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**Datasheet for the decision
of 21 February 2014**

Case Number: T 1334/10 - 3.5.05

Application Number: 03799030.6

Publication Number: 1550278

IPC: H04L27/26, H04L5/02, H04B1/713,
H04L1/06, H04B7/08

Language of the proceedings: EN

Title of invention:
Channel mapping for OFDM frequency-hopping

Applicant:
Microsoft Corporation

Headword:
Mapping of OFDM channels/MICROSOFT

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - main request (yes, after amendment)

Decisions cited:

Catchword:



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Chambres de recours**

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Case Number: T 1334/10 - 3.5.05

D E C I S I O N
of Technical Board of Appeal 3.5.05
of 21 February 2014

Appellant: Microsoft Corporation
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 15 January 2010
refusing European patent application
No. 03799030.6 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, posted on 15 January 2010, to refuse European patent application No. 03799030.6 on the grounds of lack of novelty and inventive step (Articles 54 and 56 EPC) with respect to a main request and lack of inventive step (Article 56 EPC) with respect to an auxiliary request, having regard to the disclosures of

- D1: M.F.K. Wong et al.: "Performance analysis of OFDM/FHMA hybrid system operation in ISM band", Proceedings of IEEE MILCOM'96, pp. 369-373, October 1996;
- D2: K. Takamura et al.: "Field Trial Results of a Band Hopping OFDM System", Proceedings of IEEE VTC'99, pp. 310-314, September 1999;
- D3: Z. Wang et al.: "Improving performance of multi-user OFDM systems using bit-wise interleaver", Electronics Letters, Vol. 37, No. 19, pp. 1-2, September 2001.

In an *obiter dictum* under the heading "Remarks", the examining division also expressed its opinion that the independent claims of both requests lacked clarity (Article 84 EPC).

II. Notice of appeal was received on 26 January 2010. The appeal fee was paid on the same day. With the statement setting out the grounds of appeal, received on 14 May 2010, the appellant filed new claims according to a main request and two auxiliary requests. It requested that the decision of the examining division be set aside and that a patent be granted on the basis of the main request or any of the auxiliary requests. In addition, oral proceedings were requested as an

auxiliary measure.

- III. A summons to oral proceedings scheduled for 21 February 2014 was issued on 4 December 2013. In an annex to this summons, the board expressed its preliminary opinion on the appeal pursuant to Article 15(1) RPBA. In particular, objections were raised under Articles 123(2), 54, and 56 EPC, mainly having regard to D1 and D3.
- IV. With a letter of reply dated 21 January 2014, the appellant submitted amended claims according to a main request (based on the former second auxiliary request) and an auxiliary request (based on the former first auxiliary request).
- V. Oral proceedings were held as scheduled on 21 February 2014, during which the former main request was replaced by a new main request (claims 1 to 26). The new main request was admitted into the proceedings and its patentability was discussed.

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 main request submitted during the oral proceedings, or of the auxiliary request on file. At the end of the oral proceedings, the decision of the board was announced.

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

"A method comprising:

a) associating data to be transmitted to a plurality of user elements (24) with corresponding basic access channels, BACHs, each BACH defined by a set number of

subcarriers identified by a hopping pattern distributed over a plurality of associated orthogonal frequency division multiplexing, OFDM, symbols;

b) allocating the BACHs to the plurality of user elements, wherein at a given time, the BACHs are mapped to multiple user elements, the set number of each of the plurality of BACHs being two or more;

c) mapping the data into quadrature-based symbols;

d) for each of the plurality of user elements (24), encoding the quadrature-based symbols onto the two or more sub-carriers for the BACHs associated with the user element (24); and

e) modulating the two or more sub-carriers using an Inverse Fast Fourier Transform to create OFDM symbols for transmission,

wherein the sub-carriers defining each BACH are equally spaced and distributed across an entire frequency band associated with the OFDM symbols."

Claim 12 of the main request reads as follows:

"A method at a user element (24), the method comprising:

a) receiving orthogonal frequency division multiplexing, OFDM, symbols;

b) demodulating the received OFDM symbols using a subset Fast Fourier Transform to recover only those sub-carriers encoded with quadrature-based symbols that are intended for the user element and forming a

plurality of basic access channels, BACHs, each BACH being defined by a hopping pattern over a plurality of associated OFDM symbols, wherein the BACHs have been allocated to multiple user elements, wherein at a given time, the BACHs are mapped to multiple user elements, and

c) decoding the quadrature-based symbols encoded onto the sub-carriers and de-mapping the symbols from the respective sub-carriers to recover data;

wherein the sub-carriers defining each BACH are equally spaced and distributed across an entire frequency band associated with the OFDM symbols."

The further independent claims 14 and 25 of the main request are directed to a corresponding transmitter and a receiver, respectively.

Reasons for the Decision

1. The appeal is admissible.
2. MAIN REQUEST

Although this request was submitted during the oral proceedings, i.e. at a relatively late stage of the procedure, the board admitted it into the proceedings under Article 13(1) RPBA, since it was regarded as a successful attempt to overcome the objections raised by the board under Article 56 EPC.

The new main request differs from the main request underlying the appealed decision essentially in that the present independent claims no longer comprise the

feature that the number of sub-carriers is a minimum number needed to provide a minimum service to a user, in response to the objection raised by the board under Article 123(2) EPC (cf. board's communication pursuant to Article 15(1) RPBA, section 3.1) and that independent claims 1 and 14, directed to the transmitting process, now specify that

- A) the number of sub-carriers used for a BACH is a set number;
- B) the BACHs are allocated to the plurality of user elements, wherein at a given time, the BACHs are mapped to multiple user elements;
- C) the sub-carriers defining each BACH are equally spaced and distributed across an entire frequency band associated with the OFDM symbols,

while independent claims 12 and 25, related to the receiving process, correspond to claims 1 and 14 respectively (with the corresponding amendments based on paragraphs [0046] and [0047] of the application as filed).

The amendment in relation to feature A) was made in response to the objections under Article 84 EPC raised in the *obiter dictum* of the decision under appeal (cf. section III.1) and is based on paragraph [0024] of the application as filed. Feature B) is supported by Fig. 5 whilst feature C) is based on paragraphs [0007] and [0026] of the application as filed.

Hence, the board is satisfied that the above amendments comply with Article 123(2) EPC.

2.1 Article 52(1) EPC: Novelty and inventive step

In the board's judgment, the independent claims of this request meet the requirements of Article 52(1) EPC in

conjunction with Articles 54 and 56 EPC, for the following reasons:

2.1.1 The board concurs with the examining division that document D1 represents the closest prior art and that it discloses the following limiting features of claim 1:

A method comprising:

- a) associating data ("OFDM block signal") to be transmitted to user elements with corresponding basic access channels BACHs ("voice channels"), each BACH being defined by a set number of sub-carriers ("OFDM subchannels") identified by a hopping pattern ("OFDM/FHMA") distributed over associated OFDM symbols (see D1, sections II and III);
- b) allocating the BACHs to the user elements, wherein at a given time, the BACHs are mapped to multiple user elements, the set number of each of the BACHs being two or more (see D1, page 371, left-hand column, first paragraph: "... Multiple voice channels can be assigned to users ...");
- c) mapping the data into quadrature-based symbols (see e.g. section II, first paragraph and Fig. 1);
- d) for each of the user elements, encoding the quadrature-based symbols onto the sub-carriers for the BACHs associated with the user element (see e.g. Fig. 1);
- e) modulating the sub-carriers using an IFFT to create OFDM symbols for transmission (see e.g. section II, first paragraph and Fig. 1).

2.1.2 Hence, the difference between the subject-matter of claim 1 and the disclosure of D1 is considered to be that the sub-carriers defining each BACH are equally

spaced and distributed across an entire frequency band associated with the OFDM symbols (i.e. corresponding to feature C) above). Consequently, the subject-matter of claim 1 of this request is found to be novel over D1 (Article 54 EPC).

2.1.3 The technical effect achieved by distinguishing feature C) was extensively discussed during the oral proceedings before the board. The board eventually accepted that equal spacing and distribution of the respective OFDM sub-carriers of an associated access channel over the entire frequency band - in addition to the application of frequency hopping - credibly yields a fairer distribution of signal-to-noise degradation arising from frequency-dependent channel interference among the network users. This is due to the fact that the probability that a user of an access channel is adversely affected by such performance degradation can reasonably be expected to be evenly distributed over the available users, as opposed to the case of non-equal spacing of the OFDM sub-carriers associated with an access channel (e.g. using adjacent OFDM sub-carriers per access channel, where a degraded frequency band would have a negative impact on all the sub-carriers forming an access channel of a user at the same time). The board is also satisfied that the above effect can be derived from the application as filed (see e.g. page 2, lines 5-22).

2.1.4 The objective problem to be solved by claim 1 is therefore regarded as being how to modify or adapt the system described in D1 to provide the above-mentioned technical effect.

2.1.5 Confronted with that objective problem and starting out from the teaching of D1, the skilled person in the

field of mobile networks would notice that D1 provides a somewhat enigmatic teaching in relation to the actual relationship between the OFDM sub-carriers and the voice channels (see D1, page 370, right-hand column, second paragraph: "... Once RS coding is considered and arbitrarily selected 4 OFDM subchannel to support one voice channel ..."). This wording is ambiguous as to whether the word "arbitrarily" refers to the number of OFDM sub-carriers to be selected, i.e. in this case "4", or rather to the specific OFDM sub-carriers themselves. Therefore, the board agrees with the appellant that this passage cannot provide any useful teaching as regards the spacing of the sub-carriers to be assigned to the voice channels. Also, the board has some sympathy with the view of the appellant that at the time of D1's publication date (in 1996), OFDM sub-carriers were typically supposed to be mapped in blocks to a certain access channel such that the access channels were made up of consecutively spaced sub-carriers rather than being arbitrarily selected and assigned, let alone being equally spaced over the available frequency band.

The board therefore holds that the skilled person would rather regard the passage of D1 related to dynamic channel assignment of page 371, left-hand column, third paragraph ("Dynamic channel assignment of OFDM subchannel ... similar to FH adaptive hopping, can be employed in the proposed system for better BER performance ... dynamic subchannel assignment can be performed to provide user with better BER performance quality") as a promising hint at a possible solution to the above-identified objective problem. More specifically, in order to indeed achieve a better BER (bit-error-rate) performance per user, the skilled person would ensure that - in addition to adaptive

frequency hopping performed in D1 - OFDM sub-carriers are allocated dynamically to the users based on the above teaching of D1 instead of applying the claimed sub-carrier placement scheme according to feature C). Furthermore, the board considers that the skilled person would in fact be deterred from applying the claimed solution, since he would be aware that for scenarios in which a substantially large number of voice channels are assigned to a single user, the extent to which a fair distribution of channel degradations among different users is achieved may dramatically decrease, even if the corresponding OFDM sub-carriers of a voice channel are equally spaced and distributed across the whole frequency band.

2.1.6 As regards feature C), the decision under appeal merely states that it constituted a well-known design option in the art for assigning resources in a multi-user OFDMA system depending on the complexity of the system versus the frequency selection needed (cf. appealed decision, section 5). However, the board cannot regard this as a sufficient and convincing reasoning which could demonstrate that the skilled person would indeed take up said specific "design option", out of many others, in the context of enabling a fairer performance distribution between the network users, for the reasons outlined in points 2.1.3 to 2.1.5 above.

2.1.7 Moreover, the board finds that also D2 and D3, cited as relevant prior-art documents in the decision under appeal, neither alone nor in combination with the disclosure of D1 would render the subject-matter of claim 1 obvious, for the following reasons:

Document D2 relates to a multi-user OFDM system using frequency-hopping in which one TDMA-based access

channel to be allocated to a network user is composed of several *adjacent* OFDM sub-carriers instead of using access channels made up of OFDM sub-carriers equally *distributed* over the system frequency band (see D2, section II). Moreover, it is - beyond using frequency hopping - completely silent as to the matter of fairer distribution of performance degradation over the network users.

Document D3, though also addressing the issue of multi-user OFDM systems using frequency hopping, does not provide any pointer to equally spacing and distributing the OFDM sub-carriers associated with an access channel for a user. Rather, it teaches the assignment of access channels made up of consecutive OFDM sub-carriers and time slots ("OFDM transmission blocks") to network users (see page 1, right-hand column, first paragraph; Figs. 2 and 3).

2.1.8 In view of the above, the subject-matter of claim 1 is held to involve an inventive step in the light of the cited prior art (Article 56 EPC). The above observations also apply to the corresponding independent claims 12, 14, and 25. In conclusion, the subject-matter of the present independent claims is new and involves an inventive step within the meaning of Article 52(1) EPC in conjunction with Articles 54 and 56 EPC.

2.2 Since all the other requirements of the EPC are also found to be fulfilled, the board decides to grant a patent on the basis of claims 1 to 26 according to the main request. The main request being allowable, the present auxiliary request need not be considered further.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

Description (pages):

- 1, 3-12, 14, 15 as filed on entry into the regional phase before the EPO;
- 2, 2a, 13 as filed with letter of 12 July 2007;

Claims (Nos.):

- 1 to 26 according to the main request filed during the oral proceedings before the board;

Drawings (sheets):

- 1/11 to 11/11 as originally filed.

The Registrar:

The Chair:



K. Götz

A. Ritzka

Decision electronically authenticated