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Case Number: T 0789/06 - 3.5.05

Application Number: 97306510.5

Publication Number: 0828365

IPC: H04L 27/26

Language of the proceedings: EN

Title of invention:
Multicarrier modulation using complementary codes and amplitude modulation

Applicant:
LUCENT TECHNOLOGIES INC.

Opponent:
-

Headword:
Complementary coding with amplitude modulation/LUCENT

Relevant legal provisions:
EPC Art. 84

Keyword:
"Clarity and support by the description - after amendment (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0789/06 **-** 3.5.05

D E C I S I O N
of the Technical Board of Appeal 3.5.05
of 26 May 2010

Appellant: LUCENT TECHNOLOGIES INC.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 6 December 2005 refusing European application No. 97306510.5 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: D. H. Rees
Members: P. Cretaine
F. Blumer

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division dispatched 6 December 2005, refusing European patent application No. 97 306 510.5. The decision was based on the grounds that the application contained too many independent claims of the same category (Article 84 EPC in combination with Rule 29(2) EPC 1973) and that these independent claims further did not meet the requirements of Article 84 EPC since they lacked support in the description, lacked clarity, lacked essential features, or attempted to define the invention as a result to be achieved.

II. The notice of appeal was filed with a letter dated 2 February 2006 and received by telefax on the same date. The appeal fee was paid on the same day. The statement setting out the grounds of appeal was filed with a letter dated 13 April 2006 and received by telefax on the same date. The appellant requested that a patent be granted on the basis of claims 1 to 8 annexed to the letter. Further, oral proceedings were requested as an auxiliary measure.

III. In a communication accompanying a summons to oral proceedings to be held on 16 April 2010 the board gave its preliminary opinion that the appellant's request was not allowable.

In particular, objections were raised against amended claim 1 under Articles 123(2) EPC and 84 EPC and against independent claim 5 under Article 84 EPC. The board also noted that if the appellant overcame the objections raised in the communication, the board would

probably remit the case to the first instance for examination of the questions of novelty and inventive step.

IV. With a letter dated 16 March 2010 and received by telefax on the same date, the appellant filed two sets of amended claims according to a Main Request and an Auxiliary Request, replacing the previous single claim set, together with arguments in support of the compliance of the claims with the requirements of Articles 84 and 123(2) EPC. The appellant further stated that it would be prepared to delete the Main Request and proceed with the Auxiliary Request if the application were returned to the examining division for consideration of novelty and inventive step without the need for oral proceedings.

V. In a brief official communication dated 26 March 2010 and transmitted to the appellant by telefax on the same date, the board announced that, considering the content of both requests, it would be inclined to remit the application according to the Auxiliary Request to the first instance for examination of novelty and inventive step, and invited the appellant to clarify whether it maintained the Main Request and its request for oral proceedings.

VI. In an electronically filed letter submitted 29 March 2010, the appellant announced that it withdrew the Main Request and "conditionally" withdrew its request for oral proceedings, based on whether or not the board would remit the case to the first instance.

VII. In a brief official communication sent by telefax on 30 March 2010, the board announced that the oral proceedings scheduled to be held on 16 April 2010 had been cancelled.

VIII. The appellant has requested that the decision under appeal be set aside and that the application be remitted to the first instance for examination of novelty and inventive step on the basis of claims 1 to 7 of the Auxiliary Request filed with the letter dated 16 March 2010 (sole request).

The further documents on which the appeal is based, i.e. the text of the description and the drawings, are as follows:

description	pages 3, 5 to 18	as originally filed
	pages 1, 2, 4, 19	as filed with telefax of 1 March 2005;
drawing sheets 1/1		as originally filed.

IX. Independent claim 1 of the appellant's sole request reads as follows:

"A method of encoding data for transmission by a transmitter to a receiver comprising the steps of:
- partitioning the data to be encoded into a plurality of groups of bits;
- selecting as a function of a first group of bits of the plurality of groups of bits an associated one of a plurality of amplitude patterns each defined by predetermined pattern of at least two elements;

- associating each of the remaining groups of bits of the plurality of groups of bits with a respective independent phase rotation, φ_i;
- selecting a kernel code comprising the eight bits 111-111-1l and applying the phase rotations, φ_i, to each of said bits of said kernel code as a function of a predetermined transformation to generate respective complementary codes, the predetermined transformation comprising the following phase rotations

φ_1	φ_1	φ_1	φ_1	φ_1	φ_1	φ_1	φ_1
φ_2	0	φ_2	0	φ_2	0	φ_2	0
φ_3	φ_3	0	0	φ_3	φ_3	0	0
φ_4	φ_4	φ_4	φ_4	0	0	0	0

- converting the complementary codes into phase vectors;
- associating each of said phase vectors with a corresponding one of the elements forming the selected amplitude pattern; and
- modulating carrier signals using respective ones of the resulting vectors and transmitting the modulated carrier signals to a receiver."

Independent claim 5 of the request reads as follows:

"A method of decoding at a receiver data encoded by a method as claimed in any of the preceding claims comprising:
- receiving a composite signal of the modulated signals transmitted by said transmitter and regenerating individual ones of said phase vectors as a function of the received composite signal;

- identifying the amplitude pattern of the received phase vectors as one of a plurality of pattern templates that provides the largest absolute correlation value when compared with the amplitude pattern of the received vectors, and responsive to the identification, identifying the group bits represented by the identified pattern and phase constellations associated with the identified pattern;
- applying said kernel code to said regenerated phase vectors,
- generating a number of vectors y_i, from pairs of elements forming the regenerated vectors, in which one element in each of said pair is taken as a complex conjugate so that said one element may be multiplied by the other element of the respective pair of elements, said pairing of said elements being performed in accordance with the contents of a predetermined matrix,
- deriving three of said phase rotations as a function of the multiplied results forming respective ones of said vectors y_i, said vectors, y_i, being associated with respective ones of the three phase rotation, and
- deriving the remaining phase rotation not associated with a respective vector as a function of the derived three phase rotations and a complementary code, θ_k, formed in part by the remaining phase rotation."

Reasons for the Decision

1. *Admissibility*

The appeal complies with the provisions of Article 106 to 108 EPC 1973. Therefore it is admissible (see Facts and Submissions, point II).

2. *Article 123(2)*

2.1 *Claim 1*

Claim 1 is based on the single illustrative embodiment, using the kernel code 111-111-11 and the transformation matrix:

$$\begin{matrix} \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 \\ \varphi_2 & 0 & \varphi_2 & 0 & \varphi_2 & 0 & \varphi_2 & 0 \\ \varphi_3 & \varphi_3 & 0 & 0 & \varphi_3 & \varphi_3 & 0 & 0 \\ \varphi_4 & \varphi_4 & \varphi_4 & \varphi_4 & 0 & 0 & 0 & 0, \end{matrix}$$

as described from page 2, line 54 to page 4, line 47 of the original description (all references in this decision are to the application as published).

In particular, the support in the description as originally filed for the amendments to claim 1 as originally filed is the following:

- the partitioning of the data to be encoded into a plurality of groups of bits is disclosed as the first step of the encoding method on page 3, lines 53-54;

- the step of associating the remaining groups of bits with phase rotations has been placed after the partitioning step and before the steps dealing with the complementary coding, as disclosed on page 3, lines 57-58 and page 4, lines 16-31,

- in the step of selecting a kernel code and generating complementary codes, the bits forming the kernel code and the transformation implied in the generation of the complementary codes correspond, as mentioned above, to those defined in the description of the specific embodiment on pages 2 to 4.

Claim 1 therefore complies with the requirements of Article 123(2) EPC.

2.2 *Claim 5*

Independent claim 5 relates to a method of decoding data encoded by a method according to any of claims 1 to 4.

Claim 5 is based on the combination of originally filed claims 4 and 5 and on the specific embodiment disclosed from page 6, line 28 to page 9, line 6.

In particular, the support in the description for the amendments to the combination of claims 4 and 5 as originally filed is the following:

- a single step of identifying the amplitude pattern is disclosed in page 6, lines 42 to 54;

- the change from "subtracted from the other element" to "multiplied by the other element" in the y_i vectors generating step of originally filed claim 5 is supported by the passage from page 7, line 53 to page 8, line 9;

- the step of deriving three of the phase rotations is based on the passage from page 7, line 54 to page 8, line 9 describing the determination of φ_2, φ_3, and φ_4 using the generated vectors y_2, y_3, and y_4 for the specific embodiment;

- the step of deriving the remaining phase rotation is based on the passage in page 8 from line 33 to 57 describing, for the specific embodiment, the determination of φ_1 using the previously determined phase rotations φ_2, φ_3, φ_4 substituted in the equation giving a determined complementary code θ_k (k =1 to 8).

Thus, independent claim 5 meets the requirements of Article 123(2) EPC.

3. *Article 84 EPC*

The refusal decision was based on objections under Article 84 EPC. The board is satisfied that the claims as amended in appeal overcome these objections for the following reasons.

3.1 The set of claims comprises a single independent claim for an encoding method (claim 1) and a single independent claim for a corresponding decoding method (claim 5).

Claim 6 is a claim dependent on claim 1 since it belongs to the same category ("method") and contains all the features of claim 1 (Rule 43(4) EPC).
The claims therefore meet the requirements of Article 84 EPC, taken in combination with Rule 43(2) EPC, in respect of the number of independent claims in the same category.

3.2 *Claim 1*

3.2.1 The description discloses applying a complementary coding to the phases φ_i of phase-modulated subcarriers of a multicarrier system and describes a single specific embodiment using a specific kernel code (111-111-11) and a specific transformation, leading to specific relations, representing a complementary coding, between the phase rotations φ_i and phase outputs θ_i.

The board agrees with the examining division that the application as filed does not contain sufficient information to allow the person skilled in the art, using his common general knowledge, to generate alternative complementary coding of different sizes than the one specified by said specific embodiment.

The board is however satisfied that the amended claim 1 defines a method using the specific kernel code 111-111-11 and the specific transformation using the phase rotations:

$$\begin{array}{cccccccc} \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 & \varphi_1 \\ \varphi_2 & 0 & \varphi_2 & 0 & \varphi_2 & 0 & \varphi_2 & 0 \\ \varphi_3 & \varphi_3 & 0 & 0 & \varphi_3 & \varphi_3 & 0 & 0 \\ \varphi_4 & \varphi_4 & \varphi_4 & \varphi_4 & 0 & 0 & 0 & 0. \end{array}$$

In the board's judgement, the phase angles forming each of the eight columns of said transformation, when applied to the eight bits of the specific kernel code, give the relations for the eight output phases θ_i (i = 1 to 8) as defined in page 3, lines 14 to 46 in respect of the specific embodiment.

3.2.2 In the decision under appeal, the examining division also objected that claim 1 was not supported by the description since the step of generating the complementary codes θ_i, based on phase rotations φ_i and a kernel code, preceded the step of associating groups of bits to be encoded with said phase rotations. This implied that the phase rotations φ_i and the complementary codes θ_i were first determined, independently of the values of the bits representing data to be encoded, and that the resulting modulated carrier signal could not transport any information data.

The appellant has reordered the steps of claim 1 to clearly define that the step of associating the groups of bits with the phase rotations φ_i (e.g. through a 4PSK or 8PSK modulation as described in the application) precedes the step of generating the complementary codes. This objection has therefore been overcome.

3.2.3 The examining division further objected that the wording "independent phase rotations" in claim 1 was unclear.

This objection was however based on the equations deriving the output phases θ_i from the phase rotations φ_i, which introduced dependencies between the output

phases θ_i. Since the phase rotations φ_i are, according to present claim 1, associated with the groups of bits before the generation of the output phases, the board considers that they do not present any interdependency.

3.2.4 The examining division further objected that the wording "complementary codes" used for designating the result of the transformation applied to the kernel code was inconsistent with the description and that the wording "a complementary code" should be used. In the board's judgement however the "complementary codes" in claim 1 unambiguously correspond to the output phases θ_i defined in the description since they are generated in the same way. The use of the wording "complementary codes" therefore does not render the subject-matter of claim 1 unclear.

3.2.5 The examining division also objected that the modulating step of claim 1 included the possibility of modulating the carriers in the time domain, whereas the description only envisages the possibility of modulating the carriers in the frequency domain via OFDM. In that respect, the board agrees with the appellant that, since the vectors are defined as phase vectors and are generated based on the phase rotations φ_i, the modulation of claim 1 is clearly limited to phase modulation applied to multiple carriers. Although the description is limited to an OFDM multicarrier transmission scheme, the claims as originally filed were not limited to OFDM. Moreover the teaching of the description in respect of the amplitude modulation and phase modulation of the carriers does not rely on any specific features of an OFDM system but could be applied by the skilled person to any multi-carrier

transmission scheme. The board therefore judges that the generalisation of claim 1 in respect of the carrier signals modulating step is allowable.

3.2.6 The examining division objected that the term "associating" used in claim 1 was unclear and might be understood as simply forming a loose link between groups of bits and phase rotations and between phase vectors and elements of the amplitude pattern. In the board's understanding, the term "associating" in claim 1 would be construed by the skilled person, in the context of the claim as a whole, as meaning that the groups of bits are coded by the phase rotations and that the phase vectors are amplitude modulated with the elements of the amplitude pattern, since no other meanings could plausibly be derived. Although the illustrative example uses specifically a PSK phase modulation, the board considers that the generalization to a phase modulation is allowable since it represents an obvious modification of the illustrative embodiment.

3.2.7 For the reasons given above in paragraphs 3.2.1 to 3.2.6, the board judges that claim 1 meets the requirements of Article 84 EPC.

3.3 *Claim 5*

3.3.1 Claim 5 relates to a method of decoding data encoded by a method according to any of claims 1 to 4.

Claim 5 contains a single step of identifying the amplitude pattern of the received phase vectors. Therefore the objection in the refusal decision that the presence of two identifying steps in the then

pending claim 4 was not supported by the description, as required by Article 84 EPC, has been overcome.

3.3.2 The examining division also objected that the step of applying the kernel code to the regenerated vector in the then pending claim 6 was not supported by the description, which disclosed, in respect of the specific embodiment, multiplying the complex conjugate of the kernel code with the regenerated vectors. In the board's judgement, this step is based on page 7, lines 12-14 of the originally filed application and on the interpretation of the skilled person who would construe the "applying" operation as a multiplication, based on the overall content of the claim (including the method of encoding defined in claim 1).

3.3.3 The examining division further objected that the independent claims for a decoding method lacked essential features since precise features relating to the decoding of the specific complementary coding of the phases were missing from these claims.

The appellant has introduced in claim 5 features defining the decoding procedure as described from page 7, line 4 to page 9 line 6 in respect of the specific embodiment, and which comprise in particular the steps of applying the kernel code to the phase vectors, generating vectors y_i from the phase vectors and deriving the phase rotations φ_i from the vectors y_i and a complementary code θ_k. Since claim 5 refers to claim 1, the kernel code is the specific one defined in claim 1 and the phases θ_i (i = 1 to 8) of the regenerated vectors represent a complementary coding of the phase rotations φ_i (i = 1 to 4), according to the

specific predetermined transformation defined in claim 1. The pairing of elements of the regenerated vectors used to generate the vectors y_i is performed, according to the description of the specific embodiment, based on the predetermined transformation defined in claim 1, whereas claim 5 uses the wording "a predetermined matrix". In the board's understanding however, the decoding of the specific complementary coding of the phase rotations necessitates the use of the same transformation as used for the coding of said phases. Performing the pairing in accordance with the contents of the specific predetermined transformation defined in claim 1 appears thus to be a feature which is essential to the definition of the decoding method. Therefore the examining division when resuming the examination may consider whether the wording "a predetermined matrix" in claim 5 has to be amended to "the predetermined transformation" in order for claim 5 to fully meet the requirements of Article 84 EPC.

4. Since the sole request overcomes the objections under Article 84 EPC on which the appealed decision is based (with the reservation noted in point 3.3.3) and since the questions of novelty and inventive step have not been examined as yet, the case has to be remitted.

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 on the basis of the Auxiliary Request filed on 16 March 2010.

The Registrar: The Chairman:

G. Magouliotis D. H. Rees