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**Datasheet for the decision  
of 18 January 2022**

**Case Number:** T 0274/18 - 3.5.03

**Application Number:** 10013238.0

**Publication Number:** 2262129

**IPC:** H04B7/08, H04B7/04, H04L25/03,  
H04L1/06

**Language of the proceedings:** EN

**Title of invention:**

Reduced complexity detection and decoding for a receiver in a communication system

**Applicant:**

Qualcomm Incorporated

**Headword:**

Decoding in MIMO systems/QUALCOMM

**Relevant legal provisions:**

EPC Art. 54  
RPBA 2020 Art. 12(8)

**Keyword:**

Decision in written proceedings (yes): cancellation of oral proceedings following party's announcement of non-attendance  
Novelty - (no)



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Case Number: T 0274/18 - 3.5.03

**D E C I S I O N**  
**of Technical Board of Appeal 3.5.03**  
**of 18 January 2022**

**Appellant:** Qualcomm Incorporated  
(Applicant) 5775 Morehouse Drive  
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**Decision under appeal:** **Decision of the Examining Division of the  
European Patent Office posted on 21 July 2017  
refusing European patent application  
No. 10013238.0 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chair** K. Bengi-Akyürek  
**Members:** K. Schenkel  
C. Almberg

## Summary of Facts and Submissions

- I. This case concerns the appeal of the applicant (henceforth, "appellant") against the decision of the examining division refusing the European patent application on the ground of lack of an inventive step (Article 56 EPC) in the light of the disclosure of the following prior-art document:
- D4:** WO 2004/023663 A1.
- II. The appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 14 as refused by the examining division and re-filed with the statement of grounds of appeal.
- III. In written response to the summons to oral proceedings, the appellant informed the board that it will not be attending the scheduled oral proceedings. The appellant did not file any comments concerning the board's preliminary opinion as annexed to the summons.
- IV. Following the applicant's response, the oral proceedings were cancelled.
- V. Claim 1 of the single request reads as follows:
- "An apparatus comprising:  
a receiver configured to obtain a plurality of data symbols transmitted via a multiple-input multiple-output, MIMO, channel;  
at least one processor configured to:  
perform receiver spatial processing on the obtained data symbols to obtain a set of M detected data symbols,

compute (814) log-likelihood ratios, LLRs, independently for each of D data symbols in the set of M detected data symbols, determine (816) a list of candidate hypotheses for remaining M-D data symbols in the set of M detected data symbols, and compute (818) LLRs jointly for the remaining M-D data symbols with the list of candidate hypotheses, wherein  $M > D \geq 1$ ; and a memory coupled to the at least one processor."

## **Reasons for the Decision**

1. *Decision in written proceedings*
  - 1.1 Where oral proceedings are appointed upon a party's request and that party subsequently expresses its intention not to attend, such statement is normally considered to be equivalent to a withdrawal of the request for oral proceedings.
  - 1.2 As the board did not consider holding oral proceedings to be expedient or necessary in this case (cf. Article 116(1) EPC), these were cancelled and a decision was handed down in written proceedings (Article 12(8) RPBA 2020).
  - 1.3 Given that the appellant's indication of non-attendance was not submitted within one month of notification of the board's communication under Article 15(1) RPBA 2020, the appeal fee cannot be partially reimbursed under Rule 103(4) (c) EPC.
2. Claim 1 - novelty (Articles 52(1) and 54 EPC)

2.1 The present application relates to the field of telecommunication using multiple-input multiple-output (MIMO) technology and in particular to the efficient decoding of data symbols received by the multiple inputs.

2.2 Claim 1 includes the following limiting features (labelling by the board):

An apparatus comprising:

- a) a receiver configured to obtain a plurality of data symbols transmitted via a multiple-input multiple-output (MIMO) channel,
- b) at least one processor configured to:
  - b1) perform receiver spatial processing on the obtained data symbols to obtain a set of M detected data symbols,
  - b2) compute log-likelihood ratios (LLRs), independently for each of D data symbols in the set of M detected data symbols,
  - b3) determine a list of candidate hypotheses for remaining M-D data symbols in the set of M detected data symbols,
  - b4) compute LLRs jointly for the remaining M-D data symbols with the list of candidate hypotheses, wherein  $M > D \geq 1$ ,
- c) a memory coupled to the at least one processor.

2.3 Using the language of present claim 1, document **D4** discloses an apparatus (figure 2) comprising:

- a receiver configured to obtain a plurality of data symbols transmitted via a multiple-input multiple-output (MIMO) channel (figure 4, num. 401; figure 2, num. 201, "FIRST QUALITY VALUES"; page 1, line 32 to page 2, line 2, "a linear receiver first

separates out the Mr transmitted symbols and provides Mr symbol estimates"; page 2, lines 27-30, "method and apparatus for MIMO joint detection and decoding is provided herein") **(feature a)**;

- at least one processor (page 4, lines 23-28, "It is contemplated that the elements within receiver 102 are configured in well known manners with processors, memories, instruction sets ... ") **(feature b)** configured to:
- perform receiver spatial processing on the obtained data symbols to obtain a set of M detected data symbols (figure 4, nums. 403-407; figure 2, num. 205, "INFORMATION BITS"; page 2, lines 27-30, "method and apparatus for MIMO joint detection and decoding is provided herein that performs both MIMO symbol separation and decoding") **(feature b1)**,
- compute log-likelihood ratios (LLRs) independently for each of D data symbols in the set of M detected data symbols (figure 4, nums. 411-413; figure 2, num. 205, "SECOND QUALITY VALUES"; page 3, lines 4-6: "some bits decoded with higher confidence (e.g., decoded by utilizing the output of a linear filter method)"; page 9, lines 24-25: "To create the third LLR set, some of the LLRs in the first set are updated while the rest of the LLRs of the first set are kept unchanged."; page 14, lines 18-21: "To reduce the number of considered candidates and thus the number of computations, hard decisions on bits with "high" LLRs may be made by comparing them against a bit LLR threshold, thus excluding them from any further computation.", the "bits with high LLRs" correspond

to the D data symbols for which LLRs are computed independently which implies  $D \geq 1$ ) (**feature b2**),

- determine a list of candidate hypotheses for remaining M-D data symbols in the set of M detected data symbols (figure 4, nums. 411-415; abstract: "the distances to a much smaller set of candidate constellation points are computed"; page 1, lines 22-28: "possible hypotheses for the transmitted symbol vector (i.e., a vector of constellation points)"; page 3, lines 1-7; page 4, lines 18-20: "In order to reduce the complexity of the non-linear receive method, the distances between the received signal and a much smaller set of candidate symbol vectors are computed."; page 9, lines 5-12; page 11, lines 10-13; page 14, lines 21-24), (**feature b3**) and
- compute LLRs jointly for the remaining M-D data symbols with the list of candidate hypotheses, wherein  $M > D \geq 1$  (figure 4, nums. 415-417; figure 2, num. 202, "THIRD QUALITY VALUES"; abstract: "a higher-complexity non-linear (202) method is utilized when the performance of the linear method is not adequate, for example, during poor channel conditions"; page 1, lines 29-32: "non-linear ones like the above-mentioned ML receiver ... tries to jointly detect all MT transmitted symbols at once"; page 3, lines 1-12: "some bits decoded with higher confidence (e. g., decoded by utilizing the output of a linear filter method)", "utilizing the non-linear method only when necessary, ... ", which implies  $D < M$ ; page 9, lines 5-15: "the probability information for each coded bit, provided by decoder 205, is utilized, as the side information, by non-linear receiver 202 to

eliminate calculating ... for some transmitted symbol candidates ... Therefore, the computation of ... for the less likely scan be omitted."; page 9, lines 24-25: "To create the third LLR set, some of the LLRs in the first set are updated while the rest of the LLRs of the first set are kept unchanged."; page 10, lines 7-8; page 14, lines 28-21, "bits with high LLRs") (**feature b4**);

- a memory coupled to the at least one processor (page 4, lines 23-28: "It is contemplated that the elements within receiver 102 are configured in well known manners with processors, memories, instruction sets ... ") (**feature c**).

2.4 The appellant argued that D4 did not disclose **features b2 and b4**, since D4 failed to show the claimed separation of computing LLRs partly independently and partly jointly. In this respect, the appellant argued that the "non-linear receiver" of D4 was an add-on and that the "linear receiver" computed estimates on all MT transmit symbols independently, i.e. did not process a subset of the MT transmit symbols. The appellant argued further that "the linear filter 201 has to process all MT transmitted symbols to find out if it is necessary to use the non-linear filter 202 for additional computations" (cf. page 3 of the statement of grounds of appeal, last paragraph).

2.5 The board agrees with this latter statement, but notes that **feature b2** does not exclude that LLRs for the remaining M-D data symbols are initially also computed independently and then not finally used, e.g. because they are unreliable and replaced by jointly computed LLRs from the non-linear receiver, as disclosed in **D4** (cf. page 13, lines 1-6). In accordance with D4, "hard

decisions on bits with 'high' LLRs may be made by comparing them against a bit LLR threshold, thus excluding them from any further computation" (cf. D4, page 14, lines 19-21). The group of "high" LLRs form the group of D symbols computed independently (i.e. **feature b1**). The remaining LLRs are re-computed using the non-linear filter and form the group of M-D LLRs computed jointly (i.e. **feature b2**).

Hence, **features b2 and b4** are disclosed by D4. The board in fact sees no essential difference between the method disclosed in D4 and the more detailed methods disclosed in paragraphs [062] and [063] of the description of the present application as filed.

- 2.6 The examining division held feature " $M > D \geq 1$ " as the only distinguishing feature with respect to D4, but assessed it as not contributing to inventive step (cf. appealed decision, Reasons 15.2 to 15.4). However, the board considers that this feature is implicitly disclosed in D4, since, in D4, the number of "high" LLRs computed independently (= D) is at least 1 (clearly, one or more LLRs may be above the LLR threshold) and less than the total number of input symbols (= M) if the non-linear processing is to be used. Hence, the condition " $M > D \geq 1$ " is implicitly satisfied.
- 2.7 Consequently, the subject-matter of claim 1 is not new with respect to the disclosure of document D4 (Articles 52(1) and 54 EPC).
3. Since the sole set of claims is not allowable, the appeal is to 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