere

Local domain

Corr Node

GW

Fig. 4
Activate secondary PDP ctx request

Create PDP context request

Indicate LBO capability

Create PDP context response

LBO request

LBO error handling

Activate secondary PDP context response

Fig. 7
Fig. 8

1. Home GW
2. Local GW
3. UE
4. 600: Request PDP context activation
5. 602: Request PDP context req
6. 604: Activate secondary PDP context
7. 608: Create PDP context request
8. 610: Create PDP context response
9. 614: LBO error handling
10. 800: Initiate PDP context activation
11. 802: Activate secondary PDP context resp
12. 700: LBO request
13. 702: Indicate LBO capability
A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L29/06

According to International Patent Classification (IPC) or both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
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<tbody>
<tr>
<td>A</td>
<td>WO 2004/010669 A (NOKIA CORP [FI]; 6REIS MARC [US]; FACCI STEFANO M [US]) 29 January 2004 (2004-01-29) claim 13; figure 1</td>
<td>1,5-9, 11-14, 16-18</td>
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Date of the actual completion of the international search: 20 December 2007
Date of mailing of the international search report: 03/01/2008

Authorized officer: Farese, Luca
### 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. [X] 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.
- [X] 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.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-18
   
   1.1. claims: 1,2,5-9,11-18
       
       PDP extension
   
   1.2. claim: 3
       
       use of previous rules
   
   1.3. claim: 4
       
       PDP triggering
   
   1.4. claim: 10
       
       mixed traffic
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<td>US 2004208153 A1</td>
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