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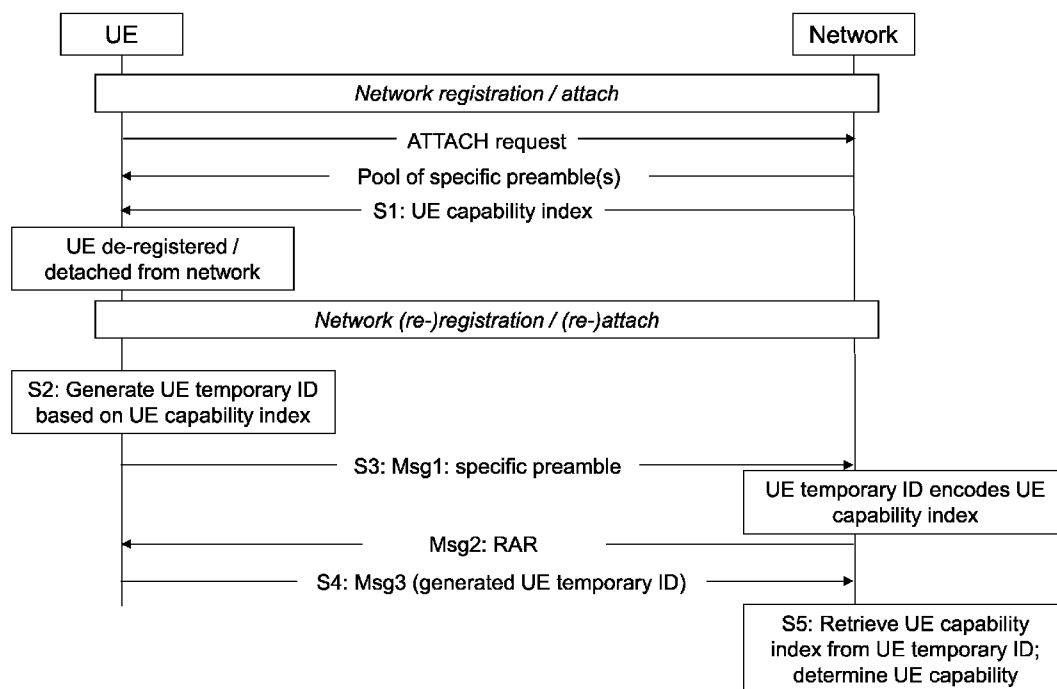


Fig. 1

(57) **Abstract:** It is provided a method, comprising generating a temporary identity of a terminal based on a capability index; indicating to the network in a random access procedure performed by the terminal for accessing the network that the terminal will identify itself in the random access procedure by the generated temporary identity; identifying the terminal in the random access procedure by the temporary identity; wherein the capability index is received by the terminal from the network prior to the random access procedure.



Informing network on UE capability

Field of the invention

- 5 The present invention relates to informing a radio network on a capability of a terminal, in particular of a detached terminal.

Abbreviations

10	3GPP	3 rd Generation Partnership Project
	3G / 4G / 5G	3 rd / 4 th / 5 th Generation
	BW	Bandwidth
	BWP	Bandwidth part
	CIoT	Cellular IoT
15	CORESET	Control Resource Set
	DL	Downlink
	DRB	Dedicated Radio Bearer
	ID	Identifier
	IoT	Internet of Things
20	LTE	Long-term Evolution
	MIB	Master Information Block
	Msg	Message
	MTC	Machine Type Communication
	NAS	Non-Access Stratum
25	NR	New Radio
	PRACH	Physical RACH
	RACH	Random Access Channel
	RAN	Radio Access Network
	RAR	Random Access Response
30	Rel	Release
	RRC	Radio Resource Control
	SAE	Service Architecture Evolution
	SIB	System Information Block
	SID	Study Item
35	S-TMSI	SAE-TMSI
	TMSI	Temporary Mobile Subscriber Identity

TR	Technical Report
TS	Technical Specification
UE	User Equipment
WiFi	Wireless Fidelity

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Background of the invention

The UE capability (e.g. related to Supported Bands and Band Combinations, Channel Bandwidths, Sub-Carrier Spacing, Carrier Aggregation, Supported MIMO layers etc.) have grown very large in recent years, with multiple enhancements done in LTE to ensure the capability is kept in check. This also holds for NR, but due to the complexity of NR, the capability is already considered to be problematic in the very first release of NR. To this end, a Rel-16 study item (SID) was created to handle this.

15 In the ongoing 3GPP TR 23.743 (Study on optimisations of UE radio capability signalling) there is a statement that: ***“The UE stores the PLMN-specific UE Capability ID in non-volatile memory when in RM-DEREGISTERED state and can use it again when it registers in the same PLMN”.***

20 In CIOT, the early capability retrieval is possible when a registered UE resumes connection to the network.

In NR system, UE accesses a cell using the MIB/SIB1 information in a complex manner: The UE only camps on a cell if it supports the so-called initial BWP (indicated in SIB1), but the UE first uses the so-called CORESET#0 from MIB to do the initial access. Once the UE receives the first RRC configuration, it may be told to start using a different BWP.

30 In the context of the present application, the terms “attach/detach” and “register/deregister” are to be read synonymously. The former term is used in 4G specifications, while the latter term is used in 5G specifications (see 3GPP TS 23.501 and 3GPP TS 23.502). Network registration and de-registration is accomplished using an attach and detach procedure, respectively.

Further relevant prior art is as follows:

35 a) Default RRC configurations allow the network to choose a configuration for a given UE even before knowing the full capabilities of the UE;

- b) EDT allows specific types of UEs to start data transmission in the uplink before establishing a full connection;
- c) PRACH partitioning allows specific UEs to gain services from the network merely by making a choice of the preamble space based on some criteria;
- 5 d) UE Information allows network to retrieve the UE capabilities;
- e) Legacy handling of UE capability allows the network to request the UE to transfer its radio capabilities for the network to configure it.

Summary of the invention

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It is an object of the present invention to improve the prior art.

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According to a first aspect of the invention, there is provided an apparatus, comprising means for generating configured to generate a temporary identity of a terminal based on a capability index; means for indicating configured to indicate to the network in a random access procedure performed by the terminal for accessing the network that the terminal will identify itself in the random access procedure by the generated temporary identity; means for identifying configured to identify the terminal in the random access procedure by the temporary identity; wherein the capability index is received by the terminal from the network prior to the random access procedure.

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According to a second aspect of the invention, there is provided an apparatus, comprising means for monitoring configured to monitor if a random access procedure of a terminal to access a network comprises an indication that the terminal identifies itself in the random access procedure by a temporary identity generated based on a capability index; means for deriving configured to derive the capability index of the terminal from the temporary identity received in the random access procedure if the random access procedure comprises the indication; means for determining configured to determine a capability of the terminal based on the capability index and a mapping table comprising one or more pairs of respective capability index and capability.

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According to a third aspect of the invention, there is provided a method, comprising generating a temporary identity of a terminal based on a capability index; indicating to the network in a random access procedure performed by the terminal for accessing the network that the terminal will identify itself in the random access procedure by the generated temporary identity; identifying the terminal in the random access procedure by the temporary

identity; wherein the capability index is received by the terminal from the network prior to the random access procedure.

5 According to a fourth aspect of the invention, there is provided a method, comprising monitoring if a random access procedure of a terminal to access a network comprises an indication that the terminal identifies itself in the random access procedure by a temporary identity generated based on a capability index; deriving the capability index of the terminal from the temporary identity received in the random access procedure if the random access procedure comprises the indication; determining a capability of the terminal based on the
10 capability index and a mapping table comprising one or more pairs of respective capability index and capability.

Each of the methods of the third and fourth aspects may be a method of informing on UE capability.
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According to a fifth aspect of the invention, there is provided a computer program product comprising a set of instructions which, when executed on an apparatus, is configured to cause the apparatus to carry out the method according to any of the third and fourth aspects. The computer program product may be embodied as a computer-readable medium or
20 directly loadable into a computer.

Further details are defined by the respective dependent claims.

According to some embodiments of the invention, at least one of the following advantages
25 may be achieved:

- Capability of the UE is known to the network right after connection request message in the random access procedure;
- Network may exploit the UE capability early;
- Backwards compatibility for both UE and network.

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

35 Brief description of the drawings

Further details, features, objects, and advantages are apparent from the following detailed description of the preferred embodiments of the present invention which is to be taken in conjunction with the appended drawings, wherein:

- 5 Fig. 1 shows a message flow according to an embodiment of the invention;
Fig. 2 shows a message flow according to an embodiment of the invention;
Fig. 3 shows a message flow according to an embodiment of the invention;
Fig. 4 shows an apparatus according to an embodiment of the invention;
Fig. 5 shows a method according to an embodiment of the invention;
10 Fig. 6 shows an apparatus according to an embodiment of the invention;
Fig. 7 shows a method according to an embodiment of the invention; and
Fig. 8 shows an apparatus according to an embodiment of the invention.

Detailed description of certain embodiments

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Herein below, certain embodiments of the present invention are described in detail with reference to the accompanying drawings, wherein the features of the embodiments can be freely combined with each other unless otherwise described. However, it is to be expressly understood that the description of certain embodiments is given by way of example only, and
20 that it is by no way intended to be understood as limiting the invention to the disclosed details.

Moreover, it is to be understood that the apparatus is configured to perform the corresponding method, although in some cases only the apparatus or only the method are
25 described.

Some example embodiments of this invention are applicable in particular to a detached UE (i.e. network has no memory of it e.g. temporary identities like S-TMSI). The detached UE may attempt to re-attach to the network. Since a temporary NAS identifier is not allocated to the UE, the UE uses a random number generated by itself during the Msg3 sending of RRC
30 Connection Setup Request (i.e. to gain access to the cell). "Msg3" indicates the 3rd message of the RA procedure (and correspondingly for Msg1, 2, etc.). It is impossible for the network to know (and infer) the UE Capability ID the UE has stored in the non-volatile memory. As a result of this, the network has to wait for several more messages (i.e. until security mode, Msg5) until it can ask the UE if it has stored any UE Capability ID. Thus, the network cannot
35 exploit the UE capability of the UE beforehand.

If the network wants to instruct the UE having received the first RRC configuration to start using a different BWP than the initial BWP, network has to consider UE capabilities to determine the BWP. However, the UE may camp on the cell even if it does not support the cell bandwidth but only supports the initial BWP bandwidth. The initial BWP may be smaller than the cell BW. Since the network does not know the UE capability, it has to instruct the UE to use a BW corresponding to the initial BWP even if the UE actually supports a larger BW. This makes even querying the UE capabilities in a later step slower than necessary.

According to some example embodiments of the invention, the network may infer UE capability immediately upon receiving connection setup request (Msg3 of RA procedure) from the UE: In order to achieve this object, the network provides an identifier (named e.g. "UE capability index") to the UE. The UE capability index indicates the capability of the UE known to the network before the UE detaches from the network (and, thus, prior to the RA procedure). UE uses UE capability index to scramble the UE identifier used in RRC connection setup request (Msg3). The network recognizes such UEs either via one or more specific bits in the connection request or via a specific PRACH preamble taken from a set of specific preambles indicated by the network. The network may also indicate whether it supports such a connection attempt to ensure compatibility with legacy UEs.

More in detail, a method according to some example embodiments of the invention is described with reference to Figs. 1 to 3. In Figs. 1 to 3, boxes with italic letters are to be read as headlines to the messages / actions further below. Some actions and messages particularly relevant for the invention are denoted by S1, S2, S3, S4, and S5. Figs. 1 to 3 differ from each other in that different options of S3 are shown.

As shown in Figs. 1 to 3, if the UE attempts to attach to the network, it sends an ATTACH request. Then, UE requests to attach to the network by an ATTACH request message.

S1: While the UE is attached (or becoming attached, or not yet becoming detached) to the network, the network indicates an index to UE ("UE Capability Index"). The index is indicative of the UE capability known to the network. The UE stores the UE capability index. The UE uses the capability index to generate the random number used as temporary UE identifier in Msg3. I.e., in NR, the random number has the same size as a S-TMSI size (i.e. the random number is 40 bits, which is the same size as used by S-TMSI in Msg3 to cope with the Msg3 size restrictions).

There are several options to provide the UE capability index to the UE:

- The network provides the UE capability index in ATTACH accept message in response to the ATTACH message. This option has the advantage that the UE may use the UE capability index even after any unexpected DETACH.
- The network provides the UE capability index in a DL NAS message, e.g. a dedicated DL NAS message. This may be particularly useful if the network does not know the UE capability immediately at ATTACH.
- The network provides the UE capability index in a DETACH message from network to UE. This option has an advantage that the UE doesn't have to store the UE capability index for unnecessarily long.

The network may use one or more of these options.

If, after some time, the UE is detached from the network, the UE may re-attach with the network. For re-attaching, the UE may perform a RA procedure.

S2: The UE generates the temporary UE identifier based on the UE capability indicator. The temporary UE identifier is to be used in Msg3 of the RA procedure.

S3: When the UE performs the RA procedure to re-attach to the network after it has been detached, it indicates to the network that it generated the random number used as UE identifier in Msg3 based on the UE capability index.

There are several options for the indication:

- In some example embodiments (e.g. that shown in Fig. 1), the network signals (either by dedicated signaling to the UE while the UE is still attached (or becoming attached, or not yet becoming detached) to the network and/or by broadcasting) a pool of PRACH resources (i.e. preambles) to be used by the UE for connection attempts if the random number used as temporary UE identifier is generated based on a UE capability index. Network may provide the pool of PRACH resources (i.e. preambles) before or together with or after the network provides the UE capability index. If the network receives Msg1 comprising a PRACH resource (i.e. a preamble) taken from the pool, network knows that the temporary UE identifier of Msg3 is generated based on the UE capability index. Network provides msg2 (RAR) in response to Msg1, as usual. According to this option, the sequence of S2 and S3 is arbitrary. According to this option, S2 and S3 may be performed fully or partly in parallel.

- 5 - In some example embodiments (e.g. that shown in Fig. 2), UE initiates RA procedure by transmitting an arbitrary preamble, and receives a corresponding RAR. Then, the UE may add (e.g. append or prepend) an indicator (e.g. a 1-bit indicator) named e.g. “UE Capability Index Indicator” to the RRC connection setup request (Msg3) to tell the network that the temporary UE identity in the RRC connection setup request was generated based on the UE capability Index (and, thus, encodes the UE Capability Index that was shared by the network earlier). In some example embodiments, the indicator may be predefined. In some example embodiments, network may inform on the indicator to be used prior to the random access procedure.
- 10 - In some example embodiments (e.g. that shown in Fig. 3), UE initiates RA procedure by transmitting an arbitrary preamble, and receives a corresponding RAR. Then, the UE may indicate a specific establishment cause in Msg3 to tell the network that the temporary UE identity in the RRC connection setup request was generated based on the UE capability Index (and, thus, encodes the UE Capability Index that was shared
- 15 by the network earlier). In some example embodiments, the specific establishment cause may be predefined. In some example embodiments, network may inform on the specific establishment cause prior to the random access procedure.

The UE may use one or more of these options.

20 **S4:** The UE sends RRC connection setup request (Msg3) to network. The temporary UE identifier used in Msg3 is the identifier generated in S2. As it is apparent from this description, for the options of the “UE capability Index Indicator” and the specific establishment cause in S2, S3 and S4 are performed by the same message, namely Msg3 of the RA procedure.

25 **S5:** If the network (e.g. gNB) receives the indication that the UE temporary identifier used in Msg3 is generated based on the UE capability index, the network applies a function inverse to the function used to generate the temporary UE identifier to the temporary UE identifier received in Msg3. Thus, network obtains the UE capability index. Based on a mapping table

30 comprising one or more pairs of (UE capability index; UE capability), network may then determine the UE capability.

Then, the RA procedure continues as usual. I.e., Network replies to Msg 3 by Msg4 (RRCSetup). In Msg5, UE confirms that the RRC connection setup is complete

35 (RRCSetupComplete). Msg5 may include a NAS message. Finally, security may be activated and a DRB may be setup. Network may take into account the UE capability from Msg4

onwards. E.g., the RRCSetup may include an indication of a BWP different from the initial BWP according to the UE capability.

In some example embodiments, network may broadcast a system information indicator that tells UEs whether the supports the RRC connection setup request using the temporary UE identity generated based on the UE capability index. This allows UEs to not employ the mechanism in networks that do not support the feature.

Fig. 4 shows an apparatus according to an embodiment of the invention. The apparatus may be a terminal such as a UE, an IoT device, a MTC device, or an element thereof. Fig. 5 shows a method according to an embodiment of the invention. The apparatus according to Fig. 4 may perform the method of Fig. 5 but is not limited to this method. The method of Fig. 5 may be performed by the apparatus of Fig. 4 but is not limited to being performed by this apparatus.

The apparatus comprises means for generating 10, means for indicating 20, and means for identifying 30. Each of the means for generating 10, means for indicating 20, and means for identifying 30 may be a generating means, indicating means, and identifying means, respectively. Each of the means for generating 10, means for indicating 20, and means for identifying 30 may be a generator, indicator, and identifier, respectively. Each of the means for generating 10, means for indicating 20, and means for identifying 30 may be a generating processor, indicating processor, and identifying processor, respectively.

The means for generating 10 generates a temporary identity of a terminal based on a capability index (S10). For example, the means for generating may perform S2 of Figs. 1 to 3. The capability index is received by the terminal from the network prior to the random access procedure discussed with respect to S20 and S30, for example in S1 of Figs. 1 to 3.

The means for indicating 20 indicates to the network in a random access procedure that the terminal will identify itself in the random access procedure by the generated temporary identity (S20). The random access procedure is performed by the terminal for accessing the network. For example, the means for indicating 20 may perform S3 of Figs. 1 to 3.

The means for identifying 30 identifies the terminal in the random access procedure by the temporary identity generated by the means for generating 10 (S30). For example, the means for indicating 20 may perform S4 of Figs. 1 to 3.

Fig. 6 shows an apparatus according to an embodiment of the invention. The apparatus may be a network function such as a base station (e.g. gNB or eNB), or an element thereof. Fig. 7 shows a method according to an embodiment of the invention. The apparatus according to Fig. 6 may perform the method of Fig. 7 but is not limited to this method. The method of Fig. 7 may be performed by the apparatus of Fig. 6 but is not limited to being performed by this apparatus.

The apparatus comprises means for monitoring 110, means for deriving 120, and means for determining 130. Each of the means for monitoring 110, means for deriving 120, and means for determining 130 may be a monitoring means, deriving means, and determining means, respectively. Each of the means for monitoring 110, means for deriving 120, and means for determining 130 may be a monitor, deriver, and determiner, respectively. Each of the means for monitoring 110, means for deriving 120, and means for determining 130 may be a monitoring processor, deriving processor, and determining processor, respectively.

The means for monitoring 110 monitors if a random access procedure of a terminal to access a network comprises an indication that the terminal identifies itself in the random access procedure by a temporary identity generated based on a capability index (S110). For example, the means for monitoring 110 may monitor if the message S3 of Figs. 1 to 3 is received.

If the random access procedure comprises the indication (S110 = yes), the means for deriving 120 derives the capability index of the terminal from the temporary identity received in the random access procedure (S120). For example, the means for deriving 120 may derive the capability index from the received message S4 of Figs. 1 to 3.

The means for determining 130 determines a capability of the terminal based on the capability index and a mapping table comprising one or more pairs of respective capability index and capability (S130). For example, the means for deriving 120 and the means for determining 130 may jointly perform S5 of Figs. 1 to 3.

Fig. 8 shows an apparatus according to an embodiment of the invention. The apparatus comprises at least one processor 810, at least one memory 820 including computer program code, and the at least one processor 810, with the at least one memory 820 and the

computer program code, being arranged to cause the apparatus to at least perform at least one of the methods according to Figs. 5 and 7.

Embodiments of the invention are described for 3GPP networks such as 3G networks, 4G networks, 5G networks. However, the invention is not restricted to 3GPP networks and may be employed in other radio networks with a random access function, too.

A UE is an example of a terminal. However, the terminal may be any device capable to connect to the (3GPP) radio network such as a MTC device, a IoT device etc.

A gNB is an example of a base station. However, the base station may be any device capable to provide a base station function in the respective radio network, such as a eNB or a NodeB.

Some example embodiments of the invention are particularly useful in case of a detached UE. However, the invention is not limited to detached UEs. For example, it may be applied to deregistered UEs, too.

S-TMSI is an example of a terminal (UE) identifier used in the RA procedure according to current 3GPP standards. However, the invention is not limited to S-TMSI. Depending on the radio standard, other temporary or permanent radio identifiers may be used.

Some example embodiments of the invention are described for a case of a re-attachment / re-registration of the UE. However, in some example embodiments of the invention, the UE may perform a RRC connection attempt (to gain access to the cell) by a RA procedure, without being detached / deregistered from the network.

In some example embodiments, the function used by UE to generate the temporary identifier used in Msg3 based on the UE capability index and its inverse function used by network to retrieve the UE capability index based on the temporary identifier received in Msg3 may be predefined. In some example embodiments, network may indicate the function to the UE while the UE is attached, e.g. at one of the occasions when network indicates the UE capability index to UE. For example, network may indicate the function together with the UE capability index.

Example functions to generate the temporary UE identifier used in Msg3 based on the UE capability index are:

- a) Generating a codeword using the UE capability index as the message vector and a generator matrix pre-agreed (or preconfigured or predefined) between the UE and the network.
- b) Generating a codeword using the UE capability index as the message vector to be used into a hash function that is pre-agreed (or preconfigured or predefined) between UE and the network.

One piece of information may be transmitted in one or plural messages from one entity to another entity. Each of these messages may comprise further (different) pieces of information.

Names of network elements, protocols, and methods are based on current standards. In other versions or other technologies, the names of these network elements and/or protocols and/or methods may be different, as long as they provide a corresponding functionality.

If not otherwise stated or otherwise made clear from the context, the statement that two entities are different means that they perform different functions. It does not necessarily mean that they are based on different hardware. That is, each of the entities described in the present description may be based on a different hardware, or some or all of the entities may be based on the same hardware. It does not necessarily mean that they are based on different software. That is, each of the entities described in the present description may be based on different software, or some or all of the entities may be based on the same software. Each of the entities described in the present description may be embodied in the cloud.

According to the above description, it should thus be apparent that example embodiments of the present invention provide, for example, a terminal such as a UE, or a component thereof, an apparatus embodying the same, a method for controlling and/or operating the same, and computer program(s) controlling and/or operating the same as well as mediums carrying such computer program(s) and forming computer program product(s). According to the above description, it should thus be apparent that example embodiments of the present invention provide, for example, a network represented by a base station such as a gNB or eNB, or a component thereof, an apparatus embodying the same, a method for controlling

and/or operating the same, and computer program(s) controlling and/or operating the same as well as mediums carrying such computer program(s) and forming computer program product(s).

- 5 Implementations of any of the above described blocks, apparatuses, systems, techniques or methods include, as non-limiting examples, implementations as hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.
- 10 It is to be understood that what is described above is what is presently considered the preferred embodiments of the present invention. However, it should be noted that the description of the preferred embodiments is given by way of example only and that various modifications may be made without departing from the scope of the invention as defined by the appended claims.

Claims:

1. Apparatus, comprising

means for generating configured to generate a temporary identity of a terminal based
5 on a capability index;

means for indicating configured to indicate to the network in a random access
procedure performed by the terminal for accessing the network that the terminal will identify
itself in the random access procedure by the generated temporary identity;

means for identifying configured to identify the terminal in the random access
10 procedure by the temporary identity; wherein

the capability index is received by the terminal from the network prior to the random
access procedure.

2. The apparatus according to claim 1, further comprising

15 means for monitoring configured to monitor if an information is received from the
network that the network supports the temporary identity;

means for inhibiting configured to inhibit at least one of the means for generating from
generating, the means for indicating from indicating, and the means for identifying from
identifying if the information is not received from the network.

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3. The apparatus according to any of claims 1 and 2, wherein

the means for indicating is configured to indicate that the terminal will identify itself by
the temporary identity by at least one of

- providing a specific indicator in a connection request message of the random
25 access procedure; and
- providing a specific establishment cause in the connection request message
of the random access procedure.

4. The apparatus according to any of claims 1 to 3, further comprising

30 means for selecting configured to select a preamble out of a pool of one or more
preambles received from the network prior to the random access procedure, wherein

the pool of the one or more preambles is for indicating that the terminal will identify
itself by the temporary identity; and

the means for indicating is configured to indicate that the terminal will identify itself by
35 the temporary identity by initiating the random access procedure with the selected preamble.

5. The apparatus according to any of claims 1 to 4, wherein
the capability index is received in at least one of the following messages received
from the network prior to the random access procedure:

- an attach accept message;
- a non-access stratum message; and
- a detach message.

6. The apparatus according to any of claims 1 to 5, wherein
the means for identifying is configured to identify the terminal by the temporary
identity in a connection request message of the random access procedure.

7. Apparatus, comprising

means for monitoring configured to monitor if a random access procedure of a
terminal to access a network comprises an indication that the terminal identifies itself in the
random access procedure by a temporary identity generated based on a capability index;

means for deriving configured to derive the capability index of the terminal from the
temporary identity received in the random access procedure if the random access procedure
comprises the indication;

means for determining configured to determine a capability of the terminal based on
the capability index and a mapping table comprising one or more pairs of respective
capability index and capability.

8. The apparatus according to claim 7, further comprising

means for providing configured to provide the capability index to the terminal prior to
the random access procedure.

9. The apparatus according to claim 8, wherein

the means for providing is configured to provide the capability index in at least one of
the following messages prior to the random access procedure:

- an attach accept message;
- a non-access stratum message; and
- a detach message.

10. The apparatus according to any of claims 7 to 9, wherein

the means for monitoring is configured to monitor if the random access procedure
comprises the indication by monitoring at least one of the following:

- a connection request message of the random access procedure comprises a specific indicator; and
- the connection request message of the random access procedure comprises a specific establishment cause.

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11. The apparatus according to any of claims 7 to 10, further comprising

means for informing configured to inform on a predefined pool of one or more preambles; wherein

10 the means for monitoring is configured to monitor if the random access procedure comprises the indication by monitoring if one of the preambles of the predefined pool is received in the random access procedure.

12. The apparatus according to any of claims 7 to 11, wherein

15 the means for deriving is configured to derive the capability index of the terminal from the temporary identity received in a connection request message of the random access procedure.

13. Method, comprising

20 generating a temporary identity of a terminal based on a capability index; indicating to the network in a random access procedure performed by the terminal for accessing the network that the terminal will identify itself in the random access procedure by the generated temporary identity;

identifying the terminal in the random access procedure by the temporary identity; wherein

25 the capability index is received by the terminal from the network prior to the random access procedure.

14. The method according to claim 13, further comprising

30 monitoring if an information is received from the network that the network supports the temporary identity;

inhibiting at least one of the generating, the indicating, and the identifying if the information is not received from the network.

15. The method according to any of claims 13 and 14, wherein

35 the indicating that the terminal will identify itself by the temporary identity comprises at least one of

- providing a specific indicator in a connection request message of the random access procedure; and
- providing a specific establishment cause in the connection request message of the random access procedure.

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16. The method according to any of claims 13 to 15, further comprising

selecting a preamble out of a pool of one or more preambles received from the network prior to the random access procedure, wherein

10 the pool of the one or more preambles is for indicating that the terminal will identify itself by the temporary identity; and

the indicating that the terminal will identify itself by the temporary identity comprises initiating the random access procedure with the selected preamble.

17. The method according to any of claims 13 to 16, wherein

15 the capability index is received in at least one of the following messages received from the network prior to the random access procedure:

- an attach accept message;
- a non-access stratum message; and
- a detach message.

20

18. The method according to any of claims 13 to 17, wherein

the means for identifying is configured to identify the terminal by the temporary identity in a connection request message of the random access procedure.

25 19. Method, comprising

monitoring if a random access procedure of a terminal to access a network comprises an indication that the terminal identifies itself in the random access procedure by a temporary identity generated based on a capability index;

30 deriving the capability index of the terminal from the temporary identity received in the random access procedure if the random access procedure comprises the indication;

determining a capability of the terminal based on the capability index and a mapping table comprising one or more pairs of respective capability index and capability.

20. The method according to claim 19, further comprising

35 providing the capability index to the terminal prior to the random access procedure.

21. The method according to claim 20, wherein

the capability index is provided in at least one of the following messages prior to the random access procedure:

- an attach accept message;
- a non-access stratum message; and
- a detach message.

22. The method according to any of claims 19 to 21, wherein

the monitoring if the random access procedure comprises the indication comprises monitoring at least one of the following:

- a connection request message of the random access procedure comprises a specific indicator; and
- the connection request message of the random access procedure comprises a specific establishment cause.

23. The method according to any of claims 19 to 22, further comprising

informing on a predefined pool of one or more preambles; wherein

the monitoring if the random access procedure comprises the indication comprises monitoring if one of the preambles of the predefined pool is received in the random access procedure.

24. The method according to any of claims 19 to 23, wherein

the capability index of the terminal is derived from the temporary identity received in a connection request message of the random access procedure.

25. A computer program product comprising a set of instructions which, when executed on an apparatus, is configured to cause the apparatus to carry out the method according to any of claims 13 to 24.

26. The computer program product according to claim 25, embodied as a computer-readable medium or directly loadable into a computer.

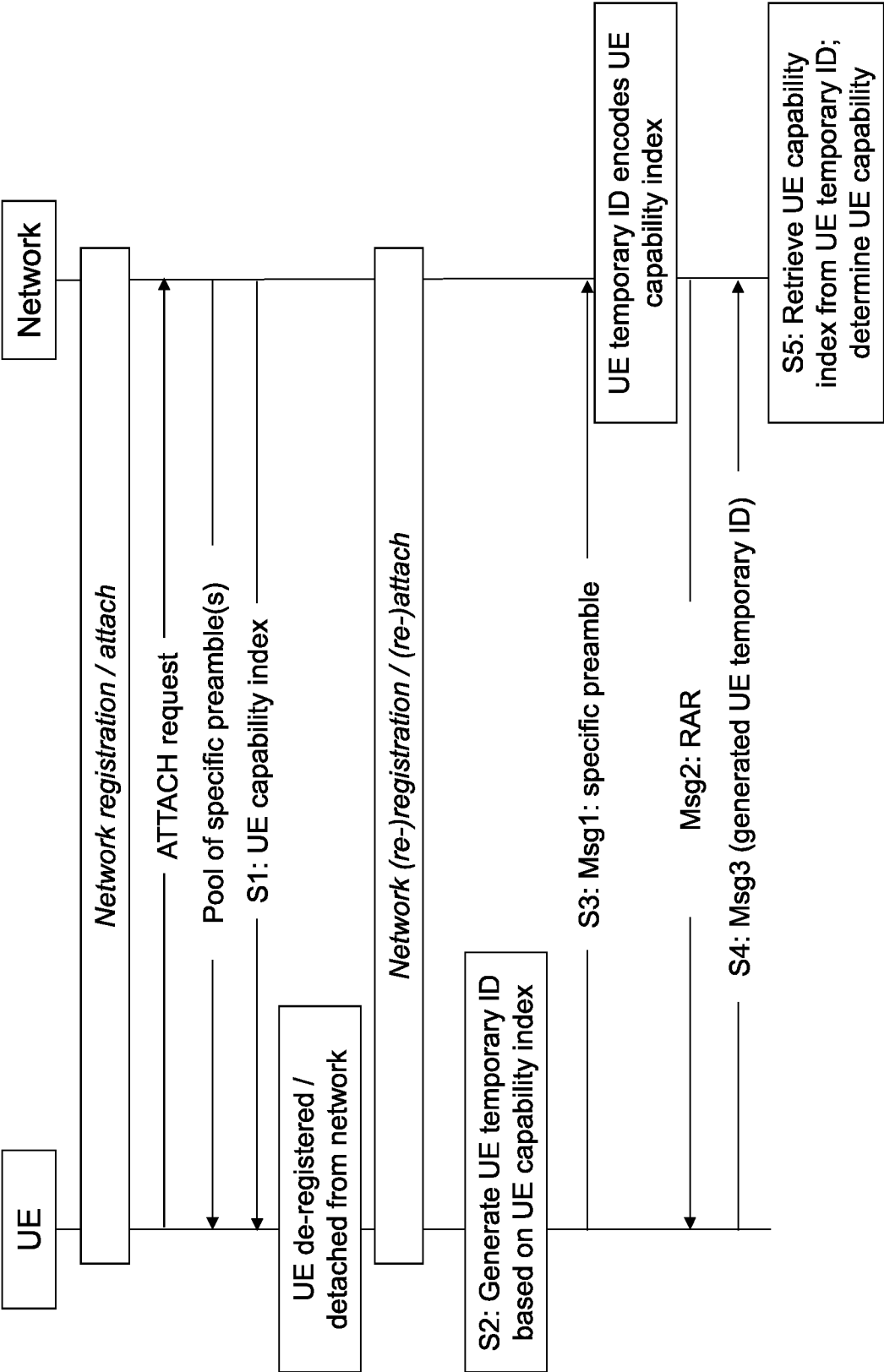


Fig. 1

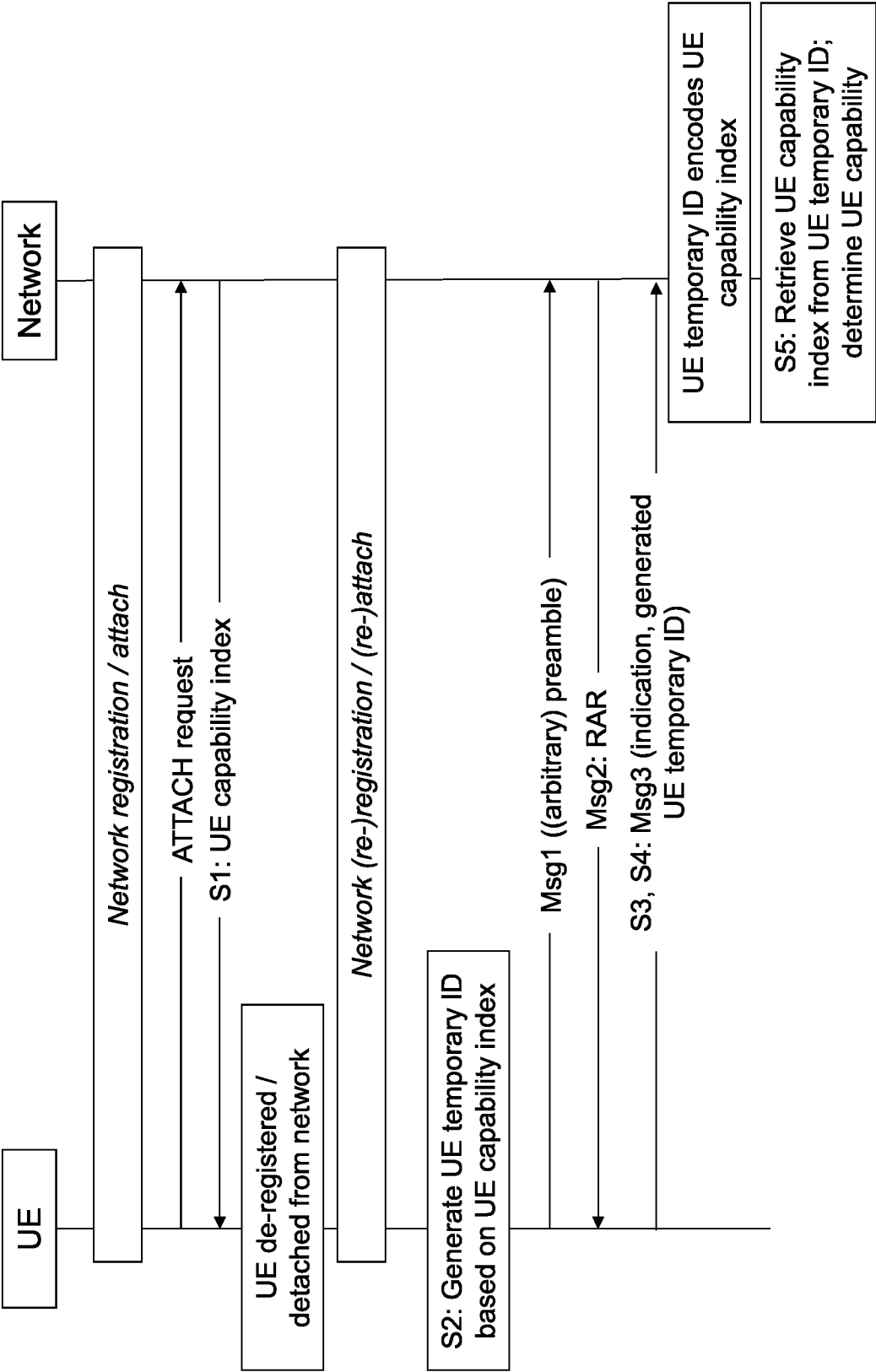


Fig. 2

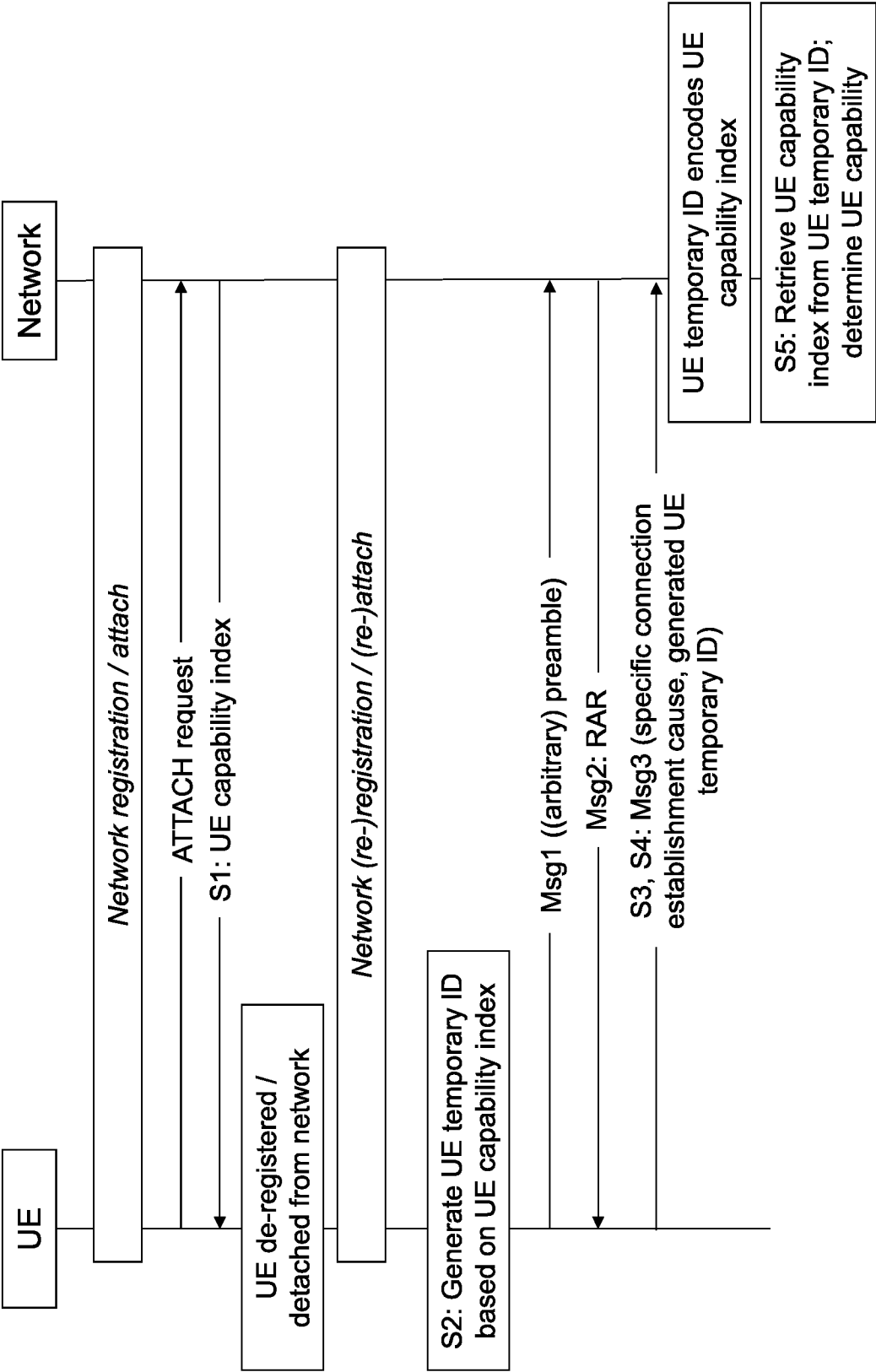


Fig. 3

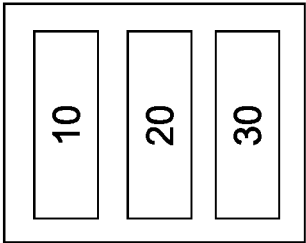


Fig. 4

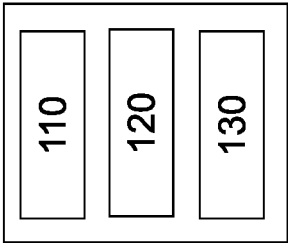


Fig. 6

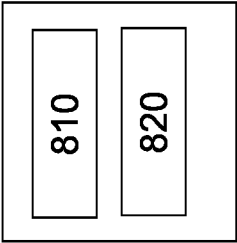


Fig. 8

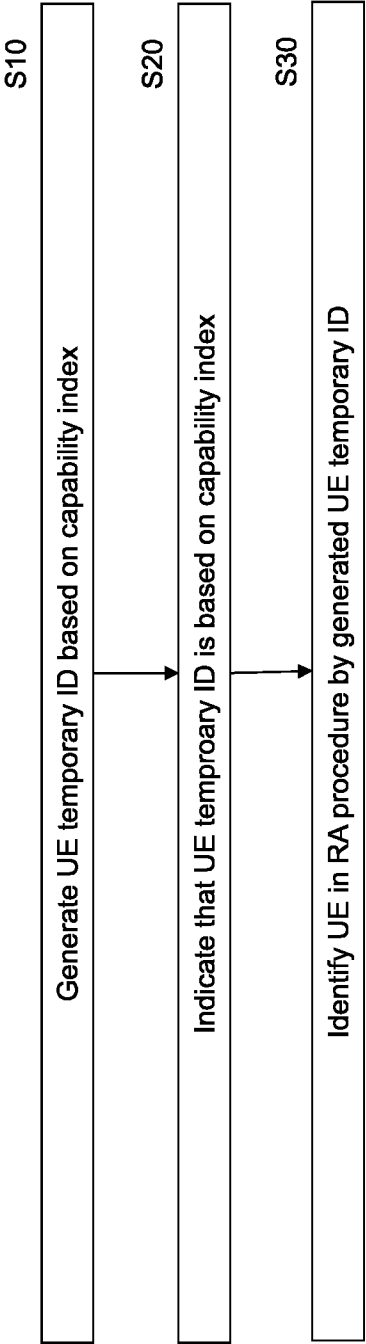


Fig. 5

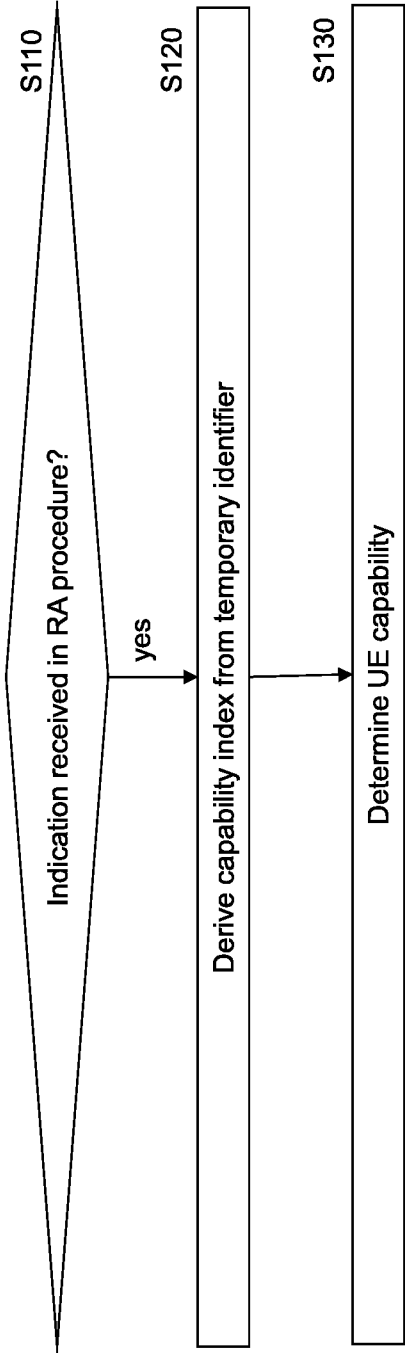


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/055821

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W74/08 H04W8/24
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

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, INSPEC, IBM-TDB, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 214 445 A1 (LG ELECTRONICS INC [KR]) 4 August 2010 (2010-08-04)	1,2,4-9, 11-14, 16-21, 23-26
Y	paragraph [0059] - paragraph [0064]; figures 1,7,8 paragraph [0072] - paragraph [0076]; figure 9 ----- -/--	3,10,15, 22



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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

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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

5 November 2019

Date of mailing of the international search report

12/11/2019

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Vercauteren, Steven

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/055821

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	SAMSUNG: "Indication of Cat.0 UE capability", 3GPP DRAFT; R2-144242, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Shanghai, P. R. China; 20141006 - 20141010 26 September 2014 (2014-09-26), XP050870217, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_87bis/Docs/ [retrieved on 2014-09-26] section 2 -----	3,10,15, 22
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2019/055821

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			US 2011287776 A1	24-11-2011
			WO 2010087569 A1	05-08-2010
