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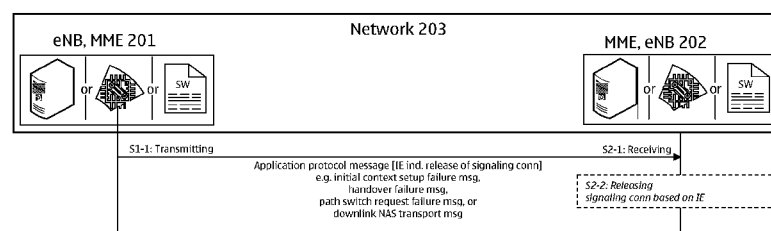
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(54) Title: METHODS, APPARATUSES, RELATED COMPUTER PROGRAM PRODUCT AND DATA STRUCTURE FOR CONNECTION RELEASE INDICATION

Fig. 2

200



(57) Abstract: It is disclosed a method (and related apparatus) comprising transmitting an application protocol message comprising an information element indicating release of a signaling connection relating to the application protocol; and a method (and related apparatus) comprising receiving the application protocol message comprising the information element.

DESCRIPTION

TITLE OF THE INVENTION

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Methods, apparatuses, related computer program product and
DaTa structure for connection release indication

FIELD OF THE INVENTION

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[0001] Examples of the present invention relate to
connection release indication. More specifically, the
examples of the present invention relate to methods,
apparatuses, a related computer program product and a data
15 structure for connection release indication. The examples of
the present invention may be applicable e.g. to long term
evolution (LTE) and an S1 mobility management entity (S1-MME)
interface. S1 application protocol (S1AP) may be used on the
S1-MME interface. S1AP may be based on the 3rd generation
20 (3G), but the differences in architecture and protocol stack
cause a behavior in LTE different from the behavior in 3G.

BACKGROUND

25 [0002] Fig. 1A shows a 3G control plane protocol stack e.g.
over an Iu interface. As shown in Fig. 1A, a communication
network 100 may comprise a mobile station MS (or user
equipment) 101, a radio network subsystem (RNS) 102 and a
serving general packet radio service (GPRS) support node
30 (SGSN) 103. The MS 101 may be connected to the RNS 102 via a
Uu interface, and the RNS 102 may be connected to the SGSN
103 via an Iu-Ps interface.

[0003] The MS 101 may comprise, from bottom to top, the
35 following 5 layers: (1) layer 1 (L1), (2) medium access
control (MAC) layer, (3) radio link control (RLC) layer, (4)
radio resource control (RRC) layer and (5) a layer for GPRS
mobility management/session management/short message service

(GMM/SM/SMS). The RNS 102 may be connected to the MS 101 on layers (1) to (4), while the MS 101 may be connected directly to the SGSN 103 on layer (5). Further, the RNS 102 may be capable of relaying (or mapping) layers (1) to (4): L1 to (a) L1, MAC to (b) layer 2 (L2), RLC to (c) signaling bearer, and RRC to (d1) signaling connection control part (SCCP) and (d2) radio access network application part (RANAP). Finally, the RNS 102 may be connected to the SGSN 103 on layers (a) to (c), (d1) and (d2).

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[0004] Further, Fig. 1B shows an LTE stack corresponding to the 3G stack shown in Fig. 1A. As shown in Fig. 1B, the communication network 100 may comprise a user equipment (UE) 101, an evolved nodeB (eNodeB or eNB) 102 and a mobility management entity (MME) 103. The UE 101 may be connected to the eNB 102 via an LTE-Uu interface, and the eNB 102 may be connected to the MME 103 via an S1-MME interface.

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[0005] The UE 101 may comprise, from bottom to top, the following 5 layers: (1) L1, (2) MAC layer, (3) RLC layer, (4) packet data convergence protocol (PDCP) layer, (5) radio resource control (RRC) layer and (6) non-access stratum (NAS) layer. The eNB 102 may be connected to the UE 101 on layers (1) to (5), while the UE 101 may be connected directly to the MME 103 on layer (6). Further, the eNB 102 may be capable of relaying (or mapping) layers (1) to (5): L1 to (a) L1, MAC to (b) L2, RLC to (c) internet protocol (IP), PDCP to (d) stream control transmission protocol (SCTP), and RRC to (e) S1AP. Finally, the eNB 102 may be connected to the MME 103 on layers (a) to (e).

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[0006] As shown in Figs. 1A and 1B, in case of 3G (Fig. 1A), there is the SCCP layer below RANAP layer and also in case of UE related messaging, an individual SCCP connection per each UE. In case of LTE (Fig. 1B), S1AP operates directly over SCTP, whereas UE related messages may be delivered e.g. over a few SCTP associations between UEs (or endpoints). Thus, one difference between 3G and LTE resides in that on LTE the S1AP

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signaling, a connection is purely logical only without any direct reference to lower layer identifiers, whereas an Iu signaling connection relies on lower layer identification as well. Another difference resides in that on 3G, the Iu signaling connection identifier consists of a single identifier allocated by the initiating party (e.g. radio network controller (RNC) or SGSN 103), but on LTE, the S1AP signaling connection may consist of an ID pair, both parties allocating its own part of the ID.

[0007] Further, Fig. 1C shows a UE context release procedure. A logical S1AP signaling connection between eNB 102 and MME 103 may be released with an explicit UE context release command message from the MME 103 to the eNB 102, which the eNB 102 acknowledges by sending a UE context release complete message.

[0008] In consideration of the above, according to the examples of the present invention, methods, apparatuses, a related computer program product and a data structure for connection release indication are provided.

[0009] In this connection, the examples of the present invention enable one or more of the following:

- Utilizing a more efficient signaling, e.g. S1AP signaling connection. This is because S1AP does not impact on lower layers to release and establish signaling connections;
- Dispensing with a need for a separate request message and a corresponding acknowledgement in return;
- Clarifying an uncertainty of some use cases where it is not explicitly clear when the S1AP signaling connection is released or exists, such as path switching procedure (both successful and unsuccessful cases) and initial context setup failure procedures;
- Clarifying another uncertainty, e.g. in case of initial context setup failure, in which the S1AP signaling connection is to be released after the failure message has been received in MME. This is because in some use cases, the radio

connection still exists and failure occurred e.g. due to bearer related problems, and thus the MME may still need to send e.g. a further NAS message to UE (e.g. attach reject or detach request);

- 5 - Avoiding an extra message pair to release the connection explicitly (e.g. UE context release command/ complete), e.g. utilizing a release indication bit e.g. on top of a downlink (DL) NAS transport message to indicate that the S1AP signaling connection is not going to be used afterwards.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The examples of the present invention are described herein below with reference to the accompanying drawings, in
15 which:

[0011] Fig. 1A shows the above-described 3G control plane protocol stack e.g. over the Iu interface;

20 [0012] Fig. 1B shows the above-described LTE control plane protocol stack e.g. over the S1-MME interface;

[0013] Fig. 1C shows the above-described UE context release procedure;

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[0014] Fig. 2 shows methods for connection release indication according to first to fourth examples of the present invention;

30 [0015] Fig. 3 shows apparatuses for connection release indication according to the first to fourth examples of the present invention;

[0016] Fig. 4A shows a data structure for connection release
35 indication according to the first example of the present invention;

[0017] Fig. 4B shows a data structure for connection release indication according to the second example of the present invention;

5 [0018] Fig. 4C shows a data structure for connection release indication according to the third example of the present invention; and

[0019] Fig. 4D shows a data structure for connection release
10 indication according to the fourth example of the present invention.

DETAILED DESCRIPTION OF THE EXAMPLES OF THE PRESENT INVENTION

15 [0020] The examples of the present invention are described herein below by way of example with reference to the accompanying drawings.

[0021] It is to be noted that for this description, the
20 terms "SlAP message, initial context setup failure message (first example), handover failure message (second example), path switch request failure message (third example) and/or downlink NAS transport message (fourth example); indication bit; and SlAP connection" are examples for "application
25 protocol message; information element; and signaling connection", respectively, without restricting the latter-named terms to the special technical or implementation details imposed to the first-named terms.

30 [0022] Fig. 2 shows methods for connection release indication according to the first to fourth examples of the present invention. Signaling between elements is indicated in horizontal direction, while time aspects between signaling may be reflected in the vertical arrangement of the signaling
35 sequence as well as in the sequence numbers. It is to be noted that the time aspects indicated in Fig. 2 do not necessarily restrict any one of the method steps shown to the step sequence outlined. This applies in particular to method

steps that are functionally disjunctive with each other. Within Fig. 2, for ease of description, means or portions which may provide main functionalities are depicted with solid functional blocks or arrows and/or a normal font, while means or portions which may provide optional functions are depicted with dashed functional blocks or arrows and/or an italic font.

[0023] As shown in Fig. 2, a communication system 200 may comprise a network 203. In turn, the network 203 may further comprise a first entity 201 (e.g. eNB or MME) and a second entity 202 (e.g. MME or eNB) different from the first entity 201.

[0024] Further, as shown in Fig. 2, in step S1-1, e.g. the first entity 201 may perform transmitting an application protocol message (e.g. S1AP message) comprising an information element (e.g. indication bit) indicating release of a signaling connection relating to the application protocol.

[0025] Then, in step S2-1, e.g. the second entity 202 may perform receiving, at the second entity 202 different from the first entity 201 performing the transmitting, the application protocol message.

[0026] Furthermore, in an optional step S2-2, e.g. the second entity 202 may perform releasing the signaling connection pertaining to a terminal (e.g. UE, not shown) based on the information element. Still further, the application protocol message may be constituted by an S1 application protocol message for which a release indication bit is applicable, as the information element, to release, as the signaling connection, a logical S1 application protocol connection.

[0027] As the first example of the method pertaining to the first and second entities 201 and 202, the application

protocol message may be constituted by an initial context setup failure message.

[0028] As the second example of the method pertaining to the first and second entities 201 and 202, the application protocol message may be constituted by a handover failure message.

[0029] As the third example of the method pertaining to the first and second entities 201 and 202, the application protocol message may be constituted by a path switch request failure message.

[0030] Finally, as the fourth example of the method pertaining to the first and second entities 201 and 202, the application protocol message may be constituted by a downlink non-access stratum transport message.

[0031] As a development pertaining to the first to fourth examples, the information element may be constituted by an indication bit providing an S1-interface application protocol connection release indication.

[0032] Fig. 3 shows apparatuses (e.g. eNB and/or MME each assuming the role of the first entity 201 and/or the second entity 202) for connection release indication according to the first to fourth examples of the present invention. Within Fig. 3, for ease of description, means or portions which may provide main functionalities are depicted with solid functional blocks or arrows and/or a normal font, while means or portions which may provide optional functions are depicted with dashed functional blocks or arrows and/or an italic font.

[0033] The first entity 201 (e.g. eNB or MME) may comprise a CPU (or circuitry) 2011, a memory 2012, a transmitter (or means for transmitting) 2013 and an optional receiver (or

means for receiving) 2014.

[0034] The second entity 202 (e.g. MME or eNB) may comprise a CPU (or circuitry) 2021, a memory 2022, an optional
5 transmitter (or means for transmitting) 2023, a receiver (or means for receiving) 2024 and an optional releaser (or means for releasing) 2025.

[0035] As indicated by the dashed extensions of the
10 functional blocks of the CPU 2011 or 2021, the means for releasing 2025 (and means for transmitting 2013, 2023/receiving 2014, 2024 of the first/second entity 201, 202) may be functionalities running on the CPU 2011 or 2021 of the served entity 201 and/or serving entity 202, or may
15 alternatively be separate functional entities or means.

[0036] The CPUs 20x1 (wherein x = 1 and/or 2) may respectively be configured, for example by software residing in the memory 20x2, to process various data inputs and to
20 control the functions of the memories 20x2, the means for transmitting 20x3 and the means for receiving 20x4 (and the means for releasing 2025 of the second entity 202). The memories 20x2 may serve e.g. for storing code means for carrying out e.g. the methods according to the example of the
25 present invention, when run e.g. on the CPUs 20x1. It is to be noted that the means for transmitting 20x3 and the means for receiving 20x4 may alternatively be provided as respective integral transceivers. It is further to be noted that the transmitters/receivers may be implemented i) as
30 physical transmitters/receivers for transceiving e.g. via the air interface (e.g. between a UE (not shown) and the first entity 201), ii) as routing entities e.g. for transmitting/receiving data packets e.g. in a PS (packet switching) network (e.g. between the first entity 201 and the
35 second entity 202 when disposed as separate network entities), iii) as functionalities for writing/reading information into/from a given memory area (e.g. in case of shared/common CPUs or memories e.g. of the first entity 201

and the second entity 202 when disposed as an integral network entity), or iv) as any suitable combination of i) to iii).

5 [0037] Further, as shown in Fig. 3, e.g. the means for transmitting 2013 of the first entity 201 may perform transmitting an application protocol message (e.g. S1AP message) comprising an information element (e.g. indication bit) indicating release of a signaling connection relating to
10 the application protocol.

[0038] Then, e.g. the means for receiving 2024 of the second entity 202 may perform receiving, at the second entity different from the first entity 201 comprising the means for
15 transmitting 2013, the application protocol message.

[0039] Furthermore, optionally, e.g. the means for releasing 2025 of the second entity 202 may perform releasing, the signaling connection pertaining to a terminal (UE, not shown)
20 based on the information element. Still further, the application protocol message may be constituted by an S1 application protocol message for which a release indication bit is applicable, as the information element, to release, as the signaling connection, a logical S1 application protocol
25 connection.

[0040] As the first example pertaining to the first and second entities 201 and 202, the application protocol message may be constituted by an initial context setup failure
30 message.

[0041] As the second example pertaining to the first and second entities 201 and 202, the application protocol message may be constituted by a handover failure message.
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[0042] As the third example pertaining to the first and second entities 201 and 202, the application protocol message

may be constituted by a path switch request failure message.

[0043] Finally, as the fourth example pertaining to the first and second entities 201 and 202, the application
5 protocol message may be constituted by a downlink non-access stratum transport message.

[0044] As for the first to fourth examples, the first entity 201 and/or the second entity 202 may be constituted by a
10 mobility management entity, an evolved nodeB or an evolved universal terrestrial radio access network nodeB.

[0045] As a development pertaining to the first to fourth examples, the information element may be constituted by an
15 indication bit providing an S1-interface application protocol connection release indication.

[0046] Furthermore, at least one of the above-described means for transmitting 2013, 2023, means for receiving 2014,
20 2024 and means for releasing 2025 as well as the first entity 201 and the second entity 202, or the respective functionalities carried out, may be implemented as a chipset, module or subassembly.

25 [0047] Finally, the example of present invention also relates to a system which may comprise the first entity 201 and the second entity 202 according to the above-described first to fourth examples of the present invention.

30 [0048] Figs. 4A to 4D show data structures 300 for connection release indication according to the first to fourth examples of the present invention.

[0049] As shown in Figs. 4A to 4D, the data structure 300
35 may comprise an information element 301 indicating release of a signaling connection relating to an application protocol.

[0050] Further, according to the first example of the present invention shown in Fig. 4A, the data structure 300 may be constituted by an initial context setup failure message. In that case, the data structure 300 may further
5 comprise the following information elements (IEs): message type 302, MME-UE S1AP ID 303, eNB-UE S1AP ID 304, cause 305 and criticality diagnostics 306.

[0051] Further, according to the second example of the present invention shown in Fig. 4B, the data structure 300
10 may be constituted by a handover failure message. In that case, the data structure 300 may further comprise the following IEs: message type 302, MME-UE S1AP ID 303, cause 304 and criticality diagnostics 305.

[0052] Further, according to the third example of the present invention shown in Fig. 4C, the data structure 300
15 may be constituted by a path switch request failure message. In that case, the data structure 300 may further comprise the following IEs: message type 302, MME-UE S1AP ID 303, eNB-UE S1AP ID 304, cause 305 and criticality diagnostics 306.
20

[0053] Finally, according to the fourth example of the present invention shown in Fig. 4D, the data structure 300
25 may be constituted by a downlink non-access stratum transport message. In that case, the data structure 300 may further comprise the following IEs: message type 302, MME-UE S1AP ID 303, eNB-UE S1AP ID 304, NAS protocol data unit (PDU) 305 and handover restriction list 306.
30

[0054] Without being restricted to the details following in this section, the examples of the present invention may be summarized as follows:

35 A release indication bit may be added e.g. into S1AP messages to indicate that the logical S1AP signaling connection has been released. Thus, the recipient may clear all resources related to the UE. The release bit may be allowed to be set

by the MME, as the MME is the entity that controls the S1AP signaling connection release. However, e.g. in initial context setup failure and handover failure cases, the eNB may indicate to the MME right away that there is no working
5 connection left for the UE and that the MME cannot use the signaling connection anymore.

A release indication bit may be incorporated into some S1AP messages. Herein below, some examples of those S1AP messages
10 are shown.

INITIAL CONTEXT SETUP FAILURE

This message is sent by the eNB to indicate that the setup of the UE context was unsuccessful.

15 Direction: eNB → MME

HANDOVER FAILURE

This message is sent by the target eNB to inform the MME that the preparation of resources has failed.

20 Direction: eNB → MME

PATH SWITCH REQUEST FAILURE

This message is sent by the MME to inform the eNB that a failure has occurred in the evolved packet core (EPC) during
25 the Path switch request procedure.

Direction: MME → eNB

DOWNLINK NAS TRANSPORT

This message is sent by the MME and is used for carrying NAS
30 information over the S1 interface.

Direction: MME → eNB

[0055] [Further examples]

35 [0056] For the purpose of the present invention as described herein above, it should be noted that

- a circuitry may refer to at least one of, or hybrids of the following:

(a) to pure hardware circuit implementations (such as implementations purely in analog and/or digital circuitry), and

(b) to combinations of circuits and software (and/or firmware), such as (as applicable):

(i) a combination of processor(s), or
(ii) portions of processor(s)/software (including digital signal processor(s)), software and memory (or memories) that work together to cause an apparatus as defined hereinabove to perform various functions, and

(c) to circuits, such as (micro)processor(s) or a portion of (a) (micro)processor(s) that require software and/or firmware for operation even if the software or firmware is not physically present;

- a processor may be any processing unit, such as CPU, arithmetic and logic unit (ALU), microprocessor unit (MPU), digital signal processor (DSP) etc., be it a single core processor, dual core processor or multi-core processor;

- a program may be embodied by or on any computer program (product), computer readable medium, processor(s), memory (or memories), circuitry, circuits, random access memory (RAM), read-only memory (ROM) and/or data structure(s), be it e.g. as compiled/non-compiled program (source) code, executable object, (meta)file or the like;

- an access technology may be any technology by means of which a user equipment can access an access network (or base station, respectively). Any present or future technology, such as WiMAX (Worldwide Interoperability for Microwave Access) or WLAN (Wireless Local area Network), Bluetooth, Infrared, and the like may be used; although the above technologies are mostly wireless access technologies, e.g. in different radio spectra, access technology in the sense of the present invention may also imply wirebound technologies, e.g. IP based access technologies like cable networks or fixed line.

- a network may be any device, unit or means by which a station entity or other user equipment may connect to and/or utilize services offered by the access network; such services

include, among others, data and/or (audio-) visual communication, data download etc.;

- generally, the present invention may be applicable in those network/user equipment environments relying on a data packet based transmission scheme according to which data are transmitted in data packets and which are, for example, based on the internet protocol (IP). The present invention is, however, not limited thereto, and any other present or future IP or mobile IP (MIP) version, or, more generally, a protocol following similar principles as (M)IPv4/6, is also applicable;

- a user equipment may be any device, unit or means by which a system user may experience services from an access network;

- method steps likely to be implemented as software code portions and being run using a processor at a network element or terminal (as examples of devices, apparatuses and/or modules thereof, or as examples of entities including apparatuses, circuitries and/or modules therefore), are software code independent and can be specified using any known or future developed programming language as long as the functionality defined by the method steps is preserved;

- generally, any method step is suitable to be implemented as software or by hardware without changing the idea of the invention in terms of the functionality implemented;

- method steps and/or devices, units or means likely to be implemented as hardware components at the above-defined apparatuses, or any module(s)/circuitry(ies) thereof, are hardware independent and can be implemented using any known or future developed hardware technology or any hybrids of these, such as MOS (Metal Oxide Semiconductor), CMOS (Complementary MOS), BiMOS (Bipolar MOS), BiCMOS (Bipolar CMOS), ECL (Emitter Coupled Logic), TTL (Transistor-Transistor Logic), etc., using for example ASIC (Application Specific IC (Integrated Circuit)) components, FPGA (Field-programmable Gate Arrays) components, CPLD (Complex Programmable Logic Device) components or DSP (Digital Signal Processor) components; in addition, any method steps and/or devices, units or means likely to be implemented as software

components may alternatively be based on any security architecture capable e.g. of authentication, authorization, keying and/or traffic protection;

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

[0057] According to an example of the present invention, in a first aspect, this object is for example achieved by **a method** comprising:

transmitting an application protocol message comprising an information element indicating release of a signaling connection relating to the application protocol.

[0058] According to an example of the present invention, in a second aspect, this object is for example achieved by **a method** comprising:

receiving an application protocol message comprising an information element indicating release of a signaling connection relating to the application protocol.

[0059] According to further refinements of the example of the present invention as defined under the above second aspect,

- the method further comprises releasing the signaling connection pertaining to a terminal based on the information element.

[0060] According to further refinements of the example of the present invention as defined under the above first and second aspects,

- the application protocol message is constituted by an S1 application protocol message for which a release indication bit is applicable, as the information element, to release, as the signaling connection, a logical S1 application protocol connection;
- the application protocol message is constituted by an initial context setup failure message, a handover failure message, a path switch request failure message or a downlink non-access stratum transport message;
- the information element is constituted by an indication bit providing an S1-interface application protocol connection release indication.

[0061] According to an example of the present invention, in a third aspect, this object is for example achieved by **an apparatus** comprising:

- means for transmitting an application protocol message comprising an information element indicating release of a signaling connection relating to the application protocol.

[0062] According to an example of the present invention, in a fourth aspect, this object is for example achieved by **an apparatus** comprising:

- means for receiving an application protocol message comprising an information element indicating release of a signaling connection relating to the application protocol.

[0063] According to further refinements of the example of the present invention as defined under the above fourth aspect,

- the apparatus further comprises means for releasing communication resources pertaining to a terminal based on the information element.

[0064] According to further refinements of the example of the present invention as defined under the above third and fourth aspects,

- the application protocol message is constituted by an S1 application protocol message for which a release indication bit is applicable, as the information element, to release, as the signaling connection, a logical S1 application protocol connection;
- the application protocol message is constituted by an initial context setup failure message, a handover failure message, a path switch request failure message or a downlink non-access stratum transport message;
- the apparatus is constituted by one of a mobility management entity, an evolved nodeB and an evolved universal terrestrial radio access network nodeB;
- the information element is constituted by an indication bit providing an S1-interface application protocol connection release indication;
- at least one of means for transmitting, means for receiving, means for releasing and the apparatus is implemented as a chipset, module or subassembly.

[0065] According to an example of the present invention, in a fifth aspect, this object is for example achieved by **an apparatus** comprising:

- a transmitter configured to transmit an application protocol message comprising an information element indicating release of a signaling connection relating to the application protocol.

[0066] According to an example of the present invention, in a sixth aspect, this object is for example achieved by an apparatus comprising:

5 a receiver configured to receive an application protocol message comprising an information element indicating release of a signaling connection relating to the application protocol.

[0067] According to further refinements of the example of
10 the present invention as defined under the above sixth aspect,

- the apparatus further comprises a releaser configured to release communication resources pertaining to a terminal based on the information element.

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[0068] According to further refinements of the example of the present invention as defined under the above fifth and sixth aspects,

- the application protocol message is constituted by an S1 application protocol message for which a release indication bit is applicable, as the information element, to release, as the signaling connection, a logical S1 application protocol connection;

- the application protocol message is constituted by an
25 initial context setup failure message, a handover failure message, a path switch request failure message or a downlink non-access stratum transport message;

- the apparatus is constituted by one of a mobility management entity, an evolved nodeB and an evolved universal
30 terrestrial radio access network nodeB;

- the information element is constituted by an indication bit providing an S1-interface application protocol connection release indication;

- at least one of a transmitter, receiver, releaser and the
35 apparatus is implemented as a chipset, module or subassembly.

[0069] According to an example of the present invention, in a seventh aspect, this object is for example achieved by a

system comprising:

an apparatus according to the above third or fifth aspects; and

5 an apparatus according to the above fourth or sixth aspects.

[0070] According to an example of the present invention, in an eighth aspect, this object is for example achieved by **a computer program product** comprising code means for performing
10 a method according to the above first and second aspects when run on a processing means or module.

[0071] According to an example of the present invention, in a ninth aspect, this object is for example achieved by **a computer program** comprising code means configured to perform:
15 transmitting an application protocol message comprising an information element indicating release of a signaling connection relating to the application protocol.

[0072] According to an example of the present invention, in a tenth aspect, this object is for example achieved by **a computer program** comprising code means configured to perform:
20 receiving an application protocol message comprising an information element indicating release of a signaling
25 connection relating to the application protocol.

[0073] According to an example of the present invention, in an eleventh aspect, this object is for example achieved by **a data structure** comprising:
30 an information element indicating release of a signaling connection relating to an application protocol.

[0074] According to further refinements of the example of the present invention as defined under the above eleventh aspect,
35

- the data structure is constituted by an initial context setup failure message, a handover failure message, a path switch request failure message, or a downlink non-access

stratum transport message.

[0075] Although the present invention has been described
herein before with reference to particular embodiments
5 thereof, the present invention is not limited thereto and
various modification can be made thereto.

CLAIMS:

1. A method, comprising:
transmitting an application protocol message comprising
5 an information element indicating release of a signaling
connection relating to the application protocol.
2. A method, comprising:
receiving an application protocol message comprising an
10 information element indicating release of a signaling
connection relating to the application protocol.
3. The method according to claim 2, further comprising
releasing the signaling connection pertaining to a terminal
15 based on the information element.
4. The method according to any one of claims 1 to 3, wherein
the application protocol message is constituted by an S1
application protocol message for which a release indication
20 bit is applicable, as the information element, to release, as
the signaling connection, a logical S1 application protocol
connection.
5. The method according to any one of claims 1 to 4, wherein
25 the application protocol message is constituted by an initial
context setup failure message, a handover failure message, a
path switch request failure message or a downlink non-access
stratum transport message.
- 30 6. The method according to any one of claims 1 to 5, wherein
the information element is constituted by an indication bit
providing an S1-interface application protocol connection
release indication.
- 35 7. An apparatus, comprising:
means for transmitting an application protocol message
comprising an information element indicating release of a
signaling connection relating to the application protocol.

8. An apparatus, comprising:

means for receiving an application protocol message
comprising an information element indicating release of a
5 signaling connection relating to the application protocol.

9. The apparatus according to claim 8, further comprising
means for releasing communication resources pertaining to a
terminal based on the information element.

10

10. The apparatus according to any one of claims 7 to 9,
wherein the application protocol message is constituted by an
S1 application protocol message for which a release
indication bit is applicable, as the information element, to
15 release, as the signaling connection, a logical S1
application protocol connection.

11. The apparatus according to any one of claims 7 to 10,
wherein the application protocol message is constituted by an
20 initial context setup failure message, a handover failure
message, a path switch request failure message or a downlink
non-access stratum transport message.

12. The apparatus according to claim 11, wherein the
25 apparatus is constituted by one of a mobility management
entity, an evolved nodeB and an evolved universal terrestrial
radio access network nodeB.

13. The apparatus according to any one of claims 7 to 12,
30 wherein the information element is constituted by an
indication bit providing an S1-interface application protocol
connection release indication.

14. The apparatus according to any one of claims 7 to 13,
35 wherein at least one of means for transmitting, means for
receiving, means for releasing and the apparatus is
implemented as a chipset, module or subassembly.

15. A computer program product comprising code means for performing a method according to any one of claims 1 to 6 when run on a processing means or module.

5 16. A data structure, comprising:
an information element indicating release of a signaling connection relating to an application protocol.

10 17. The data structure according to claim 16, wherein the data structure is constituted by
an initial context setup failure message,
a handover failure message,
a path switch request failure message, or
a downlink non-access stratum transport message.

Fig. 1A

100

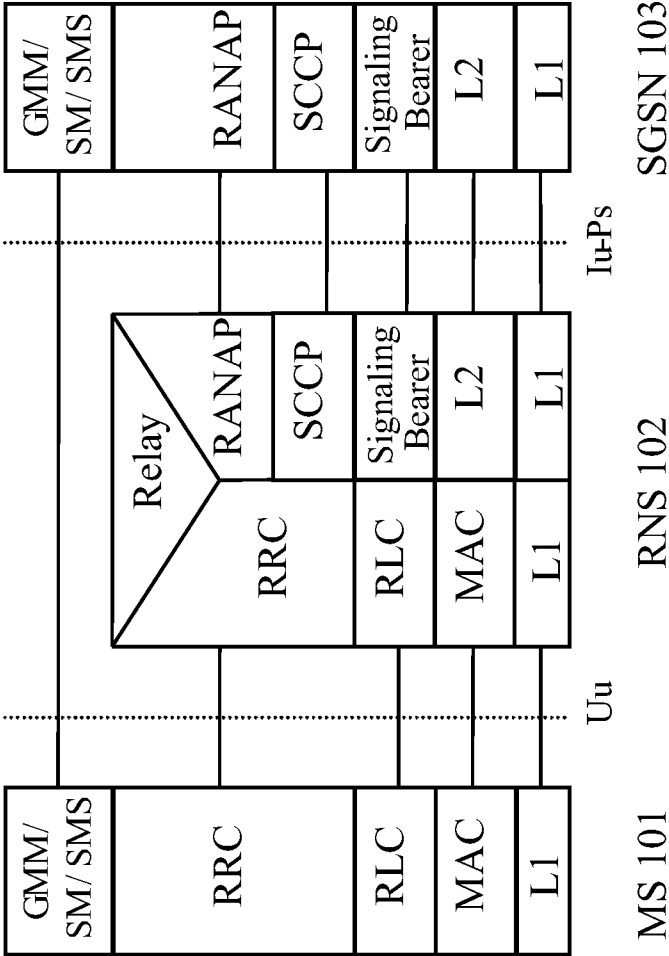


Fig. 1B

100

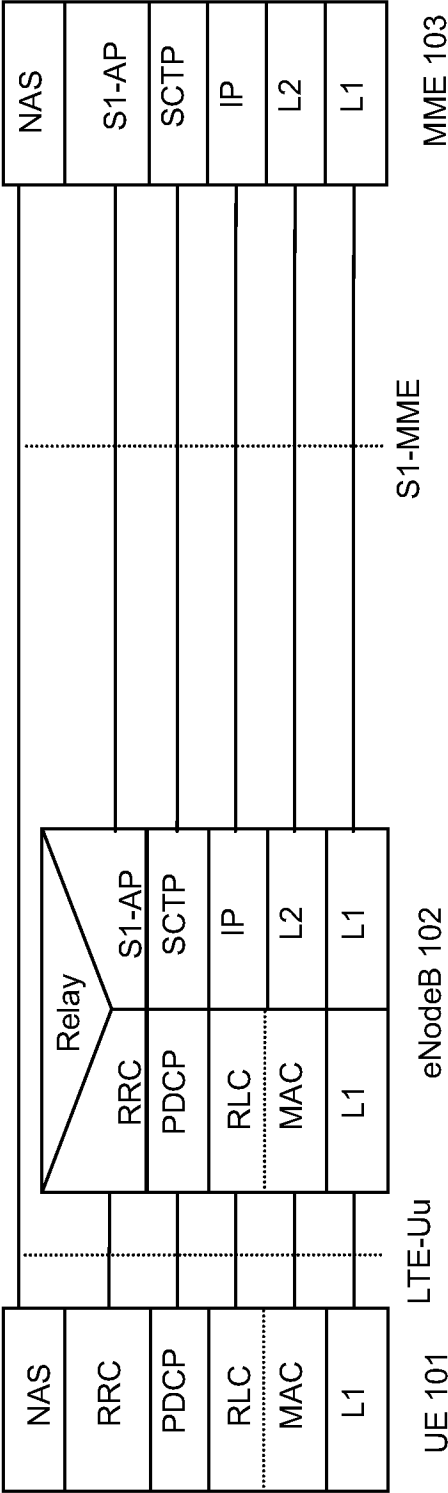


Fig. 1C

100

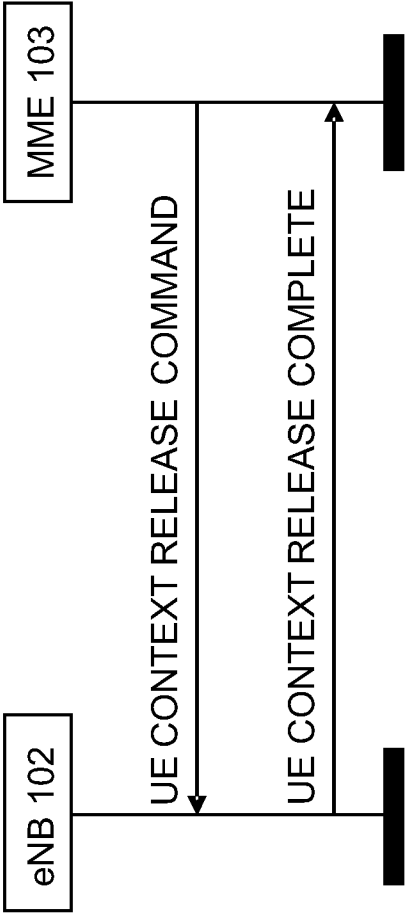


Fig. 2

200

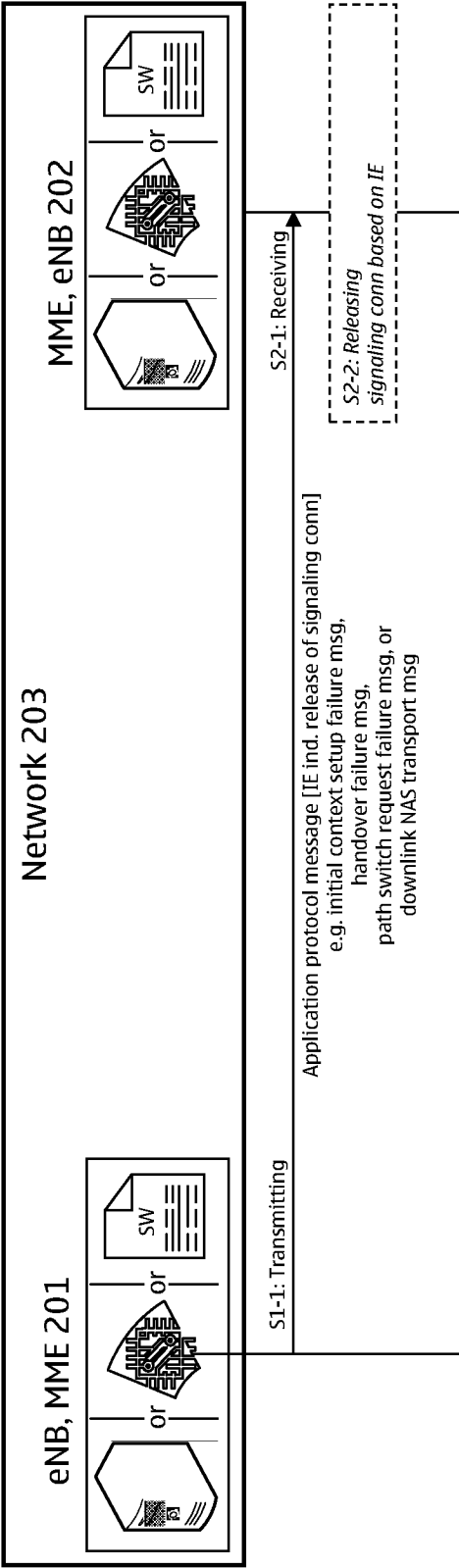


Fig. 3

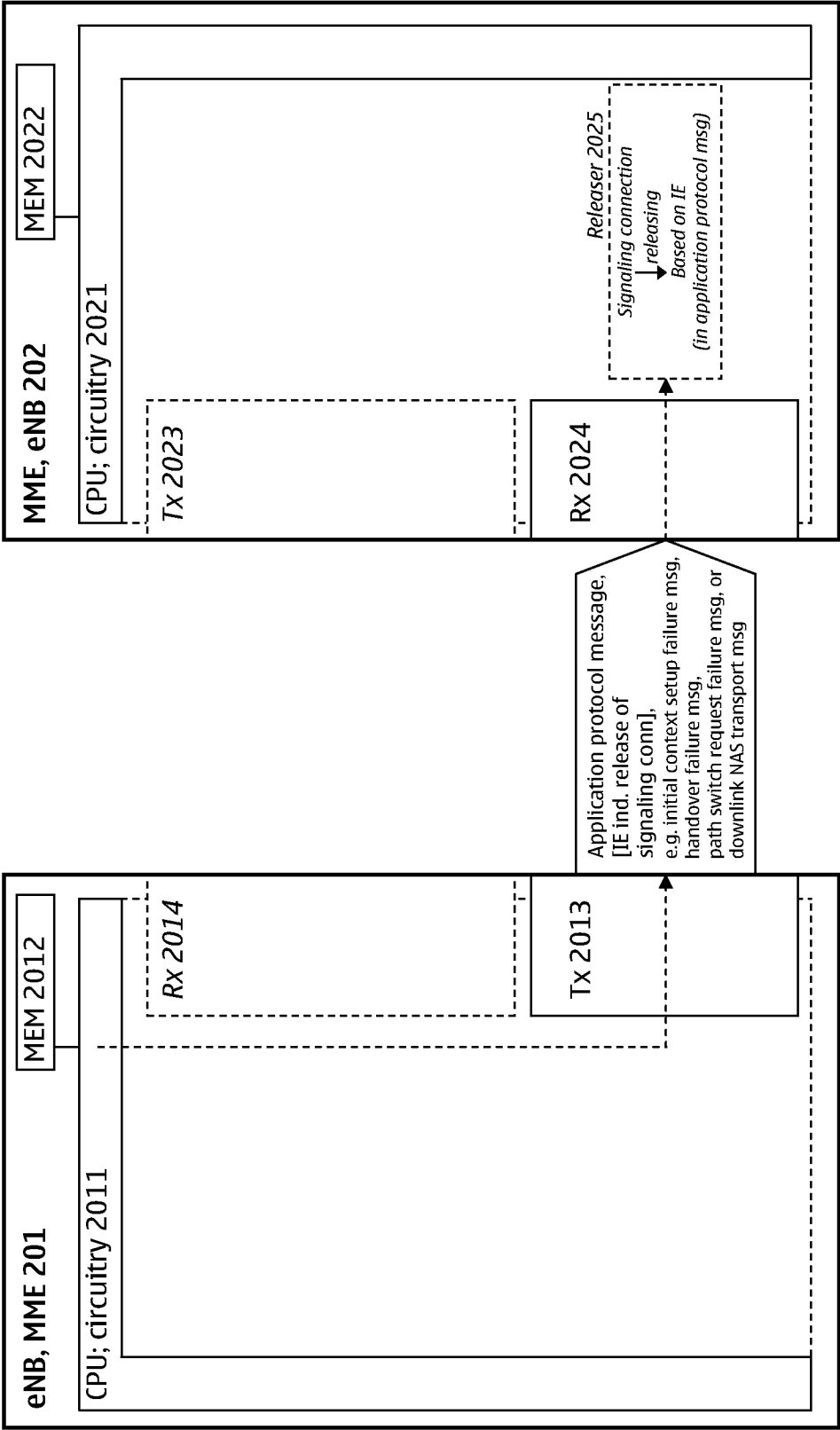


Fig. 4A

Data structure 300 (e.g. initial context setup failure)						
IE/Group Name	Presence	Range	IE type	Semantics description	Criticality	Assigned Criticality
Message Type 302	M				YES	reject
MME UE S1AP ID 303	M				YES	ignore
eNB UE S1AP ID 304	M				YES	ignore
Cause 305	M				YES	ignore
Criticality Diagnostics 306	O				YES	ignore
S1AP connection release indication 301	O				YES	ignore

Fig. 4B

Data structure 300 (e.g. handover failure)						
IE/Group Name	Presence	Range	IE type	Semantics description	Criticality	Assigned Criticality
Message Type 302	M				YES	reject
MME UE S1AP ID 303	M				YES	ignore
Cause 304	M				YES	ignore
Criticality Diagnostics 305	O				YES	ignore
S1AP connection release indication 301	O				YES	ignore

Fig. 4C

Data structure 300 (e.g. path switch request failure)						
IE/Group Name	Presence	Range	IE type	Semantics description	Criticality	Assigned Criticality
Message Type 302	M				YES	reject
MME UE S1AP ID 303	M				YES	ignore
eNB UE S1AP ID 304	M				YES	ignore
Cause 305	M				YES	ignore
Criticality Diagnostics 306	O				YES	ignore
S1AP connection release indication 301	O				YES	ignore

Fig. 4D

Data structure 300 (e.g. downlink NAS transport)						
IE/Group Name	Presence	Range	IE type	Semantics description	Criticality	Assigned Criticality
Message Type 302	M				YES	ignore
MME UE S1AP ID 303	M				YES	reject
eNB UE S1AP ID 304	M				YES	reject
NAS-PDU 305	M				YES	reject
Handover restriction list 306	O				YES	ignore
S1AP connection release indication 301	O				YES	ignore

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/058449

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W76/06

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W

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

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

EPO-Internal, COMPENDEX, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	"3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) (Release 8)" 3GPP STANDARD; 3GPP TS 36.413, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. V8.6.1, 1 June 2009 (2009-06-01), pages 1-218, XP050377697 Sections 8.3.3, 8.4.2, 8.4.4, 9.1.4.5, 9.1.4.6 and 9.1.4.7 ----- -/--	1-2,7-8, 15-16



Further documents are listed in the continuation of Box C.



See patent family annex.

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

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

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

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

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

& document member of the same patent family

Date of the actual completion of the international search

25 March 2010

Date of mailing of the international search report

06/04/2010

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/058449

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	WO 2007/037284 A1 (MATSUSHITA ELECTRIC IND CO LTD [JP]; FUKUI AKITO; AOYAMA TAKAHISA) 5 April 2007 (2007-04-05) paragraphs [0054] - [0056], [0 91] - [0098]; figures 4,5,16,17 & US 2009/270100 A1 (FUKUI AKITO [JP] ET AL) 29 October 2009 (2009-10-29) paragraphs [0054] - [0056], [0 91] - [0098]; figures 4,5,16,17 -----	1-2,7-8, 15-16
Y	WO 01/58108 A2 (QUALCOMM INC [US]) 9 August 2001 (2001-08-09) page 26, line 18 - page 27, line 2; figures 9G, 9H -----	1-2,7-8, 15-16

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International application No

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