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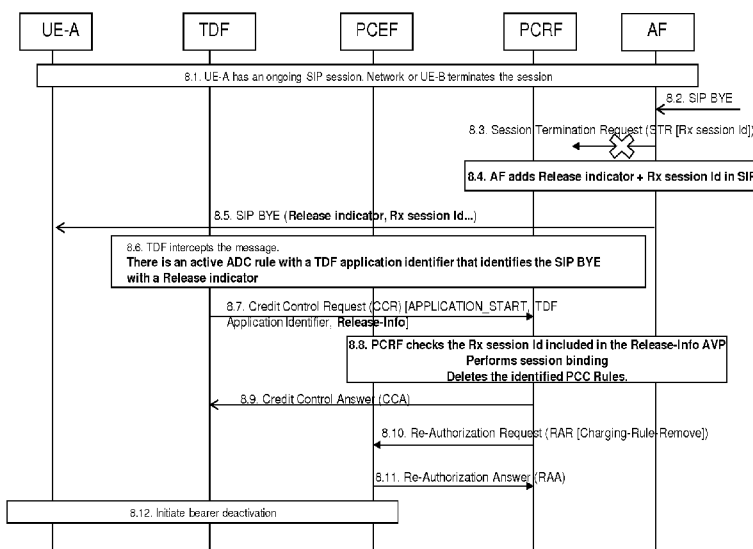


Fig. 8

(57) Abstract: Methods and apparatus for use in a telecommunications network (100) and configured to intercept messages during a telecommunications session. One or more further sessions are associated with the telecommunications session. The methods and apparatus relate to a traffic interceptor (514; 614) configured to intercept one or more messages during the telecommunications session. A traffic inspector (516; 616) is configured to determine that a message, amongst the intercepted one or more messages, comprises a release indicator specifying that a further session, amongst the one or more further sessions, is to be terminated. A release reporter (518; 618) is configured to control a transmitter (502; 602) to transmit a release message to a Policy and Charging Rules Function (106, 700), PCRF, the release message comprising data indicating that the further session is to be terminated. The PCRF comprises a receiver (704) configured to receive the release message and a session controller (716) configured to terminate the further session.

METHODS, APPARATUSES AND COMPUTER PROGRAMS FOR SESSION RELEASE IN RX INTERFACE

Technical field

5 The invention relates to telecommunications networks. More specifically, the invention relates to, but is not limited to, Third Generation Partnership Protocol telecommunications networks and/or methods and apparatus for termination of sessions and/or release of network resources in a telecommunications session.

10 Background

Figure 1a shows a block schematic diagram of the Evolved Packet Core (EPC) architecture. The EPC architecture is defined in Third Generation Partnership Project (3GPP) TS 23.401 and that document provides definitions of the Packet Data
15 Network (PDN) Gateway (PGW) 102, Serving Gateway (SGW) 104, Policy and Charging Rules Function (PCRF) 106, Mobility Management Entity (MME) 108 and User Equipment (UE) 110. A Long Term Evolution (LTE) radio access, the Evolved Universal Terrestrial Radio Access Network (E-UTRAN) 112, consists of one or more E-UTRAN Node B (eNBs) that are not shown in Figure 1a. Further, the operator's IP
20 services 113 comprises an IP Multimedia Subsystem (IMS), as described in 3GPP TS 23.228.

In the architecture of Figure 1a, the radio interface is specified by 3GPP, e.g. LTE. On a 3GPP access, the bearer is end-to-end between the UE 110 and the PGW 102.
25 The bearer ID is known by the PGW 102, the MME 108, the eNB (in the E-UTRAN 112) and the UE 110. Every PDN connection has at least one bearer and this bearer is called the default bearer. All additional bearers on the PDN connection are called dedicated bearers.

30 The architecture that supports Policy and Charging Control (PCC) functionality is shown in Figure 1b. This figure shows some elements that are also shown in Figure 1a and is taken from 3GPP TS 23.203, which specifies the PCC functionality for the Evolved 3GPP Packet Switched domain, including both 3GPP accesses and Non-3GPP accesses.

The PCRF 106 is a functional element that encompasses policy control decisions and flow based charging control functionalities. The PCRF 106 provides network control regarding the service data flow detection, gating, quality of service (QoS) and flow based charging (except credit management) towards a PCEF 114. The PCRF 106 receives session and media related information from an AF 116 and informs the AF 116 of traffic plane events.

The PCRF 106 typically informs the PCEF 114 through the use of PCC rules on the treatment of each service data flow that is under PCC control, in accordance with PCRF policy decisions.

The PCEF 114 encompasses service data flow detection (based on the filter definitions included in the PCC rules), as well as online and offline charging interactions (not described here) and policy enforcement. Since the PCEF 114 is the function in the architecture handling the bearers, the QoS is enforced there for a bearer according to the QoS information transmitted by the PCRF 106.

3GPP Release 11 has introduced a new entity in the PCC Architecture, the Traffic Detection Function (TDF) 120. The TDF 120 is a Deep Packet Inspection (DPI) function that monitors the payload of packets and can detect when an application is initiated/terminated by intercepting data transmitted by the AF 116. This functionality can also reside in the PCEF 114.

The TDF 120 can perform solicited and unsolicited application reporting. For the solicited case, the PCRF 106 instructs the TDF 120 on which applications to detect and report to the PCRF 106 by transmitting to the TDF 120 the appropriate Application Detection and Control (ADC) rules. The PCRF 106 may instruct the TDF 120 (or PCEF 114) on what enforcement actions to apply for the detected application traffic by way of the ADC rules.

The PCRF 106 typically provisions PCC Rules to the PCEF 114 via a Gx reference point in a Gx session and may provision ADC rules to the TDF 120 via a Sd reference point in an Sd session and QoS Rules to a BBERF 118 via a Gxx reference point in a Gxx session (for deployments based on Proxy Mobile Internet Protocol (PMIP) / Dual Stack Mobile Internet Protocol (DSMIP) protocol in the core network). In particular,

where the TDF is included in the PCEF, the ADC rule contents are included in the PCC rule.

5 The AF 116 is an element offering applications in which a service is delivered in a different layer (e.g. transport layer) from the layer in which the service has been requested (e.g. signalling layer). The AF 116 may be configured as a Proxy Call Session Control Function (P-CSCF) of an Internet Protocol (IP) Multimedia Core Network (IM CN) subsystem. The AF 116 may communicate with the PCRF 106 to transfer dynamic session information (i.e. description of the media to be delivered in
10 the transport layer). This communication is performed over the Rx interface in an Rx session.

The IM CN subsystem enables Public Land Mobile Network (PLMN) operators to offer their subscribers multimedia services based on and built upon Internet applications,
15 services and protocols. The complete solution for the support of IP Multimedia Subsystem (IMS) applications comprises terminals, IP-Connectivity Access Networks (IP-CAN), and specific functional elements of the IM CN subsystem as shown in 3GPP TS 23.228, figure 4.0. An example of IP-CAN is the Evolved Packet System (EPS) core network with Global System for Mobile Communications (GSM), Enhanced Data
20 Rates for GSM Evolution (EDGE), Radio Access Network (GERAN), Universal Terrestrial Radio Access Network (UTRAN) or E-UTRAN radio access networks.

The IMS utilizes the IP-CAN to transport multimedia signalling and bearer traffic.

25 The P-CSCF in the IMS Architecture (shown as AF 116 in Figure 1b) interacts with the PCRF 106 in the EPC network (Figure 1a) to guarantee QoS requirements associated with an IM CN subsystem session. In the same way, the P-CSCF will reserve the resources at IMS session creation and release the reserved resources when an IMS session is terminated. Typically, the P-CSCF is provided at the AF 116 and the
30 reservation and release of resources is done over the Rx interface, i.e. Rx reference point.

When an IMS Session is terminated, the bearers associated to that particular session are released or modified at the same time as the particular Session Initiation Protocol

(SIP) session. Reserved resources in the network are released allowing proper billing related to that service.

5 IMS session termination can occur when the end user requests the termination of the session, when for some reason the operator or network decides to terminate the session, when there is a loss of bearer for the media or IMS signalling or when the radio connection is lost, i.e. transport connectivity is lost.

10 Figure 2 shows an exemplary case where the UE initiates session termination. Steps 2.4 (originating side) and 2.10 (terminating side) refer to the interactions with the IP-CAN network. In those steps, the PCRF 106 is contacted in order to release the network resources reserved during the establishment of the session.

15 Figure 3 shows operations undertaken in steps 2.4 and 2.10 of Figure 2 in more detail. When the AF/P-CSCF 116 is informed about an IMS session termination for a certain UE 110, it contacts, at step 3.2, a Home PCRF (H-PCRF) 106 by means of a Diameter Session Termination Request (STR) command. The H-PCRF 106 then identifies, at step 3.3, the IP-CAN session for the UE 110 and IP address and obtains the PCC rules related to the session. At step 3.5, the H-PCRF 106 removes those
20 PCC Rules from the PCEF 114 and the PCEF 114 modifies/terminates the corresponding bearer in order to release those network resources.

As discussed above, when the UE 110 or the network 100 decides to terminate an IMS session, the network resources in the IP-CAN network should be released according to
25 the procedures described above.

When for some reason the transport connectivity (in the Rx session) between the PCRF 106 and the AF/P-CSCF 116 is lost and the AF/P-CSCF 116 needs to terminate an Rx session because an associated IMS session is to be terminated, the related
30 network resources in the IP-CAN network cannot be released. This leads to “resource hanging” and means that the bearers where the service was previously running will still be established according to the QoS demands of that service. Those network resources are therefore taken up needlessly.

Resources are limited in the network and an optimized use of them is desirable for operators. It is also possible that according to license agreements the operators are charged by the number and duration of established bearers and thus they need to ensure that they are kept running only when required. As the owner of the resources the network operator wants to guarantee that the reserved resources correspond to the on-going services and that no fraudulent use of those resources is taking place.

The identified problem could be solved if the AF/P-CSCF 116 buffers the Rx messages relating to Rx session termination to be sent to the PCRF 106 until the transport connectivity (used for the Rx session) is recovered. This solution would not work when the network 100 initiates the termination procedure. That is, if upon a restart in the IMS network (e.g. restart of one or more Media Gateways (MGWs) or Border Gateway Function (BGFs)), the network triggers a flood of call releases, and the AF/P-CSCF 116 could not ensure the storage of all the remaining messages to be sent to the PCRF 106 for releasing the network resources. It consumes AF/P-CSCF 116 resources until the transport connectivity is recovered and reduces the AF/P-CSCF's 116 capacity to serve other access networks during this time. Similarly the capacity of packet core nodes is impacted during the loss of transport connectivity since the packet core nodes have to maintain the bearers even after the related IMS sessions are terminated. When the transport connectivity recovers, all the accumulated Rx sessions to be cleaned during that period would generate a flood of operations towards the PCRF 106 for which it may not be prepared. A toggling transport connectivity makes the problem much worse due to retransmissions and timeouts.

Without buffering the Rx messages in AF/P-CSCF 116, the network resources can be released by manually incrementing the AF/P-CSCF 116 Origin-State-Id Attribute Value Pair (AVP) that is sent to PCRF 106. That way the PCRF 106 can find out that the AF/P-CSCF 116 has lost the state related to those Rx sessions, but it will release all the other Rx sessions including the ones that are active (e.g. Rx sessions related to UE registrations) since Rx sessions with a lower Origin-State-Id will be considered as no longer active. Besides, such a method will only work when there is no diameter proxy in between, since the Origin-State-Id AVP is related to the host represented by the Origin-Host AVP. Thus when the loss of transport connectivity occurs between the diameter agent and the PCRF 106 or AF 116, this solution will not work.

Resource hanging could also be solved based on an inactivity timer in the packet core network (e.g. in the PCEF 114). However this requires that no traffic is being sent over the bearers relating to the session to be terminated. If the UE 110 is making fraudulent use of the service, it can continue sending media over those bearers and thus overloading the EPC and radio networks without being charged for the usage.

Since bearer release in the EPC is delayed in all of the above solutions, the session termination timestamps and network usage information in PCC charging and IMS charging will be different and hence additional measures for charging correlation need to be implemented.

Summary

Exemplary methods and apparatus are aimed at alleviating or solving one or more of the problems mentioned above or any other problem with the art.

According to the invention in a first aspect, there is provided a network node for use in a telecommunications network and configured to intercept messages during a telecommunications session. One or more further sessions are associated with the telecommunications session. The network node comprises a traffic intercepting means, such as a traffic interceptor, configured to intercept one or more messages during the telecommunications session. The network node further comprises a traffic inspecting means, such as a traffic inspector, configured to determine that a message, amongst the intercepted one or more messages, comprises a release indicator specifying that a further session, amongst the one or more further sessions, is to be terminated. The network node further comprises a release reporting means, such as a release reporter, configured to control a transmitter to transmit a release message to a Policy and Charging Rules Function, PCRF, the release message comprising data indicating that the further session is to be terminated.

Optionally, the network node further comprises a receiving means, such as a receiver, configured to receive, from the PCRF, an instruction to intercept the one or more messages with the release indicator specifying that the one or more further sessions are to be terminated.

Optionally, the one or more further sessions comprise an Rx session established between a Proxy Call Session Control Function, P-CSCF, and the PCRF, and wherein the release message comprises data identifying the Rx session.

- 5 Optionally, the network node is configured as one of a Policy and Charging Enforcement Function, PCEF, and a Traffic Detection Function, TDF, and the one or more further sessions comprise one of a Gx session and an Sd session respectively.

- 10 Optionally, the network node is configured as a PCEF and the receiver is configured to receive from the PCRF a Policy and Charging Control, PCC, rules message identifying one or more PCC rules for the interception of messages during the telecommunications session.

- 15 Optionally, the receiver is configured to receive from the PCRF a PCC rules message identifying one or more PCC rules to be removed and the network node further comprises a rules remover configured to remove the identified PCC rules and a resource releaser configured to release network resources associated with the removed PCC rules.

- 20 Optionally, the network node is configured as a TDF and the receiver is configured to receive from the PCRF an Application Detection and Control, ADC, rules message identifying one or more ADC rules for the interception of messages during the telecommunications session.

- 25 According to the invention in another aspect, there is provided a method for use in a network node for use in a telecommunications network and configured to intercept messages during a telecommunications session. One or more further sessions are associated with the telecommunications session. The method comprises intercepting, by a traffic interceptor, one or more messages during the telecommunications session.

- 30 The method comprises determining, by a traffic inspector, that a message, amongst the intercepted one or more messages, comprises a release indicator specifying that a further session, amongst the one or more further sessions, is to be terminated. The method comprises controlling, by a release reporter, a transmitter to transmit a release message to a Policy and Charging Rules Function, PCRF, the release message comprising data indicating that the further session is to be terminated.
- 35

Optionally, the method comprises receiving from the PCRF, by a receiver, an instruction to intercept the one or more messages with the release indicator specifying that the one or more further sessions are to be terminated.

5

Optionally, the one or more further sessions comprise an Rx session established between a Proxy Call Session Control Function, P-CSCF, and the PCRF, and the release message comprises data identifying the Rx session.

10 Optionally, the network node is configured as one of a Policy and Charging Enforcement Function, PCEF, and a Traffic Detection Function, TDF, and the one or more further sessions comprise one of a Gx session and an Sd session respectively.

15 Optionally, the network node is configured as a PCEF, and the method further comprises receiving, by the receiver and from the PCRF, a Policy and Charging Control, PCC, rules message identifying one or more PCC rules for the interception of messages during the telecommunications session.

20 Optionally, the method further comprises receiving, by the receiver and from the PCRF, a PCC rules message identifying one or more PCC rules to be removed; removing, by a rules remover, the identified PCC rules; and releasing, by a resource releaser, network resources associated with the removed PCC rules.

25 Optionally, the network node is configured as a TDF, and the method further comprises receiving, by the receiver and from the PCRF, an Application Detection and Control, ADC, rules message identifying one or more ADC rules for the interception of messages during the telecommunications session.

30 According to the invention in another aspect, there is provided a computer program comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out any method set out above.

35 According to the invention in another aspect, there is provided a carrier containing the computer program above, wherein the carrier is one of an electronic signal, optical signal, radio signal, or non-transitory computer readable storage medium.

According to the invention in another aspect, there is provided a network node for use in a telecommunications network as a Policy and Charging Rules Function, PCRF, during a telecommunications session. One or more further sessions are associated with the telecommunications session. The network node comprises a receiving means, such as a receiver, configured to receive, from a further node configured to intercept one or more messages during the telecommunications session, a release message comprising data indicating that a further session, amongst the one or more further sessions, is to be terminated. The network node comprises a session controlling means, such as a session controller, configured to terminate the further session.

Optionally, the network node further comprises a transmitting means, such as a transmitter, configured to transmit, to the further node, an instruction to intercept the one or more messages with a release indicator specifying that the one or more further sessions are to be terminated.

Optionally, the one or more further sessions comprise an Rx session established between a Proxy Call Session Control Function, P-CSCF, and the PCRF, and the release message comprises data indicating that the Rx session is to be terminated.

Optionally, the further node is configured as a Policy and Charging Enforcement Function, PCEF, wherein the one or more further sessions further comprise a Gx session between the PCEF and the PCRF, and the network node further comprises a session binder configured to bind the Rx session to the Gx session, and determine the Gx session based on the Rx session indicated in the release message.

Optionally, the network node further comprises a rules controlling means, such as a rules controller, configured to control a transmitter to transmit, to the PCEF, a Policy and Charging Control, PCC, rules message identifying one or more PCC rules for the interception of messages during the telecommunications session.

Optionally, the further node is configured as a Traffic Detection Function, TDF, wherein the one or more further sessions further comprise an Sd session between the TDF and the PCRF.

Optionally, the network node further comprises a rules controller configured to control a transmitter to transmit, to the TDF, an Application Detection and Control, ADC, rules message identifying one or more ADC rules for the interception of messages during the telecommunications session.

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According to another aspect of the invention there is provided a method for use in a network node for use in a telecommunications network as a Policy and Charging Rules Function, PCRF, during a telecommunications session. One or more further sessions are associated with the telecommunications session. The method comprises receiving,
10 by a receiver and from a further node configured to intercept messages during the telecommunications session, a release message comprising data indicating that a further session, amongst the one or more further sessions, is to be terminated. The method further comprises terminating, by a session controller, the further session.

15 Optionally, the method comprises transmitting, by a transmitter to the further node, an instruction to intercept the one or more messages with a release indicator specifying that the one or more further sessions are to be terminated.

20 Optionally, the one or more further sessions comprise an Rx session established between a Proxy Call Session Control Function, P-CSCF, and the PCRF, and the release message comprises data indicating that the Rx session is to be terminated.

25 Optionally, the further node is configured as a Policy and Charging Enforcement Function, PCEF, wherein the one or more further sessions further comprise a Gx session between the PCEF and the PCRF, and the method further comprises binding, by a session binder, the Rx session to the Gx session, and determining, by the session binder, the Gx session based on the Rx session indicated in the release message.

30 Optionally, the method further comprises controlling, by a rules controller, a transmitter to transmit, to the PCEF, a Policy and Charging Control, PCC, rules message identifying one or more PCC rules for the interception of messages during the telecommunications session.

Optionally, the further node is configured as a Traffic Detection Function, TDF, and wherein the one or more further sessions further comprise an Sd session between the TDF and the PCRF.

5 Optionally, the method further comprises controlling, by a rules controller, a transmitter to transmit, to the TDF, an Application Detection and Control, ADC, rules message identifying one or more ADC rules for the interception of messages during the telecommunications session.

10 According to the invention in another aspect, there is provided a computer program comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out any method described above.

15 According to the invention in another aspect, there is provided a carrier containing the computer program above, wherein the carrier is one of an electronic signal, optical signal, radio signal, or non-transitory computer readable storage medium.

20 According to the invention in another aspect, there is provided a network node for use in a telecommunications network as a Proxy Call Session Control Function, P-CSCF, during a telecommunications session. One or more further sessions are associated with the telecommunications session. The network node comprises a session identifier retrieving means, such as a session identifier retriever, configured to retrieve an identifier for a further session, amongst the one or more further sessions associated with the telecommunications session, to be terminated. The network node further
25 comprises a message building means, such as a message builder, configured to build a message comprising a release indicator and the retrieved identifier for the further session, and further configured to control a transmitter to transmit the built message to one or more further nodes in the telecommunications network.

30 Optionally, the one or more further sessions comprise an Rx session established between the P-CSCF and a Policy and Charging Rules Function, PCRF, the network node further comprising a transport session controller configured to determine that transport connectivity for the Rx session is not available.

According to the invention in another aspect, there is provided a method for use in a network node for use in a telecommunications network as a Proxy Call Session Control Function, P-CSCF, during a telecommunications session. One or more further sessions are associated with the telecommunications session. The method comprises
5 retrieving, by a session identifier retriever, an identifier for a further session, amongst the one or more further sessions associated with the telecommunications session, to be terminated. The method further comprises building, by a message builder, a message comprising a release indicator and the retrieved identifier for the further session, and controlling a transmitter, by the message builder, to transmit the built
10 message to one or more further nodes in the telecommunications network.

Optionally, the one or more further sessions comprise an Rx session established between the P-CSCF and a Policy and Charging Rules Function, PCRF, and the method further comprises determining, by a transport session controller, that
15 communication over the Rx session is not possible.

According to the invention in another aspect, there is provided a computer program comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out any method described above.
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According to the invention in another aspect, there is provided a carrier containing the computer program above, wherein the carrier is one of an electronic signal, optical signal, radio signal, or non-transitory computer readable storage medium.

25 **Brief description of the drawings**

Exemplary embodiments of the invention are disclosed herein with reference to the accompanying drawings, in which:

30 Figure 1a is an architecture diagram of an EPC;
Figure 1b is a diagram of an architecture that supports PCC functionality;
Figure 2 is a signalling diagram showing signalling when a UE initiates the session termination;
Figure 3 is a signalling diagram showing in detail the signalling relating to termination of
35 a session;

Figure 4 is a block schematic diagram of an AF/P-CSCF;

Figure 5 is a block schematic diagram of a PCEF;

Figure 6 is a block schematic diagram of a TDF;

Figure 7 is a block schematic diagram of a PCRF;

5 Figure 8 is an embodiment of an exemplary signalling diagram showing signalling following termination of a telecommunications session; and

Figure 9 is an embodiment of another exemplary signalling diagram showing signalling following termination of a telecommunications session.

10 Detailed description

Generally disclosed herein are methods and apparatus allowing the network to clean an obsolete or terminated individual session (such as e.g. an IMS session, a Gx session, an Rx session or an end-to-end telecommunications session between a
15 calling UE and a called UE), which is associated with or part of a telecommunications session, and release the associated bearer resources in the network when there is loss of transport connectivity between the AF/P-CSCF 116 and the PCRF 106. Exemplary methods and apparatus disclosed are based on the addition of a new release indicator in a SIP BYE, or 200 OK for BYE messages, sent by the AF/P-
20 CSCF 116 that also includes data identifying the affected Rx session identity.

The TDF 120 may intercept a telecommunications session message and, based on instructions from the PCRF 106 included in the ADC Rules, report to the PCRF 106 about the detection of a message that indicates that resources associated with the
25 terminated session should be released. The TDF 120 may also report the related Rx session identity. Upon reception of this indicator the PCRF 106 may identify a Gx session that is bound to that reported Rx session, terminate the Rx session, initiate the removal of the related PCC Rules, and effect release of associated network resources.

30

Although the methods and apparatus disclosed consider an IMS INVITE session, similar methods and apparatus can apply for IMS registration session to support the release of corresponding Rx session resources in the PCRF 106 and the related PCC rules, if any. Further, although the methods and apparatus disclosed consider an
5 IMS network in the application layer, similar methods and apparatus can apply to those applications that support the sending of an application message to notify the UE 110 about the release of the service.

The methods and apparatus disclosed also apply when the PCEF 114 supports ADC
10 functionality. In that case, it may be the PCEF 114 (instead of or in addition to the TDF 120) that identifies the Rx session to be released based on provided PCC rules and an intercepted telecommunications session message. In the same way, the PCEF 114 could inform the PCRF 106 that the telecommunications session has been
15 terminated, allowing the PCRF 106 to terminate the associated Rx session, remove the related PCC rules in the response and control the release of the associated network resources.

Methods and apparatus disclosed herein may have one or more of the following benefits:

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- The network operator can release hanging network resources even when an Rx session transport connectivity is lost and thus avoiding fraudulent use of services;
- The network operator can optimize the use of the resources in its network,
25 avoiding non-used bearers that could affect the maximum number of allowed bearers;
- The operator can adapt the use of the resources in the network to the real demands of the users;
- The methods and apparatus disclosed may also avoid the implementation of
30 buffering mechanisms that affect the performance, capacity of the impacted nodes and create traffic floods;
- The methods and apparatus disclosed avoid the need of additional measures (in case of Rx session transport connectivity loss) for charging correlation between PCC charging data and IMS charging data.

35

Exemplary methods and apparatus disclosed propose the use of DPI for the monitoring of telecommunications session messages (e.g. SIP traffic) that is required to be released. Exemplary methods and apparatus can be implemented within a TDF 120 and/or a PCEF 114 with ADC capabilities.

5

Figure 4 shows a schematic representation of an AF/P-CSCF 400, which may be the AF 116 in the architecture of Figure 1b. The AF/P-CSCF 400 comprises a transmitter 402 and a receiver 404. The transmitter 402 and receiver 404 may be in data communication with other network entities such as UEs, servers and/or functions in a telecommunications network and are configured to transmit and receive data accordingly.

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The AF/P-CSCF 400 further comprises a memory 406 and a processor 408. The memory 406 may comprise a non-volatile memory and/or a volatile memory. The memory 406 may have a computer program 410 stored therein. The computer program 410 may be configured to undertake the methods disclosed herein. The computer program 410 may be loaded in the memory 406 from a non-transitory computer readable medium 412, on which the computer program is stored. The processor 408 is configured to undertake one or more of the functions of a transport session controller 414, session ID retriever 416 and a message builder 418, as set out below.

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Each of the transmitter 402 and receiver 404, memory 406, processor 408, transport session controller 414, session ID retriever 416 and message builder 418 is in data communication with the other features 402, 404, 406, 408, 410, 414, 416, 418 of the AF/P-CSCF 400. The AF/P-CSCF 400 can be implemented as a combination of computer hardware and software. In particular, the transport session controller 414, session ID retriever 416 and message builder 418 may be implemented as software configured to run on the processor 408. The memory 406 stores the various programs/executable files that are implemented by a processor 408, and also provides a storage unit for any required data. The programs/executable files stored in the memory 406, and implemented by the processor 408, can include the transport session controller 414, session ID retriever 416 and message builder 418, but are not limited to such.

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Figure 5 shows a schematic representation of a PCEF 500, which may be the PCEF 116 in the architecture of Figure 1b. The PCEF 500 comprises a transmitter 502 and a receiver 504. The transmitter 502 and receiver 504 may be in data communication with other network entities such as UEs, servers and/or functions in a telecommunications network and are configured to transmit and receive data accordingly.

The PCEF 500 further comprises a memory 506 and a processor 508. The memory 506 may comprise a non-volatile memory and/or a volatile memory. The memory 506 may have a computer program 510 stored therein. The computer program 510 may be configured to undertake the methods disclosed herein. The computer program 510 may be loaded in the memory 506 from a non-transitory computer readable medium 512, on which the computer program is stored. The processor 508 is configured to undertake one or more of the functions of a traffic interceptor 514, traffic inspector 516, release reporter 518, rules remover 520 and a resource releaser 522, as set out below.

Each of the transmitter 502 and receiver 504, memory 506, processor 508, traffic interceptor 514, traffic inspector 516, release reporter 518, rules remover 520 and resource releaser 522 is in data communication with the other features 502, 504, 506, 508, 510, 514, 516, 518, 520, 522 of the PCEF 500. The PCEF 500 can be implemented as a combination of computer hardware and software. In particular, the traffic interceptor 514, traffic inspector 516, release reporter 518, rules remover 520 and resource releaser 522 may be implemented as software configured to run on the processor 508. The memory 506 stores the various programs/executable files that are implemented by a processor 508, and also provides a storage unit for any required data. The programs/executable files stored in the memory 506, and implemented by the processor 508, can include the traffic interceptor 514, traffic inspector 516, release reporter 518, rules remover 520 and resource releaser 522, but are not limited to such.

Figure 6 shows a schematic representation of a TDF 600, which may be the TDF 120 in the architecture of Figure 1b. The TDF 600 comprises a transmitter 602 and a receiver 604. The transmitter 602 and receiver 604 may be in data communication with other network entities such as UEs, servers and/or functions in a telecommunications network and are configured to transmit and receive data accordingly.

The TDF 600 further comprises a memory 606 and a processor 608. The memory 606 may comprise a non-volatile memory and/or a volatile memory. The memory 606 may have a computer program 610 stored therein. The computer program 610 may be configured to undertake the methods disclosed herein. The computer program 610 may be loaded in the memory 606 from a non-transitory computer readable medium 612, on which the computer program is stored. The processor 608 is configured to undertake one or more of the functions of a traffic interceptor 614, traffic inspector 616 and release reporter 618, as set out below.

Each of the transmitter 602 and receiver 604, memory 606, processor 608, traffic interceptor 614, traffic inspector 616 and release reporter 618 is in data communication with the other features 602, 604, 606, 608, 610, 614, 616, 618 of the TDF 600. The TDF 600 can be implemented as a combination of computer hardware and software. In particular, the traffic interceptor 614, traffic inspector 616 and release reporter 618 may be implemented as software configured to run on the processor 608. The memory 606 stores the various programs/executable files that are implemented by a processor 608, and also provides a storage unit for any required data. The programs/executable files stored in the memory 606, and implemented by the processor 608, can include the traffic interceptor 614, traffic inspector 616 and release reporter 618, but are not limited to such.

Figure 7 shows a schematic representation of a PCRF 700, which may be the PCRF 116 in the architectures of Figures 1a and 1b. The PCRF 700 comprises a transmitter 702 and a receiver 704. The transmitter 702 and receiver 704 may be in data communication with other network entities such as UEs, servers and/or functions in a telecommunications network and are configured to transmit and receive data accordingly.

The PCRF 700 further comprises a memory 706 and a processor 708. The memory 706 may comprise a non-volatile memory and/or a volatile memory. The memory 706 may have a computer program 710 stored therein. The computer program 710 may be configured to undertake the methods disclosed herein. The computer program 710 may be loaded in the memory 706 from a non-transitory computer readable medium 712, on which the computer program is stored. The processor 708 is configured to

undertake one or more of the functions of a rules controller 714, session controller 716 and session binder 718, as set out below.

Each of the transmitter 702 and receiver 704, memory 706, processor 708, rules controller 714, session controller 716 and session binder 718 is in data communication with the other features 702, 704, 706, 708, 710, 714, 716, 718 of the PCRF 700. The PCRF 700 can be implemented as a combination of computer hardware and software. In particular, the rules controller 714, session controller 716 and session binder 718 may be implemented as software configured to run on the processor 708. The memory 706 stores the various programs/executable files that are implemented by a processor 708, and also provides a storage unit for any required data. The programs/executable files stored in the memory 706, and implemented by the processor 708, can include the rules controller 714, session controller 716 and session binder 718, but are not limited to such.

In TDF 120 based methods and apparatus, the PCRF 106 may install appropriate ADC rules in the TDF 120. The ADC Rules allow the monitoring of SIP Release messages in order to identify if they contain a release indicator, which indicates that a session has been terminated. The TDF Application Identifier included in the ADC rule allows the TDF 120 to monitor traffic and to report the associated Rx session identifier to the PCRF 106 when it is included in a message.

Figure 8 shows a signalling diagram in the case when the network 100 or the UE 110 on the other side of the communication terminates a telecommunications session (e.g. a SIP session). A similar procedure may apply when the UE-A initiates termination of the SIP session.

- 5 8.1 There is an ongoing telecommunications session. There is one or more further sessions, such as an Rx session, a Gx session and/or an Sd session associated with the SIP session. In exemplary methods and apparatus, the Rx session may be bound to the Gx session such that the ID of the Rx session may be used to determine the Gx session. In addition, there are one or more network resources associated with and in use by the SIP session. The SIP session is terminated. In the shown example it is the network or UE-B who initiates the termination
- 10 8.2 A SIP BYE is received by the receiver 404 of the AF/P-CSCF 116, 400
- 8.3 The transmitter 402 of the AF/P-CSCF 116, 400 attempts to transmit data to the PCRF 106 over the Rx interface in order to terminate the Rx session and to release the network resources associated with the telecommunications session
- 15 8.4 The receiver 404 of the AF/P-CSCF 116, 400 receives no response from the PCRF 106 so the transport session controller 414 determines that communication over the Rx session is not possible because the transport connectivity on the Rx interface to the PCRF 106 is lost. The session ID retriever 416 of the AF/P-CSCF 116, 400 retrieves the Rx session ID of the Rx session associated with the telecommunications session to be terminated. The message builder 418 constructs a message (such as a SIP BYE) including the retrieved Rx session ID and a release indicator, which may have been retrieved from memory
- 20 406. The release indicator comprises data within the SIP BYE message (or another type of message) that indicates that the identified Rx session associated with the telecommunications session is to be terminated
- 25 8.5 The transmitter 402 transmits the SIP BYE message towards the UE 110

- 5 8.6 The traffic interceptor 614 of the TDF 120, 600 in UE-A network intercepts the SIP BYE message. The traffic inspector 616 of the TDF 120 inspects the intercepted message and, in some exemplary methods and apparatus, if there is an installed ADC rule with a TDF-Application Identifier that relates to SIP release messages, the traffic inspector 616 determines whether there is a release indicator in the intercepted message. As a previous step (not shown), the rules controller 714 of the PCRF 106, 700 may have transmitted rules, such as ADC rules, to the TDF 120, 600 instructing it to monitor session messages for a release indicator
- 10 8.7 The release reporter 618 of the TDF 120, 600 controls the transmitter 602 to transmit a message (such as a Credit Control Request (CCR) message) towards the PCRF 106, 700 indicating that an Rx session associated with the telecommunications session is to be terminated. The release reporter 618 of the TDF 120, 600 includes in the CCR message the release information and the Rx session ID
- 15 8.8 The session controller 716 of the PCRF 106, 700 determines whether there is an IP-CAN session related to the Rx session identified in the CCR message transmitted by the TDF 120, 600. The session binder 718 may determine a Gx session based on the received Rx session ID. If an Rx session is identified that matches the received Rx session ID, the session controller 716 terminates the Rx session
- 20 8.9 The transmitter 702 of the PCRF 106, 700 transmits a message (such as a Credit Control Answer (CCA) message) to the TDF 120, 600
- 25 8.10 The session controller 716 may control the transmitter 702 of the PCRF 106, 700 to transmit a message on the Gx session to the PCEF 114 to delete the PCC rules associated with the telecommunications session.
- 30 8.11 In response to the message from the PCRF 106, 700 over the Gx interface, the rules remover 520 of the PCEF 114, 500 removes the PCC rules and the transmitter 502 transmits a response to the PCRF 106, 700
- 35 8.12 The resource releaser 522 of the PCEF 114, 500 initiates the related bearer procedure (modification or termination of the bearer) and the network resources are released

In other exemplary methods and apparatus, the PCEF 114, 500 may be configured to intercept and inspect session messages. In such exemplary methods and apparatus, the rules controller 714 of the PCRF 106, 700 may already have transmitted the necessary PCC rules to the PCEF 114, 500 and the rules may have been installed. The PCC Rules allow the monitoring of SIP Release messages in order to identify if they contain a release indicator. A TDF-Application-Identifier included in the PCC rules allows the traffic interceptor 514 and the traffic inspector 516 of the PCEF 114, 500 to monitor session traffic. The release reporter 518 may then report to the PCRF 106, 700 if the release indicator is included and include in the reporting message the Rx session ID.

Figure 9 shows a signaling diagram in the exemplary case when the network 100 or the UE 110 in the other side of the communication terminates a SIP session and when the PCEF 114, 500 intercepts and inspects session messages. A similar procedure will apply when the UE-A initiates the termination of the SIP session.

The main difference between the PCEF based methods exemplified in Figure 9 and the TDF based methods exemplified in Figure 8 is that the PCEF 114, 500 knows about the PCC rules active for the Rx session. So, the PCRF 106, 700 can already indicate in step 9.9 about the PCC rules to be removed (i.e. no need of RAR and RAA messages to remove the PCC rules). The rest of the procedure is substantially the same.

9.1-9.5 These steps are substantially same as 8.1-8.5 above

9.6 The traffic interceptor 514 of the PCEF 114, 500 in UE-A network intercepts the SIP BYE message. The traffic inspector 516 of the PCEF 114, 500 inspects the intercepted message and, in exemplary methods and apparatus, if there is an installed PCC Rule with a TDF-Application Identifier that relates to SIP Release messages, the traffic inspector 516 determines whether there is a release indicator in the intercepted message. As a previous step (not shown), the rules controller 714 of the PCRF 106, 700 may have transmitted rules, such as PCC rules, to the PCEF 114, 500 instructing it to monitor session messages for a release indicator

- 9.7 The release reporter 518 of the PCEF 114, 500 controls the transmitter 502 to transmit a message (such as a Credit Control Request (CCR) message) towards the PCRF 106, 700 indicating that an Rx session associated with the telecommunications session is to be terminated.
- 5 The release reporter 518 of PCEF 114, 500 includes in the CCR message the release information and the Rx session ID
- 9.8 This step is substantially the same as 8.8 above
- 9.9 The session controller 716 may control the transmitter 702 of the PCRF 106, 700 to transmit a message (such as a Credit Control Answer (CCA) message) on the Gx session to the PCEF 114, 500 to delete the PCC rules. In response to the CCA message from the PCRF 106, 700, the rules remover 520 of the PCEF 114, 500 removes the PCC Rules
- 10
- 9.10 This step is substantially the same as step 8.12 above.
- 15

In exemplary methods and apparatus in the AF/P-CSCF 116, 400 a new Rx-Release-Info SIP header is included in a release message towards the UE 110. The Rx-Release-Info header may comprise the release indicator and Rx Session ID. Other exemplary methods and apparatus may include the release indicator and Rx Session ID as extension parameters in an existing SIP header in a release message towards the UE 110.

20

In exemplary methods and apparatus, the Application-Detection-Information reported by the TDF/PCEF when the service is identified may include the following data:

25

Application-Detection-Information ::= < AVP Header: 1098 >
 { TDF-Application-Identifier }
 [TDF-Application-Instance-Identifier]
 *[Flow-Information]
 [Release-Info]
 *[AVP]

30

The new Release-Info AVP may comprise the Rx Session ID obtained from the SIP release message.

35

Upon receipt of the Application-Detection-Information AVP including the Release-Info AVP, the PCRF 106, 700 may apply a session binding mechanism as if an STR command was received over the Rx interface. The same procedures will then apply over Gx interface.

5

A computer program may be configured to provide any of the above described methods. The computer program may be provided on a computer readable medium. The computer program may be a computer program product. The product may comprise a non-transitory computer usable storage medium. The computer program
10 product may have computer-readable program code embodied in the medium configured to perform the method. The computer program product may be configured to cause at least one processor to perform some or all of the methods.

15

Various methods and apparatus are described herein with reference to block diagrams or flowchart illustrations of computer-implemented methods, apparatus (systems and/or devices) and/or computer program products. It is understood that a block of the block diagrams and/or flowchart illustrations, and combinations of blocks in the block diagrams and/or flowchart illustrations, can be implemented by computer program instructions that are performed by one or more computer circuits. These computer
20 program instructions may be provided to a processor circuit of a general purpose computer circuit, special purpose computer circuit, and/or other programmable data processing circuit to produce a machine, such that the instructions, which execute via the processor of the computer and/or other programmable data processing apparatus, transform and control transistors, values stored in memory locations, and other
25 hardware components within such circuitry to implement the functions/acts specified in the block diagrams and/or flowchart block or blocks, and thereby create means (functionality) and/or structure for implementing the functions/acts specified in the block diagrams and/or flowchart block(s).

30

Computer program instructions may also be stored in a computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instructions which implement the functions/acts specified in the block diagrams and/or flowchart block or
35 blocks.

A tangible, non-transitory computer-readable medium may include an electronic, magnetic, optical, electromagnetic, or semiconductor data storage system, apparatus, or device. More specific examples of the computer-readable medium would include the following: a portable computer diskette, a random access memory (RAM) circuit, a read-only memory (ROM) circuit, an erasable programmable read-only memory (EPROM or Flash memory) circuit, a portable compact disc read-only memory (CD-ROM), and a portable digital video disc read-only memory (DVD/Blu-ray).

The computer program instructions may also be loaded onto a computer and/or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer and/or other programmable apparatus to produce a computer-implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the functions/acts specified in the block diagrams and/or flowchart block or blocks.

Accordingly, the invention may be embodied in hardware and/or in software (including firmware, resident software, micro-code, etc.) that runs on a processor, which may collectively be referred to as "circuitry," "a module" or variants thereof.

It should also be noted that in some alternate implementations, the functions/acts noted in the blocks may occur out of the order noted in the flowcharts. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality/acts involved. Moreover, the functionality of a given block of the flowcharts and/or block diagrams may be separated into multiple blocks and/or the functionality of two or more blocks of the flowcharts and/or block diagrams may be at least partially integrated. Finally, other blocks may be added/inserted between the blocks that are illustrated.

The skilled person will be able to envisage other embodiments without departing from the scope of the appended claims.

CLAIMS:

1. A network node (114, 500; 120, 600) for use in a telecommunications network (100) and configured to intercept messages during a telecommunications session, wherein one or more further sessions are associated with the telecommunications session, the network node comprising:
- 5 a traffic interceptor (514; 614) configured to intercept one or more messages during the telecommunications session;
- a traffic inspector (516; 616) configured to determine that a message, amongst
- 10 the intercepted one or more messages, comprises a release indicator specifying that a further session, amongst the one or more further sessions, is to be terminated;
- a release reporter (518; 618) configured to control a transmitter (502; 602) to transmit a release message to a Policy and Charging Rules Function (106, 700), PCRF, the release message comprising data indicating that the further session is to be
- 15 terminated.
2. A network node (114, 500; 120, 600) according to claim 1, further comprising a receiver (504; 604) configured to receive, from the PCRF (106, 700), an instruction to intercept the one or more messages with the release indicator specifying that the one
- 20 or more further sessions are to be terminated.
3. A network node (114, 500; 120, 600) according to claim 1 or 2, wherein the one or more further sessions comprise an Rx session established between a Proxy Call Session Control Function (116, 400), P-CSCF, and the PCRF (106, 700),
- 25 and wherein the release message comprises data identifying the Rx session.
4. A network node (114, 500; 120, 600) according to any preceding claim, configured as one of a Policy and Charging Enforcement Function (114, 500), PCEF, and a Traffic Detection Function (120, 600), TDF, and wherein the one or more further
- 30 sessions comprise one of a Gx session and an Sd session respectively.
5. A network node (114, 500) according to claim 4, configured as a PCEF and wherein the receiver (504) is configured to receive from the PCRF a Policy and Charging Control, PCC, rules message identifying one or more PCC rules for the
- 35 interception of messages during the telecommunications session.

6. A network node (114, 500) according to claim 5, wherein the receiver (504) is configured to receive from the PCRF a PCC rules message identifying one or more PCC rules to be removed and the network node (114, 500) further comprises a rules remover (520) configured to remove the identified PCC rules and a resource releaser (522) configured to release network resources associated with the removed PCC rules.

7. A network node (120, 600) according to claim 4, configured as a TDF and wherein the receiver (604) is configured to receive from the PCRF an Application Detection and Control, ADC, rules message identifying one or more ADC rules for the interception of messages during the telecommunications session.

8. A method for use in a network node (114, 500; 120, 600) for use in a telecommunications network (100) and configured to intercept messages during a telecommunications session, wherein one or more further sessions are associated with the telecommunications session, the method comprising:

intercepting (9.6; 8.6), by a traffic interceptor (514; 614), one or more messages during the telecommunications session;

determining, by a traffic inspector (516; 616), that a message, amongst the intercepted one or more messages, comprises a release indicator specifying that a further session, amongst the one or more further sessions, is to be terminated;

controlling, by a release reporter (518; 618), a transmitter (502; 602) to transmit (9.7; 8.7) a release message to a Policy and Charging Rules Function (106, 700), PCRF, the release message comprising data indicating that the further session is to be terminated.

9. A method according to claim 8, comprising receiving from the PCRF (106, 700), by a receiver (504; 604), an instruction to intercept the one or more messages with the release indicator specifying that the one or more further sessions are to be terminated.

10. A method according to claim 8 or 9, wherein the one or more further sessions comprise an Rx session established between a Proxy Call Session Control Function (116, 400), P-CSCF, and the PCRF (106, 700),

and wherein the release message comprises data identifying the Rx session.

11. A method according to any of claims 8 to 10, wherein the network node (114, 500; 120, 600) is configured as one of a Policy and Charging Enforcement Function (114, 500), PCEF, and a Traffic Detection Function (120, 600), TDF, and wherein the one or more further sessions comprise one of a Gx session and an Sd session
5 respectively.

12. A method according to claim 11, wherein the network node (114, 500) is configured as a PCEF, and the method further comprises receiving, by the receiver (504) and from the PCRF, a Policy and Charging Control, PCC, rules message
10 identifying one or more PCC rules for the interception of messages during the telecommunications session.

13. A method according to claim 12, further comprising:
receiving (9.9), by the receiver (504) and from the PCRF, a PCC rules message
15 identifying one or more PCC rules to be removed;
removing (9.10), by a rules remover (520), the identified PCC rules; and
releasing (9.10), by a resource releaser (522), network resources associated with the removed PCC rules.

20 14. A method according to claim 11, wherein the network node (120, 600) is configured as a TDF, and the method further comprises receiving, by the receiver (604) and from the PCRF, an Application Detection and Control, ADC, rules message identifying one or more ADC rules for the interception of messages during the telecommunications session.

25 15. A computer program (510; 610) comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any one of claims 8-14.

30 16. A carrier (512; 612) containing the computer program (510; 610) of claim 15, wherein the carrier is one of an electronic signal, optical signal, radio signal, or non-transitory computer readable storage medium.

35 17. A network node (106, 700) for use in a telecommunications network (100) as a Policy and Charging Rules Function, PCRF, during a telecommunications session,

wherein one or more further sessions are associated with the telecommunications session, the network node comprising:

- 5 a receiver (704) configured to receive, from a further node (114, 500; 120, 600) configured to intercept one or more messages during the telecommunications session, a release message comprising data indicating that a further session, amongst the one or more further sessions, is to be terminated;
- a session controller (716) configured to terminate the further session.

18. A network node (106, 700) according to claim 17, further comprising:
- 10 a transmitter (702) configured to transmit, to the further node (114, 500; 120, 600), an instruction to intercept the one or more messages with a release indicator specifying that the one or more further sessions are to be terminated.

19. A network node (106, 700) according to claim 17 or 18, wherein the one or more further sessions comprise an Rx session established between a Proxy Call Session Control Function (116, 400), P-CSCF, and the PCRF (106, 700), and wherein the release message comprises data indicating that the Rx session is to be terminated.
- 15

20. A network node (106, 700) according to claim 19, wherein the further node (114, 500; 120, 600) is configured as a Policy and Charging Enforcement Function (114, 500), PCEF, wherein the one or more further sessions further comprise a Gx session between the PCEF (114, 500) and the PCRF, and the network node further comprises a session binder (718) configured to bind the Rx session to the Gx session, and determine the Gx session based on the Rx session indicated in the release message.
- 20
- 25

21. A network node (106, 700) according to claim 20, further comprising a rules controller (714) configured to control a transmitter (702) to transmit, to the PCEF (114, 500), a Policy and Charging Control, PCC, rules message identifying one or more PCC rules for the interception of messages during the telecommunications session.
- 30

22. A network node (106, 700) according to claim 19, wherein the further node (114, 500; 120, 600) is configured as a Traffic Detection Function (120, 600), TDF, wherein the one or more further sessions further comprise an Sd session between the TDF (120, 600) and the PCRF.
- 35

23. A network node (106, 700) according to claim 22, further comprising a rules controller (714) configured to control a transmitter (702) to transmit, to the TDF (120, 600), an Application Detection and Control, ADC, rules message identifying one or more ADC rules for the interception of messages during the telecommunications session.

24. A method for use in a network node (106, 700) for use in a telecommunications network (100) as a Policy and Charging Rules Function, PCRF, during a telecommunications session, wherein one or more further sessions are associated with the telecommunications session, the method comprising:

receiving (9.7; 8.7), by a receiver (704) and from a further node (114, 500; 120, 600) configured to intercept messages during the telecommunications session, a release message comprising data indicating that a further session, amongst the one or more further sessions, is to be terminated;

terminating (8.8; 9.8), by a session controller (716), the further session.

25. A method according to claim 24, comprising transmitting, by a transmitter (702) to the further node (114, 500; 120, 600), an instruction to intercept the one or more messages with a release indicator specifying that the one or more further sessions are to be terminated.

26. A method according to claim 24 or 25, wherein the one or more further sessions comprise an Rx session established between a Proxy Call Session Control Function (116, 400), P-CSCF, and the PCRF (106, 700), and wherein the release message comprises data indicating that the Rx session is to be terminated.

27. A method according to claim 26, wherein the further node (114, 500; 120, 600) is configured as a Policy and Charging Enforcement Function (114, 500), PCEF, wherein the one or more further sessions further comprise a Gx session between the PCEF (114, 500) and the PCRF, and the method further comprises binding, by a session binder (718), the Rx session to the Gx session, and determining, by the session binder (718), the Gx session based on the Rx session indicated in the release message.

28. A method according to claim 27, further comprising:

controlling, by a rules controller (714), a transmitter (702) to transmit, to the PCEF (114, 500), a Policy and Charging Control, PCC, rules message identifying one or more PCC rules for the interception of messages during the telecommunications session.

29. A method according to claim 26, wherein the further node (114, 500; 120, 600) is configured as a Traffic Detection Function (120, 600), TDF, and wherein the one or more further sessions further comprise an Sd session between the TDF (120, 600) and the PCRF.

30. A method according to claim 29, further comprising:

controlling, by a rules controller (714), a transmitter (702) to transmit, to the TDF (120, 600), an Application Detection and Control, ADC, rules message identifying one or more ADC rules for the interception of messages during the telecommunications session.

31. A computer program (710) comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any one of claims 24-30.

32. A carrier (712) containing the computer program (710) of claim 31, wherein the carrier is one of an electronic signal, optical signal, radio signal, or non-transitory computer readable storage medium.

33. A network node (116, 400) for use in a telecommunications network (100) as a Proxy Call Session Control Function, P-CSCF, during a telecommunications session, wherein one or more further sessions are associated with the telecommunications session, the network node comprising:

a session identifier retriever (416) configured to retrieve an identifier for a further session, amongst the one or more further sessions associated with the telecommunications session, to be terminated; and

a message builder (418) configured to build a message comprising a release indicator and the retrieved identifier for the further session, and further configured to

control a transmitter (402) to transmit the built message to one or more further nodes in the telecommunications network.

5 34. A network node (116, 400) according to claim 33, wherein the one or more further sessions comprise an Rx session established between the P-CSCF (116, 400) and a Policy and Charging Rules Function (106, 700), PCRF, the network node further comprising a transport session controller (414) configured to determine that transport connectivity for the Rx session is not available.

10 35. A method for use in a network node (116, 400) for use in a telecommunications network (100) as a Proxy Call Session Control Function, P-CSCF, during a telecommunications session, wherein one or more further sessions are associated with the telecommunications session, the method comprising:

15 retrieving, by a session identifier retriever (416), an identifier for a further session, amongst the one or more further sessions associated with the telecommunications session, to be terminated; and

20 building, by a message builder (418), a message comprising a release indicator and the retrieved identifier for the further session, and controlling a transmitter (402), by the message builder, to transmit the built message to one or more further nodes in the telecommunications network.

25 36. A method according to claim 35, wherein the one or more further sessions comprise an Rx session established between the P-CSCF (116, 400) and a Policy and Charging Rules Function (106, 700), PCRF, the method further comprising determining, by a transport session controller (414), that communication over the Rx session is not possible.

30 37. A computer program (410) comprising instructions which, when executed on at least one processor, cause the at least one processor to carry out the method according to any one of claims 35-36.

38. A carrier (412) containing the computer program (410) of claim 37, wherein the carrier is one of an electronic signal, optical signal, radio signal, or non-transitory computer readable storage medium.

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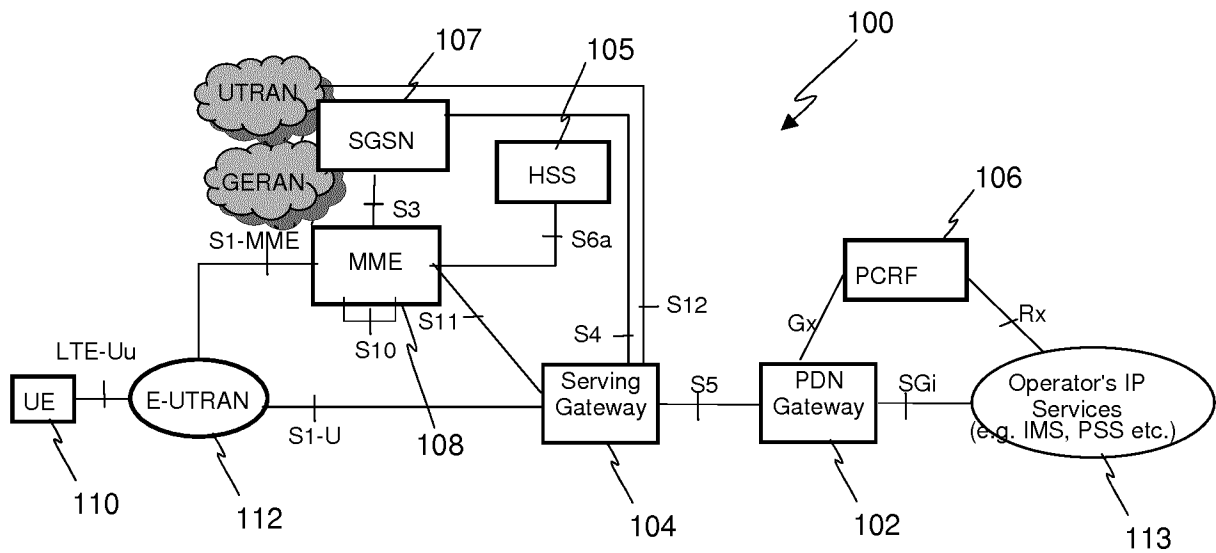


Fig. 1a

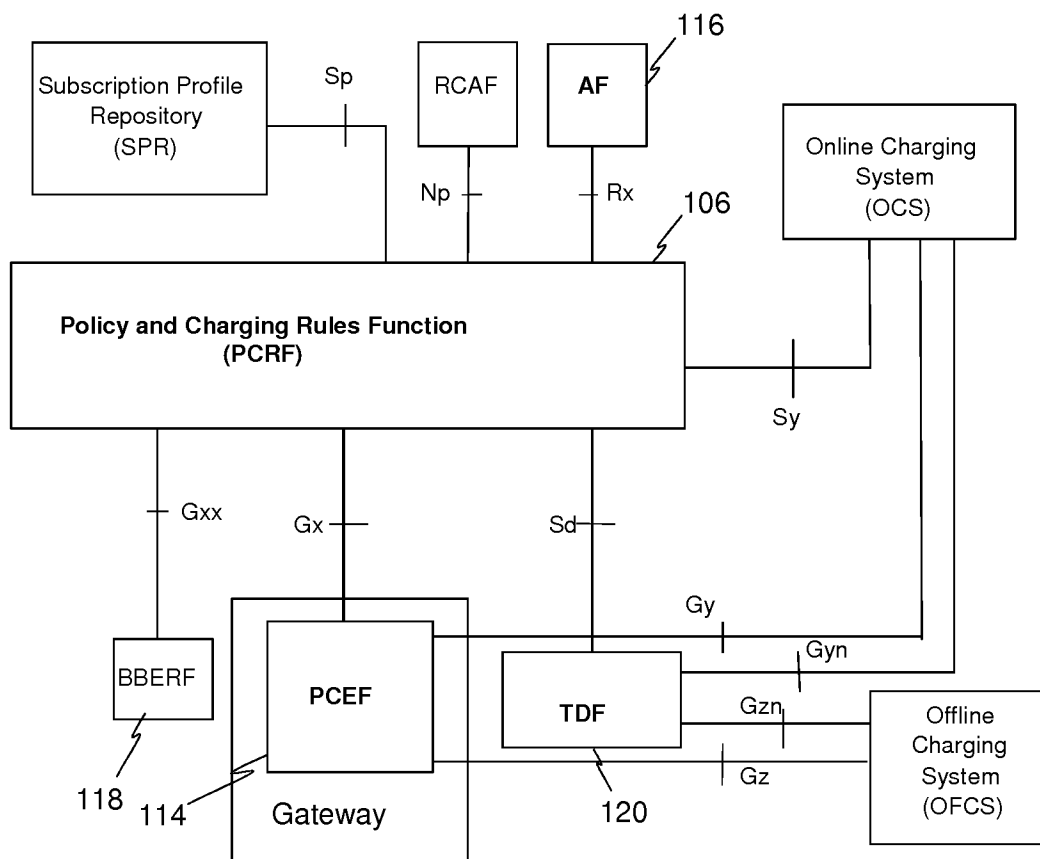


Fig. 1b

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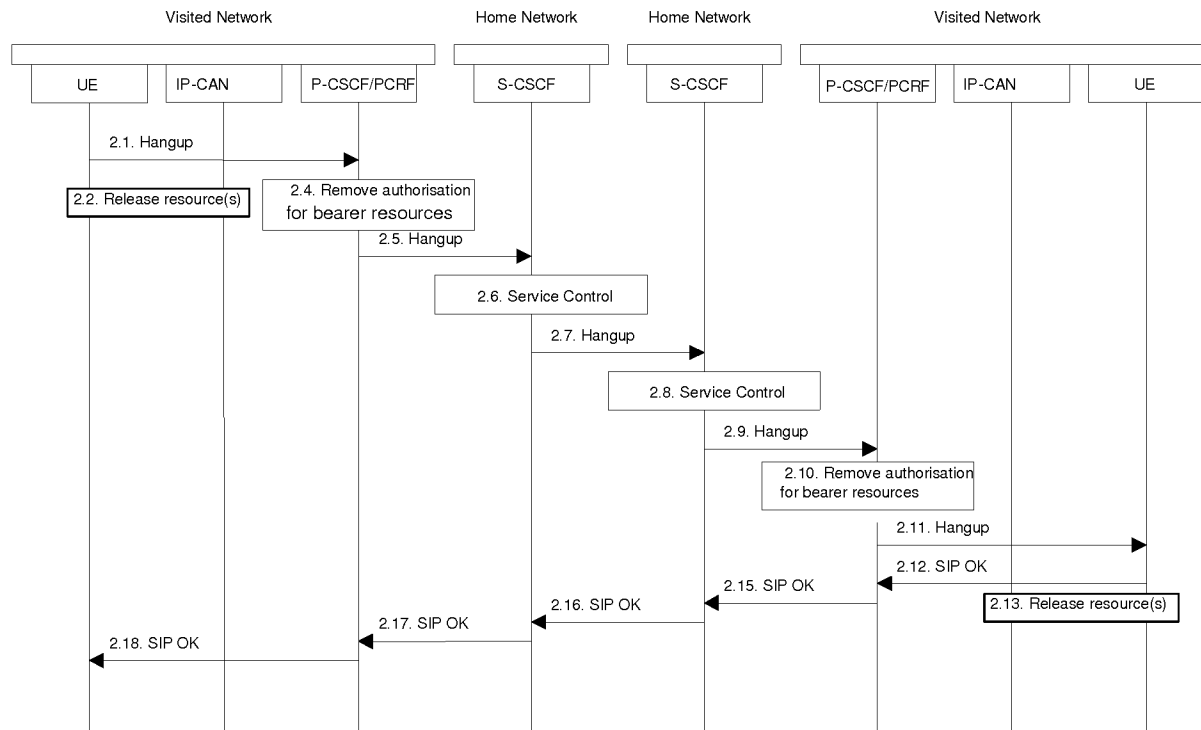


Fig. 2

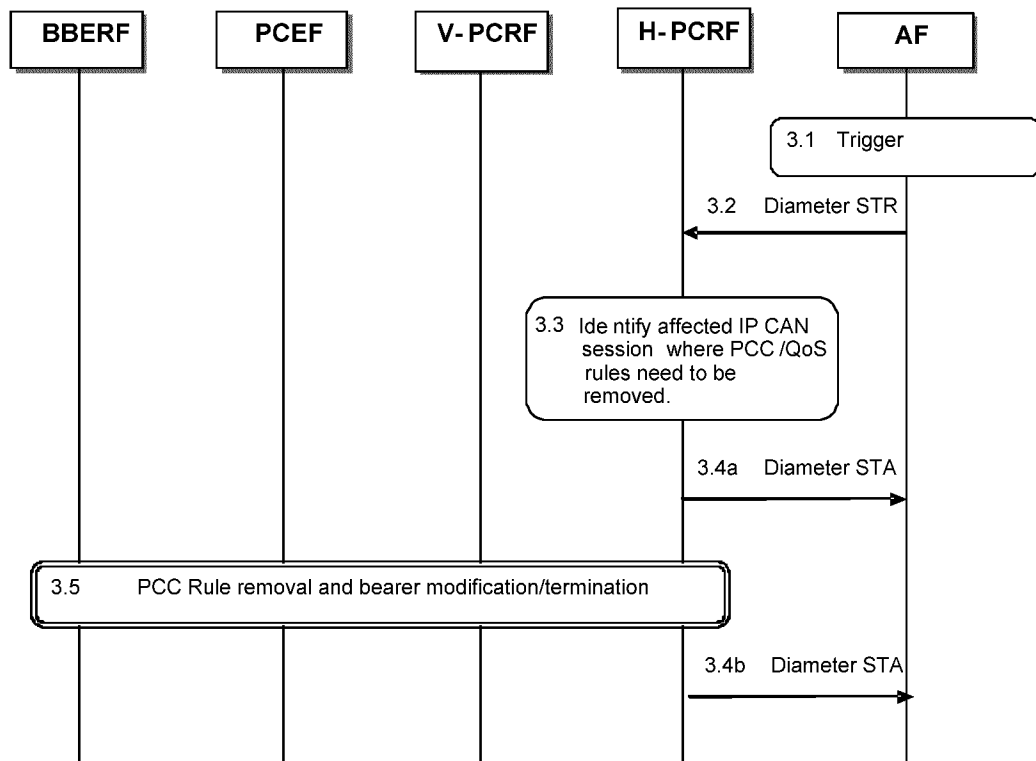


Fig. 3

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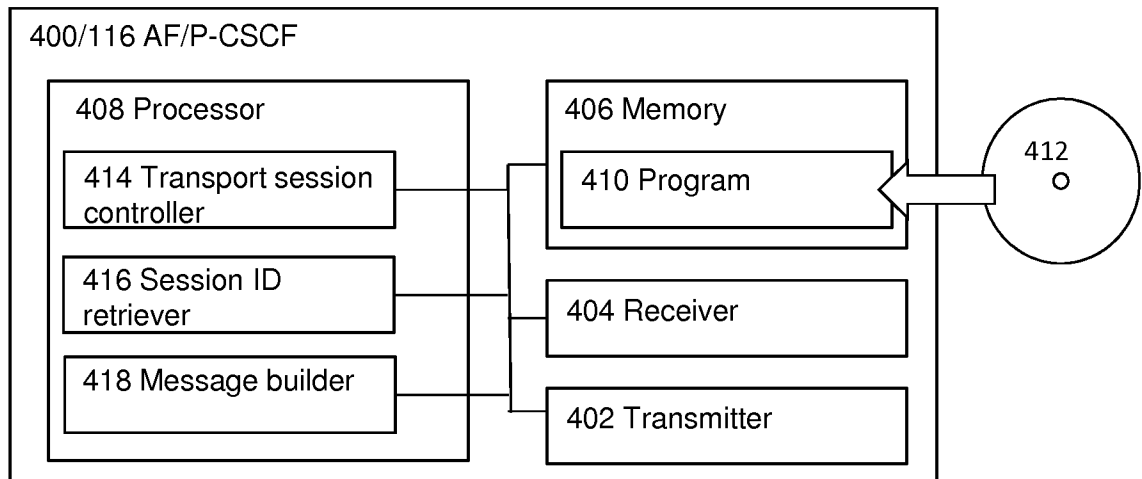


Fig. 4

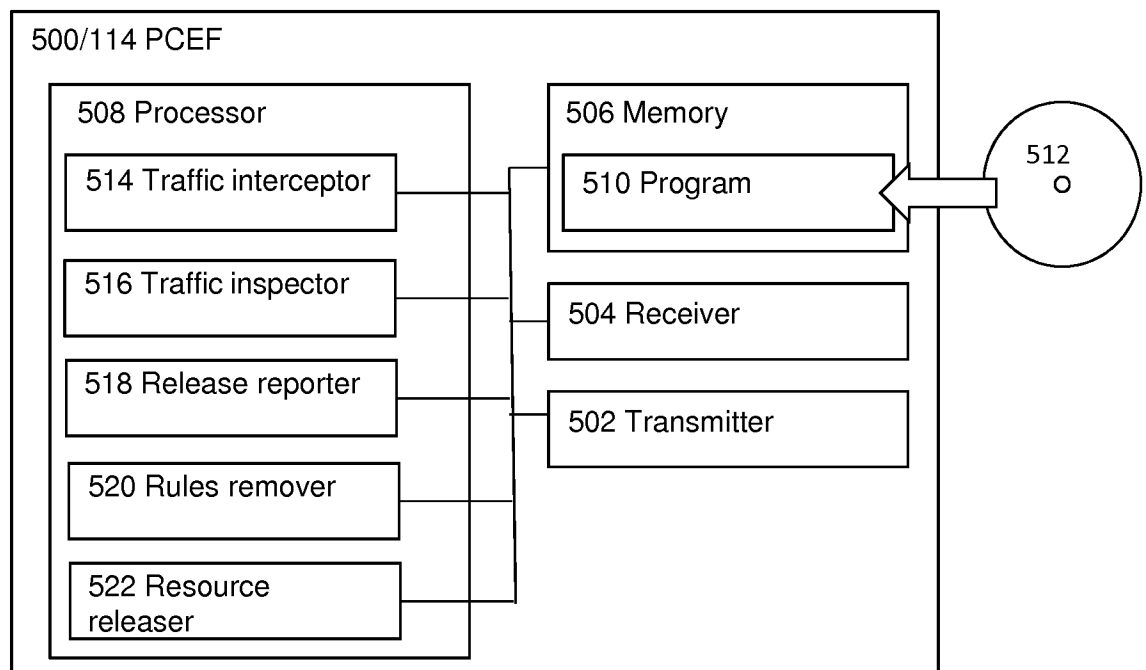


Fig. 5

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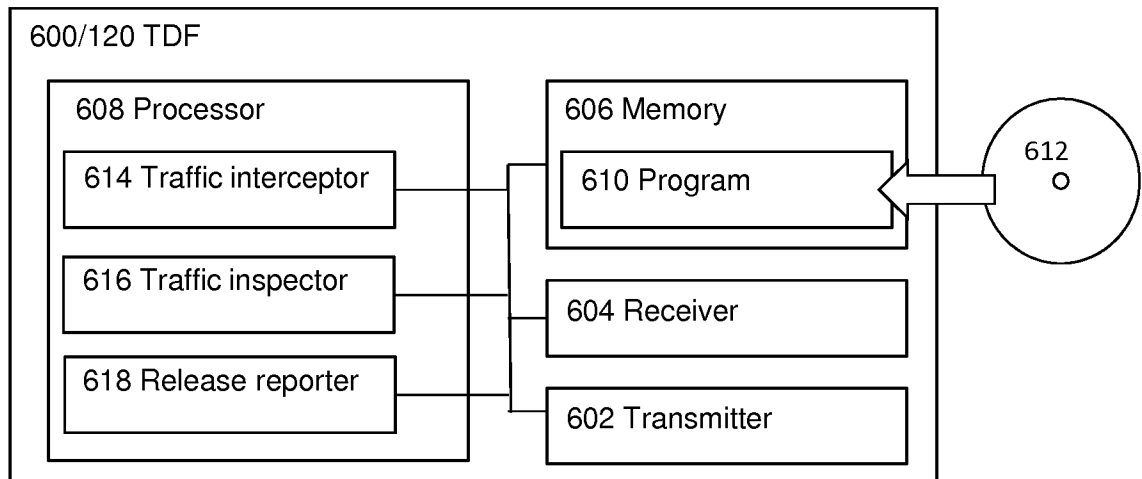


Fig. 6

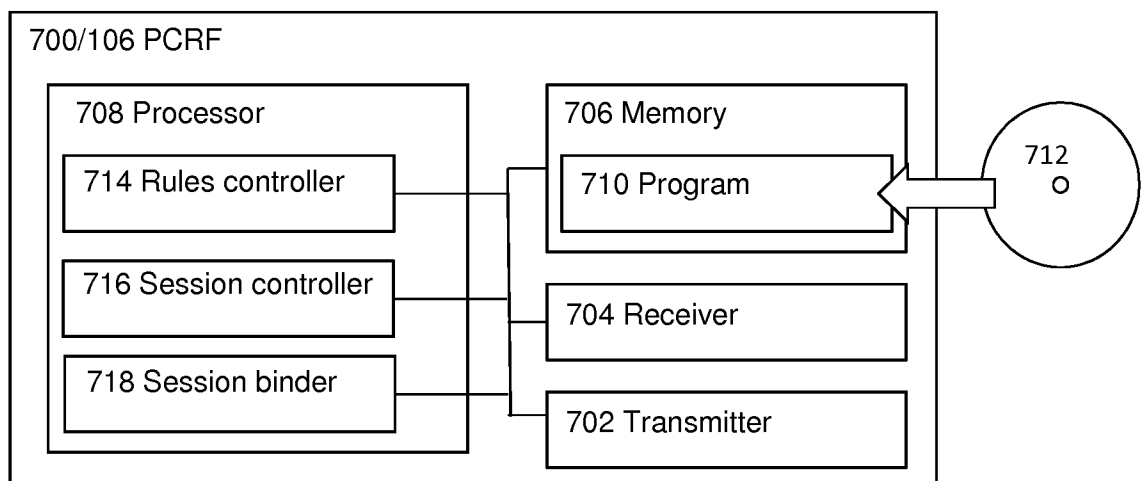


Fig. 7

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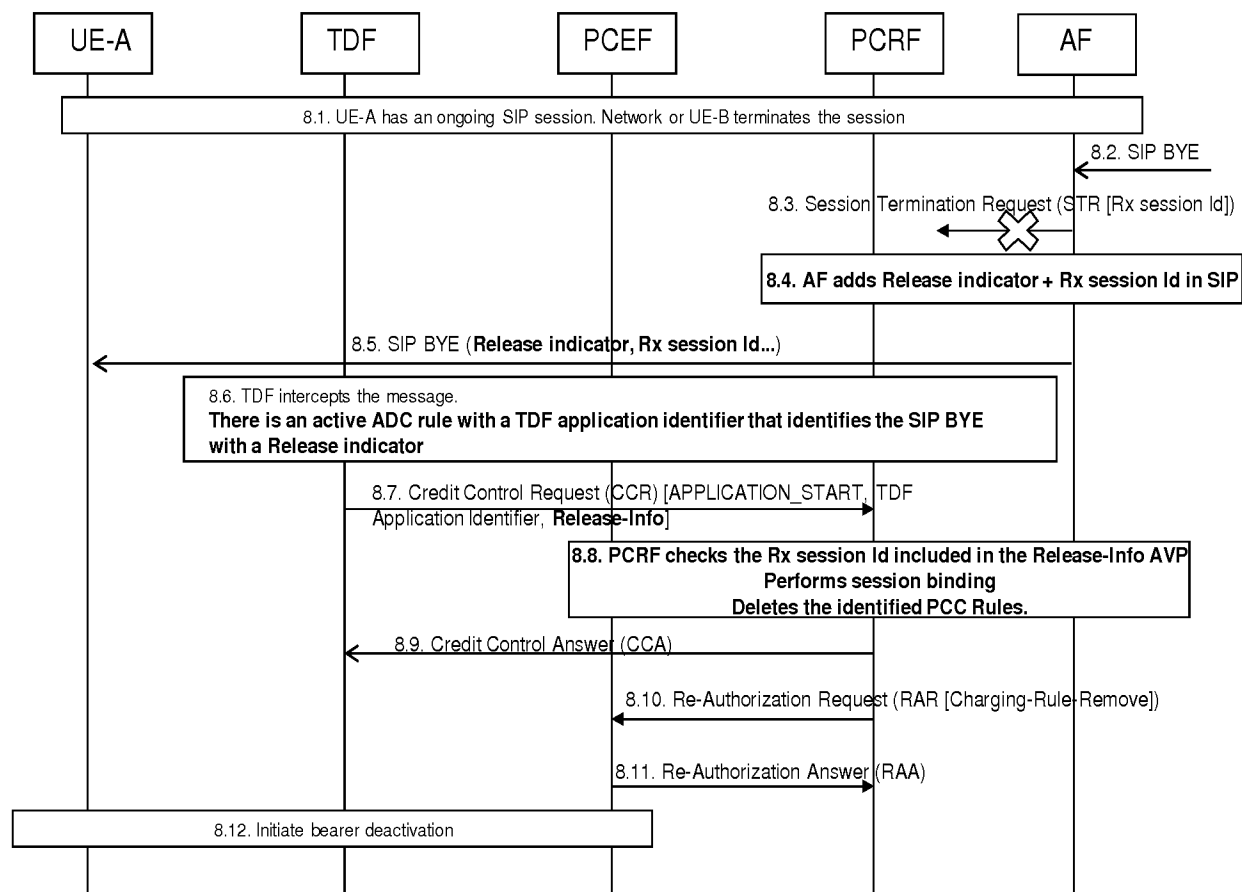


Fig. 8

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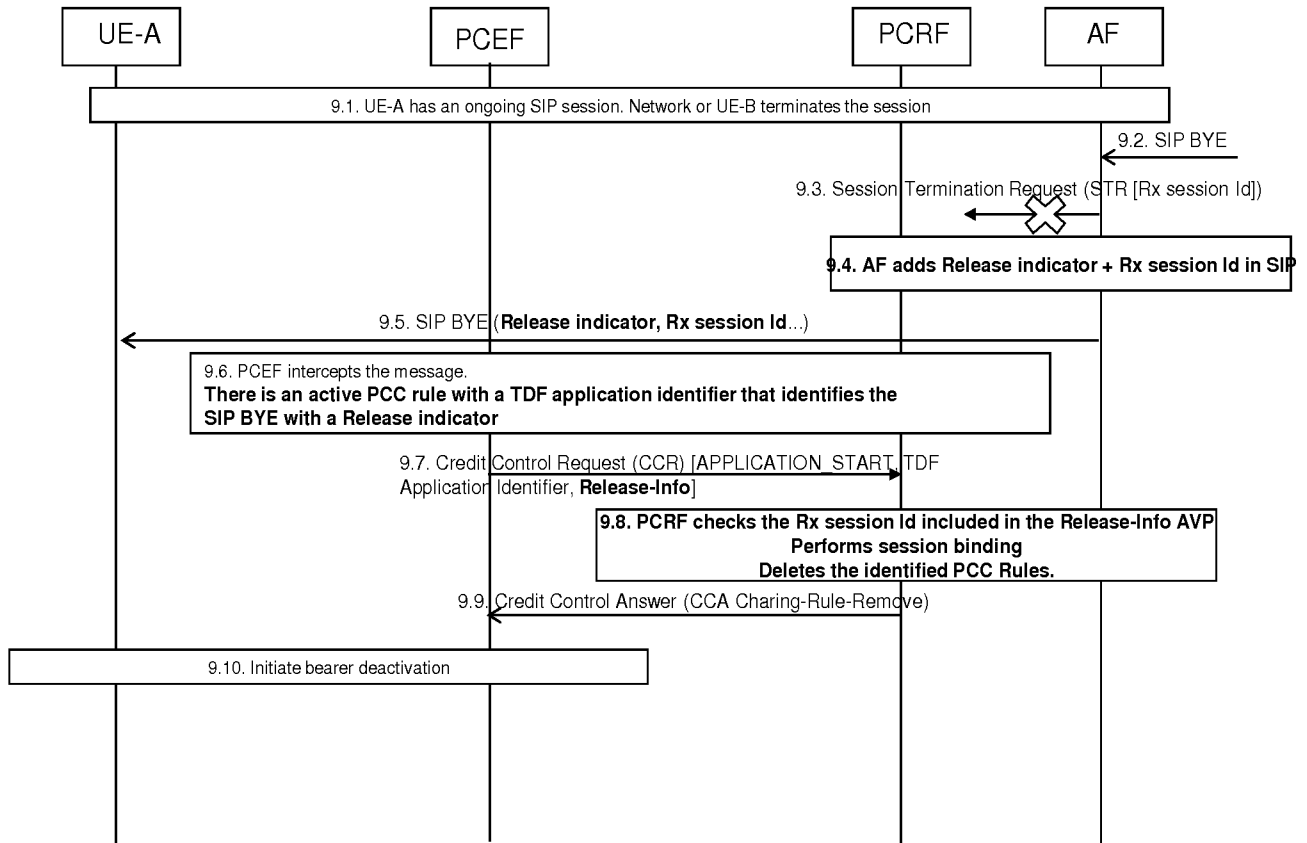


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/066562

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W4/24 H04W76/06 H04L29/14
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W H04L

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/071126 A1 (ZHOU XIAOYUN [CN] ET AL) 12 March 2015 (2015-03-12) paragraphs [0002] - [0009], [0075] - [0099]; figure 4 ----- -/--	1-38



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

30 March 2016

Date of mailing of the international search report

07/04/2016

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Authorized officer

Günther, Steffen

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2015/066562

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (Release 13)", 3GPP STANDARD; 3GPP TS 23.401, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. SA WG2, no. V13.3.0, 16 June 2015 (2015-06-16), pages 1-324, XP050966262, [retrieved on 2015-06-16] paragraphs [5.4.4] - [5.4.4.2]; figures 5.4.4.1-1,5.4.4.2-1 -----	1-38
A	"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Policy and charging control architecture (Release 13)", 3GPP STANDARD; 3GPP TS 23.203, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. SA WG2, no. V13.4.0, 16 June 2015 (2015-06-16), pages 1-235, XP050966277, [retrieved on 2015-06-16] paragraphs [07.3] - [7.4.2]; figures 7.3.1,7.3.2,7.4 -----	1-38

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/066562

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		EP 2822350 A1	07-01-2015
		US 2015071126 A1	12-03-2015
		WO 2013135213 A1	19-09-2013
