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Datasheet for the decision of 26 March 2010

Case Number: T 1559/07 - 3.5.02

Application Number: 00975565.3

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Language of the proceedings: EN

Title of invention:
Adaptive Hybrid ARQ Using Turbo Code Structure

Applicant:
Motorola, Inc.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
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Case Number: T 1559/07 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 26 March 2010

Appellant: Motorola, Inc.
1303 East Algonquin Road
Schaumburg
IL 60196 (US)

Representative: Openshaw, Paul Malcolm
Openshaw & Co.
8 Castle Street
Farnham
Surrey GU9 7HR (GB)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 28 March 2007 refusing European patent application No. 00975565.3 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: M. Ruggiu
Members: R. Lord
P. Mühlens

Summary of Facts and Submissions

I. This is an appeal of the applicant against the decision of the examining division to refuse European patent application No. 00 975 565.3.

II. The following documents of the state of the art have been cited during the procedure before the first instance:

D1: D.N. Rowitch and L.B. Milstein, "Rate Compatible Punctured Turbo (RCPT) Codes in a Hybrid FEC/ARQ System", IEEE, 1997, pages 55 to 59; and

D2: D. Chase, "Code Combining - A Maximum-Likelihood Decoding Approach for Combining an Arbitrary Number of Noisy Packets", IEEE Transactions on Communications, vol. 33, no. 5, pages 385 to 393, May 1985.

III. In a communication dated 3 December 2009 accompanying the summons to oral proceedings, the board indicated *inter alia* their preliminary opinion that the subject-matter of claims 1 and 6 as originally filed was not new with respect to D1.

With a reply dated 26 February 2010, the appellant filed *inter alia* an amended claim 1 according to a fourth auxiliary request.

Oral proceedings before the board took place on 26 March 2010. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claim 1 of the request filed as

fourth auxiliary request with letter of 26 February 2010.

IV. Claim 1 of the appellant's request reads as follows:

"A data packet communication method, the method comprising the steps of:

receiving an incoming data packet;

selecting an initial turbo code rate from among a plurality of possible turbo code rates by relating a carrier-to-interference ratio to one or more thresholds, wherein a first of the plurality of possible turbo code rates is selected if the carrier-to-interference ratio is greater than a first threshold and a second of the plurality of possible turbo code rates is selected if the carrier-to-interference ratio is less than the first threshold;

turbo encoding the data packet to produce encoded bits comprising a plurality of systematic bits and a plurality of parity bits;

transmitting a first portion of the encoded data packet based on the initial turbo code rate;

receiving the transmission of the first portion of the encoded data packet;

decoding the received first portion using a first decoding rate equal to the initial turbo code rate of the encoded data packet;

determining whether the decoding of the received first portion was successful;

when the decoding of the received first portion was unsuccessful, not sending any acknowledgement;

determining if an acknowledgement has been received for the transmitted first portion;

when no acknowledgement is received, transmitting

a second, different portion of the encoded data packet;

receiving the transmission of the second, different portion of the encoded data packet;

turbo decoding the second portion using a second decoding rate to produce decoded bits, wherein the second decoding rate is less than the first decoding rate; and

acknowledging if no error is present in the decoded bits."

V. The appellant essentially argued as follows:

The document D1 did not disclose that the second decoding rate is less than the first decoding rate. On the contrary, the protocol listing on page 57 of that document described in step 2 that the initial code rate is fixed at 1/M, and in step 5 that when carrying out the decoding at a stage when not all of the code symbols have been received, "erasures" (i.e. padding bits) are inserted for the symbols not yet received. As a result, the actual decoding rate, based on the received bits plus the padding bits, would remain constant as 1/M. This was confirmed by the description relating to Figures 4 and 5 of D1. In contrast to this, the invention of the application did not use padding, so that the decoding rate decreased for each iteration, as shown in Fig. 3 of the application.

The invention of the application addressed the problem of "fading channels", which was not addressed in D1.

D1 disclosed sending a "NAK" message from the receiver to the transmitter if the decoding was not successful, whereas the claim specified that in those circumstances

no acknowledgement was sent.

Even if D1 could be considered to disclose selecting the initial code rate on the basis of a channel condition, which he disputed, it did not disclose choosing the carrier-to-interference ratio as this condition, and the available prior art provided no motivation to make that choice amongst the many possible selection criteria. In particular the skilled person reading D1 would have no reason to consider the teaching of D2.

Reasons for the Decision

1. The appeal is admissible.

2. The present application relates to data packet communication methods combining hybrid forward error correction/automatic repeat request (FEC/ARQ) techniques with turbo coding. The document D1 describes such methods (see for instance the abstract of that document) and represents the closest prior art with respect to the present request.

2.1 The document D1 describes (see in particular section 2.3 "RCPT-ARQ Protocol" on page 57) a data packet communication method comprising the following features of the present claim:

– "*receiving an incoming data packet*", this being implicit in the protocol;

– "*selecting an initial turbo code rate from among a plurality of possible turbo code rates*", since in step 3 of the protocol the selection of the initial value of the parameter "*l*" defines the initial code rate, as is apparent from the preceding section of D1, in particular equation (1) and the paragraph in which it appears;

– "*turbo encoding the data packet to produce encoded bits comprising a plurality of systematic bits and a plurality of parity bits*", this being described in general terms in step 2 of the protocol, with the detail concerning the systematic and parity bits being depicted in Fig. 2a, to which reference is made in the description of that step;

– "*transmitting a first portion of the encoded data packet based on the initial code rate*", as defined in step 4 of the protocol, the content of the first transmission being based on the selection of the initial code rate via the reference to the matrix a(*l*);

– "*receiving the transmission of the first portion of the encoded data packet*", this being implicit in the protocol;

– "*decoding the received first portion using a first decoding rate equal to the initial turbo code rate of the encoded data packet*", as described in step 5 of the protocol, first paragraph;

– "*determining whether the decoding of the received first portion was successful*", this being the result

of step 5, paragraphs (b) and (c) of the protocol, the calculated syndrome being zero if the decoding is successful, or non-zero otherwise;

– "*determining if an acknowledgement has been received for the transmitted first portion*", as implied by step 6 of the protocol;

– "*when no acknowledgement* (of successful decoding) *is received, transmitting a second, different portion of the encoded data packet*", which results from step 7 in the protocol and the return to step 4 with incremented value of "*l*";

– "*receiving the transmission of the second, different portion of the encoded data packet*", this also being implicit in the protocol;

– "*turbo decoding the second portion using a second decoding rate to produce decoded bits, wherein the second decoding rate is less than the first decoding rate*", which results from step 5 of the protocol in the second iteration, noting that it is apparent from the matrices a(1) etc. in the left-hand column of page 57 of D1 that the second portion of encoded data will always include parity bits, so that turbo decoding would be used, and that since according to step 4 the second transmission is of encoded bits which have not previously been transmitted, the second decoding step makes use of more received bits than the first decoding step, so that the effective decoding rate is automatically lower; and

– "*acknowledging if no error is present in the decoded bits*", as described in step 5, paragraph (c), first sentence in the protocol.

2.2 As indicated in section V above, the appellant has disputed that D1 discloses that the decoding rate is determined by the selection of the parameter "l", and thus decreases between successive iterations through the steps 4 to 7 in the protocol, arguing that the insertion of "erasures" described in step 5 results in the decoding rate always being the initial coding rate 1/M set in step 2. The board does not find this argument convincing, because the insertion of "erasures" or padding bits does not have any effect on the information involved in the decoding, and thus does not affect the decoding rate. That the decoding rate (or terminologically more correctly "code rate") decreases during the iterations of the protocol is apparent from equation (1) as previously referred to, since that describes the dependency of the code rate (R_l) on the parameter "l", in such a manner that the code rate decreases as the value of "l" increases. The board is also not convinced by the appellant's argument that the method of the application does not make use of padding bits, because the application contains no teaching as to how the decoder copes with the varying number of received data bits. Given that there are only two viable options as to how this could be done, i.e. either to use a decoder adapted to decode incoming data blocks of different size, which would be extremely complex, or to use padding to achieve a constant block size, it is not possible to conclude from this absence of teaching that no padding is used.

3. The method of the present claim is thus distinguished from that of D1 by two technical features: (i) the initial turbo code rate is selected "*by relating a carrier-to-interference ratio to one or more thresholds, wherein a first of the plurality of possible turbo code rates is selected if the carrier-to-interference ratio is greater than a first threshold and a second of the plurality of possible turbo code rates is selected if the carrier-to-interference ratio is less than the first threshold*"; and (ii) after the first decoding operation, "*when the decoding of the received first portion was unsuccessful, not sending any acknowledgement*", so that the transmission of the second encoded data packet is triggered by not receiving an acknowledgement.

4. The board considers that the introduction of both of these features into the method of D1 would be obvious to the skilled person, for the following reasons.

4.1 Although, as discussed above, D1 does disclose the selection of the initial code rate in step 3 of the protocol, it does not provide any direct teaching as to how that selection should be made. The board considers however, that the skilled person would immediately recognise that this should be done on the basis of a channel condition, and that for transmission channels making use of carriers (such as wireless networks) the carrier-to-interference ratio is a very important channel characteristic, so that this would be an obvious choice to adopt as the basis for the selection of the initial code rate. That this choice should be made by relating that ratio to a threshold and selecting the rate depending on whether it was above or

below that threshold is trivial. The appellant correctly argues that other channel conditions could be chosen, but the board considers that the carrier-to-interference ratio would be an obvious selection, because the skilled person would be aware from his common general knowledge that in a carrier-based channel this is a parameter which reflects closely the fundamental characteristic of the channel, namely the signal-to-noise ratio (the parameter which is used for instance on the horizontal axes of the channel performance graphs in Figs. 4 and 5 of D1). This conclusion is supported by the disclosure of D2, which concerns the general type of transmission method of D1 and the present application. Reference is made in this context to the abstract and page 390, the first paragraph of section III.D, in particular the last two sentences of that paragraph, which suggest to the skilled person that the selection of code rate in an adaptive hybrid transmission system should be based on the amount of interference on the channel.

4.2 In contrast to the definition in the claim that no acknowledgement is sent if the decoding of the first received portion was unsuccessful, the protocol in D1 indicates in step 5, paragraph (c), second sentence, that in these circumstances a "NAK", which can be understood as a negative acknowledgement, is sent. However, the opening paragraph of section 2.3 in D1 states that "*the RCPT-ARQ protocol can be trivially adapted to either stop-and-wait or go-back-N schemes*", so that either of these alternatives, the first of which the board understands to be that presently claimed, would be obvious modifications of the method of D1.

4.3 The appellant argued additionally that the differences with respect to D1 as discussed above reflected the fact that the invention of the application was concerned with optimising transmission in "fading channels", i.e. channels in which the transmission conditions change unpredictably over time. However, although D1 does not use that particular expression, it does disclose (for instance on page 55 in the first full sentence of the right-hand column) that the protocols are intended to adapt to changing performance of the channel, which the board interprets as meaning that D1 also addresses the problem of "fading channels". Hence the appellant's argument in this context is not found convincing.

5. Therefore the subject-matter of claim 1 of the appellant's sole request does not involve an inventive step according to Article 56 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

U. Bultmann M. Ruggiu