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**D E C I S I O N**  
**of 11 October 2000**

**Case Number:** T 0239/97 - 3.5.1

**Application Number:** 87904043.4

**Publication Number:** 0296175

**IPC:** H04L 27/02

**Language of the proceedings:** EN

**Title of invention:**

Method and installation for digital communication,  
particularly between and toward moving vehicles

**Patentee:**

FRANCE TELECOM, et al

**Opponent:**

Robert Bosch GmbH  
Interessengemeinschaft für Rundfunkschutzrechte e.V.

**Headword:**

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**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step (yes, after amendment)"

**Decisions cited:**

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**Catchword:**

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Case Number: T 0239/97 - 3.5.1

**D E C I S I O N**  
**of the Technical Board of Appeal 3.5.1**  
**of 11 October 2000**

**Appellant:** FRANCE TELECOM  
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**Respondent(s):** Robert Bosch GmbH  
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**Representative:** -

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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 27 December 1996  
revoking European patent No. 0 296 175 pursuant  
to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** P. K. J. van den Berg  
**Members:** A. S. Clelland  
P. H. Mühlens

## Summary of Facts and Submissions

- I. This is an appeal against the decision of the Opposition Division to revoke European patent No. 296 175 on the ground that the subject matter of independent claims 1 and 3 as amended in the course of the opposition proceedings lacked an inventive step having regard to the disclosure of the following documents (using the Opposition Division's notation):
- D3: IEEE Transactions on Information Theory, vol. IT-14, No. 5, September 1968, pages 627-640, Cohn et al., "Performance of Selected Block and Convolutional Codes on a Fading HF Channel"
- I-5: Clark and Cain, "Error-Correcting Coding for Digital Communications", Plenum Press, 1982, pages 227-233 and 344-349.
- II. The Opposition Division also held that independent claims 4 and 6, corresponding to claims 5 and 7 as granted, met the requirements of the EPC; however, there being no request based on these claims, the patent was revoked.
- III. The Patentee (Appellant) lodged an appeal against this decision and paid the prescribed fee. In a statement of grounds of appeal it was argued that the claims considered by the Opposition Division were both novel and inventive.
- IV. In a letter dated 30 November 1998, Opponent (Respondent) I withdrew their opposition.

V. In a communication on behalf of the Board, the Rapporteur discussed the issue of inventive step in relation to independent claims 1 and 3. It was also stated that the Rapporteur saw no reason to differ from the Opposition Division's conclusion that the patent could be maintained on the basis of claims 4 to 6.

VI. Oral proceedings were held before the Board on 11 October 2000. At the oral proceedings the Appellant made the following requests:

**Main request:** maintenance of the patent on the basis of claims 1 to 6 as received on 11 September 2000.

**Auxiliary request:** maintenance of the patent on the basis of claims 4 to 6 of the main request.

The remaining Opponent, Respondent II, requested that the appeal be dismissed.

VII. At the end of the oral proceedings the Board announced its decision to set aside the appeal and to maintain the patent in accordance with the auxiliary request.

VIII. Claim 1 corresponds in substance to the versions of claim 1 as discussed in the oral proceedings before the Opposition Division, i.e. to claim 1 as granted with further limitation, namely to sound broadcasting towards movable receivers, redundant coding in the form of convolutional coding and the decoding algorithm set out in the last paragraph I reads as follows:

"Process of digital sound broadcasting toward movable receivers comprising:

- sampling information from a source to obtain data consisting of digital words,
- encoding the bits of said words using a redundant convolutional encoder to obtain a sequence of modulation symbols  $A(f_i t_i)$ , representing said data,
- transmitting said symbols in a plurality  $M$  of subchannels at different frequencies ( $f$ ) with simultaneous transmission of  $M$  symbols, with a distribution of said symbols including time interleaving such that two mutually adjacent symbols will not be transmitted either in time succession at the same one of said frequencies, or simultaneously at different frequencies, or in mutually adjacent frequencies, each symbol being transmitted only once, and
- decoding said symbols in a receiver making use of logics which make an a posteriori search for that mosaic of the symbols  $A(f_i t_i)$  which corresponds to a maximum value of the metric, defined as the probability density of the sequence received conditionally on transmission of a predetermined sequence."

Independent claim 3 corresponds to claim 4 as granted and is directed to a digital broadcast system.

Independent claim 4 corresponds to claim 5 as granted and reads as follows:

"Digital broadcasting process comprising:

- sampling information from a source to obtain data consisting of digital words,
- encoding the bits of said words using a redundant encoder to obtain a sequence of modulation symbols,
- transmitting said symbols with time interleaving and simultaneous transmission of a plurality M of different said symbols in M subchannels at different frequencies, said symbols being used for OQAM modulation; and
- simultaneously demodulating said M subchannels, and only said M subchannels, by applying a DFT to said M subchannels,

wherein a plurality L of programs are simultaneously broadcast and the M subchannels corresponding to a same one of said programs are frequency interleaved with the subchannels allocated to the other programs."

Independent claim 6 corresponds to claim 7 as granted and sets out a broadcasting system for carrying out the process of claim 4.

## **Reasons for the Decision**

### 1. *Background to the invention*

1.1 In digital broadcasting, in particular sound broadcasting toward movable receivers such as car radios, provision must be made for errors caused by noise or by fading as a result of multipath

propagation. Various error correction systems are acknowledged in the patent as known, such as convolutional and other forms of redundant encoding, spread spectrum (referred to in the patent as "frequency jump") and data interleaving. The claimed invention is said at page 3, lines 37 to 39 of the granted patent to use the known error handling techniques but to combine them "in a unique way".

1.2 It was common ground between the parties that the single most relevant prior art document is D3. This document compares the performance of various error-correcting codes - block codes, concatenated codes and convolutional codes - in an experimental HF link. The document is primarily concerned with HF communication between two fixed sites but the introduction states at page 627, left hand column that the problem of maintaining a low probability of error arises both at HF and with tropospheric scatter, the latter making use of the VHF or UHF bands.

2. *The main request*

2.1 D3 indicates in the description of the code performance studies starting at page 628, left-hand column, that the test experiments made use of a "16-channel all digital FDM modem", FDM denoting "Frequency Division Multiplex". This implies that symbols were transmitted in 16 subchannels at different frequencies with simultaneous transmission of 16 symbols. It was common ground at the oral proceedings that D3 also discloses at page 637, right-hand column onwards, a convolutional encoder operating to sample information from a source to obtain data consisting of digital words and to encode the bits of said words using a redundant

convolutional encoder to obtain a sequence of modulation symbols representing said data. Each symbol is transmitted only once.

2.2 The subject matter of claim 1 accordingly differs from the disclosure of D3 in providing the following features:

- (a) the process is for sound broadcasting towards moveable receivers;
- (b) the symbols are time interleaved in a separate step following the convolutional coding;
- (c) the distribution of the symbols in time and frequency is such that two mutually adjacent symbols will not be transmitted either in time succession at the same one of said frequencies, or simultaneously at different frequencies, or in mutually adjacent frequencies; and
- (d) decoding said symbols in a receiver making use of logics which make an a posteriori search for that mosaic of the symbols  $A(f_i t_i)$  which corresponds to a maximum value of the metric, defined as the probability density of the sequence received conditionally on transmission of a predetermined sequence.

2.3 Considering these features in turn, the appellant argued that the D3 arrangement, being concerned with fixed HF stations, was unsuitable for sound broadcasting towards moveable receivers, which used a much higher frequency range. The Board notes however that claim 1 contains no features specific to the



problems of mobile receivers; nor does it specify a particular frequency range. Since as noted above the D3 arrangements are seen as not merely applicable to HF but also to VHF and UHF frequencies it is considered that the skilled person would take D3 into account when developing a process of sound broadcasting towards mobile receivers.

- 2.4 Feature (b), time interleaving, was common general knowledge in the art at the claimed priority date. I-5, which is a textbook, shows at page 345, Figure 8-9 an example of an interleaver structure which after the initial encoding provides interleaving which, after transmission and reception, is deinterleaved prior to decoding; the discussion of the drawing explicitly mentions a Viterbi decoder as one example of a decoder to which such interleaving can be applied.
  
- 2.5 In the discussion of a convolutional coding scheme at page 638 of D3 the skilled person is taught to "produce the broadest possible distribution of bits in frequency and time across the subchannels"; in an interleaved system this implies a distribution such that two mutually adjacent symbols will not be transmitted either in time succession at one frequency or simultaneously at different frequencies, feature (c).
  
- 2.6 The Appellant argued that the above-mentioned wording did not necessarily imply the conditions of feature (c) would be met. Moreover, the mere addition of time interleaving to the convolution coding process known from D3 did not do so either. It was asserted that in the case of the shortest code in D3 it was possible to show that adjacent symbols from the encoder were transmitted simultaneously at different frequencies,

contrary to the limitation. The Board was unable to follow this reasoning. Even if the skilled person were not to set out explicitly to carry out feature (c), the result of the combination of frequency and time multiplexing applied to the symbols would inevitably lead to the claimed conditions.

- 2.7 As the Appellant explained in the oral proceedings before the Board, feature (d) sets out the Viterbi decoding algorithm. The use of this algorithm was common general knowledge at the priority date: in addition to the passage from I-5 cited at point 2.4 above, the book states on page 227, second paragraph that "In recent years convolutional coding with Viterbi decoding has become one of the most widely used forward-error-correction techniques. This is due to both the simplicity of implementation and the relatively large coding gains that can be achieved".
- 2.8 It was argued by the Appellant that the skilled person would not apply the Viterbi algorithm to the decoder of the D3 arrangement; in the example given at page 638, left-hand column of D3, diffuse (meaning long) convolutional codes were used which the skilled person would know were unsuitable for Viterbi decoding. The generator polynomial defined in D3 on page 637 and 638 when generating the shortest possible convolution code (corresponding to  $n=1$ ,  $x=10$ ) would require the unrealistic number of 232 nodes in a Viterbi decoder; in contrast, the code according to the patent required 26 nodes.
- 2.9 The Board agrees that the specific example given at page 638 would not lend itself to Viterbi decoding but notes that D3 also states in the introduction at

page 627, right-hand column, third full paragraph that "As an alternative, short codes can be used with time interleaving (time-division multiplexing) to achieve a large overall constraint length". The Board considers that D3, when read as a whole, envisages interleaving with convolutional codes. The above-cited passage from page 627 goes on to state that "a code is employed with a constraint length chosen as the maximum that practical implementation considerations will allow and the constraint length is then extended with the use of interleaving. Thus the coding techniques considered in this paper make use of moderately powerful codes together with interleaving". Constraint length is therefore limited by "practical implementation considerations" such as the difficulties faced in decoding a long code. The Board notes that D3 also mentions on page 639, right-hand column, that varying code length and addition of time interleaving is possible for all three embodiments, stating that: "It has been shown that all of these schemes must be used with some form of interleaving or time dispersion in order to combat the marked non-independence of consecutive errors caused by the HF medium". The Board therefore considers that the skilled person, using a convolutional code and aware of the advantages of Viterbi decoding, would be led by D3 to a code which makes use of interleaving.

- 2.10 The Board accordingly holds that the subject matter of claim 1 lacks an inventive step in view of the disclosure of D3 in the light of common general technical knowledge at the claimed priority date as exemplified by I-5. It follows that the main request cannot be allowed.

2.11 The Appellant argued that a prejudice existed at the priority date against the approach adopted in the patent. At this time many companies were making proposals for DAB (Digital Audio Broadcasting) but all the proposals, apart from the Appellant's, used broadband transmission and equalisation, the consensus in the art being that this was the only practical solution for DAB. There was thus a prejudice in the art against the Appellant's approach; although the skilled person would have been aware of the convolutional coding described in D3 and also of corresponding decoding algorithms, of which the Viterbi algorithm was merely one example, the consensus at that time was against it. The Board would observe that a consensus in favour of one approach does not of itself imply a technical prejudice against an alternative approach; such a consensus might emerge from commercial or historical rather than technical considerations. No evidence has been adduced that an actual technical prejudice existed at the priority date.

3. *The auxiliary request*

3.1 The remaining Respondent argued that the auxiliary request should be refused because it was late-filed, having only been received in the course of the oral proceedings. The Respondent declined to comment on the substantive issues.

3.2 In the submission of 11 September 2000, i.e. exactly one month before the oral proceedings, the Appellant asked for permission to submit a further request based on claims 4 to 6 of the main request should it appear necessary. Since it was merely based on a subset of the claims of the main request the Board decided to admit

the auxiliary request at the oral proceedings.

- 3.3 The Board notes that the identical claims were considered by the Opposition Division and that in the course of the appeal proceedings the Respondent has raised no substantive objection against the claims of this request. Consequently, the Board sees no reason to differ from the Opposition Division's conclusion that these claims are novel and inventive. The patent is accordingly maintained on the basis of the claims of the auxiliary request.

## **Order**

### **For these reasons it is decided that:**

1. The decision under appeal is set aside.
2. The main request is refused.
3. The case is remitted to the first instance with the order to maintain the patent in accordance with the Appellant's auxiliary request.

The Registrar:

The Chairman:

M. Kiehl

P. K. J. van den Berg