BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [ ] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 19 May 2011

Case Number: T 0963/08 - 3.5.05

Application Number: 04809758.8

Publication Number: 1665614

IPC: H04L 1/04

Language of the proceedings: EN

Title of invention:
An apparatus and associated methods to implement a high throughput wireless communcation system

Applicant:
Intel Corporation

Headword:
High throughput wireless communcation/INTEL

Relevant legal provisions:
EPC Art. 56, 84, 106, 107, 108
RPBA Art. 15(3)

Keyword:
"Inventive step - no (main request, auxiliary requests 1 to 5)"
"Clarity - no (auxiliary requests 1 and 4)"

Decisions cited:
T 0378/02

Catchword:
-

Case Number: T 0963/08 - 3.5.05

D E C I S I O N
of the Technical Board of Appeal 3.5.05
of 19 May 2011

Appellant: Intel Corporation
2200 Mission College Boulevard
Santa Clara
California 95052 (US)

Representative: Hutchinson, Glenn Stanley
Harrison Goddard Foote
Fountain Precinct
Balm Green
Sheffield S1 2JA (GB)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 2 January 2008 refusing European application No. 04809758.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: A. Ritzka
Members: M. Höhn
G. Weiss

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division dispatched on 2 January 2008, refusing European patent application No. 04809758.8 *inter alia* for lack of inventive step having regard to the disclosure of prior-art publications:

D1: THOMAS T A; VOOK F W: "A Method for Improving the Performance of Successive Cancellation in Mobile Spread MIMO OFDM", VTC 2002-FALL. 2002 IEEE 56TH VEHICULAR TECHNOLOGY CONFERENCE PROCEEDINGS. VANCOUVER, CANADA, vol. 1, 24 September 2002 - 28 August 2002, pages 18-22, NEW YORK, NY, US, and
D2: WANG Z ET AL: "Complex-Field Coding for OFDM Over Fading Wireless Channels", IEEE TRANSACTIONS ON INFORMATION THEORY, IEEE INC. NEW YORK, US, vol. 49, no. 3, March 2003, pages 707-720, ISSN: 0018-9448.

II. The notice of appeal was received on 12 March 2008. The appeal fee was paid on the same day. The statement setting out the grounds of appeal was received on 9 May 2008. The appellant requested that the appealed decision be set aside and that a patent be granted on the basis of one of the six sets of claims 1 to 11 submitted with the statement setting out the grounds of appeal as a main request and auxiliary requests 1 to 5. Oral proceedings were requested on an auxiliary basis.

III. A summons to oral proceedings to be held on 19 May 2011 was issued on 28 February 2011. In an annex accompanying the summons the board expressed the preliminary opinion that the subject-matter of independent claim 1 of all requests appeared not to involve an inventive step having regard to the prior art D1 and D2. Furthermore, auxiliary request 1 did not appear to fulfil the requirements of Articles 83 and 84 EPC, and auxiliary request 4 did not appear to fulfil the requirements of Article 84 EPC. The board gave its reasons for the objections and expressed its view that the appellant's arguments were not convincing.

IV. Independent claim 1 according to the main request reads as follows:

"1. A method comprising:
precoding a plurality of symbol vectors (I) to produce precoded symbol vectors, each symbol vector comprising a plurality of symbols (203);
grouping the precoded symbol vectors into two or more groups (209) respectively comprising a number of layers (207) of precoded symbol vectors;
applying power coefficients to each symbol within the groups (209) of layers (207), wherein the power coefficients are arranged to produce unequal power allocations among at least a subset of the layers (207);
mapping the precoded symbols of the precoded symbol vectors to respective subcarriers of a plurality of subcarriers of a multicarrier communication channel and to respective spatial channels of a plurality of spatial channels based on a precoded symbol's group and a precoded symbol's layer."

Independent claim 1 according to the first auxiliary request reads as follows:

"1. A method comprising:
precoding a plurality of symbol vectors (I) using a linear complex field matrix that comprises a square complex field matrix having substantially a row-wise Vandermonde structure to produce precoded symbol vectors, each symbol vector comprising a plurality of symbols (203), the plurality of symbols (203) being modulation symbols (203);
grouping the precoded symbol vectors into two or more groups (209) respectively comprising a plurality of layers (207) of precoded symbol (203) vectors;
applying power coefficients to each modulation symbol within the groups (209) of layers (207), wherein the power coefficients are arranged to produce unequal power allocations among at least a subset of the layers (207);
mapping the precoded modulation symbols (203) of the precoded symbol vectors to respective subcarriers of a plurality of subcarriers of a multicarrier communication channel and to respective spatial channels of a plurality of spatial channels based on a precoded modulation symbol's group and a precoded modulation symbol's layer."

Independent claim 1 according to the second auxiliary request reads as follows:

"1. A method comprising:
precoding a plurality of symbol vectors (I) to produce precoded symbol vectors, each symbol vector comprising eight of symbols (203), the plurality of symbols (203) being modulation symbols (203);

grouping the precoded symbol vectors into two groups (209) respectively comprising four layers (207) of precoded symbol (203) vectors;
applying power coefficients to each modulation symbol within the groups (209) of layers (207), wherein the power coefficients are arranged to produce unequal power allocations among at least a subset of the layers (207);
mapping the precoded modulation symbols (203) of the precoded symbol vectors to respective subcarriers of sixteen subcarriers of a multicarrier communication channel and to respective spatial channels of four spatial channels based on a precoded modulation symbol's group and a precoded modulation symbol's layer;
wherein said mapping comprises mapping, for the first group, a first symbol of a first layer to a first subcarrier and a first antenna, a second symbol of the first layer to a second sub carrier[sic] and a second antenna, a third symbol of the first layer to a third subcarrier and a third antenna, a fourth symbol of the first layer to a fourth subcarrier and a fourth antenna, a fifth symbol of the first layer to a ninth subcarrier and a first antenna, a sixth symbol of the first layer to a tenth subcarrier and the second antenna, a seventh symbol of the first layer to an eleventh subcarrier and the third antenna, an eighth symbol of the first layer to a twelfth subcarrier and the fourth antenna, and for the second group, a first symbol of the first layer to a fifth subcarrier and the first antenna, a second symbol of the first layer to a sixth subcarrier and the second antenna, a third symbol of the first layer to a seventh sub carrier[sic] and the third antenna, a fourth symbol of the first layer to an eighth subcarrier and the fourth antenna, a fifth symbol of

the first layer to a thirteenth subcarrier and the first antenna, a sixth symbol of the first layer to a fourteenth subcarrier and the second antenna, a seventh symbol of the first layer to a fifteenth subcarrier and the third antenna, and an eighth symbol of the first layer to a sixteenth subcarrier and the fourth antenna, wherein the mapping is similarly applied to the other layers."

Independent claim 1 according to the third auxiliary request reads as follows:

"1. A method comprising:
precoding a plurality of symbol vectors (I) using a linear complex field matrix to produce precoded symbol vectors, each symbol vector comprising eight of symbols (203), the plurality of symbols (203) being modulation symbols (203);
grouping the precoded symbol vectors into two groups (209) respectively comprising four layers (207) of precoded symbol (203) vectors;
applying power coefficients to each modulation symbol within the groups (209) of layers (207), wherein the power coefficients are arranged to produce unequal power allocations among at least a subset of the layers (207);
mapping the precoded modulation symbols (203) of the precoded symbol vectors to respective subcarriers of sixteen subcarriers of a multicarrier communication channel and to respective spatial channels of four spatial channels based on a precoded modulation symbol's group and a precoded modulation symbol's layer:
wherein said mapping comprises mapping, for the first group, a first symbol of a first layer to a first

subcarrier and a first antenna, a second symbol of the first layer to a second sub carrier[sic] and a second antenna, a third symbol of the first layer to a third subcarrier and a third antenna, a fourth symbol of the first layer to a fourth subcarrier and a fourth antenna, a fifth symbol of the first layer to a ninth subcarrier and a first antenna, a sixth symbol of the first layer to a tenth subcarrier and the second antenna, a seventh symbol of the first layer to an eleventh subcarrier and the third antenna, an eighth symbol of the first layer to a twelfth subcarrier and the fourth antenna, and for the second group, a first symbol of the first layer to a fifth subcarrier and the first antenna, a second symbol of the first layer to a sixth subcarrier and the second antenna, a third symbol of the first layer to a seventh sub carrier[sic] and the third antenna, a fourth symbol of the first layer to an eighth subcarrier and the fourth antenna, a fifth symbol of the first layer to a thirteenth subcarrier and the first antenna, a sixth symbol of the first layer to a fourteenth subcarrier and the second antenna, a seventh symbol of the first layer to a fifteenth subcarrier and the third antenna, and an eighth symbol of the first layer to a sixteenth subcarrier and the fourth antenna, wherein the mapping is similarly applied to the other layers."

Independent claim 1 according to the fourth auxiliary request reads as follows:

"1. A method comprising:
precoding a plurality of symbol vectors (I) using a linear complex field matrix that comprises a square complex field matrix having substantially a row-wise

Vandermonde structure to produce precoded symbol vectors, each symbol vector comprising eight of symbols (203), the plurality of symbols (203) being modulation symbols (203);
grouping the precoded symbol vectors into two groups (209) respectively comprising four layers (207) of precoded symbol (203) vectors;
applying power coefficients to each modulation symbol within the groups (209) of layers (207), wherein the power coefficients are arranged to produce unequal power allocations among at least a subset of the layers (207);
mapping the precoded modulation symbols (203) of the precoded symbol vectors to respective subcarriers of sixteen subcarriers of a multicarrier communication channel and to respective spatial channels of four spatial channels based on a precoded modulation symbol's group and a precoded modulation symbol's layer;
wherein said mapping comprises mapping, for the first group, a first symbol of a first layer to a first subcarrier and a first antenna, a second symbol of the first layer to a second sub carrier[sic] and a second antenna, a third symbol of the first layer to a third subcarrier and a third antenna, a fourth symbol of the first layer to a fourth subcarrier and a fourth antenna, a fifth symbol of the first layer to a ninth subcarrier and a first antenna, a sixth symbol of the first layer to a tenth subcarrier and the second antenna, a seventh symbol of the first layer to an eleventh subcarrier and the third antenna, an eighth symbol of the first layer to a twelfth subcarrier and the fourth antenna, and for the second group, a first symbol of the first layer to a fifth subcarrier and the first antenna, a second symbol of the first layer to a sixth subcarrier and the

second antenna, a third symbol of the first layer to a seventh sub carrier[sic] and the third antenna, a fourth symbol of the first layer to an eighth subcarrier and the fourth antenna, a fifth symbol of the first layer to a thirteenth subcarrier and the first antenna, a sixth symbol of the first layer to a fourteenth subcarrier and the second antenna, a seventh symbol of the first layer to a fifteenth subcarrier and the third antenna, and an eighth symbol of the first layer to a sixteenth subcarrier and the fourth antenna, wherein the mapping is similarly applied to the other layers."

Independent claim 1 according to the fifth auxiliary request reads as follows:

"1. A method comprising:
precoding a plurality of symbol vectors (I) using a linear complex field matrix that comprises a square complex field matrix having a row-wise Vandermonde structure to produce precoded symbol vectors, each symbol vector comprising eight of symbols (203), the plurality of symbols (203) being modulation symbols (203);
grouping the precoded symbol vectors into two groups (209) respectively comprising four layers (207) of precoded symbol (203) vectors;
applying power coefficients to each modulation symbol within the groups (209) of layers (207), wherein the power coefficients are arranged to produce unequal power allocations among at least a subset of the layers (207);
mapping the precoded modulation symbols (203) of the precoded symbol vectors to respective subcarriers of

sixteen subcarriers of a multicarrier communication channel and to respective spatial channels of four spatial channels based on a precoded modulation symbol's group and a precoded modulation symbol's layer; wherein said mapping comprises mapping, for the first group, a first symbol of a first layer to a first subcarrier and a first antenna, a second symbol of the first layer to a second sub carrier[sic] and a second antenna, a third symbol of the first layer to a third subcarrier and a third antenna, a fourth symbol of the first layer to a fourth subcarrier and a fourth antenna, a fifth symbol of the first layer to a ninth subcarrier and a first antenna, a sixth symbol of the first layer to a tenth subcarrier and the second antenna, a seventh symbol of the first layer to an eleventh subcarrier and the third antenna, an eighth symbol of the first layer to a twelfth subcarrier and the fourth antenna, and for the second group, a first symbol of the first layer to a fifth subcarrier and the first antenna, a second symbol of the first layer to a sixth subcarrier and the second antenna, a third symbol of the first layer to a seventh sub carrier[sic] and the third antenna, a fourth symbol of the first layer to an eighth subcarrier and the fourth antenna, a fifth symbol of the first layer to a thirteenth subcarrier and the first antenna, a sixth symbol of the first layer to a fourteenth subcarrier and the second antenna, a seventh symbol of the first layer to a fifteenth subcarrier and the third antenna, and an eighth symbol of the first layer to a sixteenth subcarrier and the fourth antenna, wherein the mapping is similarly applied to the other layers."

V. With a letter dated 17 May 2011, the appellant informed the board that it would not be attending the oral proceedings.

VI. Accordingly, nobody appeared on behalf of the appellant at the oral proceedings on 19 May 2011, which were then held in the appellant's absence. After due deliberation on the basis of the written submissions in the statement setting out the grounds of appeal, the board announced its decision.

Reasons for the Decision

1. Admissibility

The appeal complies with the provisions of Articles 106 to 108 EPC (see Facts and Submissions, point II above). Therefore the appeal is admissible.

2. Non-attendance at oral proceedings

In its letter of 17 May 2011 the appellant announced that neither it nor its representatives would be attending. The board considered it expedient to maintain the date set for oral proceedings. Nobody attended the hearing on behalf of the appellant.

Article 15(3) RPBA stipulates that the board is not obliged to delay any step in the proceedings, including its decision, by reason only of the absence at the oral proceedings of any party duly summoned, who may then be treated as relying only on its written case.

Thus, the board was in a position to take a decision at the end of the hearing.

Main request

3. Claim 1 of the main request is based on the fourth auxiliary request in the decision under appeal, with the modification that it is not limited to the concrete type of matrix used for pre-coding (i.e. the square complex field matrix having a row-wise Vandermonde structure).

Against such a claim objections under Articles 84 and 56 EPC were raised in the decision under appeal (see sections 13 and 14).

Article 56 EPC

3.1 The arguments of the decision under appeal were essentially based on D1 and the so-called "weighted BLAST" MIMO OFDM concept, according to which data streams are transmitted with different power levels through the design of unequal power weightings.

In section 14.1 of the decision under appeal the examining division argued that in figure 1 of D1 a coder/symbol mapper was disclosed which produced coded symbol vectors and which could be regarded as a pre-coder since the subsequent processing might be regarded as space-frequency coding. The examining division argued that the bit streams shown in figure 1 could be considered to be a symbol stream, because the expression "symbol stream" was a broad term which encompassed, ***inter alia,*** a bit stream since a bit was nothing else but a symbol for a certain type of information.

In the statement setting out the grounds of appeal the appellant counter-argued that there was a difference between a "bit" and a "symbol", so there was no overlap. The term "symbol" had a particular meaning, which was that it related to a modulation symbol, i.e. the result of processing information to produce a modulation symbol. The terms "symbol" and "bit" therefore referred to different entities. A bit was the information as opposed to a symbol representing the information (see page 3 of the letter dated 26 October 2007).

3.2 The board is not convinced that a bit can actually be considered to be the information, because a bit is only one possibility to represent the information (e.g. an analogue voltage). A symbol is considered to be another representation of such information and usually consists of a plurality of bits. A bit stream as disclosed in D1 (see e.g. line 2 of section II) is considered to be such a plurality of bits which can therefore be interpreted as forming a stream of symbols. When referring to different modulation schemes, the appellant mentioned BPSK (binary phase shift keying) which is an example of a situation where a bit is the symbol. Therefore, the appellant's argument that there was no overlap between "symbol" and "bit" is not considered to be convincing. In the board's judgement, the bit streams in figure 1 of D1 can be considered to be symbol vectors according to the first feature of claim 1.

According to the first feature of claim 1, each symbol vector comprises a plurality of symbols, whereas according to the description it is considered to be also within the concept of the invention that a symbol vector can consist of only a single symbol (see page 16, lines 8 and 9). Accordingly, this alleged difference does not prove a difference in the technical concept between the disclosure of D1 and the claimed invention which would involve an inventive technical contribution.

3.3 Besides, according to an alternative argumentation to point 3.2, in the board's judgement the skilled person would look for possible implementations of a pre-coder in the prior-art literature including D2, since D1 is silent on the concrete way of pre-coding to be used in the coder/symbol mapper as shown in figure 1. D2 discloses sending linear combinations of symbols, the so-called "linear precoding" (see e.g. page 707, last two lines of the right-hand column).

In addition, reference is made to section 16.1 of the decision under appeal in which it is shown that D2 discloses pre-coding of modulation symbols, i.e. a vector of BPSK coded symbols s_i is coded by Θ to become coded symbols u_i (see page 708, figure 1 and the last two paragraphs of the right hand column) as an alternative implementation.

The board considers such a combination of symbols to correspond to a plurality of symbol vectors according to claim 1. The step of precoding a plurality of symbol vectors to produce precoded symbol vectors, each symbol vector comprising a plurality of symbols, is therefore at least rendered obvious by D2.

3.4 The examining division further argued that D1 disclosed that the symbols were grouped into K symbols with a serial to parallel converter and then spread with a size K Walsh spreading matrix W (see first paragraph of section II of D1). The symbols assigned to one particular subcarrier formed a group of symbol vectors, whereas the symbols assigned to another particular subcarrier formed another group of symbol vectors. Since each subcarrier was assigned a different symbol per antenna there were a number of layers of pre-coded symbol vectors per subcarrier group (reference was made to page 19, equations 1 and 2 as well as the paragraph bridging these equations). The symbols $x_1(k=0,b)$, for example, might be regarded as the first group of symbol vectors, and the symbols $x_{l=1}(k=0,b)$ as the layer 1 symbol vectors within group 1.

In the written procedure the appellant argued only in general that D1 did not disclose two or more groups of coded symbols with different layers, but the appellant failed to address specifically the afore-mentioned arguments made by the examining division in the decision under appeal. In the board's judgement these arguments of the examining division are convincing. Since the appellant chose not to attend the oral proceedings before the board, this issue could not be further evaluated by the board. These arguments and the underlying objection therefore have not been overcome by the appellant.

3.5 The examining division's arguments are considered to be supported by table 1 and the preceding paragraph of D1. Table 1 shows that different streams 1 to 4 are interleaved across different transmit antennas Tx1 to Tx4 on each of multiple subcarriers. This corresponds to the embodiment with diagonal mapping which is shown in figure 3 and described in paragraph [0039] of the application. The upper portion of figure 3, according to paragraph [0038] of the application, shows a table with subcarriers (illustrated in columns) and spatial channels (illustrated in rows). As far as the embodiment in paragraph [0039] is concerned, where symbols are diagonally mapped, this is considered to correspond to what is shown in table 1 of D1, where multiple symbols of different streams are diagonally mapped as well. Unfortunately, the bottom part of figure 3 of the application is not legible and, therefore, can neither clarify the grouping, layering and mapping according to claim 1 nor be a basis for the disclosure and for support of claim 1.

The board therefore judges that the step of grouping the precoded symbol vectors into two or more groups respectively comprising a number of layers of precoded symbol vectors, and also the step of mapping the precoded symbols of the precoded symbol vectors to respective subcarriers of a plurality of subcarriers of a multicarrier communication channel and to respective spatial channels of a plurality of spatial channels based on a precoded symbol's group and a precoded symbol's layer according to claim 1 are known or at least rendered obvious by D1.

3.6 According to the third step of claim 1 ("applying…") and in accordance with the description of the present application (see e.g. page 14, lines 15 and 16 or page 16, lines 22 and 23) the power allocation is performed on a per-layer basis.

As is disclosed in table 1 of D1, different power weighting factors α1 to α4 are applied to the interleaved symbols. The appellant's argument that D1 at best disclosed only a single power coefficient applied to all K symbols output from each antenna is not followed by the board, since table 1 of D1 clearly shows that, for example, for antenna Tx1 four different power coefficients α1 to α4 are used on different subcarriers. The appellant's argumentation therefore does not convince.

D1 therefore discloses that the power coefficients to each symbol are arranged to produce unequal power allocations according to claim 1.

3.7 In the board's judgement, the teaching of D1 is directed to the same technical concept as the subject-matter of claim 1 which differs only in minor aspects of implementation not involving an inventive technical contribution over D1 for the reasons set out above. Despite the board's invitation in the annex to the summons for oral proceedings (see point 3.6), the appellant did not identify a technical problem underlying such an alleged difference, and the solution of which would require an inventive activity.

In the light of the afore-mentioned arguments, the board therefore agrees with the reasoning in section 14.1 of the decision under appeal (see in particular first paragraph) and concludes that the subject-matter of claim 1 does not involve an inventive step over the disclosure of D1 (Article 56 EPC) and the skilled person's common general knowledge of coding or, alternatively, in the light of a combination of the disclosures of D1 and D2.

Auxiliary request 1

4. The subject-matter of claim 1 of this request is distinguished from that of the main request by further specifying that the plurality of symbols are modulation symbols and that for pre-coding a linear complex field matrix is used that comprises a square complex field matrix having substantially a row-wise Vandermonde structure.

Article 84 EPC

4.1 Regarding the use of a linear complex field matrix, by using the term "substantially" the problem under Article 84 EPC as argued in section 13.1 of the decision under appeal persists. The appellant addresses this objection merely by alleging that such a relative term "would be clearly understood by the skilled person", without giving reasons why.

4.2 The only information found in the description is that a Vandermonde matrix is a type of matrix that arises in the polynomial least squares fitting, Lagrange interpolating polynomials and the reconstruction of a statistical distribution from the distribution's moments (page 7, lines 4 to 7).

A Vandermonde matrix of order n in general is in the form:

$$\begin{bmatrix} 1 & x_1 & x_1^2 & \cdots & x_1^{n-1} \\ 1 & x_2 & x_2^2 & \cdots & x_2^{n-1} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & x_n & x_n^2 & \cdots & x_n^{n-1} \end{bmatrix}.$$

The solution of an $n \times n$ Vandermonde matrix equation requires $O(n^2)$ operations. The determinants of Vandermonde matrices have a particularly simple form. The board would like to note that a special Vandermonde matrix is the discrete Fourier transform matrix. Regarding the use of a Vandermonde matrix in the context of the invention, the application only uses the expression "substantially row-wise Vandermonde structure" several times, without disclosing how such a matrix is used for the invention.

4.3 The examining division presented a concrete argument by raising the question whether a "substantially" row-wise Vandermonde structure encompassed a true Vandermonde matrix or not. The appellant failed to address this argument. The mere reference of the appellant to decision T 0378/02 is not a convincing counter-argument. In the afore-mentioned decision it was ruled that relative terms in claims are allowable if they are clear in view of the complete specification. This, however, is not the case for the present application, because the application as filed fails to provide any explanation as to what is to be understood by a "substantially" row-wise Vandermonde structure. The board therefore agrees with the reasoning of the examining division regarding the term "substantially" and maintains the objection under Article 84 EPC.

Article 56 EPC

4.4 As far as the modulation symbols are concerned, in D1 the grouping and the following steps are performed using symbols like QAM symbols (see e.g. section II, first paragraph with a reference to "M-ary QAM"), i.e. modulation symbols. A difference in comparison to D1 might be seen in that the pre-coding is performed on the bit stream instead of the symbol stream which, however, is considered to be obvious in the light of D2 (see point 3.3 above). Hence, this added feature does not add anything inventive in comparison to the main request.

4.5 In the statement setting out the grounds of appeal the appellant argued that "the step of pre-coding is not, in itself, the inventive contribution of the present invention…" (see page 6, second paragraph from the bottom). The board would like to note that if this were true for the further specified formulation of this step of claim 1 of this request, it would be true also for the even broader corresponding step of claim 1 of the main request. However, for the main request the appellant argued that the pre-coding step contributed to the inventive step. This is a contradiction in the appellant's argumentation, which is therefore not considered to be convincing.

4.6 The same added portion in the pre-coding step of claim 1 was identified as the sole distinguishing feature over the disclosure of D1 in section 14.1 of the decision under appeal. The examining division argued that the underlying objective technical problem was how to determine or particularise the coding scheme applied in D1. The claimed solution was rendered obvious by D2.

4.7 According to the board's analysis and as argued above (see point 3.3), D2 discloses pre-coding of modulation symbols, i.e. a vector of BPSK-coded symbols s_i is coded by Θ to become coded symbols u_i, whereby $u = \Theta s$ takes place in the complex field (see section II, in particular page 708, figure 1 and the last two paragraphs of the right hand column). The matrix Θ can therefore be considered to be a linear complex field matrix used for pre-coding modulation symbols. Furthermore, D2 also suggests the use of a Vandermonde structure (see e.g. page 708, first paragraph of the left-hand column, and the disclosure of Vandermonde encoders Θ(p) on page 712, right hand column) in accordance with the first step of claim 1.

4.8 The appellant argued that there was no reason for the skilled person to consider departing from the teaching of D1 to introduce the pre-coder of D2, but without giving reasons for this point of view.

However, D1 is silent on the concrete way of pre-coding to be used in the coder/symbol mapper as shown in figure 1. The skilled person would therefore look for possible implementations of a pre-coder in the prior-art literature including D2. The board agrees with the examining division's argument that the linear complex field coding scheme for OFDM in D2 was compatible with the teaching of D1, and the skilled person would consider the linear complex field coding scheme for OFDM in D2 in order to particularise the coding scheme applied in D1 without the need of inventive skills.

The subject-matter of claim 1 therefore lacks an inventive step in the light of a combination of the disclosures of D1 and D2.

Auxiliary request 2

5. The subject-matter of claim 1 of this request is distinguished from that of the main request by further specifying that the plurality of symbols are modulation symbols and that there is a grouping into two groups with four layers of pre-coded symbols and a special mapping scheme with sixteen subcarriers and four spatial channels as described as diagonal mapping in paragraphs [0038] and [0039] of the application.

Article 56 EPC

5.1 Regarding the amendment that the plurality of symbols are modulation symbols, reference is made to the corresponding arguments (see point 4.4) presented with regard to auxiliary request 1.

5.2 In addition, the principle of mapping symbols diagonally is rendered obvious by table 1 and the preceding paragraph of D1, where it is suggested to transmit the symbols using four transmit antennas and map the symbols of one stream to be transmitted on antenna one on subcarrier one, antenna two on subcarrier two and so on.

The present application is silent on what is the particular effect of the claimed mapping scheme in addition to the alleged general advantage of unequal power allocation, i.e. improved reliability of detection and reduction of the effect of error propagation (see page 8, lines 8 to 11). The appellant was invited to provide arguments to that effect, but failed to do so.

In the absence of any convincing arguments of the appellant it is the board's judgement that the added features of claim 1, in particular the mapping of the first and second groups of symbol vectors according to the mapping step of claim 1, are merely an obvious design option for implementing the diagonal mapping known from D1 within the common general knowledge of the skilled reader of D1. The claimed mapping scheme does not provide an additional technical advantage or overcome a technical hurdle in comparison to the subject-matter of claim 1 according to the main request, which is regarded as obvious. Hence, no inventive skills are required for such an implementation of the mapping scheme according to the added features according to claim 1 of this request.

Therefore, the subject-matter of claim 1 lacks an inventive step in the light of a combination of the disclosures of D1 and D2.

Auxiliary request 3

6. The subject-matter of claim 1 of this request is distinguished from that of the preceding request by further specifying that a linear complex field matrix is used to produce pre-coded symbol vectors.

6.1 Such a feature, however, was known from D2 for the reasons set out above when dealing with auxiliary request 1 (see points 4.7 and 4.8). The subject-matter of claim 1 of this request therefore lacks an inventive step in the light of a combination of D1 and D2 as argued above.

Auxiliary request 4

7. The subject-matter of claim 1 of this request is distinguished from that of the preceding request by further specifying that the linear complex filed matrix comprises a square complex field matrix having substantially a row-wise Vandermonde structure.

Article 84 EPC

7.1 Therefore the same objections under Article 84 EPC against the term "substantially" arise as argued in detail with regard to auxiliary request 1 (see points 4.1 to 4.3 above).

Article 56 EPC

7.2 Furthermore, as also outlined above (see points 4.4 to 4.8), D2 suggests the use of a Vandermonde structure (see e.g. page 708, first paragraph of the left-hand column, and the disclosure of Vandermonde encoders $\Theta(p)$ on page 712, right-hand column). The subject-matter of claim 1 of this request is therefore considered to be obvious in the light of a combination of D1 and D2, too.

Auxiliary request 5

8. The subject-matter of claim 1 of this request is only distinguished from that of the preceding request by avoiding the term "substantially".

8.1 Hence, the objection under Article 56 EPC persists. The subject-matter of claim 1 of this request is therefore considered to be obvious in the light of a combination of D1 and D2, for the same reasons as claim 1 of auxiliary request 4.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar The Chair

K. Götz A. Ritzka