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Datasheet for the decision of 10 November 2010

Case Number: T 1521/07 - 3.5.02

Application Number: 99925431.1

Publication Number: 1027772

IPC: H03M 13/00

Language of the proceedings: EN

Title of invention:
Channel coding device and method for rate matching

Applicant:
SAMSUNG ELECTRONICS CO., LTD.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Relevant legal provisions (EPC 1973):
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Keyword:
"Novelty - no (main request)"
"Inventive step - no (auxiliary request)"

Decisions cited:
-

Catchword:
-

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Case Number: T 1521/07 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 10 November 2010

Appellant: SAMSUNG ELECTRONICS CO., LTD.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 17 April 2007 refusing European application No. 99925431.1 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: M. Ruggiu
Members: M. Rognoni
P. Mühlens

Summary of Facts and Submissions

I. The appellant (applicant) appealed against the decision of the examining division refusing European patent application No. 99 925 431.1.

II. In the contested decision, the examining division held, *inter alia*, that none of the applicant's requests was allowable. In particular, the subject-matter of claim 1 of the main request and the subject-matter of the first auxiliary request were not new with respect to the following document:

D1: GB -A-2 296 165.

III. With the statement of grounds of appeal, the appellant filed a new set of claims.

IV. In a communication dated 3 August 2010 accompanying the summons to oral proceedings, the Board introduced the following document into the appeal proceedings:

D7: M. Öberg and P. H. Siegel, "Application of Distance Spectrum Analysis to Turbo Code Performance Improvement", published in *Proc. 35th Allerton Conf. Communication, Control and Computing*, Monticello, IL, September 1997, pages 701 to 710.

V. On 10 November 2010, oral proceedings were held before the Board.

VI. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis

of claims 1 to 43 of the main request filed with letter of 8 October 2010, or on the basis of claims 1 to 41 of the auxiliary request filed at the oral proceedings of 10 November 2010.

VII. Claim 1 according to the main request reads as follows:

"A channel coding device comprising:

a bit inserter (702, 802, 812, 902, 912, 1102, 1302, 1312, 1322, 1502, 1512) for inserting known bits in an input data bit stream at predetermined positions;

a channel coder (703, 803, 813, 903, 913, 1103, 1112, 1303, 1313, 1323, 1503, 1513, 1522) for channel coding the bit-inserted data bit stream to generate coded symbols;

a rate matcher (704, 804, 814, 904, 914, 1104, 1114, 1304, 1314, 1324, 1504, 1514, 1523) for matching a rate of the coded symbols to a given channel symbol rate; and

a channel interleaver (705, 805, 815, 906, 1106, 1307, 1507) for interleaving the rate matched channel symbols,

wherein the rate matcher comprises at least one of a puncture *(sic)* for puncturing the coded symbols and a repeater for the coded symbols according to a difference between the rate of the coded symbols and the given channel symbol rate,

wherein, when the coded symbol rate is higher than the given channel symbol rate, the rate matcher punctures a part in parity symbols of the coded symbols comprising the input data bit stream and the inserted known bits."

Claim 1 according to the auxiliary request differs from claim 1 of the main request in that it further comprises the following feature:

"wherein the rate matcher (804, 814) comprises a puncturer for puncturing the inserted known bits included in the coded symbols when the coded symbol rate is higher than the given channel symbol rate."

VIII. The appellant's arguments relevant to the present decision may be summarized as follows:

The gist of the present invention consisted in inserting known bits at predetermined positions of an input data bit stream before coding, rate matching and transmission of the data was carried out. If rate matching was performed by puncturing the inserted bits, which were known to the receiving party, and/or the parity bits but not data bits, performance degradation could be minimized.

According to D7, performance of turbo codes was improved by using distance spectrum analysis to identify information bit positions affected by low-distance error events. D7 taught that, by inserting dummy bits in these positions, a lower and steeper error floor in the bit-error-rate performance curve could be achieved. This particular teaching of D7 was therefore not related to channel rate matching. Furthermore, the encoding scheme disclosed in D7 aimed at replacing information bits, which could be particularly affected by transmission errors, with "dummy" bits to be coded, transmitted and then discarded after decoding. Thus, the bit inserter shown

in D7 did not actually insert known bits at predetermined positions in the data stream, as taught by the present invention. As D7 did not show all the features recited in claim 1 of the main request, the subject-matter of this claim was new with respect to the cited prior art.

In claim 1 of the auxiliary request it was further emphasised that an aspect of the present invention consisted in deleting the inserted bits for matching the rate of the coded symbol rate to a given a channel rate. As this feature was neither known from nor suggested by D7, the subject-matter of claim 1 involved an inventive step.

Reasons for the decision

1. The appeal is admissible.

Main request

2.1 D7 (see Abstract and 2nd page, last paragraph, to 3rd page, first paragraph) relates to a turbo encoder and teaches, *inter alia*, to improve the bit-error-rate (BER) by inserting dummy bits in predetermined bit positions, which are identified as being affected by low-distance error events (cf. page 9, lines 12 to 21 of the published application). Thus, as explained in D7 (last page, "Conclusions"), the encoding scheme disclosed in this document *"involves identification of the bit positions associated with low-weight codewords, and modifying the encoder to avoid writing information in those locations"*. If, for instance, the dummy bits are

chosen to be all 0's, the receiver associates to the corresponding known bit positions a *"strong indication that the transmitted bits were all 0's"* (see paragraph bridging pages 8 and 9 of D7).

As pointed out on page 8 (first full paragraph), the encoder according to D7 *"incurs a rate loss through this introduction of dummy bit positions"*. Although the insertion of specified dummy bits in bit positions occupied by information bits deceases the code rate, there is no actual loss of information bits, as argued by the appellant, because the bit insertion taught in D7 actually aims at shifting information bits to bit positions not affected by low-distance error events.

Furthermore, D7 points out that in order to increase the overall rate of the encoder for example from 1/3 to 1/2 *"the usual practice of puncturing every other parity bit in each dimension"* is followed (D7, third page, third paragraph). As puncturing parity bits increases the code rate k/n by reducing the number of (n-k) redundant bits, it decreases the number of bits to be transmitted and thus the coded symbol rate.

2.2 In summary, D7 discloses*, inter alia*, a coding device comprising the following features recited in claim 1 according to the main request:

– a bit inserter for inserting known bits in an input data bit stream at predetermined positions (D7, paragraph bridging second page and third page, and paragraph bridging pages 8 and 9);

– a channel coder for channel coding the bit-inserted data bit stream to generate coded symbols (see for instance D7, third page, third paragraph);

– a rate matcher for matching a rate of the coded symbols to a given channel symbol rate, wherein the rate matcher comprises a puncturer for puncturing part of the parity symbols, when the coded symbol rate is higher than the given channel symbol rate (D7, third page, third paragraph, last sentence).

2.3 D7 does not explicitly show a channel interleaver for interleaving the rate matched channel symbols. It is, however, generally known in the art that the data and parity bits of the coded and punctured symbols are interleaved before being modulated and transmitted (see, for instance, Figure 9 of D1 and Figure 1 of the application). Thus, it is implicit to the skilled reader that the coding device known from D7 has to comprise a channel interleaver as specified in claim 1, if it is to be used for the transmission of coded source data.

2.4 As D7 explicitly or implicitly discloses all the features of claim 1 of the appellant's request, the subject-matter of this claim is not new within the meaning of Article 54 EPC.

Auxiliary request

3.1 Claim 1 according to the auxiliary request further comprises the following feature:

– *"wherein the rate matcher (804, 814) comprises a puncturer for puncturing the inserted known bits included in the coded symbols when the coded symbol rate is higher than the given channel symbol rate"*.

3.2 D7 (page 8, first full paragraph) shows that the insertion of dummy bits has an impact on code rate, as it decreases the number of information bits within a codeword. Furthermore, it is pointed out in the last paragraph of page 8 that the inserted dummy bits are known to the decoder and thus need not be transmitted. It is known that puncturing bits prior to transmission modifies the coded symbol rate and can thus be used to adapt the coded symbol rate to the transmission rate. Hence, it would be obvious to the skilled person, facing the problem of decreasing the coded symbol rate to match the targeted transmission rate, to puncture before transmission not only parity bits but also the inserted known bits.

3.3 Hence, the subject-matter of claim 1 according to the auxiliary request does not involve an inventive step within the meaning of Article 56 EPC.

4. As none of the appellant's requests relates to patentable subject-matter, the application has to be refused.

Order

For the above reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

U. Bultmann M. Ruggiu