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**Datasheet for the decision
of 5 November 2013**

Case Number: T 1694/09 - 3.5.05

Application Number: 05250173.1

Publication Number: 1555785

IPC: H04L27/26

Language of the proceedings: EN

Title of invention:

Coarse frequency synchronization in a multicarrier receiver

Applicant:

Samsung Electronics Co., Ltd.

Headword:

Frequency synchronisation in OFDM/SAMSUNG

Relevant legal provisions:

EPC 1973 Art. 56
RPBA Art. 12(4), 13(1)

Keyword:

Inventive step - main request (no) - auxiliary request (no)

Decisions cited:

Catchword:



**Beschwerdekammern
Boards of Appeal
Chambres de recours**

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Case Number: T 1694/09 - 3.5.05

D E C I S I O N
of Technical Board of Appeal 3.5.05
of 5 November 2013

Appellant: Samsung Electronics Co., Ltd.
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 13 February
2009 refusing European patent application No.
05250173.1 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair: A. Ritzka
Members: P. Cretaine
G. Weiss

Summary of Facts and Submissions

I. The appeal is against the decision of the examining division, posted on 13 February 2009, refusing European patent application No. 05250173.1 on the grounds that the amended claims of the sole request did not meet the requirements of Article 84 EPC 1973 and Article 123(2) EPC and were, as a consequence, not admitted into the proceedings (Rule 137(3) EPC and Article 113(2) EPC).

Further remarks were appended to the decision, containing objections of lack of disclosure (Article 83 EPC) and lack of inventive step (Article 56 EPC 1973) of the independent claims having regard to

D1: K. BANG et al.: "A Coarse Frequency Offset Estimation in an OFDM System Using the Concept of the Coherence Phase Bandwidth", IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS (ICC 2000), vol. 2 of 3, 18 June 2000, pages 1135-1139, IEEE, NEW YORK, US

as closest prior art, in particular in combination with

D4: WO 99/17511 or

D7: EP 0 903 897.

II. Notice of appeal was received on 23 April 2009. The appeal fee was paid on the same day. The statement setting out the grounds of appeal was received on 22 June 2009. The appellant requested that a patent be granted on the basis of a new main request (claims 1 to 7) or a first auxiliary request (claims 1 to 7), both filed with the statement setting out the grounds of appeal. In addition, oral proceedings were requested as an auxiliary measure.

- III. A summons to oral proceedings scheduled for 5 November 2013 was issued on 20 June 2013. In an annex to this summons, pursuant to Article 15(1) RPBA, the board expressed its preliminary opinion on the appeal. In particular, objections under Articles 84 and 56 EPC 1973 were raised with respect to the main and auxiliary requests.
- IV. With a letter of reply dated 4 October 2013, the appellant filed an amended set of claims (claims 1 to 7) according to a main and an auxiliary request replacing the former main and first auxiliary requests, respectively.
- V. By letter of 23 October 2013, the appellant informed the board that it would not be represented at the oral proceedings.
- VI. Independent claim 1 of the main request reads as follows:

"1. A coarse frequency synchronization apparatus of an orthogonal frequency division multiplexing receiver, hereinafter referred to as OFDM, the apparatus comprising:
a buffer (311) that is arranged to receive a demodulated signal $X(k)$ output by the OFDM system in response to a phase reference signal $Z(k)$ being input to the OFDM system and to output a shifted signal $X(k+d)$ generated by cyclically shifting the signal $X(k)$ by a shift amount d ;
a controller (330) that is arranged to determine a length of a sub-band to be less than a phase coherence bandwidth B and hence to determine a number K of sub-bands into which a summation interval for the sum of

partial correlation values is divided, wherein the phase coherence bandwidth B is the frequency interval where two signals having a delay in the time domain and generated by performing a discrete Fourier Transform on the same signal maintain their correlation in the frequency domain, the delay in the time domain being the maximum time offset for which frame synchronisation in the OFDM system can be achieved and the discrete Fourier transform being performed using the subcarriers of the OFDM system;

a counter that is arranged to count the shift amount d ;
a partial correlation unit (312) that is arranged to receive the shifted signal $X(k+d)$ and the phase reference signal $Z(k)$, and is arranged to calculate a partial correlation value for each of the K sub-bands;
and

an offset estimator (314) that is arranged to calculate the shift amount d_{\max} where the sum of the partial correlation values of the K sub-bands is a maximum and to output the shift amount d_{\max} as an estimated coarse frequency offset value;

characterised by a weighted phase reference signal generating unit (320), that is arranged to generate as the phase reference signal a weighted phase reference signal $Z(k)$ whose phase is shifted by the symbol time offset and that is weighted by a weighting vector W_m giving weights for respective sub-bands."

The main request comprises a further independent claim (claim 4) directed towards a corresponding method.

Independent claim 1 of the auxiliary request adds to claim 1 of the main request that the weighting vector includes a first weight allocated to a first sub-band of a first frequency and a second weight allocated to a second sub-band of a second frequency, wherein the

first frequency is higher than the second frequency and the first weight is lower than the second weight.

The auxiliary request comprises a further independent claim (claim 4) directed towards a corresponding method.

Reasons for the Decision

1. Admissibility of the appeal

The appeal complies with the provisions of Articles 106 to 108 EPC (cf. point II above) and is therefore admissible.

2. Non-attendance at oral proceedings

Although the appellant's representative announced his intention not to attend, the appellant did not withdraw his request for oral proceedings. Pursuant to Article 15(3) RPBA, the board is not obliged to delay any step in the appeal 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.

In the present case, the appellant filed a new set of requests comprising a main request and an auxiliary request in response to the objections raised in the board's communication under Article 15(1) RPBA. The amendments to the independent claims of the new requests were made to address the objections under Article 84 EPC 1973 which had been raised by the board in said communication. With respect to the board's objections under Article 56 EPC 1973, the appellant

provided arguments which substantially corresponded to its previous submissions.

The appellant could reasonably have expected that during the oral proceedings the board would consider the objections and issues raised in the communication annexed to the summons to oral proceedings. In deciding not to attend the oral proceedings, the appellant chose to rely only on its arguments presented in the statement setting out the grounds of appeal and in the letter dated 4 October 2013.

3. Admissibility of the requests

The objections under Article 123(2) EPC and Article 84 EPC 1973 on which the decision under appeal was based and the objections under Article 84 EPC 1973 which were raised in the annex to the summons to oral proceedings have, in the board's judgment, been overcome by the amendments to the independent claims according to the main and auxiliary requests. Therefore the board decided to admit these requests into the appeal proceedings in the exercise of its discretionary power under Articles 12(4) and 13(1) RPBA.

4. Inventive step

4.1 Closest prior art

Document D1, which is an article by the inventor of the present application, represents the closest prior art. It was common ground that the preambles of claims 1 and 4 of both requests are based on D1.

4.2 Main request

4.2.1 The only difference between the subject-matter of claims 1 and 4 and the disclosure of D1 is thus that the reference signal $Z(k)$ is weighted by a weighting vector W_m giving weights for respective sub-bands. This corresponds to the weighting coefficient W_m present in equation (20).

The technical effect of this weighting is that more importance can be given to some sub-bands among the K sub-bands for the calculation of the sum of the partial correlation values. In particular, sub-bands providing a partial correlation value which is less relevant for the sum calculation of equation (20), due for instance to a low level of the received signal caused by a high channel distortion in that sub-band, may be given less importance in the sum calculation than other sub-bands (see paragraph [0060] of the published application and page 1, 8th paragraph, of the statement setting out the grounds of appeal).

The objective technical problem can thus be defined, as acknowledged by the appellant on page 2, 5th paragraph, of the statement setting out the grounds of appeal and on page 2, lines 11-12 of the letter dated 4 October 2013, as how to improve the method of D1 in the face of low signal levels or excessive channel distortion.

4.2.2 The person skilled in the field of multicarrier transmissions is aware that correlation calculations between a reference signal and a received version of it in an OFDM system may be processed by giving less weight in the correlation to some carrier frequencies which are distorted and noisy (see for instance D4, page 30, lines 20 to 22; D7, page 5, lines 9 to 18). By applying this common general knowledge to the system of

D1 in order to solve the above-mentioned problem, the skilled person would apply weights to the carrier frequencies in equation (20). While doing this, the skilled person would notice that carriers inside the same sub-band K belong to the phase coherence bandwidth of the OFDM system and that, for a large allowed symbol timing offset, the phase coherence bandwidth is rather narrow with respect to the overall OFDM bandwidth (see D1, Figure 5). It is thus plausible that the signal-to-noise ratios may be quite identical for carrier frequencies belonging to the same sub-band K, so that the skilled person would consider applying the same weight W_m to carrier frequencies inside the same sub-band K.

For these reasons the board judges that the subject-matter of claims 1 and 4 does not involve an inventive step, having regard to the disclosure of D1 (Article 56 EPC 1973).

- 4.2.3 The appellant advanced the argument that the skilled person would not arrive at the subject-matter of claims 1 and 4 by combining the teachings of D4, or D7, and D1. In that respect, the appellant argued that both D4 and D7 taught the application of weights to individual carriers whereas claims 1 and 4 required that the same weight be applied to different sub-carriers within the same sub-band. Moreover, the weightings of carriers in D4 and D7 were used for different calculations than D1, namely for an average phase error calculation. For these reasons the skilled person would not be able to integrate the teaching of D4 or D7 into the rather complex coarse frequency offset estimation of D1.

The board accepts that the calculations of D4 and D7 are different from the calculation required by claims 1

and 4. However, the board has considered in its argumentation (see point 4.2.2 above) that the quoted passages of documents D4 and D7 do not constitute prior-art features which the skilled person would combine with D1, but rather represent an illustration of the common general knowledge in the field of multi-carrier transmissions, whereby carriers affected by noise are given less influence when it comes to calculations over the carrier's whole range.

4.3 Auxiliary request

- 4.3.1 Independent claims 1 and 4 add to claim 1 and 4 according to the main request the feature that the weighting vector includes a first weight allocated to a first sub-band of a first frequency and a second weight allocated to a second sub-band of a second frequency, wherein the first frequency is higher than the second frequency and the first weight is lower than the second weight.

For the purpose of assessing the inventive step, the board interprets the wordings "a first sub-band of a first frequency" and "a second sub-band of a second frequency" as meaning sub-bands having respectively the first and the second frequency as centre frequency.

In the board's judgement, the above-mentioned additional feature merely represents a choice of a magnitude relation between weights allocated to two sub-bands among the K sub-bands, which the skilled person would consider, depending on the relative channel conditions in the two sub-bands. This feature therefore cannot, alone or in combination with the other novel features of claims 1 and 4, confer an inventive step on the subject-matter of claims 1 and 4.

Thus claims 1 and 4 do not meet the requirements of Article 56 EPC 1973.

4.3.2 The appellant argued that nothing in the cited prior-art suggests assigning a higher weight to a lower frequency sub-band. Furthermore it referred to a passage of the description (corresponding to paragraphs [0057] to [0059] of the published application) to assert that better correlation results are achieved for low coherence sub-bands. The board however notes that several passages of the originally filed application (see paragraphs [0007] and [0013], claims 5 and 7 of the published application) indicate that assigning a higher weight to a higher frequency sub-band is equally possible. Moreover the appellant itself in the statement setting out the grounds of appeal (see the third page, lines 22 to 25), states that the skilled person would simply try both options and see which one gives the better results. The board therefore finds that the selection of one option by the skilled person represents a normal procedure with no inventive merit in itself.

5. In conclusion, the main and auxiliary requests are not allowable under Article 56 EPC 1973. In the absence of an allowable request the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chair:



K. Götz

A. Ritzka

Decision electronically authenticated