



(51) International Patent Classification:
H04W 52/34 (2009.01)

(21) International Application Number:
PCT/EP2011/062509

(22) International Filing Date:
21 July 2011 (21.07.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10290434.9 2 August 2010 (02.08.2010) EP

(71) Applicant: ALCATEL LUCENT [FR/FR]; 3, avenue
Octave Gréard, F-75007 Paris (FR).

(72) Inventors; and

(75) Inventors/Applicants (for US only): AMBROSY, Anton
[DE/DE]; Parkstrasse 16/8, 75233 Tiefenbronn (DE).
ZELLER, Dietrich [DE/DE]; Sternbergweg 4, 71067
Sindelfingen (DE). KLEIN, Siegfried [DE/DE]; Steier-
märker Strasse 104, Stuttgart 70469 (DE).

(74) Agent: KLEINBUB, Oliver; Alcatel-Lucent Deutschland
AG, Intellectual Property & Standards, Lorenzstrasse 10,
70435 Stuttgart (DE).

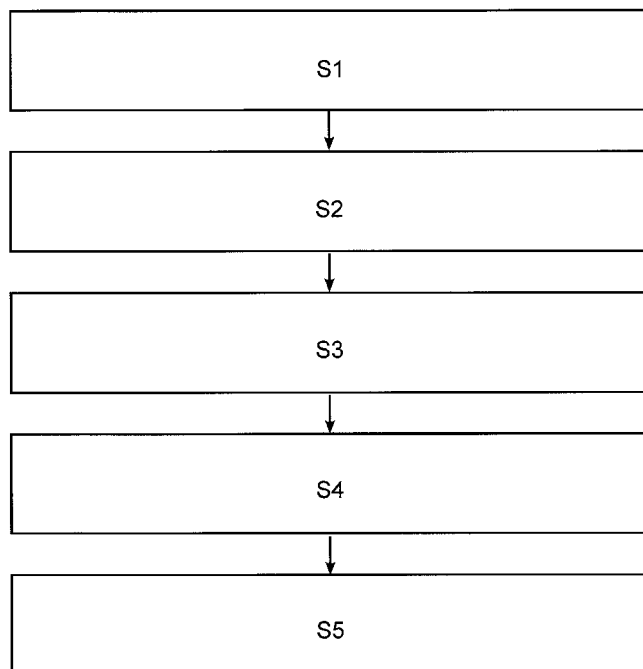
(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,
KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD,
ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,
NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD,
SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG,
ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: BANDWIDTH ADJUSTMENT IN WIRELESS TELECOMMUNICATION

Fig. 2



(57) Abstract: The invention relates to a method of re-
configuring a base station (100) of a wireless telecommu-
nication network, wherein the method comprises the fol-
lowing steps: - generating (S1) a number of pilot sym-
bols in the base station, the number of generated pilot
symbols per time corresponding to a telecommunication
bandwidth; - transmitting (S2) the number of pilot sym-
bols with a total transmission power provided by a power
amplifier (110), the total transmission power being a sum
of transmission powers of each of the number of trans-
mitted pilot symbols; - adjusting (S3) the telecommuni-
cation bandwidth to a cell load; - adjusting (S4) the num-
ber of pilot symbols to the telecommunication band-
width; and - adjusting (S5) the total transmission power
such that each transmission power of each of the number
of pilot symbols is constant.

**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

Bandwidth adjustment in wireless telecommunication

Description

Field of the invention

The invention relates to the field of wireless telecommunication, more specifically to
5 bandwidth adjustment in wireless telecommunication.

Background and related art

10 Adjusting the telecommunication bandwidth is discussed in 3GPP standards, see 3GPP TS 36.104.

Summary

15 It is an object of the present invention to provide an improved method of reconfiguring a base station of a wireless telecommunication network, an improved base station apparatus for a wireless telecommunication network, and an improved computer-readable storage medium.

20 These objects are achieved by the method, the base station apparatus, and the computer-readable storage medium according to the independent claims. Embodiments of the invention are given in the dependent claims.

The invention provides a method of reconfiguring a base station of a wireless tele-
25 communication network. A number of pilot symbols are generated in the base station. The number of generated pilot symbols per time corresponds to a telecommunication bandwidth. The telecommunication bandwidth is the bandwidth used for wireless telecommunication by the base station. The more bandwidth is used for wireless telecommunication by the base station, the more data may be transmitted

and/or received by the base station from/to mobile devices in the wireless telecommunication network.

Pilot symbols are the first broadcast symbols that are searched and acquired by mobile devices in the vicinity of the base station. The pilot symbols are used as a power, timing, and phase reference for the mobile devices.

The number of pilots corresponds to the telecommunication bandwidth because the more bandwidth is used the more pilots have to be transmitted for allowing to perform measurements on the different frequencies within the band. If, for example, one pilot is transmitted per 60kHz bandwidth, increasing the bandwidth by 60kHz would result in transmitting one more pilot symbol.

The number of pilot symbols is transmitted with a total transmission power provided by a power amplifier. The total transmission power is a sum of transmission powers of each of the number of transmitted pilot symbols. In other words, the total transmission power is split between the pilot symbols. It is to be noted that the total transmission power means the total transmission power of the pilot symbols. The term total transmission power used herein is to be understood as the total transmission power of the pilot symbols.

The telecommunication bandwidth is adjusted to a cell load. The cell load is the wireless telecommunication traffic in the cell served by the base station. The cell is a part of the wireless telecommunication network served by the base station. Mobile devices such as PDAs, laptops, or mobile phones, which are located in the geographical coverage area of the cell, are served by the base station. The higher the cell load is the more telecommunication bandwidth is needed by the base station. Thus, the telecommunication bandwidth is increased when the cell load is increased and the telecommunication bandwidth is decreased when the cell load is decreased.

After the adjustment of the telecommunication bandwidth the number of pilot symbols is adjusted to the telecommunication bandwidth. This means, the number of pilot symbols is decreased when the telecommunication bandwidth is decreased and the number of pilot symbols is increased when the telecommunication band-

width is increased. This step is necessary, because the number of transmitted pilot symbols has to correspond to the telecommunication bandwidth.

5 The total transmission power is adjusted such that each transmission power of each of the number of pilot symbols is constant. Preferably, the total transmission power is decreased when the number of pilot symbols is decreased and the total transmission power is increased when the number of pilot symbols is increased. Thus, the total transmission power is indirectly adjusted to the cell load by adjusting the total transmission power to the number of pilot symbols, which are adjusted to the cell
10 load.

The total transmission power is adjusted to keep the transmission power of each of the number of pilot symbols constant. This is advantageous because the transmission power of each pilot symbol is kept constant. Thus, the cell coverage area of the
15 cell being served by the base station is also kept constant as the transmission power of each of the number of pilot symbols is kept constant.

According to embodiments of the invention the method comprises increasing a supply voltage of the power amplifier when the total transmission power is increased, and decreasing the supply voltage of the power amplifier when the total transmission is decreased. By increasing and decreasing the supply voltage of the power
20 amplifier an operating point of the power amplifier can be chosen. Preferably, the operating point of the power amplifier is chosen such that the power amplifier operates near to its maximum output power. Near the maximum output power the power amplifier operates most efficiently. Thus, by increasing and decreasing the supply
25 voltage of the power amplifier the power amplifier is used more efficiently and power is saved.

Additionally or alternatively adjusting the total transmission power may be performed
30 by adjusting the bias of the power amplifier.

According to embodiments of the invention the supply voltage defines a maximum total transmission power. The supply voltage and the total transmission power define an operating point of the power amplifier. The supply voltage and the maximum

total transmission power define a maximum operating point. The supply voltage is increased or decreased such that the operating point is below or equal to the maximum operating point.

- 5 In other words, the power amplifier has a maximum total transmission power that corresponds to a certain supply voltage. The maximum total transmission power is the highest possible transmission power for this supply voltage. The maximum total transmission power corresponds to the maximum output power of the power amplifier. The supply voltage and the transmission power define an operating point of the
- 10 power amplifier. Here, the transmission power is the actually used transmission power. The power amplifier operates at a maximum operating point when amplifying the pilot symbols with the maximum total transmission power. By increasing or decreasing the supply voltage the operating point used for amplifying the pilot symbols is adjusted such that it is below or equal to the maximum operating point. Thus, the
- 15 power amplifier is always operated near its maximum operating point.

According to embodiments of the invention the operating point is 0-60%, preferably 0-30%, even more preferably 0-20% below the maximum operating point.

- 20 According to embodiments of the invention a central network unit triggers adjusting the telecommunication bandwidth. The bandwidth adjustment may for example be determined based on traffic observation. The central network unit could trigger adjusting the telecommunication bandwidth by transmitting a signal to the base station. The traffic could be observed in the base station and/or in the central network unit.
- 25 For example, when the observed traffic is increased, the telecommunication bandwidth of the base station is also increased. Then, the number of pilot symbols and the total transmission power are also increased.

- According to embodiments of the invention a unit within the base station triggers
- 30 adjusting the telecommunication bandwidth. The unit within the base station may for example be a processor in the base station.

According to embodiments of the invention a self-optimization algorithm of the telecommunication network triggers adjusting the telecommunication bandwidth. The

self-optimization algorithm may for example be performed in the base station, other base stations of the wireless telecommunication network, and/or at least one central unit of the wireless telecommunication network. Such a self-optimization algorithm for adjusting the telecommunication bandwidth considers the cell load of a plurality of cells of the wireless telecommunication network. When optimizing communication in the wireless telecommunication network, adjusting the telecommunication bandwidth in the cell of the base station may be advantageous then, the self-optimization algorithm triggers adjusting the telecommunication bandwidth in the cell served by the base station.

According to embodiments of the invention a self-optimization algorithm of the base station triggers adjusting the telecommunication bandwidth. In this case, the self-optimization algorithm runs only on the base station. The self-optimization algorithm optimizes communication in the cell served by the base station.

According to embodiments of the invention the base station transmits a signal to at least one neighboring base station. The signal is indicative of adjusting the telecommunication bandwidth. A neighboring base station is a base station, which serves a cell that neighbors at least partly the cell of the base station. Neighboring means here that at least parts of the cell have a common border. This is advantageous because the neighboring cells may also adjust their telecommunication bandwidth after the adjustment in the cell. Furthermore a neighboring cell may need information about the base station bandwidth for the configuration of the Allowed-MeasBandwidth value, which is specified in 3GPP TS 36.331 and used to instruct mobile devices about the used bandwidth of this base station.

According to embodiments of the invention a time schedule triggers adjusting the telecommunication bandwidth. The time schedule may for example trigger increasing the bandwidth for times when high traffic is expected and decrease the telecommunication bandwidth for times when low traffic is expected. Traffic estimations may be performed by the base station or by a central network unit. For example, the traffic in the cell is observed for a certain amount of time, for example several weeks or months. Then, based on these observations, the timetable is generated.

For example the following timetable may be generated for a cell of the base station.

Hour	Working day	Weekend
0h – 5h	3 MHz and 40 dBm	1.4 MHz and 37 dBm
5h – 8h	5 MHz and 43 dBm	3 MHz and 40 dBm
8h – 12h	10 MHz and 46 dBm	5 MHz and 43 dBm
12h – 18h	20 MHz and 49 dBm	10 MHz and 46 dBm
18h – 24h	10 MHz and 46 dBm	10 MHz and 46 dBm

The table shows that during a working day the highest bandwidth is used from noon to 6 pm. The lowest bandwidth is used from midnight to 5 am. The bandwidth is increased from 3 MHz over 5 MHz between 5 am and 8 am and 10 MHz between 8 am and noon to 20 MHz and then decreased again to 10 MHz for the time period between 6 pm and midnight. The total transmission power is accordingly increased and decreased. It increases from 40 dBm over 43 dBm and 46 dBm to 49 dBm and is then decreased from 49 dBm to 46 dBm in the corresponding time slots.

For a weekend day the bandwidth is increased from 1.4 MHz over 3 and 5 MHz to 10 MHz. The highest bandwidth is used from noon to midnight. The total transmission power is accordingly increased such that the transmission power for each of the number of pilots is kept constant.

In another aspect the invention relates to a base station apparatus for a wireless telecommunication network. The base station apparatus comprises means for generating a number of pilot symbols in the base station. The number of generated pilots per time corresponds to a telecommunication bandwidth. The pilot symbols may for example be generated by a processor of the base station apparatus.

Means for transmitting the number of pilot symbols with a total transmission power provided by a power amplifier are also comprised by the base station apparatus.

The means for transmitting may for example be an antenna. The total transmission power is a sum of transmission powers of each of the number of transmitted pilot symbols.

- 5 The processor is adapted for adjusting the telecommunication bandwidth to a cell load. Thus, the processor may also be referred to as means for adjusting the telecommunication bandwidth. Further, the processor is adapted for adjusting the number of pilot symbols to the telecommunication bandwidth and the processor is further adapted for adjusting the total transmission power such that each transmission
10 power of each of the number of pilot symbols is constant.

- In yet another aspect the invention relates to a computer-readable storage medium. The computer-readable storage medium may for example be a digital storage medium such as a DVD, CD, hard disc, and/or memory card. The storage medium
15 comprises instructions that when executed by a base station apparatus according to embodiments of the invention cause the base station apparatus to perform a method according to embodiments of the invention. The method comprises generating a number of pilot symbols in the base station. The number of generated pilot symbols per time corresponds to a telecommunication bandwidth. The number of pilot
20 symbols is then transmitted with a total transmission power provided by a power amplifier. The total transmission power is a sum of transmission powers of each of the number of transmitted pilot symbols. Further, the instructions cause the base station apparatus to adjust the telecommunication bandwidth to a cell load and to adjust the number of pilot symbols to the telecommunication bandwidth. Further the
25 base station apparatus is caused to adjust the total transmission power such that each transmission power of each of the number of pilot symbols is constant.

Brief description of the drawings

- 30 In the following preferred embodiments of the invention will be described, by way of example only, and with reference to the drawings in which:

Fig. 1 is a block diagram of a base station apparatus according to embodiments of the invention; and

Fig. 2 is a flow diagram of a method according to embodiments of the invention.

5

Detailed description

Like numbered elements in these Figs. are either identical elements or perform the same function. Elements which have been discussed previously will not necessarily be discussed in later Figs. if the function is identical.

Fig. 1 is a block diagram of a base station apparatus 100. The base station 100 comprises a data storage 102 with instructions 104 stored in the data storage 102. Further, the base station 100 comprises a processor 106 and an antenna 108.

In operating, the processor 106 executes the instructions 104 stored in data storage 102. The instructions 104 cause the processor 106 to generate a number of pilot symbols. The number of generated pilot symbols per time corresponds to a telecommunication bandwidth. The processor is further adapted for transmitting the number of pilot symbols with a total transmission power provided by a power amplifier 110. The total transmission power is a sum of transmission powers of each of the number of transmitted pilot symbols. The processor adjusts the telecommunication bandwidth to a cell load. The cell load is an indicator for the telecommunication traffic in the cell served by the base station. The processor 106 adjusts the number of pilot symbols to the telecommunication bandwidth and the processor 106 controls the power amplifier such that the total transmission power is adjusted to keep the transmission power of each of the number of pilot symbols constant.

Fig. 2 is a flow diagram of a method according to embodiments of the invention.

In step S1 a number of pilot symbols is generated in the base station. The number of generated pilot symbols per time corresponds to a telecommunication bandwidth. In step S2 the number of pilot symbols is transmitted with a total transmission power provided by a power amplifier. The total transmission power is a sum of transmission powers of each of the number of transmission pilot symbols.

In step S3 the processor of the base station adjusts the telecommunication bandwidth to the cell load and in step S4 the number of pilot symbols is adjusted to the telecommunication bandwidth. Step S5 comprises adjusting the total transmission
5 power such that each transmission power each of the number of pilot symbols is constant.

List of Reference Numerals

100	Base station
102	Data storage
104	Instructions
106	Processor
108	Antenna
110	Power amplifier

C l a i m s

- 5 1. A method of reconfiguring a base station (100) of a wireless telecommunication network, wherein the method comprises the following steps:
- generating (S1) a number of pilot symbols in the base station, the number of generated pilot symbols per time corresponding to a telecommunication bandwidth;
 - 10 - transmitting (S2) the number of pilot symbols with a total transmission power provided by a power amplifier (110), the total transmission power being a sum of transmission powers of each of the number of transmitted pilot symbols;
 - adjusting (S3) the telecommunication bandwidth to a cell load;
 - 15 - adjusting (S4) the number of pilot symbols to the telecommunication bandwidth; and
 - adjusting (S5) the total transmission power such that each transmission power of each of the number of pilot symbols is constant.
- 20 2. Method according to claim 1, wherein the method comprises further the following step:
- increasing a supply voltage of the power amplifier when the total transmission power is increased, and decreasing the supply voltage of the power amplifier when the total transmission power is decreased.
- 25 3. Method according to claim 2, wherein the supply voltage defines a maximum total transmission power, wherein the supply voltage and the total transmission power define an operating point of the power amplifier, wherein the supply voltage and the maximum total transmission power define a maximum operating point, and wherein the supply voltage is increased or decreased
- 30 such that the operating point is below or equal to the maximum operating point.

4. Method according to claim 3, wherein the operating point is 0-60%, preferably 0-30%, even more preferably 0-20%, below the maximum operating point.
5. Method according to any one of the preceding claims, wherein a central network unit triggers adjusting the telecommunication bandwidth.
6. Method according to any one of the claims 1-4, wherein a unit within the base station triggers adjusting the telecommunication bandwidth.
7. Method according to any one of the claims 1-4, wherein a self optimization algorithm of the telecommunication network triggers adjusting the telecommunication bandwidth.
8. Method according to any one of the claims 1-4, wherein a self-optimization algorithm of the base station triggers adjusting the telecommunication bandwidth.
9. Method according to claim 7, wherein the base station transmits a signal to at least one neighbouring base station, the signal being indicative of adjusting the telecommunication bandwidth.
10. Method according to any one of the claims 1-4, wherein a time schedule triggers adjusting the telecommunication bandwidth.
11. Base station apparatus (100) for a wireless telecommunication network, the base station apparatus comprising:
 - means (106) for generating a number of pilot symbols, the number of generated pilot symbols per time corresponding to a telecommunication bandwidth;
 - means (108) for transmitting the number of pilot symbols with a total transmission power provided by a power amplifier (110), the total transmission power being a sum of transmission powers of each of the number of transmitted pilot symbols;

- means (106) for adjusting the telecommunication bandwidth to a cell load;
- means (106) for adjusting the number of pilot symbols to the telecommunication bandwidth; and
- 5 - means (106) for adjusting the total transmission power such that each transmission power of each of the number of pilot symbols is constant.

12. A computer-readable storage medium (102), the computer-readable storage medium comprising instructions that when executed by a base station apparatus (100) according to claim 11 cause the base station apparatus to perform a method of reconfiguring a base station, the method comprising:

- generating a number of pilot symbols in the base station, the number of generated pilot symbols per time corresponding to a telecommunication bandwidth;
- 15 - transmitting the number of pilot symbols with a total transmission power provided by a power amplifier, the total transmission power being a sum of transmission powers of each of the number of transmitted pilot symbols;
- adjusting the telecommunication bandwidth to a cell load;
- 20 - adjusting the number of pilot symbols to the telecommunication bandwidth; and
- adjusting the total transmission power such that each transmission power of each of the number of pilot symbols is constant.

Fig. 1

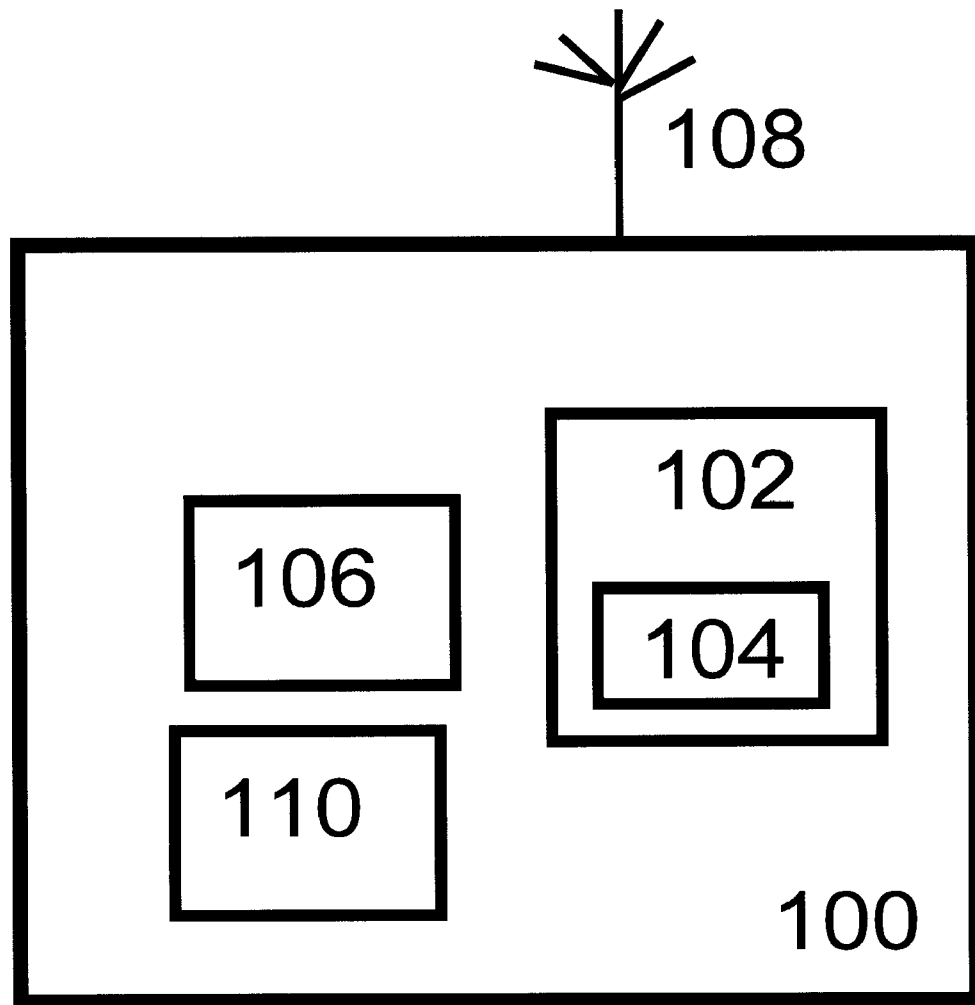
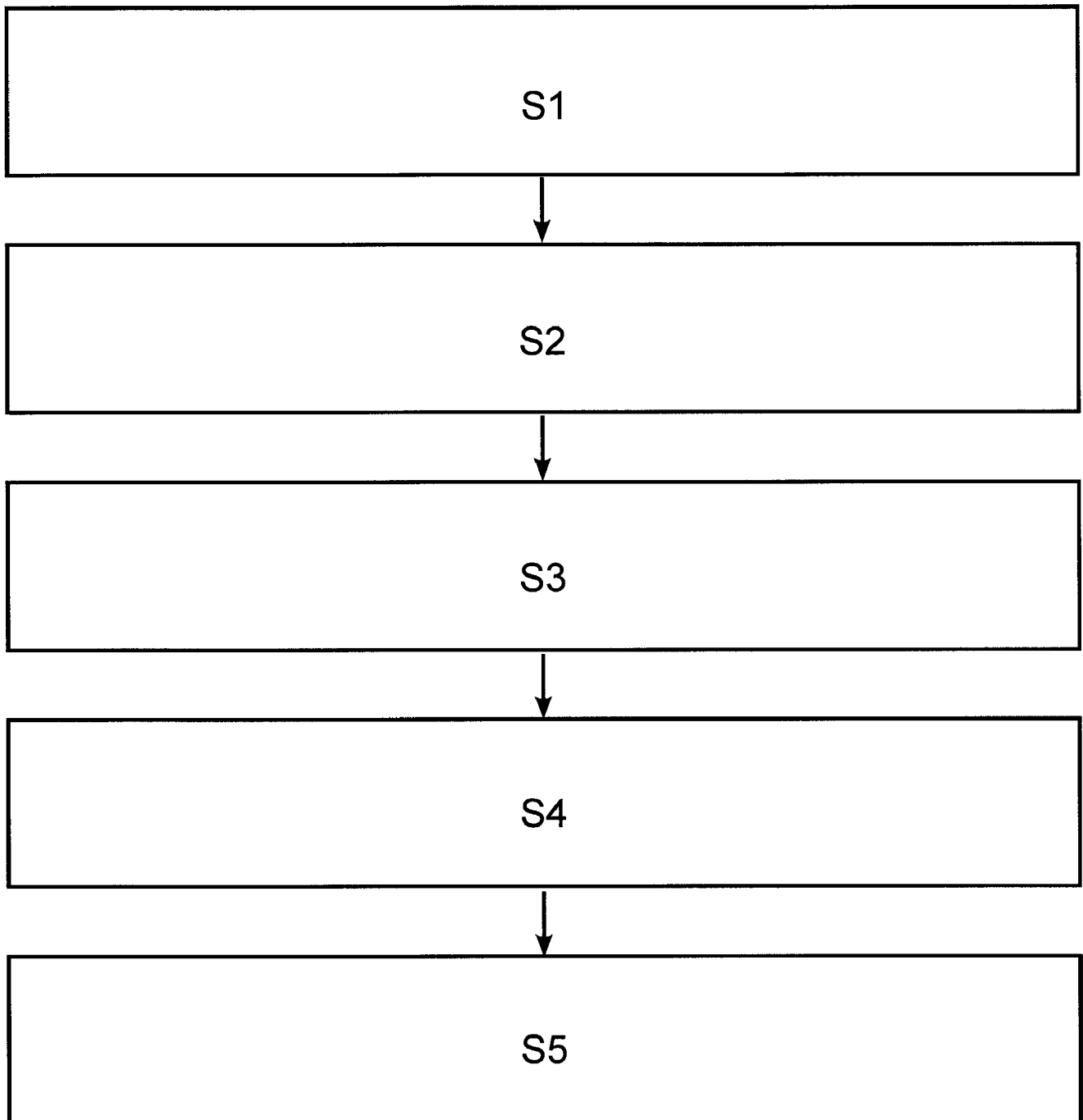


Fig. 2



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/062509

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W52/34
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2007/184869 A1 (KOO CHANGHOI [US] ET AL) 9 August 2007 (2007-08-09) page 1, paragraph 7 - paragraph 8 page 3, paragraph 29 - paragraph 33 figures 2,3 -----	1-12
A	EP 1 892 847 A1 (HUAWEI TECH CO LTD [CN]) 27 February 2008 (2008-02-27) page 2, paragraph 8 page 5, paragraph 38 - paragraph 41 figures 1,2 -----	1-12
A	WO 2009/058091 A2 (ERICSSON TELEFON AB L M [SE]; MUELLER WALTER [SE]) 7 May 2009 (2009-05-07) page 2, line 1 - line 10 page 4, line 14 - line 20 figure 8 -----	1-12



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

7 October 2011

Date of mailing of the international search report

17/10/2011

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Reville, Lenora

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2011/062509

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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