

CONTROL OF UP LINK COMMON E-DCH TRANSMISSION

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TECHNICAL FIELD

The present invention relates to a method and system for managing transmission of Up Link
10 common E-DCH transmissions in a radio system such as a Wide Band Code Division
Multiple Access (WCDMA) radio system.

BACKGROUND

In release 8 of the third generation partnership project (3GPP), work is ongoing to improve
15 the uplink performance in the so called CELL_FACH state. CELL_FACH is a Radio
Resource Control (RRC) state in which the User Equipment (UE) is known on cell level (i.e.
has a cell id), has a layer 2 connection but no dedicated physical layer resource associated
therewith. Instead, common physical layer resources are shared between different User
Equipments in the CELL_FACH state.

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One uplink improvement planned for future cellular radio systems is the activation also in
CELL_FACH of the Enhanced Dedicated Channel (E-DCH) physical channel, which is
normally used as a dedicated physical layer channel in CELL_DCH state with one separate
E-DCH resource allocated per user. This can be performed by using a pool of E-DCH
25 resources that can be temporarily assigned to a user in the CELL_FACH state. Such a pool
of E-DCH resources can be termed common E-DCH resources. E-DCH resources are
conventionally managed by a Radio Network Controller (RNC). However the pool of
common E-DCH resources is to be managed by the radio base station NodeB to speed up

the allocation of resources by not having to involve the RNC in the allocation procedure. The common E-DCH configurations are broadcasted to UEs located in a cell.

In Fig. 1 common E-DCH transmission in CELL_FACH state is shown. The procedure to
5 access the common E-DCH channel in CELL_FACH starts in a manner corresponding to Rel-99 Random Access Channel (RACH) transmission, with preamble power ramping using randomly selected preamble signatures. Having detected the preamble, the NodeB acknowledges reception using an Acquisition Indication Channel (AICH) sequence. It also informs the UE which common E-DCH resource it has assigned to the UE.

10 A common E-DCH resource is defined by:

an Up -Link (UL) scrambling code

an E-DCH Radio Network Temporary Identifier (E-RNTI)

15 a Fractional - Dedicated Physical CHannel (F-DPCH) code and timing offset

E-DCH Absolute Grant Channel (E-AGCH)/ E-DCH Relative Grant Channel (E-RGCH)/
E-DCH HARQ Acknowledgement Indicator CHannel (E-HICH) codes and signatures, and
High Speed Dedicated Physical Control Channel (HS-DPCCH) parameters such as power
offsets and Channel Quality Indicator (CQI).

20 One characteristic of the common E-DCH transmission is that at the point the base station NodeB assigns the common E-DCH resources and starts receiving the Up Link (UL) E-DCH transmission, it is not aware of the identity of the UE. As a result. two users selecting the same preamble in the same access slot will cause a collision. There are 16 preambles to
25 choose from and 15 access slots during 20 ms to choose from. If two users transmit the same preamble in the same access slot, and the base station NodeB acknowledges one of them on AICH, both UEs will start Up Link transmission. This will lead to non-optimal operation as both are transmitting, but the base station NodeB will only be able to decode one User Equipment or nothing of what is being transmitted.

To solve this problem, UEs having a RRC connection will put their Radio Network Temporary Identifier (RNTI) in the MAC header on the common E-DCH. This will enable the NodeB to read the RNTI and thus uniquely identify the user transmitting. The NodeB then echoes the detected RNTI back to on a downlink control channel. Both transmitting UEs will read the RNTI, but only the one detecting its own RNTI will continue the Up Link common E-DCH transmission.

A problem with the above solution is that it only works for UEs having an RRC connection. Users entering the system from idle state will need special attention. One solution that could be envisaged is to use a Core Network Identifier for these users. However, that would increase protocol overhead, and also complexity as protocols have to support both radio network and core network identifiers for contention resolution.

Hence there is a need for an improved method and system for managing transmission of Up Link common E-DCH transmissions.

SUMMARY

It is an object of the present invention to provide an improved method and system for managing of Up Link common E-DCH transmissions.

This object and others are obtained by the methods and radio system nodes as set out in the appended claims. Thus, by adding a checksum to each layer 3 message to check the correctness of the message, the risk that Layer 2 assembles message parts from different UEs into one corrupt message, such as a RRC or CN message that is then delivered to higher layers is avoided.

The inventors have recognized that for users in an idle state, the common E-DCH transmission is used to transmit only initial RRC and possibly initial CN messages. This

transmission typically only lasts for a very short time. It has been observed to typically last for <100 ms, after which the common E-DCH resource is again released. Also the probability of preamble collision is expected to be very low, in the order of 10^{-3} , i.e. typically less than one on one thousand.

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A result from the above observations can be that since collisions will be with a low probability and only during a limited time, contention resolution may not be necessary for users in idle state from a physical layer point of view. However, colliding transmissions can still cause problems on higher layers, as assembly of Radio Resource Control (RRC) and Non Access Stratum (NAS) messages on Layer 2 (L2) may fail. There is a risk that Layer 2 assembles parts from different UEs into one corrupt message, such as a Radio Resource Control (RRC) or Core Network (CN) message that is then delivered to higher layers. This may cause unexpected effects as higher layers start to process the messages. Such a problem needs to be avoided. To solve this problem, a checksum to each Layer 3 (L3) message, e.g. (RRC or NAS) is added to check the correctness of the message.

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Hereby the need for transmitting a long Core Network (CN) Identity (ID) for contention resolution on Layer 2 for UEs in idle mode is removed. As a result performance of the cellular radio network will be improved.

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BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described in more detail by way of non-limiting examples and with reference to the accompanying drawings, in which:

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- Fig. 1 is a view illustrating common E-DCH transmission in CELL_FACH state,
 - Fig. 2 is a general view of a cellular radio system,
 - Fig. 3 is a view illustrating different message from different UEs assembled into one corrupt message on Level 2 that is then delivered to higher layers,

- Figs. 4a – 4c are views of a header of a Level 3 message in accordance with some exemplary embodiments of the present invention, and

-Fig. 5 is a flowchart illustrating steps performed when adding a checksum to a level 3 message.

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DETAILED DESCRIPTION

In Fig. 2 a general view of a WCDMA system 100 is depicted. The system 100 comprises a base station (Node B) 101. The base station 101 serves a number of mobile terminals, usually termed User Equipment (UE) 103, located within the area covered by the base station 101. The base station 101 is also connected to a radio network controller node (RNC) 105. The RNC 105 typically also includes a Radio link controller node (RLC) 107. The RLC 107 is among other things responsible for detecting errors. The system 100 also typically comprises a power control unit 109, which preferably is co-located or an integral part of the base station 101.

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In release 6, the WCDMA specification is extended with a new uplink transport channel, the Enhanced Dedicated Channel (E-DCH). The enhanced uplink (EUL) is a natural complement to High Speed Downlink Packet Access (HSDPA) for high-performance packet-data applications.

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In Fig. 3 colliding transmissions from two different User Equipments in idle state is illustrated. Colliding transmissions from different UEs can cause problems on higher layers, as assembly of Radio Resource Control (RRC) and Non Access Stratum (NAS) messages on Layer 2 (L2) may fail. Hence there is a risk that Layer 2 assembles parts from different UEs into one corrupt message, such as a Radio Resource Control (RRC) or a Core Network (CN) message that is then delivered to higher layers. This may cause unexpected effects as higher layers start to process the messages. Such a problem therefore needs to be avoided. To solve this problem, a checksum to each Layer 3 (L3) message, e.g. RRC or NAS is added to check the correctness of the message.

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In accordance with the present invention a checksum is added to each layer 3 message to check the correctness of the message when common E-DCH transmission are transmitted when the radio base station is not aware of the identity of the UE. For WCDMA, this applies to uplink transmission on the Common Control Channel (CCCH) logical channel. Hereby it can be prevented that colliding transmissions from different UEs on the common E-DCH channel can cause problems on higher layers.

There are a few different options on how to append the checksum to a message such as a Radio Resource Control (RRC) or Non Access Stratum (NAS) message. The checksum can be on Media Access Control (MAC), Radio Link Control (RLC) or Radio Resource Control (RRC). Adding the checksum on MAC has the benefit that an error in the reassembly can be detected already in the base station, and thus the corrupt message does not need to be transmitted up to the RNC. In 3GPP Rel-8, MAC segmentation is included to support flexible RLC sizes. In accordance with one embodiment a similar MAC header structure as for the downlink MAC-ehs is used. For example the MAC can be split in two sublayers, called MAC-i and MAC-is. The segmentation and reassembly functionality is handled by the MAC-is sublayer, terminated in the C-RNC. The checksum can in accordance with one embodiment be a 16 bit Cyclic Redundancy Checksum (CRC) calculated over the MAC SDU. The Checksum can also be calculated over another unit such as a MAC-c PDU. In Fig. 4a an exemplary location of a checksum is depicted. In Fig. 4a the checksum is located after the fields of MAC-i and MAC-is and before the MAC SDU in the MAC header for Common Control Channel (CCCH). Other locations are also possible such as depicted in Fig. 4b and Fig. 4c. These show the two possible alternatives for CRC location in case the MAC SDU is segmented before transmission over the radio interface. In this case there are one MAC-i and one MAC-is header for each segment. In the MAC receiver, the MAC-i and MAC-is headers are first removed and the MAC SDU assembled. Then the CRC is calculated and checked with the appended CRC bits.

If MAC segmentation is not available, the checksum can be added on either RLC level or RRC level, in which case the processing of the checksum can be performed by the RNC, thereby easing the load on the Radio Base Station (RBS).

- 5 In accordance with one embodiment the checksum can be a 16 or 24 bit Cyclic Redundancy Check (CRC) or any other suitable number of bits. In case the checksum is transmitted on the RRC level, it is possible to use the Integrity Protection checksum calculated with a default HFN and User ID.
- 10 In Fig. 5 a flowchart illustrating steps performed when forming and receiving a message on level 2 when receiving messages from at least one User Equipment in idle state is shown. Because two users can select the same preamble in the same access slot thereby causing a collision, there is a risk that Layer 2 assembles messages from different users. To enable identification of such erroneously assembled messages a checksum is added to each MAC
- 15 SDU in a step 501 in each User Equipment. Then, in a step 503 messages from at least one User Equipment is received as a common E-DCH transmission. Thereupon, in a step 505, the checksum is checked to determine the correctness of the message. The determination in step 505 can be performed either locally in the radio base station NodeB or in the Radio Network Controller (RNC).
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- Using the method and system as described herein will remove the need for transmitting a long Core Network (CN) Identity (ID) for contention resolution on Layer 2 for UEs in idle mode. As a result performance of the cellular radio network will be improved.

CLAIMS

1. A method in a radio base station for detecting an error in a message formed by layer 2 from a number of assembled messages generated by at least one User Equipment UE in an idle state and transmitted on an enhanced Dedicated Channel, E-DCH, **characterized by** the
5 step of:
 - adding (503) a checksum to Layer 3 of the message, and
 - checking (505) the correctness of the assembled message based on the checksum.
2. The method according to claim 1, wherein the checksum is appended to a Non Access
10 Stratum, NAS, message.
3. The method according to claim 1, wherein the checksum is appended to a Radio Resource Control, RRC, message.
- 15 4. The method according to any of claims 2 or 3, wherein the checksum is added in the Media Access Control, MAC, header.
5. The method according to any of claims 2 - 4, wherein the checksum is appended to the beginning or the end of a MAC-d Packet Data Unit, PDU
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6. A method in a radio network controller for detecting an error in a message formed by layer 2 from a number of assembled messages generated by at least one User Equipment UE in an idle state and transmitted on an enhanced Dedicated Channel, E-DCH, **characterized by** the step of:
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 - receiving a Layer 3 message comprising a checksum, and
 - checking the correctness of the assembled message based on the checksum.
7. The method according to claim 6, wherein the checksum is appended to a Non Access Stratum, NAS, message.

8. The method according to claim 6, wherein the checksum is appended to a Radio Resource Control, RRC, message.

5 9. The method according to any of claims 7 or 8, wherein the checksum is located in the Media Access Control, MAC, header.

10. The method according to any of claims 7 -9, wherein the checksum is appended to the beginning or the end of a MAC-d Packet Data Unit, PDU.

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11. A radio base station (101) comprising means (101) for forming a layer 2 message from a number of assembled messages generated by at least one User Equipment UE (103) in an idle state and transmitted on an enhanced Dedicated Channel, E-DCH, **characterized by:** means (101) for adding a checksum to Layer 3 of the message.

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12. The radio base station according to claim 11, further comprising means for checking the correctness of the assembled message based on the checksum.

13. The radio base station according to claim 11 or 12, further comprising means for
20 appending the checksum to a Non Access Stratum, NAS, message.

14. The radio base station according to claim 11 or 12, further comprising means for appending the checksum to a Radio Resource Control, RRC, message.

25 15. The radio base station according to any of claims 13 or 14, comprising means for adding the checksum in the Media Access Control, MAC, header.

16. The radio base station according to any of claims 13 - 15, comprising means for appending the checksum to the beginning or the end of a MAC-d Packet Data Unit, PDU.

17. A radio network controller adapted to detect an error in a message formed by layer 2 from a number of assembled messages generated by at least one User Equipment UE in an idle state and transmitted on an enhanced Dedicated Channel, E-DCH, **characterized by:**
- means for receiving a Layer 3 message comprising a checksum, and
 - means for checking the correctness of the assembled message based on the checksum.
18. The radio network controller according to claim 17, wherein the checksum is appended to a Non Access Stratum, NAS, message.
19. The radio network controller according to claim 17, wherein the checksum is appended to a Radio Resource Control, RRC, message.
20. The radio network controller according to claim 18 or 19, wherein the checksum is located in the Media Access Control, MAC, header.