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**Datasheet for the decision
of 4 February 2025**

Case Number: T 0812/23 - 3.5.05

Application Number: 18776231.5

Publication Number: 3598674

IPC: H04L1/00

Language of the proceedings: EN

Title of invention:

Encoding method, decoding method, apparatus and device

Applicant:

Huawei Technologies Co., Ltd.

Headword:

Mapping frozen bits/HUAWEI

Relevant legal provisions:

EPC Art. 83

Keyword:

Sufficiency of disclosure - all claim requests (no)



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Case Number: T 0812/23 - 3.5.05

D E C I S I O N
of Technical Board of Appeal 3.5.05
of 4 February 2025

Appellant: Huawei Technologies Co., Ltd.
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 9 January 2023
refusing European patent application
No. 18776231.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair K. Bengi-Akyürek
Members: P. Tabery
C. Almberg

Summary of Facts and Submissions

I. The appeal lies from the decision of the examining division to refuse the present European application. The examining division found that the main request as well as auxiliary requests 1 and 2 did not comply with Articles 83 and 123(2) EPC.

In addition, auxiliary request 1A, filed during the oral proceedings before the examining division, was not admitted into the proceedings under Rule 116(1) and (2) EPC.

II. Oral proceedings before the board were held on 4 February 2025. The final requests of the appellant were as follows:

The appellant requested that the appealed decision be set aside and that a patent be granted on the basis of the claims of one of the **main request** and **auxiliary requests 1 and 2**, all underlying the appealed decision, and **auxiliary requests 3 and 4**, both filed in response to the board's communication under Article 15(1) RPBA.

At the end of the oral proceedings, the board's decision was announced.

III. Claim 1 of the **main request** reads as follows (board's labelling):

"A method for rate matching, wherein the method comprises:

- (a) obtaining a bit sequence whose length is N, wherein the bit sequence comprises K information bits, and K, N are positive integers,

- (b) determining (210) a transmission code rate $R=K/M$, wherein M is the length of a target code, M is a positive integer, N is greater than or equal to M ;
- (c) determining (220) when the transmission code rate R is greater than or equal to a first code rate threshold, that a rate matching manner is a shortening mode or when the transmission code rate R is less than the first code rate threshold, that the rate matching manner is a puncturing mode;
- (d) dividing the bit sequence whose length is N into equal length bit groups and determining an order sequence of the equal length bit groups and of bits in the equal length bit groups corresponding to an order of punctured bits and an order sequence of the equal length bit groups and of bits in the equal length bit groups corresponding to an order of shortened bits, wherein each order sequence itself is symmetrical;
- (e) mapping one or more frozen bits into one or more polarized channels corresponding to one or more bit sequence numbers in the order sequence according to the rate matching manner, and the K information bits are mapped into remaining polarized channels based on reliability;
- (f) polar encoding (230) the bit sequence whose length is N , to obtain a first encoded bit sequence whose length is N ; and
- (g) rate matching (230) the first encoded bit sequence whose length is N to obtain a second encoded sequence whose length is M by removing $N-M$ bits according to the order sequence of the rate matching manner from the first encoded bit sequence whose length is N by first removing equal length bit groups until the number of remaining bit is less than the length of an equal length bit group

and then removing the remaining bits from the next equal length bit group in the order sequence."

Claim 1 of **auxiliary request 1** differs from claim 1 of the main request in that features (d) and (g) now read as follows (board's labelling and appellant's markup):

- (d-1) "dividing the bit sequence whose length is N into equal length bit groups and determining, if the rate matching manner is a puncturing mode, an order sequence of the equal length bit groups corresponding to an order of punctured bit groups and an order sequence of bits in the equal length bit groups corresponding to an order of punctured bits and determining, if the rate matching manner is a shortening mode, an order sequence of the equal length bit groups corresponding to an order of shortened bit groups and an order sequence of bits in the equal length bit groups corresponding to an order of shortened bits, wherein each order sequence itself is symmetrical;"
- (g-1) "rate matching (230) the first encoded bit sequence whose length is N to obtain a second encoded sequence whose length is M by removing N-M bits according to the order sequences of the rate matching manner from the first encoded bit sequence whose length is N by first removing equal length bit groups according to the order sequence of equal length bit groups until the number of remaining bit is less than the length of an equal length bit group and then removing the remaining bits from the next equal length bit

group in the order sequence according to the order sequence of bits in the equal length bit groups."

Claim 1 of **auxiliary request 2** differs from claim 1 of auxiliary request 1 in that feature (d-1) now specifies that "each order sequence of the equal length bit groups itself is symmetrical".

Claim 1 of **auxiliary request 3** differs from claim 1 of the main request in that feature (g) now reads as follows (board's labelling; deletions not shown):

(g-3) "rate matching (230) the first encoded bit sequence whose length is N to obtain a second encoded sequence whose length is M."

Claim 1 of **auxiliary request 4** differs from claim 1 of auxiliary request 3 in that feature (g) now reads as follows (board's labelling):

(g-4) "rate matching (230) the first encoded bit sequence whose length is N according to the rate matching manner by shortening or puncturing the first encoded bit sequence to obtain a second encoded sequence whose length is M."

Reasons for the Decision

1. The present application concerns channel coding using a polar code. In actual implementations, rate matching may be necessary. This may be realised using either puncturing or shortening of the encoded data sequence. However, in situations where the "mother code" includes

a relatively large quantity of information bits, rate matching by directly puncturing or shortening the mother code may lead to information loss during decoding (see paragraph [0006] of the present description as filed).

2. Main request - sufficiency of disclosure (Article 83 EPC)

2.1 With respect to the "mapping" step of **feature (e)**, the board notes that the corresponding paragraph [0061] of the description as filed discloses a three-step approach:

- First, "frozen bits" are mapped according to the shortening/puncturing order sequence.
- Second, some information bits are mapped into the remaining polarised channels with high reliability.
- Lastly, the remaining polarised channels are filled with frozen bits.

2.2 The second and the last steps are known to be inherent properties of polar coding. The first step is based on the shortening/puncturing order sequence. However, the application as originally filed neither provides any guidance how a suitable order sequence may actually be determined, nor how the order sequence may be used to determine appropriate positions for the "frozen bits". The term "order sequence" does not even occur in paragraph [0061] of the original description (the same holds true for paragraph [0012]).

Since an "order sequence" typically indicates a rearranged order of *all* bits, it does not indicate which *particular* bit positions are to be filled with "frozen bits". Rather, to determine such positions, a

sequence indicating only the positions of the "frozen bits" would be required. However, the application as filed fails to disclose how such a sequence of positions is actually to be derived. Therefore, the skilled person in the field of channel coding would in fact have to resort to inventive skills in order to determine advantageous positions of the "frozen bits". In other words, the skilled person would be confronted with an undue burden when trying to figure out which one of the myriad of possible permutations of "frozen bit"-positions would indeed be suitable, depending on the circumstances.

- 2.3 In this context, the appellant's argument that paragraph [0061] as filed refers back to the "sorting sequences" of polarisation weight (PW) values disclosed in paragraphs [0049] to [0060] does not help. This is because these "sorting sequences" fail to indicate specific positions for the "frozen bits". Moreover, the appellant's argument that "order sequence" and "sorting sequence" are synonyms does also not help since, in the appellant's favour, the board already assumed this understanding in its interpretation of the original disclosure.
- 2.4 Furthermore, the originally filed claims 7, 9, 10, etc., invoked by the appellant, also fail to fill the gap as to how the positions for the "frozen bits" or the "punctured bits" are actually to be determined.
- 2.5 Lastly, the appellant alleges in its statement of grounds of appeal that the advantage of what is claimed would lie in mapping a "frozen bit" into a polarised channel where the encoded bit was a candidate for removal by rate matching.

2.6 The board is not convinced by this argument either. First and foremost, the aspect of mapping a "frozen bit" such that it is likely to be removed during rate matching is not originally disclosed. Moreover, this argument assumes a direct correspondence between an "input bit" and an "encoded bit". This however is generally not the case, since polar coding is typically performed per bit sequence. In addition, this advantage may only be achieved if the "order sequence" assigned during the "determining" step of feature (d) points to a bit whose encoded counterparts are subsequently subject to a shortening/puncturing operation. However, the original description does not provide any guidance how the "order sequence" is eventually to be determined, as already pointed out by the examining division (see appealed decision, Reasons 5). Therefore, the application as filed does not enable the skilled person to achieve this alleged advantage without undue burden. This is exacerbated by the fact that the application as filed does not mention this alleged advantage, thus leaving it to the skilled person to discover this alleged advantage (assuming that it indeed exists) before determining an "order sequence" that is indeed suitable for achieving it.

2.7 Hence, the application as filed does not enable the skilled person to carry out, at least, feature (e) of claim 1.

2.8 In view of the above, the **main request** is not allowable under Article 83 EPC.

3. Auxiliary requests 1 to 4

3.1 Claim 1 of each of the auxiliary requests contains, without any amendments, feature (e) of claim 1 of the

main request. Therefore, the objection raised with respect to claim 1 of the main request applies likewise to claim 1 of each of the auxiliary requests. In respect of auxiliary requests 3 and 4, this conclusion applies regardless of the underlying admittance issue.

3.2 In consequence, auxiliary requests 1 to 4 are not allowable under Article 83 EPC either.

4. With no allowable claim request on file, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chair:



B. Brückner

K. Bengi-Akyürek

Decision electronically authenticated