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

Datasheet for the decision of 3 March 2015

Case Number: T 2113/11 - 3.5.05

Application Number: 07020307.0

Publication Number: 1914947

IPC: H04L25/03, H04L1/06, H04B7/06

Language of the proceedings: EN

Title of invention:
Pre-coding for MIMO system

Applicant:
NTT DoCoMo, Inc.

Headword:
Pre-coding for MIMO system/NTT

Relevant legal provisions:
EPC Art. 56
RPBA Art. 13(1)

Keyword:
Inventive step - (no)
Late-filed auxiliary requests - justification for late filing (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern
Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 2113/11 - 3.5.05

D E C I S I O N
of Technical Board of Appeal 3.5.05
of 3 March 2015

Appellant: (Applicant)	NTT DoCoMo, Inc. Sanno Park Tower 36th Floor 11-1 Nagata-cho 2-chome Chiyoda-ku Tokyo 100-6150 (JP)
Representative:	Zimmermann, Tankred Klaus Schoppe, Zimmermann, Stöckeler Zinkler, Schenk & Partner mbB Patentanwälte Radlkoferstrasse 2 81373 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 20 April 2011 refusing European patent application No. 07020307.0 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair	A. Ritzka
Members:	M. Höhn
	F. Blumer

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division, posted on 20 April 2011, refusing European patent application No. 07020307.0 on the grounds of Article 123(2) EPC, lack of clarity (Article 84 EPC) and lack of inventive step (Article 56 EPC) with regard to prior-art publications:

D1: US 2006/093065 A1,
D2: SAMANTA R, HEATH R W: "Codebook Adaptation for Quantized MIMO Beamforming Systems", ASILOMAR CONFERENCE ON SIGNALS, SYSTEMS AND COMPUTERS, 28 October 2005, pages 376-380, PISCATAWAY, NJ, USA, IEEE, ISBN: 1-4244-0131-3 and
D6: EUN YONG KIM; JOOHWAN CHUN: "Random Beamforming in MIMO Systems Exploiting Efficient Multiuser Diversity", IEEE VEHICULAR TECHNOLOGY CONFERENCE, vol. 1, 30 May 2005, pages 202-205, IEEE, Piscataway, NJ, USA, ISBN: 978-0-7803-8887-1.

II. The notice of appeal was received on 29 June 2011. The appeal fee was paid on the same day. The statement setting out the grounds of appeal was received on 9 August 2011. The appellant requested that the appealed decision be set aside and that a patent be granted on the basis of the main request filed with the statement setting out the grounds of appeal. Oral proceedings were requested as an auxiliary measure.

III. With a communication dated 8 December 2014 the board summoned the appellant to oral proceedings on 3 March 2015. In an annex to the summons the board expressed its preliminary opinion that the request lacked novelty and inventive step (Articles 54(2) and 56 EPC) and did

not appear to fulfil the requirements of Article 123(2) EPC.

IV. By letter dated 30 January 2015 the appellant submitted a set of claims according to an amended main request and presented arguments supporting the view that the amendments were based on the original disclosure and that the subject-matter of the claims involved an inventive step.

V. Oral proceedings were held on 3 March 2015. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 6 as filed with letter dated 30 January 2015 (main request) or, subsidiarily, on the basis of the auxiliary request (claims 1 to 6) as filed during the oral proceedings before the board.

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

"1. A pre-coding method for a Multi Input Multi Output system, characterized in that, comprising steps of:
determining, by a receiver, a corresponding codebook from a multi-codebook including multiple codebooks according to a location of a resource block and a predetermined switching utilization pattern assigning one of the multiple codebooks to each location, selecting a corresponding codeword index from the determined codebook and transmitting the codeword index to a transmitter;
determining, by the transmitter, the corresponding codebook from the multi-codebook including multiple codebooks according to the location of the resource block where transmission data is to be transmitted, selecting a corresponding codeword from the determined

codebook according to the codeword index and performing pre-coding for the transmission data with the selected codeword; wherein
the receiver and the transmitter determine the corresponding codebook from the multi-codebook including multiple codebooks according to a subframe and/or subband where the resource block locates and the predetermined switching utilization pattern assigning one of the multiple codebooks to each location;
the multi-codebook is obtained by left handed multiplying a single codebook by a unitary matrix;
the resource block is one of resource blocks in different time domains or in different frequency domains or different in both time domains and frequency domains;
resource blocks of subframes at different time periodically and sequentially use multiple codebooks in the multi-codebook with an interval of one or more subframes; and/or resource blocks of subbands at different frequencies periodically and sequentially use multiple codebooks in the multi-codebook with an interval of one or more subbands;
when the number of the codebooks in the multi-codebook is less than the number of the subframes or the subbands, the codebooks are circularly used."

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

"1. A pre-coding method for a Multi Input Multi Output system, characterized in that, comprising steps of:
determining, by a receiver, a corresponding codebook from a multi-codebook including multiple codebooks according to a location of a resource block and a predetermined switching utilization pattern assigning one of the multiple codebooks to each location,

selecting a corresponding codeword index from the determined codebook and transmitting the codeword index to a transmitter;
determining, by the transmitter, the corresponding codebook from the multi-codebook including multiple codebooks according to the location of the resource block where transmission data is to be transmitted, selecting a corresponding codeword from the determined codebook according to the codeword index and performing pre-coding for the transmission data with the selected codeword; wherein
the receiver and the transmitter determine the corresponding codebook from the multi-codebook including multiple codebooks according to a subband where the resource block locates and the predetermined switching utilization pattern assigning one of the multiple codebooks to each location;
the multi-codebook is obtained by left handed multiplying a single codebook by a unitary matrix;
the resource block is one of resource blocks in different time domains or in different frequency domains or different in both time domains and frequency domains;
resource blocks of subbands at different frequencies periodically and sequentially use multiple codebooks in the multi-codebook with an interval of one or more subbands;
when the number of the codebooks in the multi-codebook is less than the number of the subbands, the codebooks are circularly used."

VII. After due consideration of the appellant's arguments the chair announced the decision.

Reasons for the Decision

1. Admissibility

The appeal complies with Articles 106 to 108 EPC (see Facts and Submissions, point II above). It is therefore admissible.

Main request

2. Article 56 EPC - Inventive step

2.1 The board agrees with the decision under appeal that D2 is to be regarded as the closest prior art and essentially agrees with the analysis of D2 therein (see point 2.2.1 of the decision under appeal).

2.2 The board concurs with the decision under appeal that the application and D2 both start from prior art having a single fixed codebook (page 2, lines 13-14 of the description and D2: section I, second paragraph, respectively) and propose the use of multiple switched codebooks (page 6, lines 1-4 of the description in comparison to D2, section I, third paragraph) in order to solve the same problem (page 2, lines 15-22 of the description in comparison to D2, abstract, "to provide significant diversity and array gain"; section I, first paragraph, "track the rapid fluctuations of the channel").

2.3 D2 discloses a pre-coding method for a Multi Input Multi Output system (see D2, abstract, "Quantized multiple-input multiple-output (MIMO) beamforming systems use predesigned codebooks for the quantization of transmit beamforming vectors") comprising the steps of:

- determining, by a receiver, a corresponding codebook from a multi-codebook including multiple codebooks (D2: section III, first paragraph, "the codebook for quantization of beamforming vectors is dynamically chosen at the receiver from a set of pre-designed codebooks, called the codeset") according to a location of a resource block (D2, section I, third paragraph, "The codebook is switched periodically, at a rate on the order of 10 - 100 coherence times"; section IV, first paragraph, "Once chosen, this codebook is fixed for a block duration equal to Tstat symbol periods", i.e. the codebook is chosen according to the location of the (resource-) block in time, where the (resource-) block is a number of symbol periods), selecting a corresponding codeword index from the determined codebook and transmitting the codeword index to a transmitter (D2, section III, first paragraph, "The receiver then uses instantaneous channel information to choose the optimal codeword from the selected codebook, and conveys its index to the transmitter through the feedback channel");
- determining, by the transmitter, the corresponding codebook from the multi-codebook including multiple codebooks (D2, section III, first paragraph, "The codeset ... is available at both the transmitter and the receiver") according to the location of the resource block where transmission data is to be transmitted (D2, section I, third paragraph, "The codebook is switched periodically, at a rate on the order of 10 - 100 coherence times"; section IV, first paragraph, "Once chosen, this codebook is fixed for a block duration equal to Tstat symbol periods", i.e. the codebook is chosen according to the location of the (resource-) block in time, where the (resource-) block is a number of symbol periods), selecting a corresponding codeword from the determined codebook

according to the codeword index (D2, section III, first paragraph, "The receiver then uses instantaneous channel information to choose the optimal codeword from the selected codebook, and conveys its index to the transmitter through the feedback channel") and performing pre-coding for the transmission data with the selected codeword (D2, abstract, "The quantized vector, which is conveyed to the transmitter using a low-rate feedback channel, is used for transmission to provide significant diversity and array gain"; see also beamforming vector w[k] in equation (1)); wherein
- the receiver and the transmitter determine the corresponding codebook from the multi-codebook including multiple codebooks according to a subframe where the resource block is located (D2: section I, third paragraph, "The codebook is switched periodically, at a rate on the order of 10 - 100 coherence times"; section IV, first paragraph, "Once chosen, this codebook is fixed for a block duration equal to Tstat symbol periods", i.e. the codebook is chosen according to the location of a block in time, where the (resource-) block is a number of symbol periods);
- the multi-codebook is obtained by left-handed multiplication of a single codebook by a unitary matrix (D2: section III, fifth paragraph, "all other codebooks are derived from this root codebook"; section III, Definition 1, equation (4));
- the resource block is one of resource blocks in different time domains (D2, section I, third paragraph, "The codebook is switched periodically, at a rate on the order of 10 - 100 coherence times"; section IV, first paragraph, "Once chosen, this codebook is fixed for a block duration equal to Tstat symbol periods", i.e. the resource-block is a block duration equal to Tstat symbol periods);

- resource blocks of subframes at different times periodically and sequentially use multiple codebooks in the multi-codebook with an interval of one or more subframes (D2, section I, third paragraph, "The codebook is switched periodically, at a rate on the order of 10 - 100 coherence times"; section IV, first paragraph, "Once chosen, this codebook is fixed for a block duration equal to Tstat symbol periods", i.e. the codebook switches periodically in time with an interval of several coherence times);
- when the number of the codebooks in the multi-codebook is less than the number of the subframes, the codebooks are circularly used (D2, section I, third paragraph, "The codebook is switched periodically, at a rate on the order of 10 - 100 coherence times", i.e. the codebooks are periodically used, also when the number of codebooks is less than the number of blocks; since the number of codebooks is limited, the codebooks need to be circularly used; see also page 9, lines 9-10 of the description).

3. Independent claim 1

3.1 Since the features of claim 1 identified as distinguishing features in the decision under appeal (see point 2.2.2) referring to the use of different resource blocks in the frequency domain, and in both the time and frequency domains, are formulated as alternatives ("or", "and/or"), they are not limiting features.

3.2 With regard to the feature added during the appeal proceedings that the codebook is determined according to a location of a resource block and "a predetermined switching utilization pattern" the appellant referred to the original description (see page 9, last line to

page 10, line 1) where it is disclosed that "All the utilization modes can be predetermined by the system".

3.3 The board interprets the term "predetermined" of claim 1 in a broad manner, since there is no more specific disclosure in the application as filed providing more details as to how such a predetermination is achieved by the system. D2 discloses (see D2, abstract and section III, first paragraph) that the codebook is dynamically chosen from a structured set of pre-designed codebooks (see also decision under appeal, point 2.2.8, last paragraph) which are switched periodically at a rate on the order of 10 - 100 coherence times while codewords are updated at a more frequent rate (see D2, page 376, right-hand column, second paragraph). Therefore, the board judges that such a codebook in D2 can be regarded as "predetermined".

Even if the codebook is determined using channel characteristics as in D2, it is still considered to be predetermined for a particular interval of coherence times and it has been predetermined by the system according to the present application, thereby assigning one of the structured set of codebooks to each location, i.e. an interval of 10 - 100 coherence times. The corresponding feature of claim 1 is drafted so broadly that it also encompasses such a way of predetermining a codebook as disclosed in D2.

3.4 The application is furthermore silent about any technical effect or advantage which is achieved by this feature over the known prior art. The original application documents do not provide a basis for the effect of an improved dynamic fluctuation as presented by the appellant during oral proceedings.

3.5 The pre-coding according to the present invention cannot be regarded as being independent of channel feedback information, as the receiver-side selects a best pre-coding codeword according to the channel characteristics and feeds back a corresponding codeword index to the transmitter-side, which performs pre-coding for transmission data with a codeword selected according to this codeword index (see page 2, lines 1 and 2 and page 3, lines 1 to 9). The board therefore does not agree with the appellant that the way of deciding the codebook (see page 3, paragraph 3 onwards of the statement setting out the grounds of appeal) and the way of signalling (see page 4, paragraph 4 onwards of the statement setting out the grounds of appeal) in D2 are different from the present invention according to claim 1. Consequently, the board also does not agree with the appellant's formulation of the problem starting from D2 as being to use open-loop codebook switching, since such a problem is not solved by the claimed subject-matter.

3.6 Therefore neither the alleged distinguishing feature (see point 3.3 above) nor the underlying advantage convinces the board. Consequently, this feature is not considered to involve an inventive step over the prior art according to D2 (Article 56 EPC).

3.7 In consequence, the subject-matter of claim 1 at least lacks inventive step over the disclosure of D2 with regard to the common general knowledge of the skilled reader of D2 (Article 56 EPC).

Auxiliary request

4. Claim 1 of this request has been amended by limiting its subject-matter to the use of different resource blocks in the frequency domain.

4.1 Admission of late-filed request

The auxiliary request was filed during oral proceedings and therefore is considered to be late-filed. However, the request was admitted into the proceedings according to Article 13(1) RPBA, because the amendment concerned merely a deletion of alternatives which had already been present in claim 1 according to the main request, rather than the introduction of new subject-matter. By limiting the claim to a particular alternative which had already been dealt with by the board in the annex to the summons for oral proceedings, the amendment aimed at focusing the discussion on this particular alternative.

4.2 Article 56 EPC - Inventive step

4.3 D2, which discloses the technical concept as discussed in detail above for the time domain, therefore differs from the subject-matter of claim 1 of this request in that the concept is applied in the frequency domain.

4.4 In view of the use of a fast Fourier transform module for the present invention (see e.g. claims 3 and 5), the underlying objective technical problem can be regarded as how to improve the multi-user scheduling gain, i.e. the multi-user diversity gain by increasing the channel fluctuation range in the frequency domain (see also the description, page 2, lines 13-22; page 5, lines 17-28).

4.5 In the board's judgement the claimed solution still lacks inventive step in view of a combination of the teaching of D2 with the disclosure of either D6 or D1, which both disclose improving the channel fluctuation range in the frequency domain by performing scheduling according to channel feedback information returned from a user and a scheduling rule also in the frequency domain, i.e. in an OFDM system, and mapping the user data accordingly.

4.6 D6 concerns the same technical field and the board agrees with the decision under appeal that it discloses that with the feedback information the base station uses a proportional scheduling algorithm to allocate the common channel to mobile stations (see D6, section III, step 4 of the procedure), which is explicitly solving the same problem (D6, abstract, "exploits efficient multiuser diversity and spatial multiplexing gain"). In particular, it discloses (see D6, section IV, penultimate paragraph) that in MIMO OFDMA systems a beamforming technique is well adapted to induce channel fluctuations in both time and frequency. The skilled person looking for a solution of the objective technical problem would therefore consider that the same concept as known from D2 could be applied to both the time and frequency domains without the need to exercise inventive skills or overcome technical hurdles. Also, the application is silent as to what these potential technical hurdles might be.

4.7 Alternatively, D1 discloses communicating a set of power weightings between a transmitting device and a receiving device in a communication system (see figures 4, 5; paragraphs [0016], [0020]-[0021] and

[0025]-[0026]). In particular it discloses that a codebook weight vector is determined over a group of frequency-domain subcarriers for each MIMO data stream along with a power weighting for each stream. Then a codebook weight and power weighting are fed back for each stream for the group of subcarriers (see [0016]).

4.8 The board does not follow the appellant's argument that both D1 and D6 only disclosed the use of codewords, but not so as to distinguish between codewords and codebooks. Apart from the fact that D1 explicitly refers to "codebooks", the board considers the distinction between codewords and codebooks consisting of codewords to be merely a grouping of codewords by criteria which are not specified, neither in the claims nor in the description of the present application. This argument therefore cannot provide a basis for an inventive technical contribution.

4.9 Therefore, the subject-matter of independent claim 1 of this request does not involve an inventive step over D2 combined with either D6 or D1 (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

K. Götz-Wein A. Ritzka

Decision electronically authenticated