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(71) Applicant (for all designated States except US): **TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)**
[SE/SE]; Torshamnsgatan 23, S-126 25 Stockholm (SE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **WALLENTIN, Pontus** [SE/SE]; Hjälmåsättersgatan 2B, S-582 17 Linköping (SE).

(74) Agent: **MAGNUSSON, Monica**; c/o Ericsson AB, Patent Unit Radio Networks, S-164 80 Stockholm (SE).

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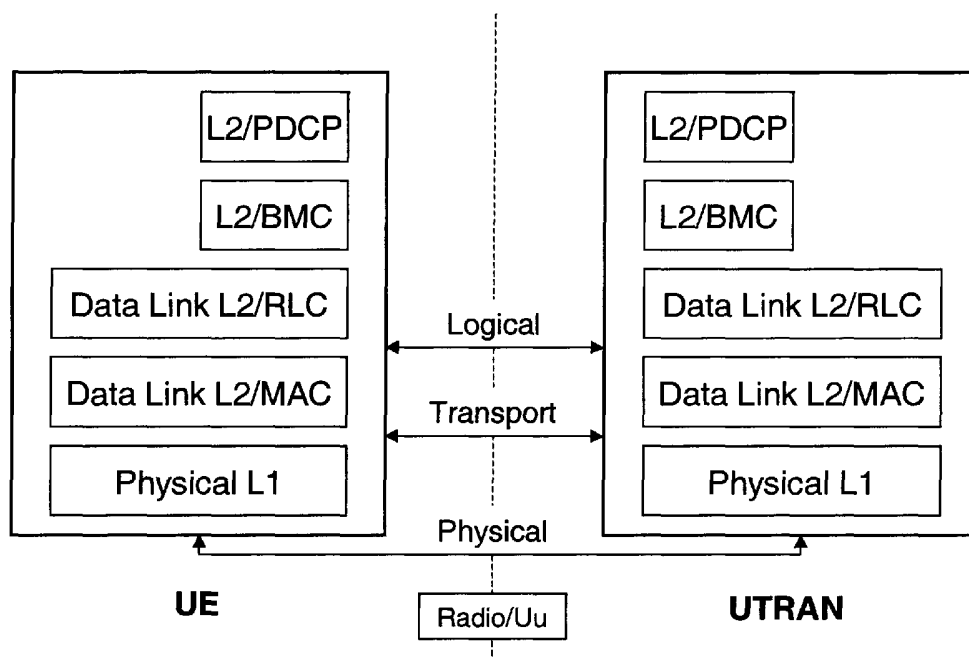
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(54) Title: METHOD AND SYSTEM OF FAILURE AVOIDANCE



(57) Abstract: The present invention relates to transmissions and retransmissions in a communications system. Especially, it relates to radio link transmissions and avoidance of message transmission failures, such as paging failures, in a cellular mobile radio system, particularly a Universal Mobile Telecommunications System, UMTS, or WCDMA system.



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Method and system of failure avoidance

TECHNICAL FIELD OF THE INVENTION

The present invention relates to transmissions and retransmissions in a communications system. Especially, it relates to radio link transmissions and avoidance of message transmission failures, such as paging failures, in a cellular mobile radio system, particularly a Universal Mobile Telecommunications System, UMTS, or WCDMA system.

BACKGROUND AND DESCRIPTION OF RELATED ART

10 In many radio communications system, such as UMTS, mobile stations and user equipment are paged when there is an incoming call. Paging is commonly initiated from a controlling element of a radio access network, such as a radio network controller, RNC.

15 Within this patent application, a radio network controller, RNC, is understood as a network element including an RRM (Radio Resource Management) entity. The RNC is connected to a fixed network. Node B is a logical node responsible for radio transmission/reception in one or more cells
20 to/from a User Equipment. A base station, BS, is a physical entity representing Node B.

With reference to figure 1, base stations «BS 1» and «BS 2» are physical entities representing Nodes B «Node B 1» and «Node B 2» respectively. «Node B 1» and «Node B 2» terminate the air interface, called Uu interface within UMTS,
25 between UE and respective Node B towards the radio network controller «RNC». «RNC» is connected to a fixed network «Network».

In figure 1, the base stations are connected to the same radio network controller RNC. However, this specification also covers the exemplary situation where the base stations are connected to different RNCs. In UMTS, the RLC protocol
5 is terminated in a serving RNC, SRNC, responsible for interconnecting the radio access network of UMTS to a core network «Network».

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, Radio Interface Protocol Architecture, 3GPP TS 25.301 v3.6.0, France, September*
10 *2000*, describes an overall protocol structure of a Universal Mobile Telecommunications System (UMTS). There are three protocol layers:

- physical layer, layer 1 or L1,
- 15 - data link layer, layer 2 or L2, and
- network layer, layer 3 or L3.

Layer 2, L2, and layer 3, L3 are divided into Control and User Planes. Layer 2 consists of two sub-layers, RLC and MAC, for the Control Plane and four sub-layers, BMC, PDCP,
20 RLC and MAC, for the User Plane. The acronyms BMC, PDCP, RLC and MAC denote Broadcast/Multicast Control, Packet Data Convergence Protocol, Radio Link Control and Medium Access Control respectively.

Figure 2 displays a simplified UMTS layers 1 and 2 protocol
25 structure for a Uu Stratum, UuS, or Radio Stratum, between a User Equipment UE and a Universal Terrestrial Radio Access Network, UTRAN.

Radio Access Bearers, RABs, are associated with the application for transportation of services between core network,
30 CN, and user equipment, UE, through a radio access network. Each RAB is associated with quality attributes such as

service class, guaranteed bit rate, transfer delay, residual BER, and traffic handling priority. An RAB may be assigned one or more Radio Bearers, RBs, being responsible for the transportation between UTRAN and UE. For each mobile station there may be one or several RBs representing a radio link comprising one or more channels between UE and UTRAN. Data flows (in the form of segments) of the RBs are passed to respective Radio Link Control, RLC, entities which amongst other tasks buffer the received data segments. There is one RLC entity for each RB. In the RLC layer, RBs are mapped onto respective logical channels. A Medium Access Control, MAC, entity receives data transmitted in the logical channels and further maps logical channels onto a set of transport channels. In accordance with subsection 5.3.1.2 of the 3GPP technical specification MAC should support service multiplexing e.g. for RLC services to be mapped on the same transport channel. In this case identification of multiplexing is contained in the MAC protocol control information.

Transport channels are finally mapped to a single physical channel which has a total bandwidth allocated to it by the network. In frequency division duplex mode, a physical channel is defined by code, frequency and, in the uplink, relative phase (I/Q). In time division duplex mode a physical channel is defined by code, frequency, and time-slot. As further described in subsection 5.2.2 of the 3GPP technical specification, the L1 layer is responsible for error detection on transport channels and indication to higher layer, FEC encoding/decoding and interleaving/deinterleaving of transport channels.

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, Radio Link Control (RLC) protocol specification, 3GPP TS 25.322 v4.4.0,*

France, March 2002, specifies the RLC protocol. The RLC layer provides three services to the higher layers:

- transparent data transfer service,
- unacknowledged data transfer service, and
- 5 - acknowledged data transfer service,

in the sequel referred to as transparent mode, TM, unacknowledged mode, UM, and acknowledged mode, AM, respectively.

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, Radio Link Control (RLC) protocol specification, 3GPP TS 25.331 v3.9.0, France, December 2001*, specifies radio resource control, RRC, protocol. Section 8.1.2 describes paging and section 8.3.1 describes cell and UTRAN registration area, URA, up-
10 date procedures. Section 8.5.6 describes radio link failure criteria and actions upon radio link failure. Section 10.2.20 describes Paging Type 1, using PCCH (Paging Control Channel), and Paging Type 2, using DCCH (Dedicated Control Channel), messages for paging. Section 10.3.3.47 briefly
15 describes u-RNTI (UTRAN Radio Network Temporary Identity) being allocated to a UE having an RRC connection and identifying the UE within UTRAN.
20

At paging, paging messages are transferred to a Node B communicating with the UE (in states CELL_DCH, CELL_FACH or
25 CELL_PCH) or to one or more Nodes B in one or more areas where UE is expected to be (in state URA_PCH).

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, UTRAN Overall Description, 3GPP TS 25.401 v3.6.0, France, March 2001*, comprises
30 an overall description of UTRAN. Among other things it de-

scribes in section 6.1.7 UE identifiers. There are four types of radio network temporary identifiers, RNTIs,

1. Serving RNC RNTI (s-RNTI);
2. Drift RNC RNTI (d-RNTI);
- 5 3. Cell RNTI (c-RNTI);
4. UTRAN RNTI (u-RNTI).

s-RNTI is used by UE to uniquely identify itself to a Serving RNC, SRNC. It is also used by SRNC to address the UE and by Drift RNC, DRNC, to identify the UE to Serving RNC.
10 s-RNTI is allocated for all UEs having an RRC connection. s-RNTI is reallocated when the SRNC for an RRC connection is changed. At RRC connection establishment, a UE context is defined in SRNC. The UE context encompasses a state (CELL_DCH, CELL_FACH, CELL_PCH or URA_PCH state).

15 d-RNTI is used by serving RNC to identify the UE to Drift RNC, DRNC. The d-RNTI is never used on radio interface Uu. d-RNTI is allocated by DRNC upon UE contexts establishment and it shall be unique within the DRNC. Serving RNC shall know the mapping between s-RNTI and the d-RNTIs allocated
20 in DRNCs for the same UE. DRNC shall know the s-RNTI and SRNC-ID related to existing d-RNTI within the DRNC.

c-RNTI is used by UE to identify itself to controlling RNC, CRNC, and by CRNC to address the UE. It is allocated by CRNC upon UE accessing a new cell. c-RNTI shall be unique
25 within the accessed cell. CRNC shall know the d-RNTI associated to the c-RNTI within the same logical RNC (if any). For the initial access a unique core network UE identifier is used. c-RNTI is used as a UE identifier in all other DCCH/DTCH common channel messages on air interface.

u-RNTI is allocated to a UE having an RRC connection and identifies the UE within UTRAN. u-RNTI is composed of SRNC identity and s-RNTI.

5 u-RNTI is used as a UE identifier for the first cell access (at cell change) when an RRC connection exists for the UE and for UTRAN originated paging including associated response messages. RNC-ID is used by Controlling RNC to route the received uplink messages towards SRNC.

Figure 3 illustrates Paging Type 1 message elements according to 3GPP TS 25.331 v3.9.0. This message is used to send information on the paging channel. One or several UEs, in idle or connected mode, can be paged in one message. «Message Type» is a message type defined for the logical channel type (Paging Control Channel, PCCH, for Paging Type :
10 1. «Paging Record List» comprises an integer between 1 and 8, indicating the number of UEs paged in the Paging Type 1 message and also indicating the number of paging records «Paging Record» in the Paging Type 1 message. There is one paging record «Paging Record» for each UE paged in the message.
20 Each paging record comprises paging cause, CN domain identity, UE identity (IMSI(GSM-MAP), TMSI(GSM-MAP/P-TMSI(GSM-MAP), IMSI(DS-41) or TMSI (DS-41)), u-RNTI and CN originated page to connected mode UE (including paging cause, CN domain identity and paging record type identifier
25 described below in relation to figure 4). To reach UEs in idle mode, CELL_PCH state and URA_PCH state, the information element «BCCH modification info» is contained in a PAGING TYPE 1 message transmitted on the PCCH in all paging occasions in the cell. It comprises two integers: an MIB
30 (Master Information Block) value tag between 1 and 8 and an integer representing BCCH modification time. For modification of some system information elements, e.g. reconfiguration of the channels, it is important for the UE to know

exactly when a change occurs. In such cases, the UTRAN should notify SFN (System Frame Number), indicating when the change will occur, and new value tag for the master information block.

5 Figure 4 illustrates Paging Type 2 message elements according to 3GPP TS 25.331 v3.9.0. This message is used to page a UE in connected mode, when using the DCCH for CN originated paging. The information element «RRC transaction identifier» may be used, together with information element
10 «Message Type», for identification of an invocation of a downlink procedure (transaction) as specified in section 8.3.6.11 of 3GPP TS 25.331 v3.9.0. «Integrity Check Info» comprises, e.g., an information element with authentication code. If no Integrity Check Info is present, the message
15 is discarded. «Paging Cause» and «Paging Record Type ID» are forwarded to higher layers. Paging cause is an enumerated reference representing e.g. terminating conversational, streaming, interactive or background call. «CN Domain ID» indicates whether core network domain is Circuit
20 Switched or Packet Switched. The information is routed to higher layers. Paging Record Type ID is an enumerated information element representing e.g. IMSI(GSM-MAP), TMSI(GSM-MAP)/P-TMSI, IMSI(DS-41) or TMSI.

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network*, UTRAN Iur interface
25 RNSAP signaling, 3GPP TS 25.423 v3.6.0, France, June 2001, comprises an overall description of the Iur signaling protocol RNSAP (Radio Network System Application Part).

A UE Context contains the necessary information for a Drift
30 RNC, DRNC, to communicate with a specific UE. The UE Context is created by a Radio Link Setup procedure or by an Uplink Signaling Transfer procedure when UE makes its first

access in a cell controlled by the DRNS. The UE Context is deleted by the Radio Link Deletion procedure, by the Common Transport Channel Resources Release procedure, or by the Downlink Signaling Transfer procedure when neither any Ra-
5 dio Links nor any common transport channels are established for the UE concerned.

International Patent Application WO9204782 discloses busy and out-of-range indicators in time division duplex systems for distinguishing different causes of radio link failure.

10 *Japanese Patent Application JP2001352570* reveals transmission of URA paging to a drift base-station control station and a mobile station, and after cell update transmission of a paging message from the drift base-station control station to the mobile station.

15 None of the cited documents above discloses a method and system, particularly for paging, providing avoidance of failure or locking due to state inconsistency. Specifically, none of the cited documents reveals a method and system of transmitting different paging messages during
20 different time intervals or transmitting information elements enabling reception of paging messages.

SUMMARY OF THE INVENTION

At radio link failure and during cell update, there is an uncertainty as to whether a mobile station or User Equip-
25 ment can receive information transmitted from a base station or Node B to which it is connected, or at least was prior to the radio link failure.

Depending on operating mode of a User Equipment, it is required to be paged accordingly. There are at least two
30 types of paging, in the sequel referred to as Paging Type 1 and Paging Type 2.

Basically, state inconsistency between user equipment and RNC causes problems. According to prior art there is a risk of RNC operating as if the user equipment were operating in one mode, whereas it is actually operating in another mode.

Another problem occurs due to a User Equipment, which does not receive signals carrying parameters sent from RNC, cannot properly receive messages, such as paging messages, transmitted later on and requiring this information.

Consequently, it is an object of this invention to provide a method and system of paging a User Equipment such that the User Equipment can be paged irrespective of state or mode inconsistencies.

It is also an object to incorporate one or more information elements required for retrieving the paging message.

Another object is to page User Equipment on shared or common control channels other than paging control channel, PCCH.

A further object is to assign proper control channel and transmission mode for transport of the required one or more information elements.

A still further object is to relate paging message type to state changes and state periods.

Finally, it is an object to introduce a mechanism for reducing paging delay.

These objects are met by the invention, which is particularly well suited for a Universal Mobile Telecommunications System, UMTS, transmitting different paging messages during

different time intervals or transmitting information elements enabling reception of paging messages.

Preferred embodiments of the invention, by way of examples, are described with reference to the accompanying drawings
5 below.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows communication between a UE and a base station involved in a connection between an RNC and the UE.

Figure 2 displays a layered protocol structure, according
10 to prior art, in a radio communications system.

Figure 3 illustrates Paging Type 1 message elements according to prior art.

Figure 4 illustrates Paging Type 2 message elements according to prior art.

15 Figure 5 illustrates a timing diagram of a successful cell update at an exemplary radio link failure.

Figure 6 shows a timing diagram of an unsuccessful cell update when a User Equipment cannot be reached within preset time limit and maximum number of cell update attempts
20 at an exemplary radio link failure.

Figure 7 depicts a timing diagram of an unsuccessful cell update when a suitable cell is not found within prescribed time limit at an exemplary radio link failure.

Figure 8 illustrates paging and problems related with paging
25 ing and state and mode inconsistencies.

Figure 9 displays a flowchart schematically illustrating paging according to a first embodiment of the invention.

Figure 10 shows a flowchart schematically illustrating paging according to a second embodiment of the invention.

Figure 11 illustrates Paging Type 2 message elements according to a fourth and fifth embodiment of the invention.

5 DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to figure 1, paging messages and other messages are transmitted over the radio interface between «UE/Client Device» and «BS 2/Node B 2». Paging messages are transmitted in downlink direction. In uplink direction
10 «BS 2/Node B 2» represents the receiver side of the radio interface and in downlink direction receiver side is represented by «UE/Client Device» and «BS 2/Node B 2» is on the transmitter side. Paging is commonly initiated from a controlling element of a radio access network, such as a radio ;
15 network controller «RNC».

Figure 5 illustrates a timing diagram of a successful cell update at an exemplary radio link failure. An established radio link is considered to be out of sync when received signal quality deteriorates below a specified level for a
20 specified time. In figure 5, a User Equipment «UE» detects downlink criteria for out-of-sync being fulfilled and registers a radio link failure. Assuming a Radio Access Bearer, RAB, has been established for the packet-switched, PS, domain, the RAB is associated with a first timer
25 «T315».

User Equipment «UE» will start the first timer «T315» when it detects a radio link failure. From the use of timer «T315», User Equipment «UE» can be guaranteed to enter idle mode if it does not recover from the radio link failure
30 within a prescribed time interval. The timer «T315» is stopped, and possibly reset, if the recovery is successful.

In the case illustrated this occurs when cell update is confirmed.

«Node B» sends a radio link failure indication «Radio Link Failure Indication» to radio network controller «RNC».

5 When «UE» starts a cell update procedure in response to the radio link failure criteria being fulfilled, it sends a cell update message «Cell Update», destined for radio network controller «RNC» and transmitted over «Node B». The User Equipment «UE» enters Forward Access Channel state
10 «Cell_FACH», sets a counter «V302» to 1 and starts a second timer «T302». Both first and second timers «T315, T302» are stopped when User Equipment «UE» receives a cell update confirm message «Cell Update Confirm» from radio network controller «RNC». In response to a received cell update
15 confirm message an exemplary physical channel reconfiguration complete message destined for «RNC» is sent over «Node B», completing the cell update procedure.

If, however, User Equipment «UE» does not receive the cell update confirm message «Cell Update Confirm» within a pre-
20 set time, the process is as shown in the timing diagram of figure 6. User Equipment «UE» checks the counter «V302», which is increased by one for each transmitted cell update message «Cell Update». If the present value of the counter «V302» is not greater than a preset threshold value «N302»,
25 it transmits a second cell update message «Cell Update» and increases the counter «V302» by one and the second timer «T302» is restarted. Further cell update messages may be transmitted each time the second timer «T302» elapses after a restart at transmission of a cell update message «Cell
30 Update» as long as the preset threshold value is not exceeded by the counter «V302». If the present value of the counter «V302» becomes greater than the preset threshold

value «N302», User Equipment «UE» enters idle mode. Exemplary time intervals for this to occur are between 0.1 s and 64 s.

In figures 5 and 6, it is anticipated that a suitable cell
5 (or base station) is found before the first timer «T315» times out, to which cell a cell update message «Cell Update» could be transmitted.

Figure 7 depicts a timing diagram of an unsuccessful cell update when a suitable cell is not found prior to the first
10 timer «T315» timing out after a prescribed time interval at an anticipated radio link failure. Exemplary time intervals are in the range 1800 s (30 min) or shorter. A radio link failure message is transmitted from «Node B» to radio network controller «RNC» as in figures 5 and 6.

15 When the first timer «T315» times out, User Equipment «UE» enters idle mode.

UTRAN uncertainties as regards UE operating modes, such as connected mode and idle mode, and different states, such as CELL_FACH state and CELL_DCH state, entail problems when it
20 comes message transmissions from Universal Terrestrial Radio Access Network, UTRAN, e.g. when paging for incoming calls. Below, paging messages are used to illustrate such messages.

When UTRAN receives a request from Core Network, CN, to
25 page user equipment UE, RNC parameters, e.g. IMSI (International Mobile Subscriber Identity), TMSI (Temporary Mobile Subscriber Identity) and P-TMSI (Packet Temporary Mobile Subscriber Identity), for selection of appropriate paging method are included.

30 - If RNC does not have a context for received IMSI, RNC assumes that UE is in idle mode and

prepares paging using a Paging Type 1 message, paging User Equipment by the CN user equipment identity, such as IMSI, TMSI or P-TMSI.

- 5 - If RNC does have a context for received user equipment identity, RNC either sends a Paging Type 1 or a Paging Type 2 message:

- 10 * If UE is in CELL_DCH or CELL_FACH state, a Paging Type 2 message is typically sent to UE on DCCH. DCCH is mapped to FACH or DCH.
- 15 * If UE is in CELL_PCH or URA_PCH state, a Paging Type 1 message is generally sent on PCCH, paging User Equipment by u-RNTI. PCCH is mapped to PCH.

This is illustrated in figure 8.

Since DCCH is a dedicated control channel messages transmitted on this channel are received only by the dedicated destination, whereas messages transmitted on a broadcast
20 channel such as PCCH are received by all User Equipments camping on the cell where the message is transmitted.

When UE is in connected mode, it listens for both Paging Type 1 and Paging Type 2 messages, whereas according to existing standardization, it is only required to listen to
25 Paging Type 1 messages with CN user equipment identity (IMSI, TMSI, P-TMSI) on PCCH in idle mode.

At radio link failure, there is a risk of RNC acting as if UE were in connected mode and since UE context is available either a Paging Type 1 message or a Paging Type 2 message
30 is transmitted as explained above.

When an RNC timer, corresponding to the first timer «T315» in UE, started when the radio link failure is detected in RNC has elapsed, the UE context is deleted, and consequently only Paging Type 1 messages will be transmitted for
5 paging.

As identified, a problem is related to whether UE is in connected mode or idle mode. Even if the RNC timer has not elapsed, UE may have entered idle mode already. The reason may be, e.g., the retransmission counter «V302» increasing
10 beyond the threshold value «N302». If this is the case, it will ignore paging with Paging Type 1 messages for u-RNTI or with Paging Type 2 messages. This may occur in the exemplary situation illustrated in figure 6. Cell Update Confirm is not detected at UE, e.g. due to different cell
15 sizes for uplink and downlink. UTRAN may detect signals from UE on Random Access Channel, RACH, and simultaneously UE cannot detect signals from UTRAN on Forward Access Channel, FACH.

If the first timer «T315» and the corresponding RNC timer
20 do not time out until after 1800 s (30 min), there is a risk that UE will be unreachable for up to 30 minutes.

If RNC were forced to page with Paging Type 1 messages for CN user equipment identity (IMSI, TMSI or P-TMSI) during cell update procedure this would be ignored by UE. After
25 transmitting a Cell Update message at radio link failure UE will enter CELL_FACH state. In this state paging with one or more Paging Type 2 messages is required to be sent on DCCH and in acknowledged mode.

Paging using paging type 2 messages of prior art requires
30 the paged UE to have received its c-RNTI (Cell Radio Network Temporary Identity) used as identity in MAC for RLC PDU for identification of one or more RLC PDUs containing

the one or more Paging Type 2 messages and their acknowledgements. However, c-RNTI is assigned to UE in a Cell Update Confirm message «Cell Update Confirm». If this message is not received in UE, as illustrated in figure 6, UE
5 cannot detect Paging Type 2 messages.

Consequently, there is a risk of UE not being able to detect any of the paging messages according to the 3GPP specification.

These and related problems are solved by the invention and
10 its embodiments.

According to a first embodiment, after reception of an NBAP message Radio Link Failure, RNC will page both using Paging Type 2 message and Paging Type 1 message paging UE by u-RNTI while a timer «T315» in RNC, corresponding to UE
15 timer «T315», has not yet elapsed. When the timer has elapsed, RNC will page using Paging Type 1 message paging UE by CN user equipment identity, e.g. IMSI, TMSI or P-TMSI. Also, RNC will remove UE context. This is illustrated in figure 9.

20 In a second embodiment of the invention, as schematically shown in figure 10, when RNC receives a first Cell Update message «Cell Update» after a radio link failure, it starts a new timer, Tremax, timing out after an interval corresponding to the maximum time of allowed retransmissions for
25 cell update, i.e. the time-out interval of Tremax

$$TO_{Tremax} = (N302+1)TO_{T302} ,$$

where N302 is the predetermined limit on number of retransmissions and TO_{T302} is a predetermined time-out interval of timer T302. When Tremax has been started and while not
30 having timed out, RNC pages using all three described Paging Type messages. Thereby, if UE has entered idle mode it

may be reached by paging prior to timer T315', as described in relation to the first embodiment, timing out.

When timer Tremax times out, RNC will remove UE context and only page using Paging Type 1 message paging UE by CN user
5 equipment identity (e.g. IMSI, TMSI or P-TMSI).

According to a third embodiment of the invention, the Cell Update Confirm message is modified to carry a paging indicator. This paging indicator comprises information of the paging record type identifier of a Paging Type 2 message.
10 Preferably, the paging indicator is included as an Information Element, in addition to other existing Information Elements. With such a paging indicator RNC can forward paging in the Cell Update Confirm message. When UE receives the Cell Update Confirm message it forwards the paging
15 indicator to upper layers as for a Paging Type 1 or Paging Type 2 message.

According to a fourth embodiment a Paging Type 2 message is transmitted in unacknowledged mode, as opposed to acknowledged mode transmissions in prior art. Thereby, c-RNTI is
20 not needed in UE and u-RNTI can be used as MAC header for the Paging Type 2 message transmitted on the DCCH.

In a fifth embodiment u-RNTI is included as an Information Element in the RRC protocol and Paging Type 2 messages in accordance with the protocol. Further, Paging Type 2 messages are preferably transmitted unencrypted. Hereby, Paging
25 Type 2 messages can be transmitted on CCCH, for which reason also user equipment in idle mode can detect the paging messages.

Figure 11 illustrates message elements of a Paging Type 2 message according to the fourth and fifth embodiments of
30 the invention. As opposed to prior art Paging Type 2 mes-

sage shown in figure 4, the Paging Type 2 message according to the embodiments of the invention includes element «u-RNTI», representing u-RNTI of paged User Equipment.

Preferably, all system elements, such as UEs and RNCs in
5 UMTS, where applicable operate according to the invention. However, the invention can also be used in systems also including some equipment, such as UEs and RNCs, not operating according to the invention.

A person skilled in the art readily understands that the
10 receiver and transmitter properties of a BS or a UE are general in nature. The use of concepts such as BS, UE or RNC within this patent application is not intended to limit the invention only to devices associated with these acronyms. It concerns all devices operating correspondingly,
15 or being obvious to adapt thereto by a person skilled in the art, in relation to the invention. As an explicit non-exclusive example the invention relates to mobile stations without a subscriber identity module, SIM, as well as user equipment including one or more SIMs. Further, protocols
20 and layers are referred to in close relation with UMTS and 3GPP terminology. However, this does not exclude applicability of the invention in other systems with other protocols and layers of similar functionality. As a non-exclusive example, the invention applies for transmission
25 of paging messages avoiding state inconsistency locking.

The invention is not intended to be limited only to the embodiments described in detail above. Changes and modifications may be made without departing from the invention. It covers all modifications within the scope of the following
30 claims.

CLAIMS

1. A method of transferring one or more receiver state or mode dependant messages in a communications system including a receiver and a network element, the method characterized in that the network element, upon detection of a state or mode affecting event starts a timer and that one or more messages according to a first message type are transmitted to the receiver if the timer has timed out.
2. The method according to claim 1 characterized in that the receiver state or mode dependent one or more messages are paging messages.
3. The method according to claim 1 or 2 characterized in that the first message type is Paging Type 1.
4. The method according to any of claims 1-3 characterized in that the first message type is a Paging Type 1 message for paging by core network user equipment identity.
5. The method according to any of claims 1-4 characterized in that the timer times out after approximately the same time as a corresponding timer of the receiver.
6. The method according to any of claims 1-4 characterized in that the timer times out after the same time as a corresponding timer of the receiver increased by a few seconds.
7. The method according to any of claims 1-6 characterized in that if the timer has not timed

out, one or more messages according to one out of a plurality of message types is transmitted.

8. The method according to claim 7 characterized in that if the timer has not timed out, one out of a plurality of message types is transmitted depending on receiver state.

9. The method according to claim 7 or 8 characterized in that a first out of the plurality of message types is a Paging Type 1 message for paging by u-RNTI and a second out of the plurality of message types is a Paging Type 2 message for paging on a dedicated control channel.

10. The method according to any of claim 7-9 characterized in that one or more messages according to the first out of the plurality of message types is transmitted if receiver state is CELL_DCH or CELL_FACH.

11. The method according to any of claims 7-10 characterized in that one or more messages according to the second out of the plurality of message types is transmitted if receiver state is CELL_PCH or URA_PCH.

12. The method according to any of claims 7-11 characterized in that the plurality of message types comprises two message types.

13. The method according to any of claims 1-4 characterized in that the timer times out after an interval depending on a predetermined maximum number of cell update attempts and the frequency of cell update attempts.

14. The method according to any of claims 1-4 characterized in that the timer times out after an

interval depending on a predetermined maximum number of cell update attempts and a predetermined transmission interval of successive cell update messages.

15 15. The method according to any of claims 1-4, 13 and 14 characterized in that if the timer has not timed out, each one out of a plurality of message types is transmitted periodically.

10 16. The method according to claim 15 characterized in that the plurality of message types include at least one of

- Paging Type 1 message for paging by Core Network user equipment identity,
- Paging Type 2 message, and
- Paging Type 1 message for paging by u-RNTI.

15 17. The method according to claim 16 characterized in that the core network user equipment identity is IMSI, TMSI or P-TMSI.

20 18. The method according to any of claims 1-17 characterized in that the communications system is a radio communications system.

19. The method according to any of claims 1-18 characterized in that the network element is a radio network controller.

25 20. A method of sending one or more paging messages in a radio communications system characterized in that a paging indicator is included in one or more cell update confirm messages to the receiver, such that the paging message can be detected for a plurality of receiver states or modes.

21. The method according to claim 20 c h a r a c t e r -
i z e d i n that the paging indicator is sent from Core
Network and forwarded to the receiver by a UTRAN element.
22. The method according to claim 21 c h a r a c t e r -
5 i z e d i n that the UTRAN element is a radio network
controller.
23. The method according to claim 20 c h a r a c t e r -
i z e d i n that the paging indicator is a record type
identifier of a Paging Type 2 message.
- 10 24. The method according to claim 20 or 23 c h a r a c -
t e r i z e d i n that the paging indicator is an Infor-
mation Element of a Radio Resource Control protocol of the
radio communications system.
25. The method according to any of claims 18-24 c h a r -
15 a c t e r i z e d i n that the radio communications sys-
tem is a Universal Mobile Telecommunications System or a
WCDMA system.
26. The method according to any of claims 1-25 c h a r -
a c t e r i z e d i n that one or more Paging Type 2 mes-
20 sages are transmitted in unacknowledged mode.
27. The method according to any of claims 1-26 c h a r -
a c t e r i z e d i n that one or more Paging Type 2 mes-
sages are transmitted unencrypted.
28. The method according to any of claims 1-27 c h a r -
25 a c t e r i z e d i n that the one or more messages are
transmitted on a Common Control Channel.
29. The method according to any of claims 1-27 c h a r -
a c t e r i z e d i n that u-RNTI is included in a Paging
Type 2 message.

30. A receiver for receiving one or more paging messages in a radio communications system, the receiver characterized by detection means for detecting a paging indicator in one or more cell update confirm messages, providing paging message detection for a plurality of receiver states or modes.

31. The receiver according to claim 30 characterized in that the paging indicator is a record type identifier of a Paging Type 2 message.

32. The receiver according to claim 30 or 31 characterized in that the paging indicator is an Information Element of a Radio Resource Control protocol of the radio communications system.

33. The receiver according to any of claims 30-32 characterized in that the radio communications system is a Universal Mobile Telecommunications System or a WCDMA system.

34. The receiver according to any of claims 30-32 characterized in that the receiver is included in or is a User Equipment of a Universal Mobile Telecommunications System or a WCDMA system.

35. A network element of transferring one or more receiver state or mode dependant messages in a communications system including a receiver, the network element characterized by processing means and a timer, the processing means being instructed to start the timer upon detection of a state or mode affecting event.

36. The network element according to claim 35 characterized by transmitting means for conditionally transmitting one or more messages according to a first message type if the timer has timed out.

37. The network element according to claim 35 or 36 characterized in that the receiver state or mode dependent one or more messages are paging messages.

38. The network element according to any of claims 35-37
5 characterized in that the first message type is Paging Type 1.

39. The network element according to any of claims 35-38
10 characterized in that the first message type is a Paging Type 1 message for paging by core network user equipment identity.

40. The network element according to any of claims 35-39
characterized in that the timer times out after approximately the same time as a corresponding timer of the receiver.

15 41. The network element according to any of claims 35-39
characterized in that the timer times out after the same time as a corresponding timer of the receiver increased by a few seconds.

42. The network element according to any of claims 35-41
20 characterized in that if the timer has not timed out, one or more messages according to one out of a plurality of message types is transmitted by the transmitting means.

43. The network element according to claim 42
25 characterized in that if the timer has not timed out, one out of the plurality of message types is transmitted depending on receiver state.

44. The network element according to claim 42 or 43
30 characterized in that a first out of the plurality of message types is a Paging Type 1 message for

paging by u-RNTI and a second out of the plurality of message types is a Paging Type 2 message for paging on a dedicated control channel.

45. The network element according to any of claims 42-44
5 c h a r a c t e r i z e d i n that the first out of the plurality of message types is transmitted if receiver state is CELL_DCH or CELL_FACH.

46. The network element according to any of claims 42-45
10 c h a r a c t e r i z e d i n that the second out of the plurality of message types is transmitted by the transmitting means if receiver state is CELL_PCH or URA_PCH.

47. The network element according to any of claims 42-46
c h a r a c t e r i z e d i n that the plurality of message types comprises two message types.

15 48. The network element according to any of claims 35-38 c h a r a c t e r i z e d i n that the timer times out after an interval depending on a predetermined maximum number of cell update attempts and the frequency of cell update attempts.

20 49. The network element according to any of claims 35-38 c h a r a c t e r i z e d i n that the timer times out after an interval depending on a predetermined maximum number of cell update attempts and a predetermined transmission interval of successive cell update messages.

25 50. The network element according to any of claims 36, 48 and 49 c h a r a c t e r i z e d i n that if the timer has not timed out, each one out of a plurality of message types is periodically transmitted by the transmitting means.

51. The network element according to claim 50 c h a r -
a c t e r i z e d i n that the plurality of message types
include at least one of

- 5 - Paging Type 1 message for paging by Core Net-
work user equipment identity,
- Paging Type 2 message, and
- Paging Type 1 message for paging by u-RNTI.

52. The network element according to claim 51 c h a r -
a c t e r i z e d i n that the core network user equip-
10 ment identity is IMSI, TMSI or P-TMSI.

53. A network element for transmitting one or more paging
messages in a radio communications system c h a r a c -
t e r i z e d b y processing means for including a paging
indicator in one or more cell update confirm messages to
15 the receiver, providing paging message detection for a plu-
rality of receiver states or modes.

54. The network element according to claim 53 c h a r -
a c t e r i z e d b y forwarding means for forwarding the
paging indicator from Core Network to the receiver.

20 55. The network element according to claim 53 c h a r -
a c t e r i z e d i n that the paging indicator is a rec-
ord type identifier of a Paging Type 2 message.

56. The network element according to claim 53 or 55
c h a r a c t e r i z e d i n that the paging indicator
25 is an Information Element of a Radio Resource Control pro-
tocol of the radio communications system.

57. The network element according to any of claims 35-62
c h a r a c t e r i z e d i n that one or more Paging

Type 2 messages are transmitted in unacknowledged mode by the transmitting means.

58. The network element according to any of claims 35-57 characterized in that one or more Paging
5 Type 2 message are transmitted unencrypted by the transmitting means.

59. The network element according to any of claims 35-58 characterized in that the one or more messages are transmitted on a Common Control Channel.

10 60. The network element according to any of claims 35-58 characterized in that the processing means comprises means for including u-RNTI in a Paging Type 2 message.

61. The network element according to any of claims 35-60
15 characterized in that the communications system is a radio communications system.

62. The network element according to any of claims 61 characterized in that the radio communications system is a Universal Mobile Telecommunications System or a WCDMA system.
20

63. The network element according to any of claims 35-62 characterized in that the network element is a radio network controller.

64. A signal format characterized by conditionally comprising first and second type paging messages, such that it can be detected for a plurality of receiver states or modes.
25

65. The signal format according to claim 64 characterized in that the condition is that a started timer of the transmitter has not yet timed out.

66. The signal format according to claim 64 or 65
5 characterized by two or more different first type paging messages for the same user equipment.

67. The signal format according to claim 64 or 65 characterized by one first type paging message for the same user equipment.

10 68. The signal format according to claims 66 or 67 characterized by two or more first type paging messages for the same user equipment if a timer dependent on maximum number or retransmissions has not yet timed out and one first type paging message for the same user
15 equipment if the timer dependent on maximum number of retransmissions has elapsed.

69. The signal format according to any of claims 64-67 characterized in that at least one of the two or more paging first type paging messages includes CN
20 user equipment identity and at least one of the two or more paging first type paging messages includes u-RNTI.

70. The signal format according to any of claims 64-69 characterized in that the first and second type paging messages are Paging Type 1 and Paging Type 2
25 messages.

71. A signal format characterized by one or more cell update confirm messages comprising a paging indicator, such that it can be detected for a plurality of receiver states or modes.

72. The signal format according to claim 71 c h a r a c -
t e r i z e d b y the paging indicator being a paging re-
cord type identifier.

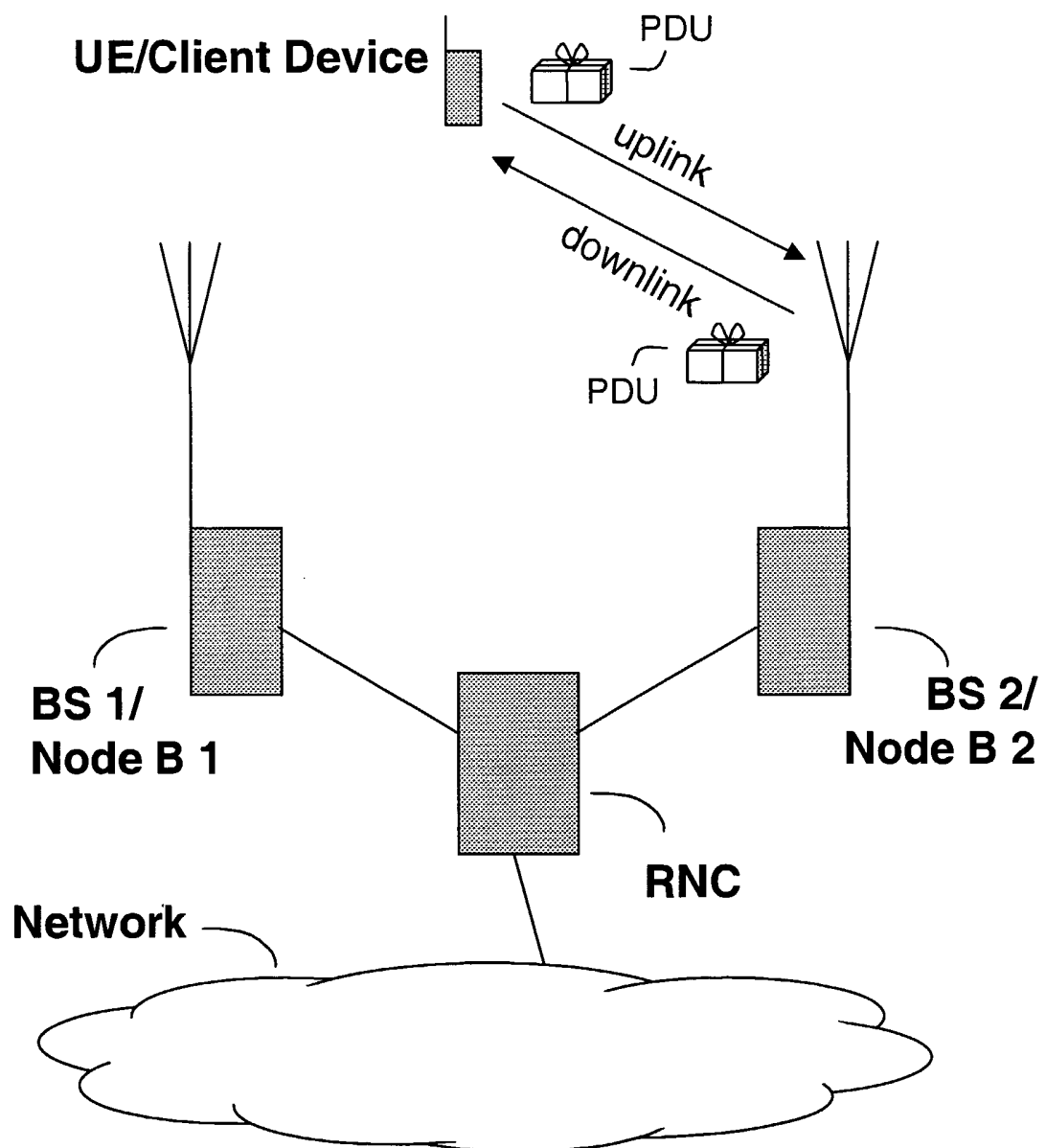
73. A signal format c h a r a c t e r i z e d b y u-
5 RNTI being used as MAC header of a Paging Type 2 message,
such that it can be detected for a plurality of receiver
states or modes.

74. A radio communications system c h a r a c t e r -
i z e d b y means for carrying out the method in any of
10 claims 1-29.

75. A radio communications system c h a r a c t e r -
i z e d b y a plurality of receivers according to any of
claims 30-34.

76. A radio communications system c h a r a c t e r -
15 i z e d b y a plurality of network elements according to
any of claims 35-63.

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**Fig. 1**

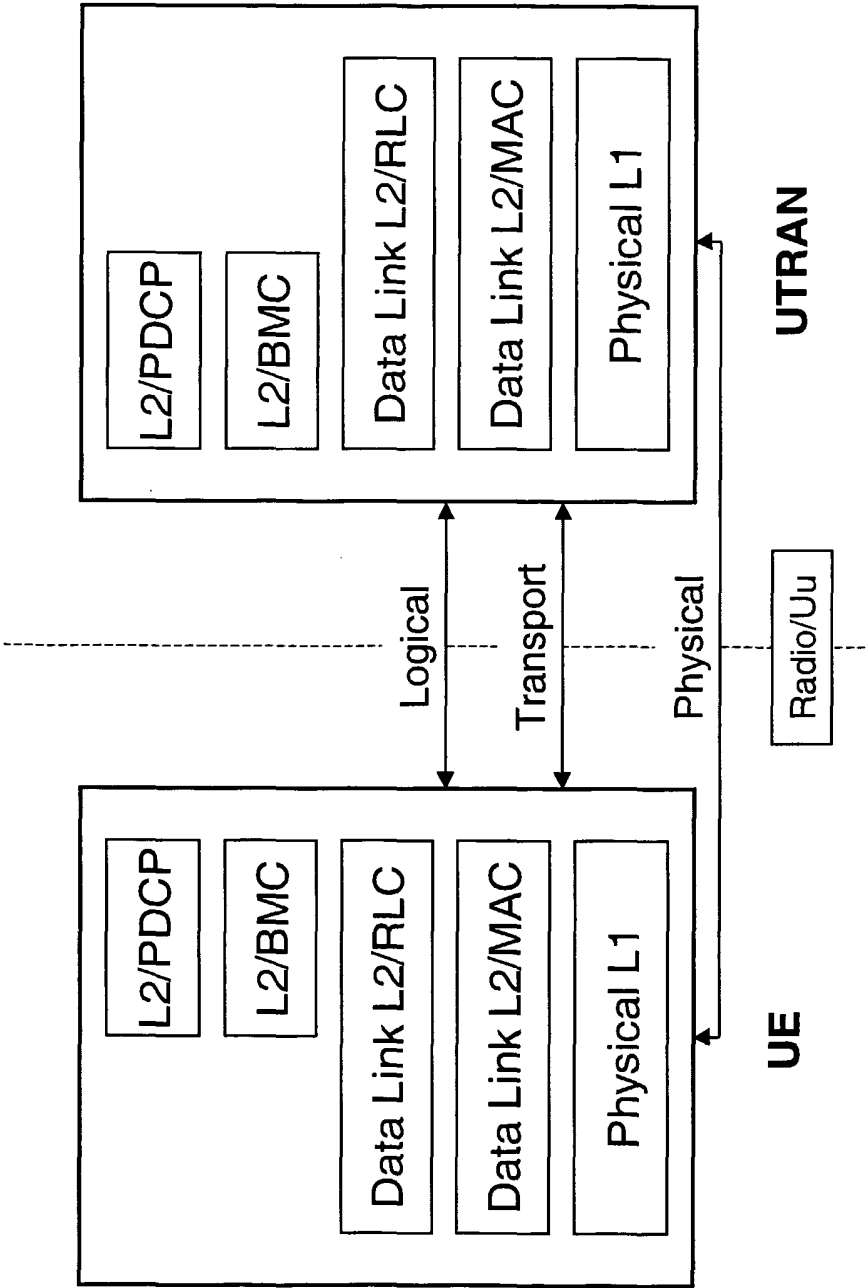


Fig. 2

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Message Type	Paging Record List	Paging Record	...	Paging Record	BCCH Modification Info
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Fig. 3

Message Type	RRC Transaction ID	Integrity Check Info	Paging Cause	CN Domain ID	Paging Record Type ID
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Fig. 4

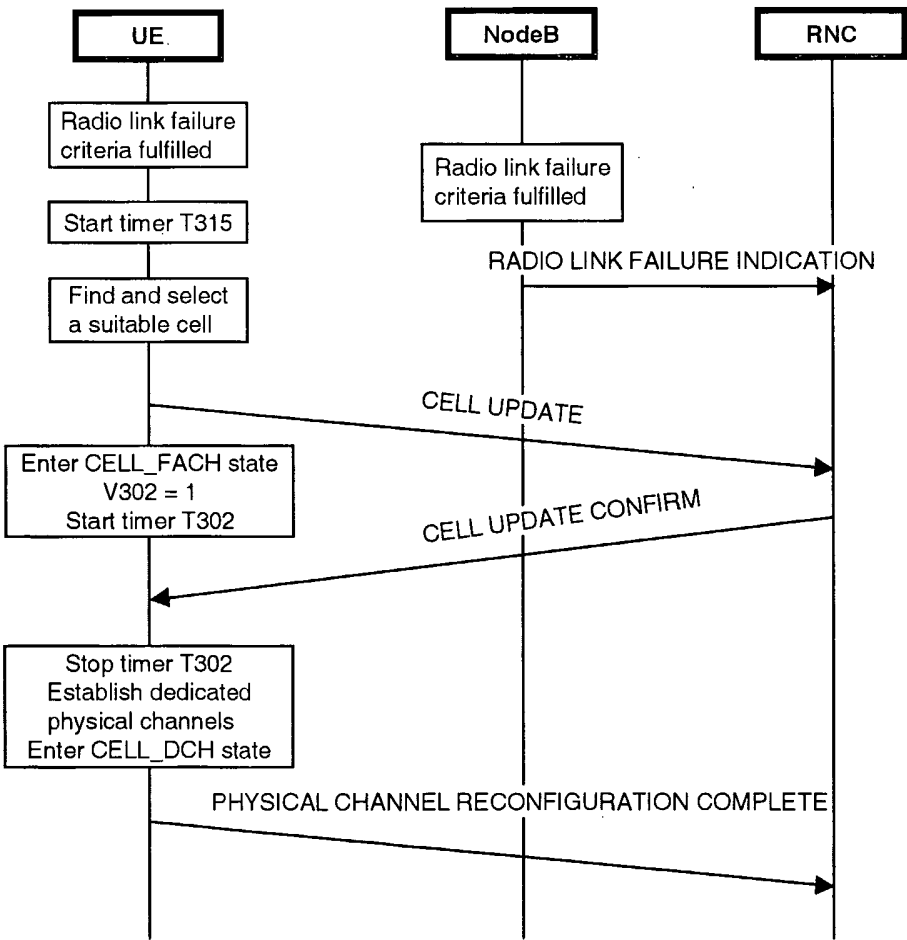
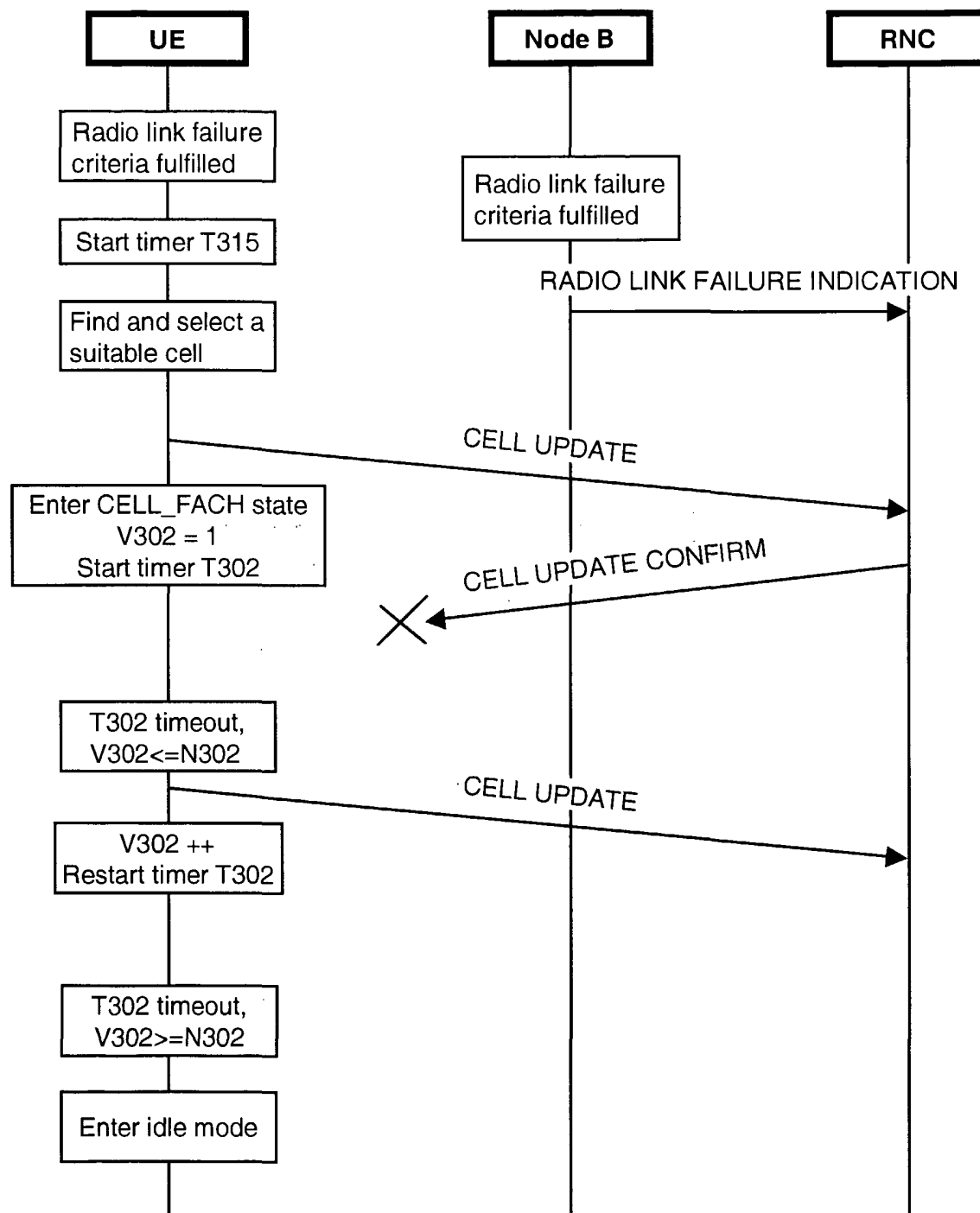


Fig. 5

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**Fig. 6**

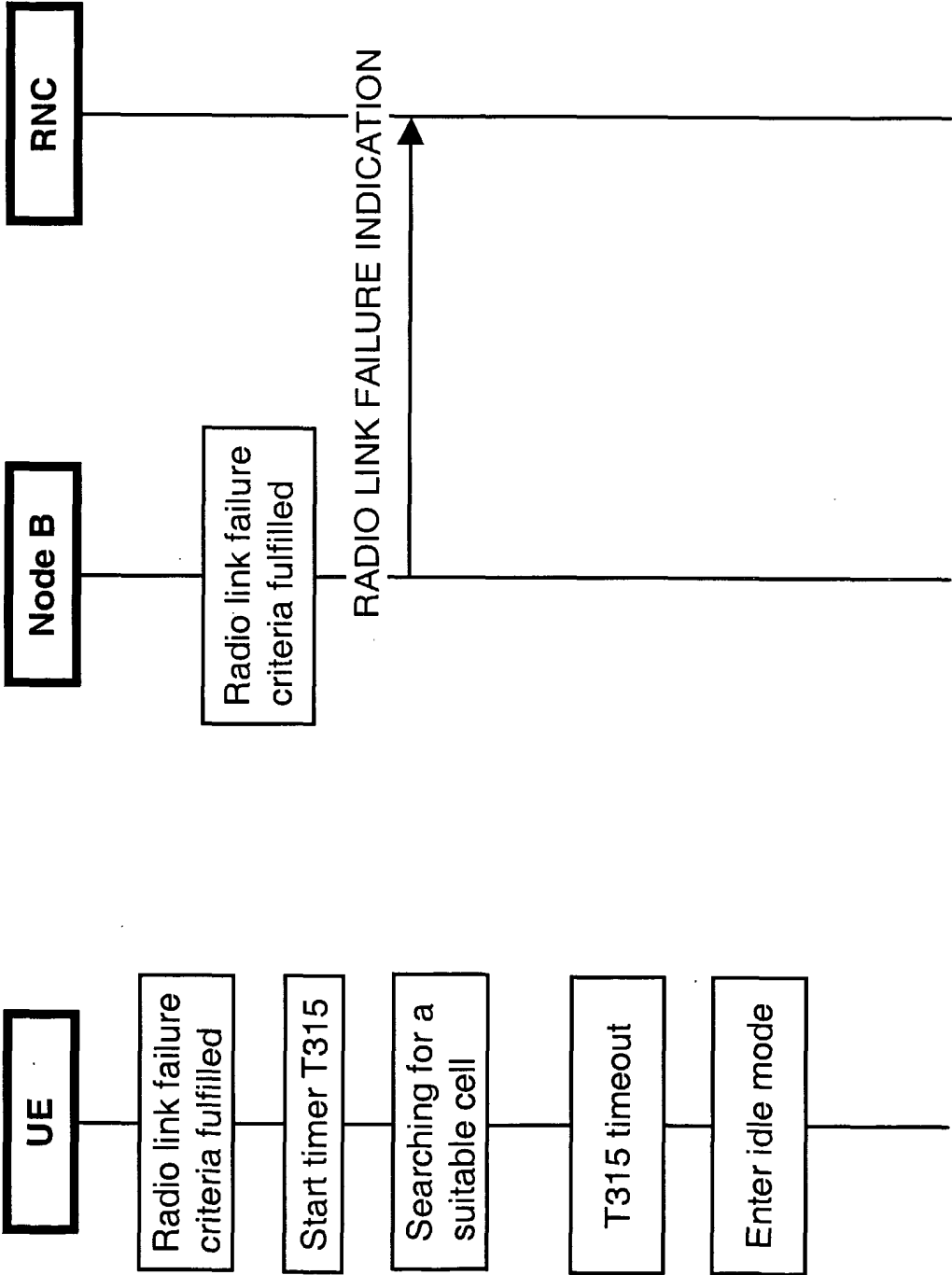
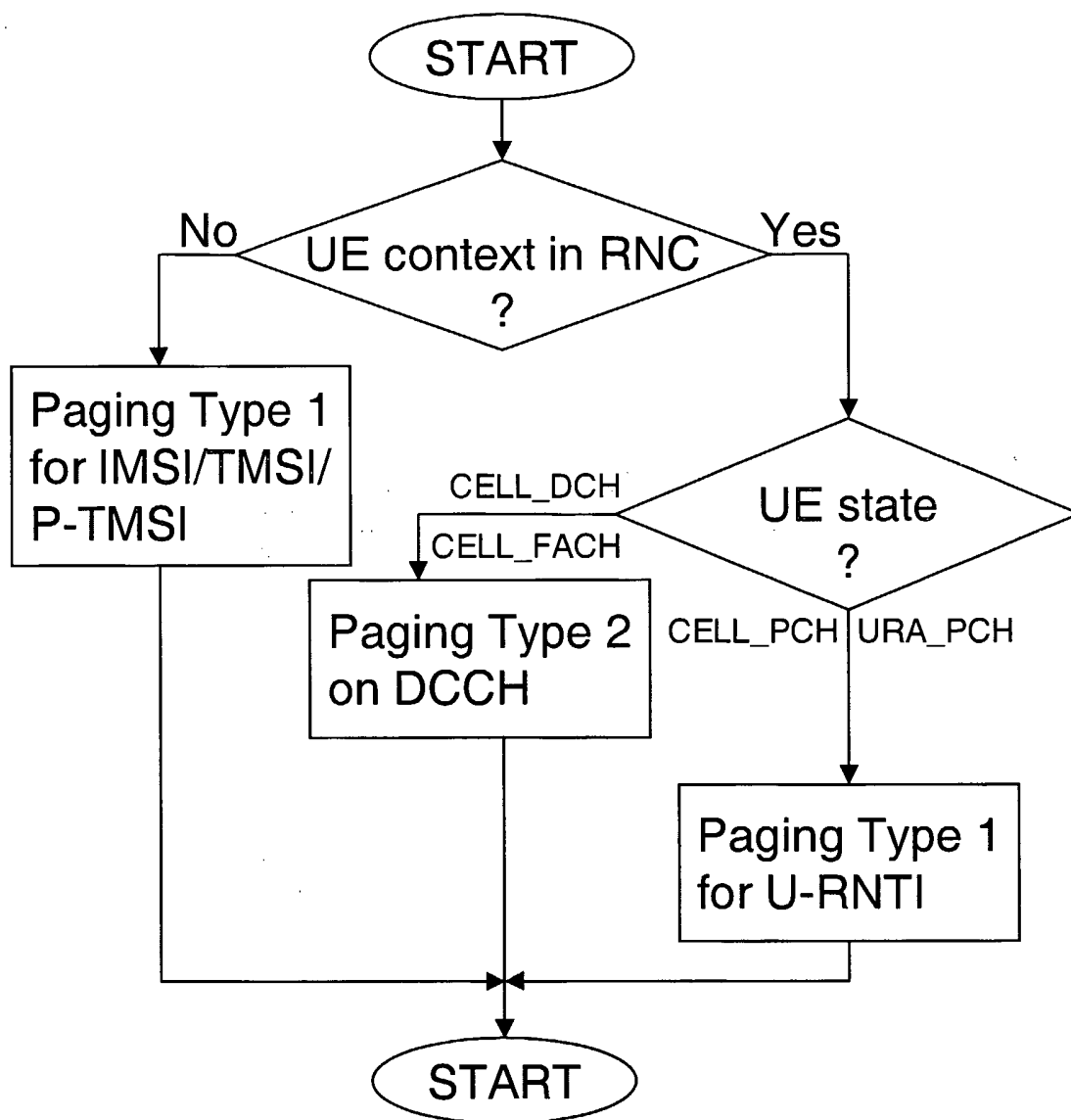
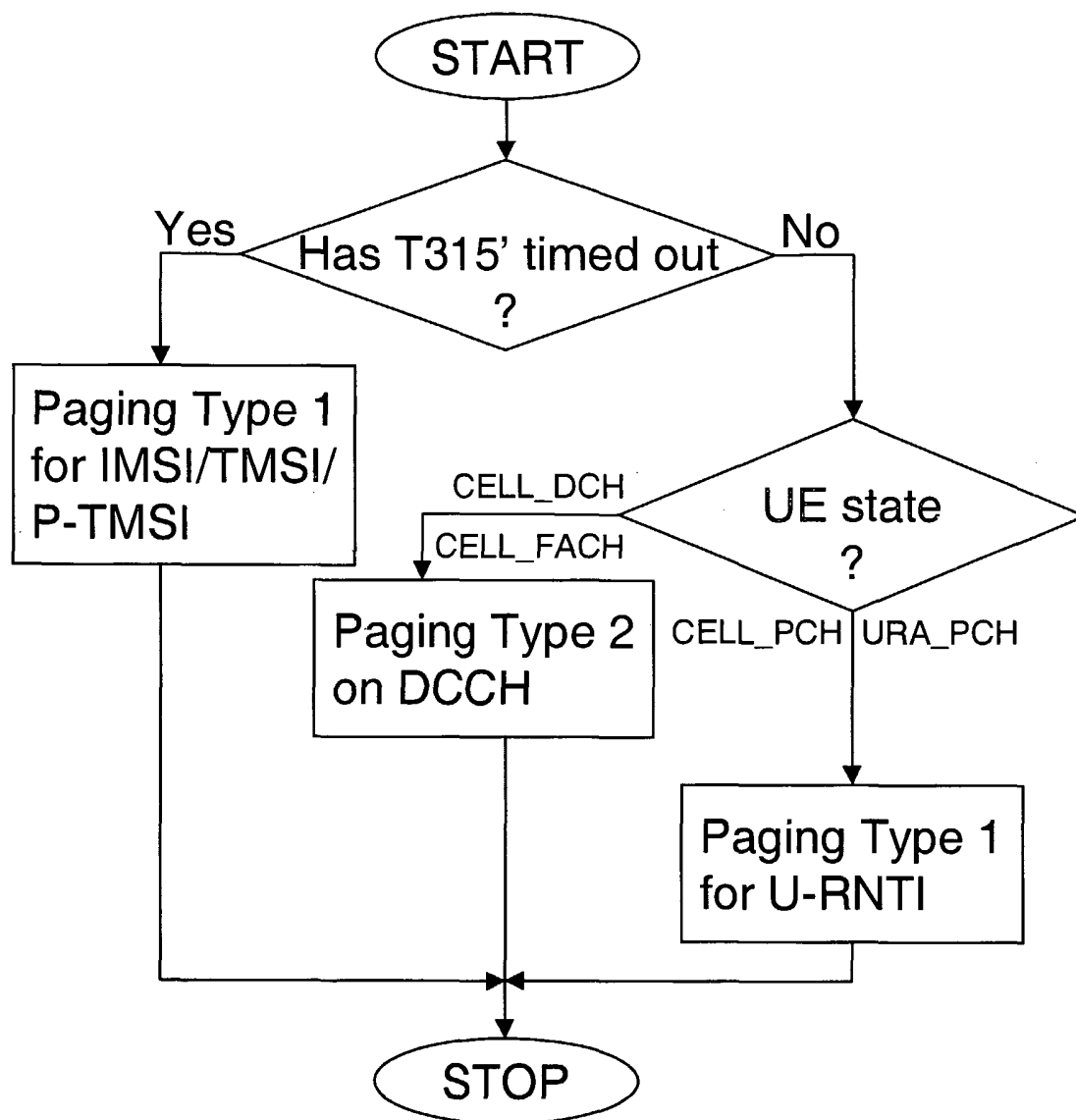


Fig. 7

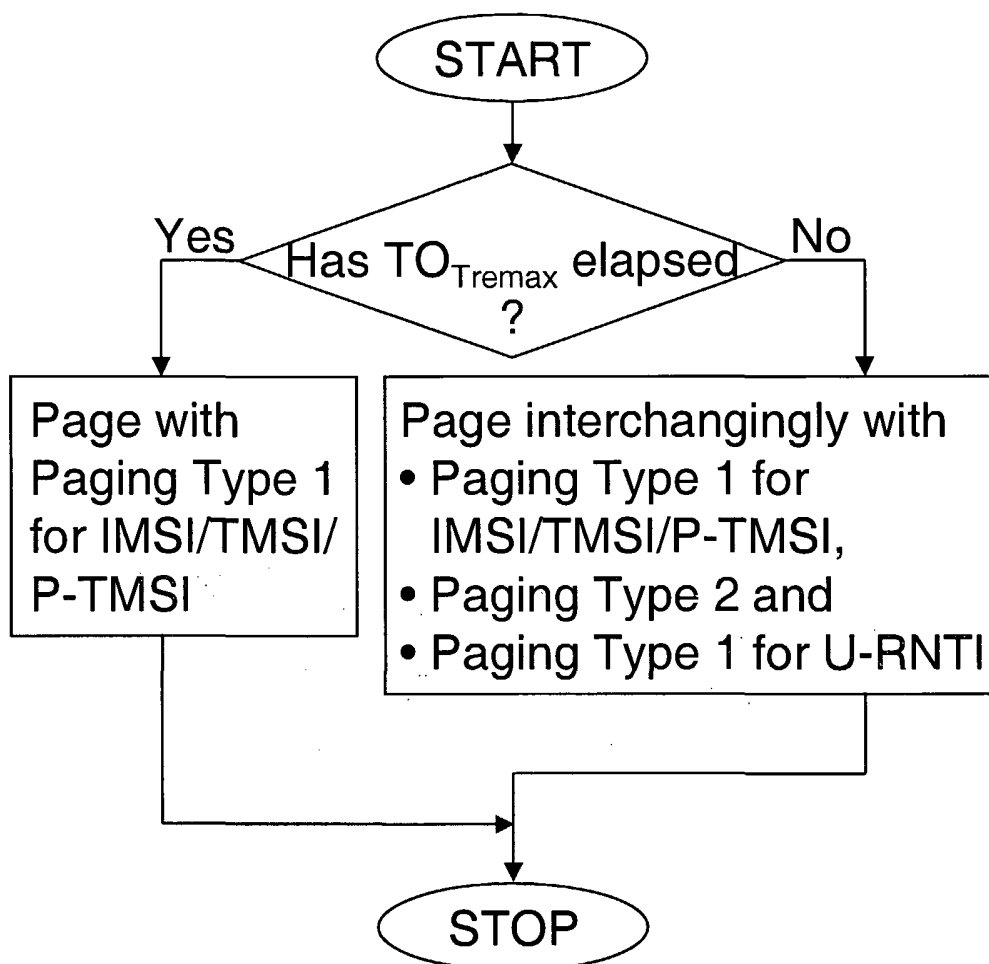
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**Fig. 8**

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**Fig. 9**

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**Fig. 10**

Message Type	u-RNTI	RRC Transaction ID	Integrity Check Info	Paging Cause	CN Domain ID	Paging Record Type ID
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Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 2003/001447

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/38

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)

IPC7: H04Q

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

SE,DK,FI,NO classes as above

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

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6438383 B1 (GÖRAN HALL ET AL), 20 August 2002 (20.08.2002), column 1, line 11 - line 34; column 2, line 52 - line 60; column 4, line 6 - line 42, claims 1,2,12-14, spalt 5, rad 18 - spalt 5, rad 55; se också fortsättning av karven 63,76;	1,2,13,14, 18,19,35-37, 42,48,49,61
Y	--	5,6,40,41
Y	WO 0028769 A1 (TELIA AB), 18 May 2000 (18.05.2000), page 6, line 11 - line 29 --	5,6,40,41
A	US 5301225 A (KAZUHIRO SUZUKI ET AL), 5 April 1994 (05.04.1994), se hela dokumentet --	1,14

☒ 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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

27 January 2004

Date of mailing of the international search report

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Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Peter Hedman/MN

Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 2003/001447

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1094675 A1 (HYUNDAI ELECTRONICS INDUSTRIES CO., LTD.), 25 April 2001 (25.04.2001), column 24, line 43 - line 56; column 28, line 35 - column 29, line 9 --	20,21,23,24, 30-32,53-56, 71,72
X	EP 1191800 A2 (TELEFONAKTIEBOLAGET LM ERICSSON), 27 March 2002 (27.03.2002), column 18, line 9 - line 28; column 24, line 13 - column 25, line 8; column 26, line 50 - column 27, line 5, claims 1,8,14, abstract --	64-67,70,72, 74,75
X	US 6175557 B1 (JOHN DIACHINA ET AL), 16 January 2001 (16.01.2001), column 6, line 10 - line 41 -- -----	64,66,67,70, 72,74,75

INTERNATIONAL SEARCH REPORT

Information on patent family members

24/12/2003

International application No.

PCT/SE 2003/001447

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				GB	2352138	A,B	17/01/2001
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				JP	2003047068	A	14/02/2003
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				WO	9516330	A	15/06/1995

INTERNATIONAL SEARCH REPORT

Information on patent family members

24/12/2003

International application No.

PCT/SE 2003/001447

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				NZ	276272	A	27/04/1998
				NZ	329740	A	28/05/1999
				NZ	329741	A	28/05/1999
				US	5734645	A	31/03/1998
				US	5923649	A	13/07/1999
				WO	9512934	A	11/05/1995

INTERNATIONAL SEARCH REPORTInternational application No.
PCT/SE 2002/001447**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see next page

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2002/001447

Box No. IV Text of the abstract (Continuation of item 5 of the first sheet)

Invention I:

The invention claimed in claims 1-19,26-29,35-52 and 57-63 is focused on the problem of transferring receiver state or mode dependent messages in a communication system. The special technical feature of the invention is a timer, which allows a delay of the transmitted messages associated with a certain event.

Invention II:

The invention claimed in claims 20-25, 30-34, 53-56 and 64-75 is focused on the problem of identifying paging messages for a plurality of receiver states or modes. The special technical feature is an indicator which is added to a paging message.

The both inventions fails to teach of any common technical features which goes beyond what is previously known to the person skilled in the art.