PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

	Date of mailing *(day/month/year)* 09 November 2016 (09.11.2016)
Applicant´s or agent´s file reference NOK253PCT	**FOR FURTHER ACTION** See paragraph 2 below

International application No. PCT/FI2016/050510	International filing date *(day/month/year)* 08 July 2016 (08.07.2016)	Priority date *(day/month/year)* NONE

International Patent Classification (IPC) or both national classification and IPC
See supplemental box

Applicant
NOKIA TECHNOLOGIES OY

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [x] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/FI Finnish Patent and Registration Office P.O. Box 1160, FI-00101 HELSINKI, Finland Facsimile No. +358 9 6939 5328	Date of completion of this opinion 03 November 2016 (03.11.2016)	Authorized officer Jorma Ristola Telephone No. +358 9 6939 500

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/FI2016/050510

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	---	YES
	Claims	1-30	NO
Inventive step (IS)	Claims	---	YES
	Claims	1-30	NO
Industrial applicability (IA)	Claims	1-30	YES
	Claims	---	NO

2. Citations and explanations:

2.1 Reference is made to the following documents:

D1 US 8199728 B2 (KIM SOENG-HUN [KR] et al.) 12 June 2012 (12.06.2012),

D2 WO 2010086156 A1 (PANASONIC CORP [JP]) 05 August 2010 (05.08.2010),

D3 US 8254315 B2 (SUZUKI TAKASHI [JP] et al.) 28 August 2012 (28.08.2012),

D4 US 2007248025 A1 (PHAN VINH V [FI] et al.) 25 October 2007 (25.10.2007).

2.2 Claimed invention

The claimed invention relates apparatuses, methods, and a non-transitory computer readable medium, and a computer program product for managing error controlling in communication systems according to independent claims 1, 12, 23, 26, 27, 29, and 30. The embodiments of the claimed invention are defined in dependent claims 2-11, 13-22, 24-25, and 28.

An object of the present invention is to provide new improved techniques for communication of data, the communication employing automatic repeat request protocols.

All patent claims were subjected to a novelty search.

2.3 Novelty and Inventive Step under PCT Article 33-(2), (3)

Document D1, which is considered to represent the most relevant prior art, presents (abstract) a method and apparatus for non-scheduled transmission for a packet service in a mobile communication system. A plurality of allowed maximum packet sizes are defined for the non-scheduled transmission and a UE selects one of the maximum packet sizes under circumstances and sends packets.

D1 discloses (fig. 9, col. 8 lines 8-17) that the UE includes a plurality of higher-layer entities, a Multiplexer, and a HARQ processor, and a non-scheduled transmission controller. The higher-

Continued to next page

Supplemental Box

Continuation of: Box V (1 / 2)

layer entities are configured, each on a per-service basis. They reconfigure higher-layer data to a predetermined size and provide control to Automatic Repeat request, ARQ, for example.
Furthermore D1 discloses (fig. 4, col. 5 lines 23-53) that a plurality of maximum MAC-e PDU content sizes and a switching condition are signaled, according to the characteristics of services mapped to the MAC-d flow, as the E-DCH MAC-d flow configuration information. If VoIP is mapped to the MAC-d flow, a first non-scheduled grant for the transient state, Max MAC-e PDU content size 1, i.e. a maximum packet size for the transient state, and a second non-scheduled grant for the steady state Max MAC-e PDU content size 2, i.e. maximum packet size for the steady state, are signaled. Max MAC-e PDU content size 1 is set according to the size of full VoIP packets. Max MAC-e PDU content size 2 is set according to the size of VoIP packets with compressed headers. Max MAC-e PDU content size 1 is first used in an early state of the service. If a predetermined switching condition is satisfied, both the UE and the Node B switch from Max MAC-e PDU content size 1 to Max MAC-e PDU content size 2.

D1 implicitly discloses all the features of claims 1-4, 7, 8, 11-15, 18, 19, 22, 23, and 26-30. Thus, the subject matter of said claims is not novel. Consequently, the subject matter of said claims does not involve an inventive step either.

D1 does not disclose all the features of claims 5, 6, 9, 10, 16, 17, 20, 21, 24, and 25. Based on D1 said claims are considered obvious design option for a man skilled in the art, and therefore not to involve an inventive step.

Document D2 presents (abstract) a method for transmitting packet data units from a eNodeB via a relay node to a mobile node. The relay node determines whether each PDU from the eNB is appropriate for the current channel conditions to the MN. Consequently, only if PDU is appropriate for the channel quality, same is transmitted. If not, eNB re-transmits the PDU according to current channel conditions. Moreover, the MN when failing to decode a PDU correctly, requests the re-transmission of said PDU from the eNB via a status report.

D2 discloses (page 10 line 5 – page 11 line 20) that an object of the invention is to improve the re-transmission mechanism for packet data units transmitted between the eNB and the mobile node over the relay node. The relay node is provided with functionality to determine whether the packet data unit, received from the radio resource control entity, the eNB, is appropriate for the current channel conditions to the mobile node. Consequently, in case the packet data unit is appropriate for the channel quality, same is transmitted to the mobile node. Conversely, the packet data unit is not transmitted to the mobile node, but the radio resource control entity is informed about the failed transmission, thus requesting to re-transmit the packet data unit in accordance with current channel conditions.
If the size of the packet data unit is smaller than or equal to a current maximum transport block size, the packet data unit is transmitted. The maximum transport block size is given by the channel condition, and indirectly by the highest possible MCS level that can be chosen to transmit the PDU. The higher the MCS level, the better the channel conditions have to be. In other words, the current channel conditions allow only up to a certain level of MCS to be used for transmission of the packet data unit to the UE, and thus up to a certain RLC PDU size. However, in case the RLC PDU size is too large, the previously decided modulation and coding would have to be used which is not possible due to the worsened channel conditions.
If the packet data unit size is larger than the maximum transport block size, the packet data unit most likely would not be successfully transmitted to the UE. Therefore, the packet data unit is not transmitted, but an imitated status report is generated at the RN instead and transmitted back to the radio resource control entity, thus requesting the retransmission of the data of said packet data unit.
In order for the radio resource control entity to segment the RLC SDUs into RLC PDUs of a size that can indeed be transmitted also with the worsened channel conditions, it is necessary to inform the radio resource control entity accordingly. There are several alternatives for doing so.
The relay node regularly updates its knowledge on the current channel conditions, e.g. by receiving CQI messages from the UE. The channel conditions may vary all the time to a greater or lesser extent. It would be possible for the RN to inform the radio resource control entity immediately about every change in channel conditions. This would however generate a lot of traffic over the air, and thus would waste resources, especially bearing in mind that sometimes the changes of channel conditions might have no impact on the segmentation of the RLC SDUs.

Continued to next page

Supplemental Box

Continuation of: Box V (2 / 2)

In order to save resources, it is possible to inform the radio resource control entity only in case the changes in channel condition are such (better or worse) that a different segmentation can be applied to the RLC SDUs; in other words, in case another MCS level may be applied to the transmission of RLC PDUs.
For some scenarios, it might be also beneficial to only report on a change of channel condition, if the change is for worse, i.e. an RLC PDU would not be appropriate for the new channel conditions, the RLC PDU size being too large.

D2 implicitly discloses all the features of claims 1-6, 9-17, and 20-30. Thus, the subject matter of said claims is not novel. Consequently, the subject matter of said claims does not involve an inventive step either.

D2 does not disclose all the features of claims 7, 8, 18, and 19. Based on D2 said claims are considered obvious design option for a man skilled in the art, and therefore not to involve an inventive step.

Document D3 presents (abstract) a method for packet data retransmission on Hybrid Automatic Repeat Request, HARQ, transmission failure having the steps of: checking whether changes to HARQ transmission error performance characteristics are greater than a threshold and/or a deterioration of channel conditions is indicated or less than threshold; if yes, re-segmenting an RLC-SDU or RLC-PDU data into smaller PDU data sizes; and transmitting said re-segmented RLC-PDU data; and if not yes, transmitting previous RLC-PDU data.

D3 discloses (figs. 3, 4, col. 4 lines 3-16) that on HARQ retransmission failure, there are choices in handling the error: 1) Do nothing-this means relying on the polling and status report functions of the ARQ function to recover the error. 2) Re-segment and retransmit immediately-the failed data unit is re-segmented into a more appropriate size according to the current radio conditions before the retransmission. This option should be chosen when retransmitting the original transport block is not considered to be effective due to a deteriorated channel condition and/or decreased availability of radio resources.

D3 implicitly discloses all the features of claims 1-5, 7, 12-16, 18, and 27-30. Thus, the subject matter of said claims is not novel. Consequently, the subject matter of said claims does not involve an inventive step either.

D3 does not disclose all the features of claims 6, 8-11, 17, and 19-26. Based on D3 said claims are considered obvious design option for a man skilled in the art, and therefore not to involve an inventive step.

In summary none of the claims 1-30 is novel and consequently does not involve an inventive step either.

Document D4 represent the general state of the art.

2.4 Industrial applicability under PCT Article 33(4)

The claimed invention and the embodiments are considered industrially applicable.

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/FI2016/050510

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

No document reflecting the prior art is identified in the description (PCT Rule 5.1(a)(ii)).

The features of the claims are not provided with reference signs placed in parentheses. (Rule 6.2(b) PCT)

The claims are not cast in a two-part form in accordance with Rule 6.3 (b) PCT.

Claim 28 refers to performing the method according to any of claims 14-24 or 26 although claims 23 and 24 are apparatus claims. It appears that this is a typographical error and claim 28 should instead refer to performing the method according to any of claims 14-22 or 26.

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**

Continuation of: International Patent Classification (IPC)

IPC
H04W 28/04 (2009.01)
H04W 28/06 (2009.01)
H04L 1/00 (2006.01)
H04L 1/18 (2006.01)