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Datasheet for the decision of 22 May 2019

Case Number: T 1338/15 - 3.5.05

Application Number: 10164886.3

Publication Number: 2234306

IPC: H04L1/06, H04L27/26

Language of the proceedings: EN

Title of invention:
OFDM-transmitting apparatus and method, and OFDM-receiving apparatus and method

Applicant:
Saturn Licensing LLC

Headword:
Adaptive OFDM detection/SATURN

Relevant legal provisions:
EPC Art. 84, 56

Keyword:
Clarity - (yes)
Inventive step - (yes, after amendments)

Decisions cited:
T 2296/10

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Beschwerdekammern

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Case Number: T 1338/15 - 3.5.05

D E C I S I O N
of Technical Board of Appeal 3.5.05
of 22 May 2019

Appellant: (Applicant)	Saturn Licensing LLC 25 Madison Avenue New York, NY (US)
Representative:	D Young & Co LLP 120 Holborn London EC1N 2DY (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 23 February 2015 refusing European patent application No. 10164886.3 pursuant to Article 97(2) EPC**

Composition of the Board:

Chair	A. Ritzka
Members:	K. Bengi-Akyuerek
	D. Prietzel-Funk

Summary of Facts and Submissions

I. The appeal is against the decision of the examining division to refuse the present European patent application (divided from its parent application EP 08253749.9 underlying appeal case T 2296/10) for lack of clarity (Article 84 EPC) and lack of inventive step (Article 56 EPC) with respect to the claims of a main request and first and second auxiliary requests, having regard to the combined disclosures of

D1: O. Haffenden: "Pilot patterns for MISO/MIMO", BBC Research, pp. 1-6, 29 November 2007

and

D3: B. Özbek et al.: "On Space-Frequency Block Codes for Unequal Channels", Proceedings of the COST Workshop on Broadband Wireless Local Access, pp. 1-6, May 2003,

and, in addition, for added subject-matter (Article 123(2) EPC) in respect of the second auxiliary request.

II. With its statement setting out the grounds of appeal, the appellant re-filed the claim sets according to the main request and first and second auxiliary requests on which the decision under appeal was based. It requested that the examining division's decision be set aside and that a patent be granted on the basis of one of those claim requests.

III. In a communication annexed to the summons to oral proceedings pursuant to Article 15(1) RPBA, the board gave its preliminary opinion on the appeal. It

introduced the following prior-art document into the appeal proceedings:

D2: O. Haffenden: "Alamouti in varying channels", BBC Research, pp. 1-18, 5 October 2007.

In particular, the board raised objections under Articles 123(2), 76(1), 84 and 56 EPC, having regard to prior-art document D1 combined with D2 or D3.

IV. With a letter of reply, the appellant submitted amended claims according to a new main request and new first and second auxiliary requests, replacing the former main and auxiliary requests on file, together with counter-arguments on the objections raised in the board's communication under Article 15(1) RPBA.

V. Oral proceedings were held on 22 May 2019, during which the appellant filed a new main request replacing the former claim requests on file.

The appellant's final request was that the decision under appeal be set aside and that a patent be granted on the basis of the new main request.

At the end of the oral proceedings, the board's decision was announced.

VI. Claim 1 of the **main request** reads as follows:

"An apparatus for receiving data from Orthogonal Frequency Divisional Multiplexed (OFDM) symbols transmitted by a transmitter, the OFDM symbols when transmitted by the transmitter comprising a plurality of data bearing sub-carriers and one or more continuous pilot sub-carrier symbols, which are located

in the same position for each of the OFDM symbols and scattered pilot carrier symbols, which change position between one OFDM symbol and another in accordance with a predetermined pattern, the predetermined pattern of scattered pilot carrier symbols being in accordance with a Digital Video Broadcast Terrestrial, DVB-T, standard and the data bearing sub-carriers carrying data symbols which are paired by generating a first pair of modulation symbols for each of the pairs of data symbols, the first pair of modulation symbols forming first and second modulation symbols of an Alamouti cell, the transmitter having transmitted a first version of the OFDM symbols in which the sub-carriers allocated for carrying the one or more pilot carriers have been modulated in accordance with the predetermined pattern, and in which the sub-carriers allocated for carrying the data have been modulated with the first and second data symbols of the Alamouti cell, and the transmitter having generated a second pair of modulation symbols for each of the pairs of data symbols, the second pair of modulation symbols forming third and fourth modulation symbols of the Alamouti cell formed for the pair of data symbols in the first version of the OFDM symbols, and the transmitter having transmitted a second version of the OFDM symbols in which the sub-carriers allocated for carrying the one or more pilot carriers have been modulated in accordance with the predetermined pattern, and the sub-carriers allocated for carrying the data have been modulated with the third and fourth modulation symbols of the Alamouti cell, the first version of the OFDM symbols having been transmitted from a first antenna (112) of the transmitter, and the second version of the OFDM symbols having been transmitted from a second antenna (114) of the transmitter, the apparatus comprising

a receiver (200, 204, 206, 208, 210) for receiving the first version of the OFDM symbols transmitted from the first antenna (112), and the second version of the OFDM symbols transmitted from the second antenna (114),

a demodulator (200) operable

to form an estimate of a first pair of modulation symbols for each of the pairs of data symbols from the first version of the OFDM symbols, using the one or more pilot carriers, the first pair of modulation symbols forming first and second modulation symbols of an Alamouti cell,

to form an estimate of a second pair of modulation symbols for each of the pairs of data symbols from the second version of the OFDM symbol, using the one or more pilot carriers, the second pair of modulation symbols forming third and fourth modulation symbols of the Alamouti cell corresponding to the pair of data symbols in the second version of the OFDM symbols,

a data detector (206) operable to generate an estimate of each of the pairs of the data symbols from the first, second, third and fourth modulation symbols corresponding to each of the Alamouti cells recovered from the first and second versions of the OFDM symbols,

wherein for at least one of the pairs of data symbols carried by the first and second versions of the OFDM symbols, the sub-carriers carrying the modulation symbols of the first and second modulation symbols and the third and the fourth modulation symbols forming the Alamouti cells are separated within the first and second versions of the OFDM symbol respectively by at least one other data bearing sub-carrier or one or more of the pilot carriers, and the apparatus including

a controller (208) operable to provide the predetermined pattern of scattered and continuous pilot sub-carriers for the OFDM symbols to the data detector and to control the data detector (206) to detect the

pairs of data symbols according to whether the pairs of first and second and third and fourth modulation symbols are separated by the one or more other data bearing sub-carriers or one or more of the scattered or continuous pilot symbol sub-carriers according to the provided predetermined pattern of scattered and continuous pilot sub-carriers for the OFDM symbols, and the data detector (206) is operable to detect the pairs of data symbols carried by the sub-carriers by

adapting a detection technique for recovering the data symbols from the Alamouti cells depending on whether the pairs of data symbols are detected from sub-carriers which are adjacent or whether the sub-carriers have one or more other sub-carriers or pilot carriers inter-posed there between, and

if the Alamouti cells have been transmitted on pairs of adjacent sub-carriers, then for these Alamouti cells using a simplified decoding technique according to a classical Alamouti decoding by assuming that a coefficient of the channel frequency response corresponding to the position of each of the sub-carriers within each of the first and second versions of the OFDM symbol are the same, or

if the Alamouti cells have not been transmitted on adjacent pairs of sub-carriers, using a zero forcing decoding technique assuming a different estimate of a coefficient of the channel frequency response corresponding to the position of each of the sub-carriers within each of the first and second versions of the OFDM symbol."

Further independent claims 3 and 5 of the main request are directed to a corresponding method and system respectively.

Reasons for the Decision

1. *The present invention*

The present application is concerned with the processing, by a wireless OFDM receiver, of Alamouti cell pairs (which consist of a first pair containing first and second OFDM-based modulation symbols and a second pair containing third and fourth OFDM modulation symbols) that are split across the OFDM sub-carriers in the presence of continuous and scattered pilot symbols.

It describes the encoding scheme performed by a transmitter (see page 11, line 18 to page 14, line 5 of the application as filed) and the use of a simplified or classical and an alternative "zero-forcing" Alamouti decoding method (for adjacent and split Alamouti pairs respectively) performed by the ODFM receiver (see page 15, line 18 to page 17, line 9 as filed). The claimed subject-matter is based on the Alamouti decoding method (see e.g. page 14, line 6 to page 17, line 9 as filed), while the claimed subject-matter of the respective parent application underlying appeal case T 2296/10 was related to the encoding and transmission process.

According to the present description, the technical problem to be solved by the present application is to "completely decouple Alamouti encoding from pilot spacing and to increase the diversity in one more dimension" (see page 17, first two paragraphs as filed).

2. MAIN REQUEST

The new main request differs from the main request refused by the examining division essentially in that the present independent claims now specify that (emphasis added by the board)

A) it is the transmitter that generates the first and second versions of the OFDM symbols received;
B) if the Alamouti cells have been transmitted on pairs of adjacent sub-carriers, then for these Alamouti cells a simplified decoding technique according to a classical Alamouti decoding is used by assuming that a coefficient of the channel-frequency response corresponding to the position of each of the sub-carriers within each of the first and second versions of the OFDM symbol are the same;
C) if the Alamouti cells have not been transmitted on adjacent pairs of sub-carriers, a zero-forcing decoding technique is used assuming a different estimate of a coefficient of the channel-frequency response corresponding to the position of each of the sub-carriers within each of the first and second versions of the OFDM symbol.

The board is satisfied that new feature A) is supported e.g. by page 11, line 18 to page 15, line 17 of the present application as originally filed and that added features B) and C) find their basis in page 5, lines 25-32 and page 18, line 21 to page 19, line 8 of the application as filed. Hence, the above amendments comply with Article 123(2) EPC.

2.1 *Clarity (Article 84 EPC)*

2.1.1 The examining division held that the independent claims were not clear, since the reference to a "DVB-T

standard" was a source of ambiguities due to the fact that technical standards evolved over time (see appealed decision, Reasons 3).

2.1.2 In that regard, the board takes the view that the use of a predetermined pattern according to a DVB-T (Digital Video Broadcasting-Terrestial) standard is to be understood by a skilled reader as meaning that the predetermined pattern of scattered pilot-carrier symbols is taken from any DVB-T standard available before the present application's priority date (see also T 2296/10, Reasons 2.1.9). Hence, this definition is considered to be very broad but not unclear.

2.2 *Inventive step (Article 56 EPC)*

2.2.1 The board concurs with the finding of the decision under appeal that prior-art document **D1** constitutes a suitable starting point for the assessment of inventive step, since it relates to the same technical problem as the present invention, namely dealing with Alamouti pairs split across the system sub-carriers in connection with Alamouti-type encoding of OFDM symbols using pilot symbols.

2.2.2 It is apparent to the board that the subject-matter of claim 1 differs from the disclosure of document D1 essentially in that

(i) the predetermined pattern of scattered pilot carrier symbols is in accordance with a DVB-T standard;

(ii) the receiver detects from the received pattern of scattered and continuous pilot sub-carriers whether or not the pairs of first to fourth modulation symbols are

separated by the data-bearing sub-carriers or the pilot symbol sub-carriers;

(iii) based on the detected adjacency of the Alamouti cell pairs received, the receiver either uses a simplified decoding technique according to a classical Alamouti decoding assuming identical channel-frequency response coefficients as regards the respective sub-carriers (i.e. in the case of adjacent cell pairs) or, uses a zero-forcing decoding technique assuming different estimates of channel-frequency response coefficients.

Accordingly, the subject-matter of present claim 1 is considered to be novel over D1 (Article 54 EPC).

2.2.3 As to distinguishing feature (i), the board is convinced by the conclusion of the decision under appeal (see Reasons 10 and 11) that the use of a *predetermined*, standard-based pilot pattern rather than *adapting* the underlying pilot pattern, as done in D1, cannot - by itself - justify an inventive step in the present case.

2.2.4 As to the combination of distinguishing features (ii) and (iii), though, the board is satisfied that it credibly yields the overall synergistic technical effect of *dynamically* adapting the decoding method to be used to the current channel conditions on a symbol-by-symbol basis. Hence, the objective technical problem solved by claim 1 may - in view of the amendments made - be framed as "how to optimise the coding gain of an OFDM-based Alamouti decoding scheme for distinct channel conditions", rather than merely as "how to improve the performance of the split Alamouti

pairs in an alternative manner", as formulated in the impugned decision (see Reasons 12).

2.2.5 The person skilled in the field of 3GPP-based mobile networks would be aware that D1 is concerned with avoiding the separation of Alamouti cell pairs across the OFDM sub-carriers by data or pilot signals through relying on "paired pilot symbols" (see fourth and fifth slides of D1). Thus, the skilled person would conclude that in the case of Alamouti cell pairs transmitted via adjacent sub-carriers, implying substantially equal channel conditions (channel-estimate coefficients), the "classical Alamouti decoding scheme" can be used. In that regard, the board concurs with the conclusion of the impugned decision (see Reasons 12). On the other hand, the skilled person would understand from document **D2** or **D3** that in the case of non-paired pilot symbols (such as in the case of predetermined pilot patterns according to any DVB-T standard), with the consequence of split Alamouti cell pairs associated with distinct channel conditions, an alternative decoding scheme such as the "zero-forcing" technique could be used in order to avoid a severe decoding performance degradation (see e.g. D2, pages 7 to 16; D3, section 3).

However, there are no discernible hints or incentives in the available prior art that would render it obvious that the receiver would switch *dynamically*, i.e. essentially in real time, between those two decoding schemes, depending on the detected pilot pattern on a signal-by-signal basis. On the contrary, the skilled person would most likely either try to adapt and further optimise the respective pilot pattern along the lines of the teaching of D1 so that the classical decoding technique might be used or attempt to optimise

further the respective channel-estimate coefficients based on the approaches of D2 or D3.

Furthermore, at least due to the resulting implementation complexity, the board considers that the skilled person would in fact be deterred from applying the claimed solution. In particular, the skilled person would - in order to arrive at the claimed invention - have to ensure that the underlying OFDM receiver applies the following intermediary steps:

- continuously detecting the pilot pattern applicable and in particular the adjacency of Alamouti cell pairs received;
- incorporating two different Alamouti decoding algorithms;
- selecting either of those two algorithms, depending on the detected adjacency.

In other words, it would be too far-fetched, or even contrived, to conclude from the fact that the skilled person had knowledge of a classical Alamouti decoding and a zero-forcing Alamouti decoding scheme that he/she not just *could* but also *would* indeed apply dynamic and adaptive switching between those two different known decoding schemes, without the benefit of hindsight.

2.2.6 Overall, the board sees no reason why the skilled person, starting from D1, would come up with this solution that credibly provides a synergistic effect going beyond the sum of the individual effects of its distinguishing features.

2.2.7 In view of the above, and having regard to the prior art available, the subject-matter of independent claims 1, 3 and 5 of the present main request is held

to be new and to involve an inventive step within the meaning of Articles 54 and 56 EPC.

3. Since all the other requirements of the EPC are also found to be fulfilled, the board decides that a patent is to be granted on the basis of the claims according to the main request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the examining division with the order to grant a patent on the basis of claims 1 to 5 of the main request submitted during the oral proceedings before the board and the description and drawings as originally filed.

The Registrar: The Chair:

K. Götz-Wein A. Ritzka

Decision electronically authenticated