

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 174467aa/mwa	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/EP2014/064311	International filing date (day/month/year) 04.07.2014	Priority date (day/month/year)	
International Patent Classification (IPC) or national classification and IPC INV. H04L5/06			
Applicant SES S.A.			
1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of <u>7</u> sheets, including this cover sheet. 3. This report is also accompanied by ANNEXES, comprising: a. ☐ (sent to the applicant and to the International Bureau) a total of sheets, as follows: ☐ sheets of the description, claims and/or drawings which have been amended and/or sheets containing rectifications authorized by this Authority, unless those sheets were superseded or cancelled, and any accompanying letters (see Rules 46.5, 66.8, 70.16, 91.2, and Section 607 of the Administrative Instructions). ☐ sheets containing rectifications, where the decision was made by this Authority not to take them into account because they were not authorized by or notified to this Authority at the time when this Authority began to draw up this report, and any accompanying letters (Rules 66.4bis, 70.2(e), 70.16 and 91.2). ☐ superseded sheets and any accompanying letters, where this Authority either considers that the superseding sheets contain an amendment that goes beyond the disclosure in the international application as filed, or the superseding sheets were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in item 4 of Box No. I and the Supplemental Box (see Rule 70.16(b)). b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing, in the form of an Annex C/ST.25 text file, as indicated in the Supplemental Box Relating to Sequence Listing (see paragraph 3ter of Annex C of the Administrative Instructions).			
4. This report contains indications relating to the following items: ☒ Box No. I Basis of the report ☐ Box No. II Priority ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability ☐ Box No. IV Lack of unity of invention ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement ☐ Box No. VI Certain documents cited ☒ Box No. VII Certain defects in the international application ☒ Box No. VIII Certain observations on the international application			
Date of submission of the demand 22.03.2016		Date of completion of this report 14.06.2016	
Name and mailing address of the international preliminary examining authority:  European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Fax: +31 70 340 - 3016		Authorized officer Orozco Roura, Carles Telephone No. +31 70 340-3890	



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2014/064311

Box No. I Basis of the report

1. With regard to the **language**, this report is based on
- ☒ the international application in the language in which it was filed
 - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
 - ☐ international search (under Rules 12.3(a) and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4(a))
 - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a) and (b))
2. With regard to the **elements*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

Description, Pages

1-28 as originally filed

Claims, Numbers

1-30 as originally filed

Drawings, Sheets

1/15-15/15 as originally filed

- ☐ a sequence listing - see Supplemental Box Relating to Sequence Listing.
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-bis)):
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
5. ☐ This report has been established:
- ☐ taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rules 66.1(d-bis) and 70.2(e)).
 - ☐ without taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91(Rules 66.4bis and 70.2(e)).

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6. ☒ With regard to top-up searches (Rules 66.1 *ter* and 70.2(f)):
- ☒ A top-up search was carried out by this Authority on 03.06.2016 (all discovered documents are listed in the Supplemental Box Relating to Top-up Search).
 - ☐ Additional relevant documents have been discovered during the top-up search.
 - ☐ No top-up search was carried out by this Authority because it would serve no useful purpose.
7. ☐ Supplementary international search report(s) from Authority(ies) has/have been received and taken into account in establishing this report (Rule 45bis.8(b) and (c)).

* If item 4 applies, some or all of those sheets may be marked "superseded".

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	<u>1-30</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	<u>1-30</u>
	No: Claims	
Industrial applicability (IA)	Yes: Claims	<u>1-30</u>
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

- D1 PIAZZA ROBERTO ET AL: "Data predistortion for multicarrier satellite channels using orthogonal memory polynomials",
2013 IEEE 14TH WORKSHOP ON SIGNAL PROCESSING ADVANCES
IN WIRELESS COMMUNICATIONS (SPAWC), IEEE, 16 June 2013
(2013-06-16), pages 689-693, XP032490449,
ISSN: 1948-3244, DOI: 10.1109/SPAWC.2013.6612138
[retrieved on 2013-09-25]
- D2 DAYONG ZHOU ET AL: "Novel Adaptive Nonlinear Predistorters Based on the Direct Learning Algorithm",
IEEE TRANSACTIONS ON SIGNAL PROCESSING, IEEE SERVICE
CENTER, NEW YORK, NY, US,
vol. 54, no. 1, 1 January 2007 (2007-01-01), pages 120-133,
XP011152345,
ISSN: 1053-587X
cited in the application

- 1 Document D1 is regarded as being the prior art closest to the subject-matter of claim 1 and discloses (the references in parentheses applying to that document):

Method, carried out by a transmitter, hereinafter referred to as "gateway transmitter" (section II.A, first paragraph, "gateway"), for compensating, at least partially, the nonlinearities of a communication channel (page 690, right-hand column, first paragraph, "non-linear") comprising at least one repeater (section II.A, "satellite"), the method comprising

modulating a plurality of digital signals on a plurality of carriers respectively, wherein symbols of the constellation diagram used for modulation of each carrier are distorted in accordance with a function, hereinafter referred to as "pre-distortion function" (figure 1, "multicarrier"; "predistortion");

frequency division multiplexing the plurality of modulated digital signals (figure 1); and

sending the frequency division multiplexed plurality of modulated digital signals for transmission, through the communication channel, to at least one receiver (figure 1);

wherein the pre-distortion function (section III.A, "predistortion function") involves a plurality of polynomial functions (section III.A, first paragraph, "basis functions"; "orthogonal polynomials"), each of which taking as input the symbols from all the carriers (section III.A, first paragraph, "predistorted output for m th carrier depends on symbols from other carriers"), and the polynomial functions' coefficients being hereinafter referred to as "pre-distortion coefficients" (section III.A, "kernel coefficients", " $h_{w,m}(k)$ ").

1.1 The subject-matter of claim 1 therefore differs from this known method in that:

the pre-distortion coefficients are computed in accordance with a direct learning approach, the computation being performed jointly for the plurality of carriers, and the computation comprising iteratively updating the pre-distortion coefficients based on received signals being fed back from at least one among the at least one receiver to the gateway transmitter.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

1.2 The problem to be solved by the present invention may be regarded as how to improve the robustness against noise of the estimation of the pre-distortion coefficients.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

- Document D1 teaches away from the solution of claim 1 as the pre-distortion coefficients are computed in accordance with an indirect learning approach (see D1, section III.D).
 - Document D2 discloses nonlinear predistorters based on the direct learning algorithm. However, the teaching of document D2 cannot be combined with the disclosure of document D1 as document D2 is not applicable to a multicarrier system. D2 applies to a single carrier system and the person skilled in the art would not know how to extrapolate its teaching to a multicarrier system. In particular D2 does not consider interference from other carriers, while such an interference dominates multicarrier systems.
- 2 The same reasoning applies, *mutatis mutandis*, to the subject-matter of the corresponding independent claims 11, 12, 13, 22, 30, which therefore are also considered new and inventive.
- 3 Dependent claims 2-10, 14-21, 23-29 contain all the features of the independent claims to which they refer and therefore also meet the requirements of the PCT in respect of novelty and inventive step.

Re Item VII

Certain defects in the international application

- 4 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in D1 is not mentioned in the description, nor is this document identified therein.
- 5 The independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

Re Item VIII

Certain observations on the international application

- 6 Although claims 11, 12, 13 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.