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Datasheet for the decision of 18 January 2012

Case Number: T 1582/09 - 3.5.03

Application Number: 02728894.3

Publication Number: 1382141

IPC: H04H 1/00, H04L 27/34, H04B 1/12

Language of the proceedings: EN

Title of invention:
Power division multiplexing with incoherent signals and fixed power hierarchy

Applicant:
Hughes Electronics Corporation

Opponent:
-

Headword:
Power division multiplexing/HUGHES

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Inventive step (yes, following amendment)"

Decisions cited:
-

Catchword:
-

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Case Number: T 1582/09 **-** 3.5.03

D E C I S I O N
of the Technical Board of Appeal 3.5.03
of 18 January 2012

Appellant: (Applicant)
Hughes Electronics Corporation
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Representative:
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Decision under appeal:
Decision of the Examining Division of the European Patent Office posted 14 January 2009 refusing European patent application No. 02728894.3 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: A. S. Clelland
Members: T. Snell
R. Moufang

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division refusing European patent application No. 02728894.3, with international publication number WO-A-02/089371.

The refusal was based on the ground that the subject-matter of independent claims 1 and 6 did not meet the requirement of inventive step pursuant to Article 52(1) in combination with Article 56 EPC. The examining division referred, *inter alia*, to the following documents in its decision:

D5: Arslan et al: "Iterative co-channel interference cancellation in narrowband mobile radio systems", 2000 IEEE Emerging Technologies Symposium: Broadband, Wireless Internet Access, April 10-11 2000, pages 1 to 5, XP010538900.

D9: Scalart et al: "Performance Analysis of a COFDM/FM In-band Digital Audio Broadcasting System", IEEE Transactions on Broadcasting, Vol, 43, No. 2, June 1997, pages 191 to 198, XP011006070.

II. The appellant filed a notice of appeal against the above decision. Claims of a main request and an auxiliary request were subsequently filed together with a statement of grounds of appeal.

In the statement of grounds, the appellant requested that the decision under appeal be set aside and a patent granted on the basis of either the claims of the main or the auxiliary request.

Oral proceedings were conditionally requested.

III. In a communication accompanying a summons to oral proceedings the board gave a preliminary opinion in which, ***inter alia***, it was considered that the subject-matter of the independent claims of both requests did not involve an inventive step having regard to the disclosure of document D5.

IV. With a response to the board's communication, the appellant filed claims of a main and first to third auxiliary requests intended to replace the requests on file, provided that the new requests were admitted to the proceedings.

V. Oral proceedings were held on 18 January 2011. At the oral proceedings the appellant submitted claims of a new main request to replace all previous requests. The appellant requested that the decision under appeal be set aside and a patent granted on the basis of claims 1 to 9 of the main request filed at the oral proceedings.

At the end of the oral proceedings the board announced its decision.

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

"A system compatibly receiving a signal (416) having an upper layer digital signal, broadcast at frequency ω_u on an upper carrier, and a lower layer digital signal, broadcast at frequency ω_L on a lower carrier, non-coherently added together, whereby the upper layer digital signal is boosted in power with respect to the

lower layer digital signal and the frequency ω_u and the frequency ω_L are offset, the system comprising:

a receiver (314) comprising:

a first demodulator (404) configured to demodulate the signal (416) to produce a first demodulated signal (420) in which the upper carrier has been removed;

a first layer decoder (402), coupled to the first layer demodulator (404), configured to decode the first demodulated signal (420) to produce upper layer signal symbols (102) and to output the upper layer symbols to an upper layer transport;

a reproducer (406), coupled to the first layer decoder (404), configured to produce from the upper layer signal symbols (102) an idealized first demodulated signal (100);

a subtracter (412), coupled to the first demodulator (404) and the reproducer (406), configured to subtract the idealized first demodulated signal from the first demodulated signal to produce the lower layer digital signal (106);

a second layer demodulator (410), coupled to the subtracter (412), the second layer demodulator (410) configured to demodulate the lower layer digital signal to produce a second demodulator output; and

a second layer decoder (408), coupled to the second layer demodulator (410), the second layer decoder configured to decode the second layer demodulated output to produce lower layer signal symbols (104) and to output the lower layer symbols to a lower layer transport."

VII. Independent claim 6 reads as follows:

"A method of receiving a signal (416) having an upper layer digital signal broadcast at frequency ω_u on an upper carrier, and a lower layer digital signal broadcast at frequency ω_L on a lower carrier, non-coherently added together, whereby the upper layer digital signal is boosted in power with respect to the lower layer digital signal and the frequency ω_u and the frequency ω_L are offset, the method comprising: receiving the signal (416) in a receiver, comprising the steps in the receiver of:

demodulating the signal to produce a first demodulated signal (420) in which the upper carrier has been removed;

decoding the first demodulated signal to produce upper layer symbols (102), and outputting the upper layer symbols to an upper layer transport;

reproducing, from the upper layer signal symbols (102), an idealized first demodulated signal (100);

subtracting the idealized first demodulated signal (100) from the first demodulated signal (420) to produce the lower layer digital signal;

demodulating the lower layer digital signal; and

decoding the demodulated lower layer digital signal to produce lower layer decoded symbols (104), and outputting the lower layer decoded symbols (104) to a lower layer transport."

Reasons for the Decision

1. *Amendments (Article 123(2) EPC)*

1.1 In the following, "as filed" refers to the published application WO-A-02/089371.

1.2 Claim 1 has been amended by removing the limitation that the upper layer signal is a "legacy" signal. This amendment is supported by page 7, lines 8 to 14 of the description as filed. The amendment that the upper and lower signals are "digital" signals is supported by page 1, lines 3 to 5 of the description as filed. The amendment that the upper and lower layer digital signals are "broadcast" is equally supported by page 1, lines 3 to 5 of the description as filed. The expressions "[broadcast] at frequency ω_u on an upper carrier", "[broadcast] at frequency ω_L on a lower carrier" and "the frequency ω_u and the frequency ω_L are offset" are supported by the equations on page 9, lines 7 and 8 and the passages on page 9, lines 10 to 11 and page 10, lines 8 to 9 of the description as filed. The expression "whereby the upper layer signal is boosted in power with respect to the lower layer" is supported by page 5, lines 1 to 3 of the description as filed. The expression "in which the upper carrier has been removed" is supported by page 5, lines 15 to 16 of the description as filed. The amendment from "remodulator ..." to "reproducer ... to produce from the upper layer symbols ..." is considered supported by the embodiment of Fig. 4A, which in contrast to the embodiment of Fig. 4B, discloses a "remodulator" which does not "remodulate" (in the sense of performing "demodulation" in reverse) the input signal onto the

upper carrier but merely reverses operations carried out in the decoder. The term "idealized" first demodulated signal is supported by page 8, lines 1 to 3 of the description as filed.

The board concludes that the amendments to claim 1 comply with Article 123(2) EPC.

1.3 These comments apply, ***mutatis mutandis***, to independent claim 6.

2. ***Clarity and claim interpretation (Article 84 EPC)***

2.1 In the board's view, claim 1 is sufficiently clear when read in the context of the application as whole, despite the somewhat unconventional reference to signal "layers". The expression "to demodulate the signal to produce a first demodulated signal ... in which the upper carrier has been removed" is considered to be clear in not embracing merely changing the upper carrier signal frequency to a lower value, ie does not embrace down-converting the signal to an IF carrier frequency. The term "idealized first demodulation signal" in claim 1 is considered clear in the present context as meaning a "clean" version of the demodulated upper layer signal.

The board however draws attention to the fact that claim 1 should read "A system for compatibly receiving ...". It is proposed that this matter be dealt with by the examining division.

Apart from this point, claim 1 is considered to comply with Article 84 EPC.

2.2 Independent claim 6 likewise complies with Article 84 EPC.

3. *Inventive step*

3.1 The present invention relates to the field of broadcasting of digital signals. The broadcast signal comprises two "layers", a so-called upper layer signal and a lower layer signal, by which is merely meant two different signals, either originating from the same or different transmitters. The power of one of the signals is boosted relative to the other. An expression for such a transmission scheme used in the art is "power [division] multiplexing", a term used in the title of the present application as well as in certain of the prior art documents (cf. eg D9, page 191, left-hand column, line 6 ff.). The signal layers are transmitted at carrier frequencies, referred to respectively as the upper carrier and the lower carrier, which in accordance with claim 1 are offset from one another. The basic principle of operation of the receiver is that the upper layer (ie the higher power signal) is demodulated to produce a first demodulated signal which is then decoded to produce output symbols (this being possible due to the power differential between the upper and lower layer signals). These symbols are used to produce an "idealized" version of the first demodulated signal (ie the upper layer component thereof), which is subtracted from the actual first demodulated signal to leave the lower layer signal. The lower layer signal is then itself demodulated and decoded.

3.2 *Inventive step in relation to document D9*

3.2.1 The closest prior art document is regarded by the board as being document D9 which, like the present invention, concerns a broadcasting system making use of a composite signal formed from a high power first signal and a low power second signal. In this case (cf. Fig. 1 of D9), the first signal is an analog FM signal and the second signal a COFDM digital signal, eg for transmitting DAB signals. The FM signal is demodulated making use of the so-called "capture effect", which results in the COFDM signal being strongly suppressed at the output of the FM demodulator. The demodulated output signal is remodulated in an FM modulator (ie an "idealized" FM signal is produced) and subtracted from the received signal in order to leave the COFDM signal, which is itself then demodulated.

3.2.2 The subject-matter of claim 1 differs from the disclosure of document D9 essentially in the following aspects:

(a) The upper layer signal of D9 is an analog FM signal whereas claim 1 requires both signals to be digital.

(b) In D9, the COFDM signal (lower layer signal) uses the same broadcast frequency as the FM signal (cf. page 191, right-hand column, section II, lines 2-4), whereas in accordance with claim 1 the two carrier frequencies are offset.

(c) In D9, the point of subtraction acts directly on the FM signal before demodulation, whereas in

accordance with claim 1, the point of subtraction occurs following demodulation of the received signal (ie after removal of the upper carrier).

3.2.3 Re (a): The board considers that the skilled person starting out from document D9 would be unlikely to replace the analog FM signal by a digital signal because a basic premise of D9 is to produce a backward-compatible broadcasting system, ie one which continues to broadcast the existing FM signal. It is an aim of D9 that conventional receivers (ie legacy receivers) must be able to receive FM broadcasts without interference from the new second layer signal (cf. page 191, right-hand column, section II, lines 6-7). If on the other hand the skilled person wished to design a digital broadcasting system from scratch, eg for DAB signals, without needing to transmit the existing FM signal, there would be no obvious need to "piggyback" a second signal onto a main digital signal since the main digital signal could itself be designed to provide sufficient bandwidth for the DAB channels.

Re (b): The board considers that the skilled person would be unlikely to introduce a frequency offset into the system of D9, as this may result in interfering with a neighbouring broadcast FM channel. Moreover, if for the sake of argument the system were designed with a frequency offset, plausibly the receiver system would be designed with different receiver branches, as for example proposed by document D5 for adjacent channel reception (cf. page 3, left-hand column, lines 3 to 9 and Fig. 4).

Re (c): The examining division argued essentially that it was common practice to provide a first conversion stage to convert the received signal to an intermediate frequency, and that this down-conversion could be construed as "demodulation". However claim 1 has been amended to be limited to demodulation "in which the upper carrier has been removed". As mentioned above, the board does not regard down-conversion to an IF frequency, whereby the carrier frequency is merely changed, as demodulation in which the upper carrier has been removed. This argument is therefore no longer relevant. The board has also considered whether the skilled person starting out from D9 would move the FM demodulation block ahead of the subtraction point, and concludes that this would be illogical, since, due to the "capture effect", the lower layer signal would be suppressed and no longer recoverable.

3.2.4 The examining division also argued that in the light of D9 the skilled person would consider adding a weaker DAB signal to an existing stronger digital data signal which is encoded with error correction. However, in the board's view it is doubtful that a document dealing principally with analog FM demodulation relying on the capture effect to suppress the lower layer signal would, without the benefit of hindsight, lead the skilled person to contemplate the same concept when starting out from a digital modulation scheme. In any case, it is not self-evident that a receiver structure as claimed would result rather than one in which subtraction takes place before demodulation of the upper layer signal (cf. the embodiment of Fig. 4B of the application).

3.2.5 The board concludes that in the light of the disclosure of document D9, the subject-matter of claim 1 involves an inventive step (Articles 52(1) and 56 EPC).

3.2.6 These comments apply, ***mutatis mutandis***, to independent claim 6.

3.3 *Inventive step in relation to document D5*

Document D5 concerns interference cancellation in a cellular radio system caused by channel re-use in distant cells (cf. page 1, left-hand column, second paragraph). The desired and interfering signals are not "broadcast", as required by claim 1, and in fact cellular radio systems at the priority date of the application, as far as is known to the board, were not used for broadcasting purposes. Further, although the various interfering signals implicitly have different power levels, there is no disclosure of an "upper layer digital signal ... boosted in power with respect to [a] lower layer digital signal" as also required by claim 1, which implies an intentional power relationship. Document D5, being neither a system for broadcast nor one making use of "power division multiplexing", is, in the board's view, not a plausible starting point with respect to the present invention. The board concludes that document D5 is not relevant to inventive step.

3.4 *Other documents*

None of the remaining documents cited in the examining proceedings is any more relevant than the documents discussed above in respect of inventive step.

4. *Conclusion*

For the above reasons, the board concludes that claims 1 and 6 comply with Articles 123(2), 84 (apart from the minor point noted at point 2.1 above with respect to claim 1) and 52(1) EPC. As the board has not examined the rest of the application (in particular the dependent claims, the description and drawings) for compliance with the EPC, the case is remitted to the department of first instance for further prosecution.

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 for further prosecution.

The Registrar: The Chairman:

G. Rauh A. S. Clelland