(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 240 334 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
06.10.2021 Bulletin 2021/40

(51) Int Cl.:
H04W 52/14 *(2009.01)* ***H04W 52/34*** *(2009.01)*
H04W 52/36 *(2009.01)*

(21) Application number: **17155113.8**

(22) Date of filing: **22.08.2013**

(54) **METHOD AND APPARATUS FOR CONTROLLING UPLINK POWER OF USER EQUIPMENT IN CARRIER AGGREGATION SCENARIO**

VERFAHREN UND VORRICHTUNG ZUR STEUERUNG DER UPLINK-LEISTUNG EINES BENUTZERGERÄTS IN EINEM TRÄGERAGGREGATIONSSZENARIO

PROCÉDÉ ET APPAREIL DE COMMANDE DE PUISSANCE DE LIAISON MONTANTE D'UN ÉQUIPEMENT D'UTILISATEUR DANS UN SCÉNARIO D'AGRÉGATION DE PORTEUSES

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **24.08.2012 CN 201210305269**

(43) Date of publication of application:
01.11.2017 Bulletin 2017/44

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
13830915.8 / 2 882 235

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Description

TECHNICAL FIELD

[0001] The present invention relates to communications technologies, and in particular, to a method and an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario.

BACKGROUND

[0002] In LTE-A (Long Term Evolution Advanced) R10 (Release 10), timing of multiple carriers makes reference to a timing advance (Timing Advance, TA for short) value of a primary cell (PCell), that is, multiple carriers correspond to one TA value. However, in LTE-AR11 (Release 11), different carriers allow different TA values. Carriers may be grouped into different timing advance groups (Timing Advance Group, TAG for short) according to different TA values. That is, TA values in one TAG are the same, and TA values in different TAGs are different.
Because TA values in different TAGs are different, for different carriers (that is, carriers in different TAGs), a case in which a portion of adjacent subframes overlap may occur, and a maximum overlap period is 30 us. Furthermore, in a short overlap period, total transmit power of a user equipment (User Equipment, UE for short) may exceed maximum transmit power of the UE, causing that power is limited or that interference is limited because an interference level is reached.

[0003] LG ELECTRONICS, "Simultaneous transmissions in multiple TA groups", 3GPP DRAFT; R1-120424 MULTIPLE TA_SIMULTANEOUS TX, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, (20120131), vol. RAN WG1, no. Dresden, Germany; 20120206 - 20120210, XP050562913, discusses the simultaneous transmission of multiple channels in multiple TAGs and the related issues on the UE maximum TXP limitation. The proposals in this paper are summarized as follows: Proposal 1: Simultaneous transmission of SRS and PUSCH/PUCCH through different TAGs is allowed in Rel-11. Proposal 2: Simultaneous transmission of PRACH in a SCell TAG and PUSCH/PUCCH/SRS through other TAG(s) is allowed in Rel-11. Proposal 3: Define TXP reduction rule for the case of maximum TXP limitation with simultaneous transmissions of PUSCH(s) and/or PUCCH in multiple TAGs, which guarantees constant TXP for the PUSCH/PUCCH transmissions. Proposal 4: Drop SRS when the total TXP for simultaneous transmission of SRS and other channels exceeds maximum TXP. Proposal 5: Reduce TXP of PUSCH/PUCCH when the total TXP for simultaneous transmission of PRACH and PUSCH/PUCCH exceeds maximum TXP.

SUMMARY

[0004] The present invention provides a method and an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario, which are used to mitigate a power limitation or an interference limitation caused by overlap of a portion of adjacent subframes when TA of different carriers is different.
The present invention is defined in the independent claims. Preferred embodiments are defined in the dependent claims.

[0005] Technical effects of the present invention are: acquiring first maximum transmit power corresponding to the first subframe and second maximum transmit power corresponding to the second subframe; and performing power control over transmit power of multiple carriers in an overlap region, so that total transmit power of the multiple carriers in the overlap region after the power control is lower than or equal to the first maximum transmit power or the second maximum transmit power, where, the first subframe and the second subframe are adjacent subframes, and the overlap region is a portion in which the first subframe and the second subframe overlap. Therefore, a power limitation or an interference limitation caused by overlap of a portion of adjacent subframes is mitigated effectively when TA of different carriers is different.

[0006] Further, technical effects of the present invention are: acquiring first maximum transmit power corresponding to the first subframe and second maximum transmit power corresponding to the second subframe; and using a minimum value of the first maximum transmit power and the second maximum transmit power as first configured maximum transmit power, and performing power control over transmit power of multiple carriers in an overlap region according to the first configured maximum transmit power, so that total transmit power of the multiple carriers in the overlap region after the power control is lower than or equal to the minimum value of the first maximum transmit power and the second maximum transmit power, where, the first subframe and the second subframe are adjacent subframes, and the overlap region is a portion in which the first subframe and the second subframe overlap. Therefore, a power limitation or an interference limitation caused by overlap of a portion of adjacent subframes is mitigated in a single attempt when TA of different carriers is different.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

FIG. 1 is a flowchart of an embodiment of a method for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention;
FIG. 2 is a schematic principle diagram of multiple timing advance (Multiple Timing Advance, MTA for short) according to the present invention;
FIG. 3 is another schematic principle diagram of MTA according to the present invention;
FIG. 4 is yet another schematic principle diagram of MTA according to the present invention;
FIG. 5 is a schematic structural diagram of an embodiment of an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention;
FIG. 6 is a schematic structural diagram of another embodiment of an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention;
FIG. 7 is a schematic structural diagram of yet another embodiment of an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention; and
FIG. 8 is a schematic structural diagram of yet another embodiment of an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention.

DESCRIPTION OF EMBODIMENTS

[0008] FIG. 1 is a flowchart of an embodiment of a method for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention. As shown in FIG. 1, the method in this embodiment includes:

Step 101: Separately acquire first maximum transmit power of the user equipment corresponding to a first subframe and second maximum transmit power of the user equipment corresponding to a second subframe.
Step 102: When the first maximum transmit power and the second maximum transmit power are different, perform power control over transmit power of multiple carriers in an overlap region, so that total transmit power of the multiple carriers in the overlap region after the power control is lower than or equal to the first maximum transmit power or the second maximum transmit power.

[0009] The first subframe and the second subframe are adjacent subframes, and the overlap region is a portion in which the first subframe and the second subframe overlap due to a difference in timing advance values of the multiple carriers.

[0010] In this embodiment, the first maximum transmit power corresponding to the first subframe and the second maximum transmit power corresponding to the second subframe are separately acquired; and when the first maximum transmit power and the second maximum transmit power are different, power control is performed for the transmit power of the multiple carriers in the overlap region, so that the total transmit power of the multiple carriers in the overlap region after the power control is lower than or equal to the first maximum transmit power or the second maximum transmit power, where the first subframe and the second subframe are adjacent subframes. The overlap region is the portion in which the first subframe and the second subframe overlap. Therefore, a power limitation or an interference limitation caused by overlap of a portion of adjacent subframes is mitigated effectively when TA of different carriers is different.

[0011] Further, in another embodiment of the present invention, on a basis of the embodiment shown in FIG. 1, the performing power control over transmit power of multiple carriers in an overlap region in step 102 includes:
using any value or a minimum value of the first maximum transmit power and the second maximum transmit power as first configured maximum transmit power, and performing power control over the transmit power of the multiple carriers in the overlap region according to the first configured maximum transmit power.

[0012] Preferably, the performing power control over the transmit power of the multiple carriers in the overlap region according to the first configured maximum transmit power may be specifically implemented in the following manners:

first manner: separately performing, according to the first configured maximum transmit power, power control over transmit power of the first subframe located in the overlap region and transmit power of the second subframe located in the overlap region;
second manner: separately performing, according to the first configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe and power of a symbol forming the overlap region in the second subframe; and
third manner: performing power control over transmit power of samples in the overlap region according to the first configured maximum transmit power.

[0013] The sample may be specifically an FFT sample.

[0014] Further, in yet another embodiment of the present invention, on the basis of the embodiment shown in FIG. 1, the method may further include:

acquiring an upper limit $P_{CMAX\_H\_CA\_1}$ of the first maximum transmit power by using a formula $P_{CMAX\_H\_CA\_1} = \min\{10\log_{10}\sum P_{EMAX.C}, P_{PowerClass}\}$ and according to maximum transmit power $P_{EMAX.1}$, of a first carrier delivered by a network in the first subframe located in the overlap region and maximum transmit power $P_{EMAX.2}$ of a second carrier delivered by the network in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$ or the maximum transmit power $P_{EMAX.2}$ is not allowed;

acquiring a lower limit $P_{CMAX\_L\_CA\_1}$ of the first maximum transmit power according to the $P_{EMAX.1}$ and the $P_{EMAX.2}$ by using a formula $P_{CMAX\_L\_CA\_1} = \min\{10\log_{10}\sum P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max(MPR+A\text{-}MPR, P\text{-}MPR) - \Delta T_c\}$; and

acquiring first reference transmit power P_{CMAX_O1} according to the $P_{CMAX\_H\_CA\_1}$ and the $P_{CMAX\_L\_CA\_1}$, so that the P_{CMAX_O1} satisfies $P_{CMAX\_L\_CA\_1} \leq P_{CMAX\_O1} \leq P_{CMAX\_H\_CA\_1}$, where

the performing power control over transmit power of multiple carriers in an overlap region in step 102 includes:

performing power control over transmit power of the first carrier and the second carrier in the overlap region by using the first reference transmit power.

[0015] The first carrier bearer is located in a first timing advance group; the second carrier is located in a second timing advance group; C in the $P_{EMAX.C}$ is {1,2}; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the *MPR* , the *A-MPR,* and the *P-MPR* all indicate maximum power back-off; and $\Delta T_c = 1.5dB$ or $\Delta T_c = 0dB$. For this embodiment of the present invention, timing advance values of multiple carriers in a same timing advance group are the same, but timing advance values of carriers in different timing advance groups are different.

[0016] In this embodiment, FIG. 2 is a schematic principle diagram of MTA according to the present invention. In this embodiment, the technical solution of this embodiment is described in detail by using two timing advance groups as an example: A carrier in the first timing advance group is a first carrier, a carrier in the second timing advance group is a second carrier, and a timing advance value of the first carrier and a timing advance value of the second carrier are different. Because the timing advance value of the first carrier and the timing advance value of the second carrier are different, as shown in FIG. 2, a first subframe of the first carrier and a second subframe of the second carrier overlap, and the overlap region may be an overlap portion (Overlap period) in FIG. 2.

[0017] In addition, the first reference transmit power P_{CMAX_O1} is calculated by assuming that subframes forming the overlap region (Overlap period) of the first carrier and the second carrier that overlap with each other are aligned, that is, the first subframe (subframe 1) of the first carrier and the second subframe (subframe 2) of the second carrier overlap. The first carrier is located in the first timing advance group (TAG 1), and the second carrier is located in the second timing advance group (TAG 2).

[0018] Optionally, a specific implementation manner of performing power control over transmit power of the first carrier and the second carrier in the overlap region by using the first reference transmit power in step 102 is:

using any value or a minimum value of the first maximum transmit power and the first reference transmit power as second configured maximum transmit power, and performing, according to the second configured maximum transmit power, power control over power of the first subframe located in the overlap region in the first carrier; and

using any value or a minimum value of the second maximum transmit power and the first reference transmit power as third configured maximum transmit power, and performing, according to the third configured maximum transmit power, power control over power of the second subframe located in the overlap region in the second carrier.

[0019] Further optionally, another specific implementation manner of performing power control over transmit power of the first carrier and the second carrier in the overlap region by using the first reference transmit power in step 102 is:

using any value or a minimum value of the first maximum transmit power and the first reference transmit power as second configured maximum transmit power, and performing, according to the second configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the first carrier; and

using any value or a minimum value of the second maximum transmit power and the first reference transmit power as third configured maximum transmit power, and performing, according to the third configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the second carrier.

[0020] Further optionally, yet another specific implementation manner of performing power control over transmit power of the first carrier and the second carrier in the overlap region by using the first reference transmit power in step 102 is: performing power control over transmit power of samples in the overlap region according to the first reference transmit power.

[0021] Further, in another embodiment of the present invention, on the basis of the embodiment shown in FIG. 1, the method may further include:

acquiring an upper limit $P_{CMAX\_H\_CA\_2}$ of the second maximum transmit power by using a formula $P_{CMAX\_H\_CA\_2} = \min\{10\log_{10} \sum P_{EMAX.C}, P_{PowerClass}\}$ and according to maximum transmit power $P_{EMAX.1}$ of a first carrier delivered by a network in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.2}$ of a second carrier delivered by the network in the first subframe located in the overlap region, and maximum transmit power $P_{EMAX.3}$ of a third carrier delivered by the network in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.2}$, or the maximum transmit power $P_{EMAX.3}$ is not allowed;

acquiring an upper limit $P_{CMAX\_H\_CA\_3}$ of third maximum transmit power by using a formula $P_{CMAX\_H\_CA\_3} = \min\{10\log_{10} \sum P_{EMAX.N}, P_{PowerClass}\}$ and according to the maximum transmit power $P_{EMAX.1}$ of the first carrier in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.4}$ of the second carrier in the second subframe located in the overlap region, and the maximum transmit power $P_{EMAX.3}$ of the third carrier delivered by the network in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.4}$, or the maximum transmit power $P_{EMAX.3}$ is not allowed;

acquiring a lower limit $P_{CMAX\_L\_CA\_2}$ of the second maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.2}$, and the $P_{EMAX.3}$ by using a formula $P_{CMAX\_L\_CA\_2}=\min\{10\log_{10}\sum P_{EMAX.C}-\Delta T_c, P_{PowerClass}-\max(MPR+A\text{-}MPR, P\text{-}MPR)-\Delta T_c\}$

acquiring a lower limit $P_{CMAX\_L\_CA\_3}$ of the third maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.4}$, and the $P_{EMAX.3}$ by using a formula $P_{CMAX\_L\_CA\_3}= \min\{10\log_{10} \sum P_{EMAX.N} -\Delta T_N, P_{PowerClass} -\max(MPR+A\text{-}MPR, P\text{-}MPR)-\Delta T_N\}$;

acquiring second reference transmit power P_{CMAX_O2} according to the $P_{CMAX\_H\_CA\_2}$ and the $P_{CMAX\_L\_CA\_2}$, so that the P_{CMAX_O2} satisfies $P_{CMAX\_L\_CA\_2} \le P_{CMAX\_O2} \le P_{CMAX\_H\_CA\_2}$; and

acquiring third reference transmit power P_{CMAX_O3} according to the $P_{CMAX\_H\_CA\_3}$ and the $P_{CMAX\_L\_CA\_3}$, so that the P_{CMAX_O3} satisfies $P_{CMAX\_L\_CA\_3} \le P_{CMAX\_O3} \le P_{CMAX\_H\_CA\_3}$, where

the performing power control over transmit power of multiple carriers in an overlap region in step 102 includes: performing power control over transmit power of the first carrier, the second carrier, and the third carrier in the overlap region by using the second reference transmit power and the third reference transmit power.

[0022] The first carrier bearer is located in a first timing advance group; the second carrier is located in a second timing advance group; the third carrier is located in a third timing advance group; C in the $P_{EMAX.C}$ is {1,2,3}; *N* in the $P_{EMAX.N}$ is {1,4,3}; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the *MPR* , the *A-MPR,* and the *P-MPR* all indicate maximum power back-off; and $\Delta T_c=1.5dB$ or $\Delta T_c=0dB$. For this embodiment of the present invention, timing advance values of multiple carriers in a same timing advance group are the same, but timing advance values of carriers in different timing advance groups are different.

[0023] FIG. 3 is another schematic principle diagram of MTA according to the present invention. In this embodiment, the technical solution of this embodiment is described in detail by using three timing advance groups as an example: A carrier in the first timing advance group (TAG 1) is a first carrier; a carrier in the second timing advance group (TAG 2) is a second carrier; a carrier in the third timing advance group (TAG 3) is a third carrier; and a timing advance value of the first carrier, a timing advance value of the second carrier, and a timing advance value of the third carrier are different. Because the timing advance value of the first carrier, the timing advance value of the second carrier, and the timing advance value of the third carrier are different, as shown in FIG. 3, the overlap region may be an overlap region (Overlap period) in FIG. 3.

[0024] In addition, in this embodiment, maximum transmit power allowed when a first subframe of the first carrier, a first subframe of the second carrier, and a second subframe of the third carrier overlap, is different from maximum transmit power allowed when the first subframe of the first carrier, a second subframe of the second carrier, and the second subframe of the third carrier overlap. Therefore, there are two different reference transmit powers, and the two reference transmit powers are second reference transmit power P_{CMAX_O2} and third reference transmit power P_{CMAX_O3}, respectively.

[0025] It should be noted that when the maximum transmit power allowed when the first subframe of the first carrier, the first subframe of the second carrier, and the second subframe of the third carrier overlap, is the same as the maximum transmit power allowed when the first subframe of the first carrier, the second subframe of the second carrier, and the second subframe of the third carrier overlap, P_{CMAX_O2} is equal to P_{CMAX_O3}.

[0026] Optionally, a specific implementation manner of performing power control over transmit power of the first carrier, the second carrier, and the third carrier in the overlap region by using the second reference transmit power and the third reference transmit power in step 102 is:

using any value or a minimum value of the first maximum transmit power, the second reference transmit power, and the third reference transmit power as fourth configured maximum transmit power, and performing, according to the fourth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the first carrier;
using any value or a minimum value of the first maximum transmit power and the second reference transmit power as fifth configured maximum transmit power, and performing, according to the fifth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the second carrier;
using any value or a minimum value of the second maximum transmit power and the third reference transmit power as sixth configured maximum transmit power, and performing, according to the sixth configured maximum transmit power, power control over power of the second subframe located in the overlap region in the second carrier; and
using any value or a minimum value of the second maximum transmit power, the second reference transmit power, and the third reference transmit power as seventh configured maximum transmit power, and performing, according to the seventh configured maximum transmit power, power control over power of the second subframe located in the overlap region in the third carrier.

[0027] Further optionally, another specific implementation manner of performing power control over transmit power of the first carrier, the second carrier, and the third carrier in the overlap region by using the second reference transmit power and the third reference transmit power in step 102 is:

using any value or a minimum value of the first maximum transmit power, the second reference transmit power, and the third reference transmit power as fourth configured maximum transmit power, and performing, according to the fourth configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the first carrier;
using any value or a minimum value of the first maximum transmit power and the second reference transmit power as fifth configured maximum transmit power, and performing, according to the fifth configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the second carrier;
using any value or a minimum value of the second maximum transmit power and the third reference transmit power as sixth configured maximum transmit power, and performing, according to the sixth configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the second carrier; and
using any value or a minimum value of the second maximum transmit power, the second reference transmit power, and the third reference transmit power as seventh configured maximum transmit power, and performing, according to the seventh configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the third carrier.

[0028] Further optionally, yet another specific implementation manner of performing power control over transmit power of the first carrier, the second carrier, and the third carrier in the overlap region by using the second reference transmit power and the third reference transmit power in step 102 is:

separately performing, according to the second reference transmit power, power control over transmit power of samples in a first portion in the overlap region in the first subframe in the first carrier, transmit power of samples in the overlap region in the first subframe in the second carrier, and transmit power of samples in a first portion in the overlap region in the second subframe in the third carrier; and
separately performing, according to the third reference transmit power, power control over transmit power of samples in a second portion in the overlap region in the first subframe in the first carrier, transmit power of samples in the overlap region in the second subframe in the second carrier, and transmit power of samples in a second portion in the overlap region in the second subframe in the third carrier, where
the first portion is a portion in which the first subframe of the first carrier, the first subframe of the second carrier, and the second subframe of the third carrier overlap, and the second portion is a portion in which the first subframe of the first carrier, the second subframe of the second carrier, and the second subframe of the third carrier overlap.

[0029] Further optionally, still another specific implementation manner of performing power control over transmit power of the first carrier, the second carrier, and the third carrier in the overlap region by using the second reference transmit power and the third reference transmit power in step 102 is:

using any value or a minimum value of the second reference transmit power and the third reference transmit power as eighth configured maximum transmit power, and separately performing, according to the eighth configured maximum transmit power, power control over transmit power of samples in the overlap region in the first subframe in the first carrier and transmit power of samples in the overlap region in the second subframe in the third carrier; performing, according to the second reference transmit power, power control over transmit power of samples in the overlap region in the first subframe in the second carrier; and performing, according to the third reference transmit power, power control over transmit power of samples in the overlap region in the second subframe in the second carrier.

[0030] Further, in another embodiment of the present invention, on the basis of the embodiment shown in FIG. 1, the method may further include:

acquiring an upper limit $P_{CMAX\_H\_CA\_4}$ of fourth maximum transmit power by using a formula $P_{CMAX\_H\_CA\_4} = \min\{10\log_{10} \sum P_{EMAX.C}, P_{PowerClass}\}$ and according to maximum transmit power $P_{EMAX.1}$ of a first carrier delivered by a network in a first subframe located in the overlap region, maximum transmit power $P_{EMAX.2}$ of a second carrier delivered by the network in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.3}$ of a third carrier delivered by the network in the first subframe located in the overlap region, and maximum transmit power $P_{EMAX.4}$ of a fourth carrier delivered by the network in a second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.2}$, the maximum transmit power $P_{EMAX.3}$, or the maximum transmit power $P_{EMAX.4}$ is not allowed;

acquiring an upper limit $P_{CMAX\_H\_CA\_4}$ of fifth maximum transmit power by using a formula $P_{CMAX\_H\_CA\_5} = \min\{10\log_{10} \sum P_{EMAX.N}, P_{PowerClass}\}$ and according to the maximum transmit power $P_{EMAX.1}$ of the first carrier in the first subframe located in the overlap region, the maximum transmit power $P_{EMAX.2}$ of the second carrier in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.5}$ of the third carrier in the second subframe located in the overlap region, and the maximum transmit power $P_{EMAX.4}$ of the fourth carrier in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.2}$, the maximum transmit power $P_{EMAX.5}$, or the maximum transmit power $P_{EMAX.4}$ is not allowed;

acquiring an upper limit $P_{CMAX\_H\_CA\_6}$ of sixth maximum transmit power by using a formula $P_{CMAX\_H\_CA\_6} = \min\{10\log_{10} \sum P_{EMAX.N}, P_{PowerClass}\}$ and according to the maximum transmit power $P_{EMAX.1}$ of the first carrier in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.6}$ of the second carrier in the second subframe located in the overlap region, the maximum transmit power $P_{EMAX.5}$ of the third carrier in the second subframe located in the overlap region, and the maximum transmit power $P_{EMAX.4}$ of the fourth carrier in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.6}$, the maximum transmit power $P_{EMAX.5}$, or the maximum transmit power $P_{EMAX.4}$ is not allowed;

acquiring a lower limit $P_{CMAX\_L\_CA\_4}$ of the fourth maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.2}$, the $P_{EMAX.3}$, and the $P_{EMAX.4}$ by using a formula $P_{CMAX\_L\_CA\_4} = \min\{10\log_{10} \sum P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max(MPR+A\text{-}MPR, P\text{-}MPR) - \Delta T_c\}$

acquiring a lower limit $P_{CMAX\_L\_CA\_5}$ of the fifth maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.2}$, the $P_{EMAX.5}$, and the $P_{EMAX.4}$ by using a formula $P_{CMAX\_L\_CA\_5} = \min\{10\log_{10} \sum P_{EMAX.N} - \Delta T_N, P_{PowerClass} - \max(MPR+A\text{-}MPR, P\text{-}MPR) - \Delta T_N\}$

acquiring a lower limit $P_{CMAX\_L\_CA\_6}$ of the sixth maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.6}$, the $P_{EMAX.5}$, and the $P_{EMAX.4}$ by using a formula $P_{CMAX\_L\_CA\_6} = \min\{10\log_{10} \sum P_{EMAX.M} - \Delta T_N, P_{PowerClass} - \max(MPR+A\text{-}MPR, P\text{-}MPR) - \Delta T_N\}$

acquiring fourth reference transmit power P_{CMAX_O4} according to the $P_{CMAX\_H\_CA\_4}$ and the $P_{CMAX\_L\_CA\_4}$, so that the P_{CMAX_O4} satisfies $P_{CMAX\_L\_CA\_4} \le P_{CMAX\_O4} \le P_{CMAX\_H\_CA\_4}$;

acquiring fifth reference transmit power P_{CMAX_O5} according to the $P_{CMAX\_H\_CA\_5}$ and the $P_{CMAX\_L\_CA\_5}$, so that the P_{CMAX_O5} satisfies $P_{CMAX\_L\_CA\_5} \le P_{CMAX\_O5} \le P_{CMAX\_H\_CA\_5}$; and

acquiring fifth reference transmit power P_{CMAX_O6} according to the $P_{CMAX\_H\_CA\_6}$ and the $P_{CMAX\_L\_CA\_6}$, so that the P_{CMAX_O5} satisfies $P_{CMAX\_L\_CA\_6} \le P_{CMAX\_O6} \le P_{CMAX\_H\_CA\_6}$, where

the performing power control over transmit power of multiple carriers in an overlap region in step 102 includes: performing power control over transmit power of the first carrier, the second carrier, the third carrier, and the fourth carrier in the overlap region by using the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power.

[0031] The first carrier bearer is located in a first timing advance group; the second carrier is located in a second timing advance group; the third carrier is located in a third timing advance group; the fourth carrier is located in a fourth timing advance group; C in the $P_{EMAX.C}$ is {1,2,3,4} ; N in the $P_{EMAX.N}$ is {1,2,5,4} ; M in the $P_{EMAX.M}$ is {1,6,5,4}; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the MPR , the A-MPR, and the $P\text{-}MPR$ all indicate maximum power back-off; and $\Delta T_c = 1.5dB$ or $\Delta T_c = 0dB$. For this embodiment of the present invention, timing advance values of multiple carriers in a same timing advance group are the same, but timing advance values of carriers in different timing advance groups are different.

[0032] FIG. 4 is yet another schematic principle diagram of MTA according to the present invention. In this embodiment, the technical solution of this embodiment is described in detail by using four timing advance groups as an example: A carrier in the first timing advance group (TAG 1) is a first carrier, a carrier in the second timing advance group (TAG 2) is a second carrier, a carrier in the third timing advance group (TAG 3) is a third carrier, and a carrier in the fourth timing advance group (TAG 4) is a fourth carrier. A timing advance value of the first carrier, a timing advance value of the second carrier, a timing advance value of the third carrier, and a timing advance value of the fourth carrier are different. Therefore, as shown in FIG. 4, the overlap region may be an overlap region (Overlap period) in FIG. 4.

[0033] In addition, in this embodiment, maximum transmit power allowed when a first subframe of the first carrier, a first subframe of the second carrier, a first subframe of the third carrier, and a second subframe of the fourth carrier overlap, is different from maximum transmit power allowed when the first subframe of the first carrier, the first subframe of the second carrier, a second subframe of the third carrier, and the second subframe of the fourth carrier overlap, and maximum transmit power allowed when the first subframe of the first carrier, a second subframe of the second carrier, the second subframe of the third carrier, and the second subframe of the fourth carrier overlap. Therefore, there are three different reference transmit powers, and the three reference transmit powers are fourth reference transmit power P_{CMAX_O4}, fifth reference transmit power P_{CMAX_O5}, and sixth reference transmit power P_{CMAX_O6}, respectively.

[0034] It should be noted that: when any two or all three of the maximum transmit power allowed when the first subframe of the first carrier, the first subframe of the second carrier, the first subframe of the third carrier, and the second subframe of the fourth carrier overlap; the maximum transmit power allowed when the first subframe of the first carrier, the first subframe of the second carrier, the second subframe of the third carrier, and the second subframe of the fourth carrier overlap; and the maximum transmit power allowed when the first subframe of the first carrier, the second subframe of the second carrier, the second subframe of the third carrier, and the second subframe of the fourth carrier overlap, are equal, reference transmit power values corresponding to any two equal maximum transmit power values are equal or three reference transmit power values are equal.

[0035] Optionally, a specific implementation manner of performing power control over transmit power of the first carrier, the second carrier, the third carrier, and the fourth carrier in the overlap region by using the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power in step 102 is:

using any value or a minimum value of the first maximum transmit power, the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power as ninth configured maximum transmit power, and performing, according to the ninth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the first carrier;

using any value or a minimum value of the first maximum transmit power, the fourth reference transmit power, and the fifth reference transmit power as tenth configured maximum transmit power, and performing, according to the tenth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the second carrier;

using any value or a minimum value of the second maximum transmit power and the sixth reference transmit power as eleventh configured maximum transmit power, and performing, according to the eleventh configured maximum transmit power, power control over power of the second subframe located in the overlap region in the second carrier;

using any value or a minimum value of the first maximum transmit power and the fourth reference transmit power as twelfth configured maximum transmit power, and performing, according to the twelfth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the third carrier;

using any value or a minimum value of the second maximum transmit power, the fifth reference transmit power, and the sixth reference transmit power as thirteenth configured maximum transmit power, and performing, according to the thirteenth configured maximum transmit power, power control over power of the second subframe located in the overlap region in the third carrier; and

using any value or the minimum value of the first maximum transmit power, the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power as fourteenth configured maximum transmit power, and performing, according to the fourteenth configured maximum transmit power, power control over power of the second subframe located in the overlap region in the fourth carrier.

[0036] Further optionally, another specific implementation manner of performing power control over transmit power of the first carrier, the second carrier, the third carrier, and the fourth carrier in the overlap region by using the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power in step 102 is:

using any value or a minimum value of the first maximum transmit power, the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power as ninth configured maximum transmit power, and performing, according to the ninth configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the first carrier;

using any value or a minimum value of the first maximum transmit power, the fourth reference transmit power, and the fifth reference transmit power as tenth configured maximum transmit power, and performing, according to the tenth configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the second carrier;

using any value or a minimum value of the second maximum transmit power and the sixth reference transmit power as eleventh configured maximum transmit power, and performing, according to the eleventh configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the second carrier;

using any value or a minimum value of the first maximum transmit power and the fourth reference transmit power as twelfth configured maximum transmit power, and performing, according to the twelfth configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the third carrier;

using any value or a minimum value of the second maximum transmit power, the fifth reference transmit power, and the sixth reference transmit power as thirteenth configured maximum transmit power, and performing, according to the thirteenth configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the third carrier; and

using any value or the minimum value of the first maximum transmit power, the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power as fourteenth configured maximum transmit power, and performing, according to the fourteenth configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the fourth carrier.

[0037] Further optionally, yet another specific implementation manner of performing power control over transmit power of the first carrier, the second carrier, the third carrier, and the fourth carrier in the overlap region by using the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power in step 102 is:

separately performing, according to the fourth reference transmit power, power control over transmit power of samples in a first portion in the overlap region in the first subframe in the first carrier, transmit power of samples in a first portion in the overlap region in the first subframe in the second carrier, transmit power of samples in the overlap region in the first subframe in the third carrier, and transmit power of samples in a first portion in the overlap region in the second subframe in the fourth carrier;

separately performing, according to the fifth reference transmit power, power control over transmit power of samples in a second portion in the overlap region in the first subframe in the first carrier, transmit power of samples in a second portion in the overlap region in the first subframe in the second carrier, transmit power of samples in a first portion in the overlap region in the second subframe in the third carrier, and transmit power of samples in a second portion in the overlap region in the second subframe in the fourth carrier; and

separately performing, according to the sixth reference transmit power, power control over transmit power of samples in a third portion in the overlap region in the first subframe in the first carrier, transmit power of samples in the overlap region in the second subframe in the second carrier, transmit power of samples in a second portion in the overlap region in the second subframe in the third carrier, and transmit power of samples in a third portion in the overlap region in the second subframe in the fourth carrier, where

the first portion is a portion in which the first subframe of the first carrier, the first subframe of the second carrier, the first subframe of the third carrier, and the second subframe of the fourth carrier overlap; the second portion is a portion in which the first subframe of the first carrier, the first subframe of the second carrier, the second subframe of the third carrier, and the second subframe of the fourth carrier overlap; and the third portion is a portion in which the first subframe of the first carrier, the second subframe of the second carrier, the second subframe of the third carrier, and the second subframe of the fourth carrier overlap.

[0038] Further optionally, still another specific implementation manner of performing power control over transmit power of the first carrier, the second carrier, the third carrier, and the fourth carrier in the overlap region by using the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power in step 102 is:

using any value or a minimum value of the fourth reference transmit power, the fifth reference transmit power, and the third reference transmit power as fifteenth configured maximum transmit power, and separately performing, according to the fifteenth configured maximum transmit power, power control over transmit power of samples in the overlap region in the first subframe in the first carrier and transmit power of samples in the overlap region in the second subframe in the fourth carrier;

using any value or a minimum value of the fourth reference transmit power and the fifth reference transmit power as sixteenth configured maximum transmit power, and performing power control over transmit power of samples in the overlap region in the first subframe in the second carrier according to the sixteenth configured maximum transmit power;

performing power control over transmit power of samples in the overlap region in the second subframe in the second carrier according to the sixth reference transmit power;

performing power control over transmit power of samples in the overlap region in the first subframe in the third carrier according to the fourth reference transmit power; and

using any value or a minimum value of the fifth reference transmit power and the sixth reference transmit power as seventeenth configured maximum transmit power, and performing power control over transmit power of samples in the overlap region in the second subframe in the third carrier according to the seventeenth configured maximum transmit power.

[0039] FIG. 5 is a schematic structural diagram of an embodiment of an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention. As shown in FIG. 5, the apparatus of this embodiment includes: an acquiring module 11 and a power control module 12. The acquiring module 11 is configured to separately acquire first maximum transmit power of the user equipment corresponding to a first subframe and second maximum transmit power of the user equipment corresponding to a second subframe; and the power control module 12 is configured to perform power control over transmit power of multiple carriers in an overlap region when the first maximum transmit power acquired by the acquiring module 11 and the second maximum transmit power acquired by the acquiring module 11 are different, so that total transmit power of the multiple carriers in the overlap region after the power control is lower than or equal to the first maximum transmit power or the second maximum transmit power.

[0040] The first subframe and the second subframe are adjacent subframes, and the overlap region is a portion in which the first subframe and the second subframe overlap due to a difference in timing advance values of the multiple carriers.

[0041] The apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario in this embodiment may execute the technical solution of the method embodiment shown in FIG. 1. Implementation principles of the apparatus and the method are similar, and are not further described herein.

[0042] In this embodiment, the first maximum transmit power corresponding to the first subframe and the second maximum transmit power corresponding to the second subframe are separately acquired; and when the first maximum transmit power and the second maximum transmit power are different, power control is performed for transmit power of the multiple carriers in the overlap region, so that total transmit power of the multiple carriers in the overlap region after the power control is lower than or equal to the first maximum transmit power or the second maximum transmit power, where the first subframe and the second subframe are adjacent subframes, and the overlap region is a portion in which the first subframe and the second subframe overlap. Therefore, a power limitation or an interference limitation caused by overlap of a portion of adjacent subframes is mitigated effectively when TA of different carriers is different.

[0043] FIG. 6 is a schematic structural diagram of another embodiment of an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention. On the basis of the embodiment shown in FIG. 5, as shown in FIG. 6, the power control module 12 includes: a configuring unit 121 and a power control unit 122. The configuring unit 121 is configured to use any value or a minimum value of the first maximum transmit power and the second maximum transmit power as first configured maximum transmit power when the first maximum transmit power and the second maximum transmit power are different; and the power control unit 122 is configured to perform power control over transmit power of the multiple carriers in the overlap region according to the first configured maximum transmit power configured by the configuring unit 121.

[0044] Optionally, the power control unit 122 is specifically configured to separately perform, according to the first configured maximum transmit power, power control over transmit power of the first subframe located in the overlap region and transmit power of the second subframe located in the overlap region; or

the power control unit 122 is specifically configured to separately perform, according to the first configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe and power of a symbol forming the overlap region in the second subframe; or

the power control unit 122 is specifically configured to perform power control over transmit power of samples in the overlap region according to the first configured maximum transmit power.

[0045] FIG. 7 is a schematic structural diagram of yet another embodiment of an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention. On the basis of the embodiment shown in FIG. 5, as shown in FIG. 7, the apparatus may further include: an upper limit calculating module 13 and a lower limit calculating module 14. The upper limit calculating module 13 is configured to acquire an upper limit $P_{CMAX\_H\_CA\_1}$ of the first maximum transmit power by using a formula $P_{CMAX\_H\_CA\_1} = \min\{10\log_{10} \sum P_{EMAX.C}, P_{PowerClass}\}$ and according to maximum transmit power $P_{EMAX.1}$ of a first carrier delivered by a network in the first subframe located in the overlap region, and maximum transmit power $P_{EMAX.2}$ of a second carrier delivered by the network in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$ or the maximum transmit power $P_{EMAX.2}$ is not allowed; the lower limit calculating module 14 is configured to acquire a lower limit $P_{CMAX\_L\_CA\_1}$ of the first maximum transmit power according to the $P_{EMAX.1}$ and the $P_{EMAX.2}$ by using a formula $P_{CMAX\_L\_CA\_1}=\min\{10\log_{10}\Sigma P_{EMAX.C}-\Delta T_c, P_{PowerClass}-\max(MPR+A\text{-}MPR, P\text{-}MPR)-\Delta T_c\}$

the acquiring module 11 is further configured to acquire first reference transmit power P_{CMAX_O1} according to the $P_{CMAX\_H\_CA\_1}$ acquired by the upper limit calculating module 13 and the $P_{CMAX\_L\_CA\_1}$ acquired by the lower limit calculating module 14, so that the P_{CMAX_O1} satisfies $P_{CMAX\_L\_CA\_1} \leq P_{CMAX\_O1} \leq P_{CMAX\_H\_CA\_1}$; and the power control module 12 is specifically configured to perform power control over transmit power of the first carrier and the second carrier in the overlap region by using the first reference transmit power.

[0046] The first carrier is located in a first timing advance group; the second carrier is located in a second timing advance group; timing advance values of the first timing advance group and the second timing advance group are different; C in the $P_{EMAX.C}$ is {1,2}; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the *MPR* , the *A-MPR,* and the *P-MPR* all indicate maximum power back-off; and $\Delta T_c=1.5dB$ or $\Delta T_c=0dB$.

[0047] Optionally, FIG. 8 is a schematic structural diagram of yet another embodiment of an apparatus for controlling uplink power of a user equipment in a carrier aggregation scenario according to the present invention. On the basis of the embodiment shown in FIG. 7, the power control module 12 includes: a configuring unit 121 and a power control unit 122. The configuring unit 121 is configured to use any value or a minimum value of the first maximum transmit power and the first reference transmit power as second configured maximum transmit power; the power control unit 122 is configured to perform, according to the second configured maximum transmit power, power control over power of the first subframe located in the overlap region in the first carrier; the configuring unit 121 is further configured to use any value or a minimum value of the second maximum transmit power and the first reference transmit power as third configured maximum transmit power; and the power control unit 122 is further configured to perform, according to the third configured maximum transmit power, power control over power of the second subframe located in the overlap region in the second carrier.

[0048] Further optionally, in still another embodiment of the present invention, on the basis of the embodiment shown in FIG. 7, the power control module 12 includes: a configuring unit and a power control unit. The configuring unit is configured to use any value or a minimum value of the first maximum transmit power and the first reference transmit power as second configured maximum transmit power; the power control unit is configured to perform, according to the second configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the first carrier; the configuring unit is further configured to use any value or a minimum value of the second maximum transmit power and the first reference transmit power as third configured maximum transmit power; and the power control unit is further configured to perform, according to the third configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the second carrier.

[0049] Further optionally, in another embodiment of the present invention, on the basis of the embodiment shown in FIG. 7, the power control module 12 is specifically configured to perform power control over transmit power of samples in the overlap region according to the first reference transmit power.

[0050] Further, in yet another embodiment of the present invention, on the basis of the embodiment shown in FIG. 5, the apparatus may further include: an upper limit calculating module and a lower limit calculating module. The upper limit calculating module is configured to acquire an upper limit $P_{CMAX\_H\_CA\_2}$ of the second maximum transmit power by using a formula $P_{CMAX\_H\_CA\_2} = \min\{10\log_{10} \Sigma P_{EMAX.C}, P_{PowerClass}\}$ and according to maximum transmit power $P_{EMAX.1}$ of a first carrier delivered by a network in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.2}$ of a second carrier delivered by the network in the first subframe located in the overlap region, and maximum transmit power $P_{EMAX.3}$ of a third carrier delivered by the network in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.2}$, or the maximum transmit power $P_{EMAX.3}$ is not allowed.

[0051] The upper limit calculating module is further configured to acquire an upper limit $P_{CMAX\_H\_CA\_3}$ of third maximum transmit power by using a formula $P_{CMAX\_H\_CA\_3} = \min\{10\log_{10} \Sigma P_{EMAX.N}, P_{PowerClass}\}$ and according to the maximum transmit power $P_{EMAX.1}$ of the first carrier in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.4}$ of the second carrier in the second subframe located in the overlap region, and the maximum transmit power $P_{EMAX.3}$ of the third carrier delivered by the network in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.4}$, or the maximum transmit power $P_{EMAX.3}$ is not allowed.

[0052] The lower limit calculating module is configured to acquire a lower limit $P_{CMAX\_L\_CA\_2}$ of the second maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.2}$, and the $P_{EMAX.3}$ by using a formula $P_{CMAX\_L\_CA\_2}=\min\{10\log_{10}\Sigma P_{EMAX.C}-\Delta T_c, P_{PowerClass}-\max(MPR+A\text{-}MPR, P\text{-}MPR)-\Delta T_c\}$

[0053] The lower limit calculating module is further configured to acquire a lower limit $P_{CMAX\_L\_CA\_3}$ of the third maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.4}$, and the $P_{EMAX.3}$ by using a formula $P_{CMAX\_L\_CA\_3}$=min{10log$_{10}\Sigma P_{EMAX.N}$-ΔT_N,$P_{PowerClass}$-max(MPR+A-MPR,P-MPR)-ΔT_N}

[0054] The acquiring module is further configured to acquire second reference transmit power P_{CMAX_O2} according to the $P_{CMAX\_H\_CA\_2}$ acquired by the upper limit calculating module and the $P_{CMAX\_L\_CA\_2}$ acquired by the lower limit calculating module, so that the P_{CMAX_O2} satisfies $P_{CMAX\_L\_CA\_2} \leq P_{CMAX\_O2} \leq P_{CMAX\_H\_CA\_2}$.

[0055] The acquiring module is further configured to acquire third reference transmit power P_{CMAX_O3} according to the $P_{CMAX\_H\_CA\_3}$ acquired by the upper limit calculating module and the $P_{CMAX\_L\_CA\_3}$ acquired by the lower limit calculating module, so that the P_{CMAX_O3} satisfies $P_{CMAX\_L\_CA\_3} \leq P_{CMAX\_O3} \leq P_{CMAX\_H\_CA\_3}$.

[0056] The power control module 12 is specifically configured to perform power control over transmit power of the first carrier, the second carrier, and the third carrier in the overlap region by using the second reference transmit power and the third reference transmit power.

[0057] The first carrier bearer is located in a first timing advance group; the second carrier is located in a second timing advance group; the third carrier is located in a third timing advance group; timing advance values of the first timing advance group, the second timing advance group, and the third timing advance group are different; C in the $P_{EMAX.C}$ is {1,2,3}; N in the $P_{EMAX.N}$ is {1,4,3}; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the *MPR*, the *A-MPR*, and the *P-MPR* all indicate maximum power back-off; and $\Delta T_c = 1.5dB$ or $\Delta T_c = 0dB$.

[0058] Optionally, the power control module 12 may be formed by using the following structures according to different power control manners:

[0059] A first power control manner: performing power control over transmit power of a subframe forming an overlap region.

[0060] The power control module 12 may include: a configuring unit and a power control unit. The configuring unit is configured to use any value or a minimum value of the first maximum transmit power, the second reference transmit power, and the third reference transmit power as fourth configured maximum transmit power.

[0061] The power control unit is configured to perform, according to the fourth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the first carrier.

[0062] The configuring unit is further configured to use any value or a minimum value of the first maximum transmit power and the second reference transmit power as fifth configured maximum transmit power.

[0063] The power control unit is further configured to perform, according to the fifth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the second carrier.

[0064] The configuring unit is further configured to use any value or a minimum value of the second maximum transmit power and the third reference transmit power as sixth configured maximum transmit power.

[0065] The power control unit is further configured to perform, according to the sixth configured maximum transmit power, power control over power of the second subframe located in the overlap region in the second carrier.

[0066] The configuring unit is further configured to use any value or a minimum value of the second maximum transmit power, the second reference transmit power, and the third reference transmit power as seventh configured maximum transmit power.

[0067] The power control unit is further configured to perform, according to the seventh configured maximum transmit power, power control over power of the second subframe located in the overlap region in the third carrier.

[0068] A second power control manner: performing power control over power of a symbol forming an overlap region in a subframe in a carrier.

[0069] The power control module 12 includes: a configuring unit and a power control unit. The configuring unit is configured to use any value or a minimum value of the first maximum transmit power, the second reference transmit power, and the third reference transmit power as fourth configured maximum transmit power.

[0070] The power control unit is configured to perform, according to the fourth configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the first carrier.

[0071] The configuring unit is further configured to use any value or a minimum value of the first maximum transmit power and the second reference transmit power as fifth configured maximum transmit power.

[0072] The power control unit is further configured to perform, according to the fifth configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the second carrier.

[0073] The configuring unit is further configured to use any value or a minimum value of the second maximum transmit power and the third reference transmit power as sixth configured maximum transmit power.

[0074] The power control unit is further configured to perform, according to the sixth configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the second carrier.

[0075] The configuring unit is further configured to use any value or a minimum value of the second maximum transmit power, the second reference transmit power, and the third reference transmit power as seventh configured maximum transmit power.

[0076] The power control unit is further configured to perform, according to the seventh configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the third carrier.

[0077] A third power control manner: performing power control over transmit power of samples in an overlap region.

[0078] The power control module 12 includes a first power control unit and a second power control unit.

[0079] Specifically, the first power control unit is configured to separately perform, according to the second reference transmit power, power control over transmit power of samples in a first portion in the overlap region in the first subframe in the first carrier, transmit power of samples in the overlap region in the first subframe in the second carrier, and transmit power of samples in a first portion in the overlap region in the second subframe in the third carrier.

[0080] The second power control unit is configured to separately perform, according to the third reference transmit power, power control over transmit power of samples in a second portion in the overlap region in the first subframe in the first carrier, transmit power of samples in the overlap region in the second subframe in the second carrier, and transmit power of samples in a second portion in the overlap region in the second subframe in the third carrier.

[0081] The first portion is a portion in which the first subframe of the first carrier, the first subframe of the second carrier, and the second subframe of the third carrier overlap; and the second portion is a portion in which the first subframe of the first carrier, the second subframe of the second carrier, and the second subframe of the third carrier overlap.

[0082] A fourth power control manner: performing power control over transmit power of samples in an overlap region.

[0083] The power control module includes: a configuring unit and a power control unit.

[0084] The configuring unit is configured to use any value or a minimum value of the second reference transmit power and the third reference transmit power as eighth configured maximum transmit power.

[0085] The power control unit is configured to separately perform, according to the eighth configured maximum transmit power, power control over transmit power of samples in the overlap region in the first subframe in the first carrier and transmit power of samples in the overlap region in the second subframe in the third carrier.

[0086] The power control unit is further configured to perform, according to the second reference transmit power, power control over transmit power of samples in the overlap region in the first subframe in the second carrier.

[0087] The power control unit is further configured to perform, according to the third reference transmit power, power control over transmit power of samples in the overlap region in the second subframe in the second carrier.

[0088] Further, in still another embodiment of the present invention, on the basis of the embodiment shown in FIG. 5, the apparatus may further include: an upper limit calculating module and a lower limit calculating module.

[0089] Specifically, the upper limit calculating module is configured to acquire an upper limit $P_{CMAX\_H\_CA\_4}$ of fourth maximum transmit power by using a formula $P_{CMAX\_H\_CA\_4} = \min\{10\log_{10}\sum P_{EMAX.C}, P_{PowerClass}\}$ and according to maximum transmit power $P_{EMAX.1}$ of a first carrier delivered by a network in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.2}$ of a second carrier delivered by the network in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.3}$ of a third carrier delivered by the network in the first subframe located in the overlap region, and maximum transmit power $P_{EMAX.4}$ of a fourth carrier delivered by the network in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.2}$, the maximum transmit power $P_{EMAX.3}$, or the maximum transmit power $P_{EMAX.4}$ is not allowed.

[0090] The upper limit calculating module is further configured to acquire an upper limit $P_{CMAX\_H\_CA\_4}$ of fifth maximum transmit power by using a formula $P_{CMAX\_H\_CA\_5} = \min\{10\log_{10}\sum P_{EMAX.N}, P_{PowerClass}\}$ and according to the maximum transmit power $P_{EMAX.1}$ of the first carrier in the first subframe located in the overlap region, the maximum transmit power $P_{EMAX.2}$ of the second carrier in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.5}$ of the third carrier in the second subframe located in the overlap region, and the maximum transmit power $P_{EMAX.4}$ of the fourth carrier in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.2}$, the maximum transmit power $P_{EMAX.5}$, or the maximum transmit power $P_{EMAX.4}$ is not allowed.

[0091] The upper limit calculating module is further configured to acquire an upper limit $P_{CMAX\_H\_CA\_6}$ of sixth maximum transmit power by using a formula $P_{CMAX\_H\_CA\_6} = \min\{10\log_{10}\sum P_{EMAX.N}, P_{PowerClass}\}$ and according to the maximum transmit power $P_{EMAX.1}$ of the first carrier in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.6}$ of the second carrier in the second subframe located in the overlap region, the maximum transmit power $P_{EMAX.5}$ of the third carrier in the second subframe located in the overlap region, and the maximum transmit power $P_{EMAX.4}$ of the fourth carrier in the second subframe located in the overlap region, where exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.6}$, the maximum transmit power $P_{EMAX.5}$, or the maximum transmit power $P_{EMAX.4}$ is not allowed.

[0092] The lower limit calculating module is configured to acquire a lower limit $P_{CMAX\_L\_CA\_4}$ of the fourth maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.2}$, the $P_{EMAX.3}$, and the $P_{EMAX.4}$ by using a formula $P_{CMAX\_L\_CA\_4} = \min\{10\log_{10}\sum P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max(MPR+A\text{-}MPR, P\text{-}MPR) - \Delta T_c\}$

[0093] The lower limit calculating module is further configured to acquire a lower limit $P_{CMAX\_L\_CA\_5}$ of the fifth maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX\,2}$, the $P_{EMAX.5}$, and the $P_{EMAX.4}$ by using a formula $P_{CMAX\_L\_CA\_5} = \min\{10\log_{10}\sum P_{EMAX.N} - \Delta T_N, P_{PowerClass} - \max(MPR+A\text{-}MPR, P\text{-}MPR) - \Delta T_N\}$

[0094] The lower limit calculating module is further configured to acquire a lower limit $P_{CMAX\_L\_CA\_6}$ of the sixth maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.6}$, the $P_{EMAX.5}$ and the $P_{EMAX.4}$ by using a formula $P_{CMAX\_L\_CA\_6}$ = min{10log$_{10}$ $\Sigma P_{EMAX.M}$ -ΔT_N, $P_{PowerClass}$ - max(MPR+A-MPR,P-MPR)-ΔT_N}

[0095] The acquiring module is further configured to acquire fourth reference transmit power P_{CMAX_O4} according to the $P_{CMAX\_H\_CA\_4}$ acquired by the upper limit calculating module and the $P_{CMAX\_L\_CA\_4}$ acquired by the lower limit calculating module, so that the P_{CMAX_O4} satisfies $P_{CMAX\_L\_CA\_4} \leq P_{CMAX\_O4} \leq P_{CMAX\_H\_CA\_4}$.

[0096] The acquiring module is further configured to acquire fifth reference transmit power P_{CMAX_O5} according to the $P_{CMAX\_H\_CA\_5}$ acquired by the upper limit calculating module and the $P_{CMAX\_L\_CA\_5}$ acquired by the lower limit calculating module, so that the P_{CMAX_O5} satisfies $P_{CMAX\_L\_CA\_5} \leq P_{CMAX\_O5} \leq P_{CMAX\_H\_CA\_5}$.

[0097] The acquiring module is further configured to acquire fifth reference transmit power P_{CMAX_O6} according to the $P_{CMAX\_H\_CA\_6}$ acquired by the upper limit calculating module and the $P_{CMAX\_L\_CA\_6}$ acquired by the lower limit calculating module, so that the P_{CMAX_O5} satisfies $P_{CMAX\_L\_CA\_6} \leq P_{CMAX\_O6} \leq P_{CMAX\_H\_CA\_6}$.

[0098] The power control module 12 is specifically configured to perform power control over transmit power of the first carrier, the second carrier, the third carrier, and the fourth carrier in the overlap region by using the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power.

[0099] The first carrier bearer is located in a first timing advance group; the second carrier is located in a second timing advance group; the third carrier is located in a third timing advance group; the fourth carrier is located in a fourth timing advance group; timing advance values of the first timing advance group, the second timing advance group, the third timing advance group, and the fourth timing advance group are different; C in the $P_{EMAX.C}$ is {1,2,3,4} ; N in the $P_{EMAX.N}$ is {1,2,5,4} ; M in the $P_{EMAX\,M}$ is {1,6,5,4} ; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the MPR , the A-MPR, and the P-MPR all indicate maximum power back-off; and $\Delta T_c=1.5dB$ or $\Delta T_c=0dB$.

[0100] Optionally, the power control module 12 may be formed by using the following structures according to different power control manners:

[0101] A first power control manner: performing power control over transmit power of a subframe forming an overlap region.

[0102] The power control module includes: a configuring unit and a power control unit.

[0103] The configuring unit is configured to use any value or a minimum value of the first maximum transmit power, the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power as ninth configured maximum transmit power.

[0104] The power control unit is configured to perform, according to the ninth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the first carrier.

[0105] The configuring unit is further configured to use any value or a minimum value of the first maximum transmit power, the fourth reference transmit power, and the fifth reference transmit power as tenth configured maximum transmit power.

[0106] The power control unit is further configured to perform, according to the tenth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the second carrier.

[0107] The configuring unit is further configured to use any value or a minimum value of the second maximum transmit power and the sixth reference transmit power as eleventh configured maximum transmit power.

[0108] The power control unit is further configured to perform, according to the eleventh configured maximum transmit power, power control over power of the second subframe located in the overlap region in the second carrier.

[0109] The configuring unit is further configured to use any value or a minimum value of the first maximum transmit power and the fourth reference transmit power as twelfth configured maximum transmit power.

[0110] The power control unit is further configured to perform, according to the twelfth configured maximum transmit power, power control over power of the first subframe located in the overlap region in the third carrier.

[0111] The configuring unit is further configured to use any value or a minimum value of the second maximum transmit power, the fifth reference transmit power, and the sixth reference transmit power as thirteenth configured maximum transmit power.

[0112] The power control unit is further configured to perform, according to the thirteenth configured maximum transmit power, power control over power of the second subframe located in the overlap region in the third carrier.

[0113] The configuring unit is further configured to use any value or the minimum value of the first maximum transmit power, the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power as fourteenth configured maximum transmit power.

[0114] The power control unit is further configured to perform, according to the fourteenth configured maximum transmit power, power control over power of the second subframe located in the overlap region in the fourth carrier.

[0115] A second power control manner: performing power control over power of a symbol forming an overlap region in a subframe in a carrier.

[0116] The power control module includes: a configuring unit and a power control unit.

[0117] The configuring unit is configured to use any value or a minimum value of the first maximum transmit power, the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power as ninth configured maximum transmit power.

[0118] The power control unit is configured to perform, according to the ninth configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the first carrier.

[0119] The configuring unit is further configured to use any value or a minimum value of the first maximum transmit power, the fourth reference transmit power, and the fifth reference transmit power as tenth configured maximum transmit power, and according to the tenth configured maximum transmit power.

[0120] The power control unit is further configured to perform, power control over power of a symbol forming the overlap region in the first subframe in the second carrier.

[0121] The configuring unit is further configured to use any value or a minimum value of the second maximum transmit power and the sixth reference transmit power as eleventh configured maximum transmit power.

[0122] The power control unit is further configured to perform, according to the eleventh configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the second carrier.

[0123] The configuring unit is further configured to use any value or a minimum value of the first maximum transmit power and the fourth reference transmit power as twelfth configured maximum transmit power.

[0124] The power control unit is further configured to perform, according to the twelfth configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the third carrier.

[0125] The configuring unit is further configured to use any value or a minimum value of the second maximum transmit power, the fifth reference transmit power, and the sixth reference transmit power as thirteenth configured maximum transmit power.

[0126] The power control unit is further configured to perform, according to the thirteenth configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the third carrier.

[0127] The configuring unit is further configured to use any value or the minimum value of the first maximum transmit power, the fourth reference transmit power, the fifth reference transmit power, and the sixth reference transmit power as fourteenth configured maximum transmit power.

[0128] The power control unit is further configured to perform, according to the fourteenth configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the fourth carrier.

[0129] A third power control manner: performing power control over transmit power of samples in an overlap region.

[0130] The power control module 12 includes a first power control unit, a second power control unit, and a third power control unit.

[0131] Specifically, the first power control unit is configured to separately perform, according to the fourth reference transmit power, power control over transmit power of samples in a first portion in the overlap region in the first subframe in the first carrier, transmit power of samples in a first portion in the overlap region in the first subframe in the second carrier, transmit power of samples in the overlap region in the first subframe in the third carrier, and transmit power of samples in a first portion in the overlap region in the second subframe in the fourth carrier.

[0132] The second power control unit is configured to separately perform, according to the fifth reference transmit power, power control over transmit power of samples in a second portion in the overlap region in the first subframe in the first carrier, transmit power of samples in a second portion in the overlap region in the first subframe in the second carrier, transmit power of samples in a first portion in the overlap region in the second subframe in the third carrier, and transmit power of samples in a second portion in the overlap region in the second subframe in the fourth carrier.

[0133] The third power control unit is configured to separately perform, according to the sixth reference transmit power, power control over transmit power of samples in a third portion in the overlap region in the first subframe in the first carrier, transmit power of samples in the overlap region in the second subframe in the second carrier, transmit power of samples in a second portion in the overlap region in the second subframe in the third carrier, and transmit power of samples in a third portion in the overlap region in the second subframe in the fourth carrier.

[0134] The first portion is a portion in which the first subframe of the first carrier, the first subframe of the second carrier, the first subframe of the third carrier, and the second subframe of the fourth carrier overlap; the second portion is a portion in which the first subframe of the first carrier, the first subframe of the second carrier, the second subframe of the third carrier, and the second subframe of the fourth carrier overlap; and the third portion is a portion in which the first subframe of the first carrier, the second subframe of the second carrier, the second subframe of the third carrier, and the second subframe of the fourth carrier overlap.

[0135] A fourth power control manner: performing power control over transmit power of samples in an overlap region.

[0136] The power control module 12 includes: a configuring unit and a power control unit.

[0137] The configuring unit is configured to use any value or a minimum value of the fourth reference transmit power, the fifth reference transmit power, and the third reference transmit power as fifteenth configured maximum transmit power.

[0138] The power control unit is configured to separately perform, according to the fifteenth configured maximum transmit power, power control over transmit power of samples in the overlap region in the first subframe in the first carrier and transmit power of samples in the overlap region in the second subframe in the fourth carrier.

[0139] The configuring unit is further configured to use any value or a minimum value of the fourth reference transmit power and the fifth reference transmit power as sixteenth configured maximum transmit power.

[0140] The power control unit is further configured to perform power control over transmit power of samples in the overlap region in the first subframe in the second carrier according to the sixteenth configured maximum transmit power.

[0141] The power control unit is further configured to perform power control over transmit power of samples in the overlap region in the second subframe in the second carrier according to the sixth reference transmit power.

[0142] The power control unit is further configured to perform power control over transmit power of samples in the overlap region in the first subframe in the third carrier according to the fourth reference transmit power.

[0143] The configuring unit is further configured to use any value or a minimum value of the fifth reference transmit power and the sixth reference transmit power as seventeenth configured maximum transmit power.

[0144] The power control unit is further configured to perform power control over transmit power of samples in the overlap region in the second subframe in the third carrier according to the seventeenth configured maximum transmit power.

[0145] Persons of ordinary skill in the art may understand that all or a part of the steps of the method embodiments may be implemented by a program instructing relevant hardware. The program may be stored in a computer readable storage medium. When the program runs, the steps of the method embodiments are performed. The storage medium includes any medium that can store program code, such as a ROM, a RAM, a magnetic disk, or an optical disc.

Claims

1. A method for controlling uplink power of a user equipment in a carrier aggregation scenario, comprising:

acquiring (101), by the user equipment, first maximum transmit power of the user equipment corresponding to a first subframe and second maximum transmit power of the user equipment corresponding to a second subframe, wherein the first maximum transmit power and the second maximum transmit power are different; and
performing (102), by the user equipment, power control over transmit power of multiple carriers in an overlap region, so that total transmit power of the multiple carriers in the overlap region after the power control is lower than or equal to a minimum value of the first maximum transmit power and the second maximum transmit power;
wherein, the first subframe and the second subframe are adjacent subframes, and the overlap region is a portion in which the first subframe and the second subframe overlap due to a difference in timing advance values of the multiple carriers.

2. The method according to claim 1, wherein the performing power control over transmit power of multiple carriers in an overlap region comprises:

performing, according to a first configured maximum transmit power, power control over transmit power of the first subframe located in the overlap region and transmit power of the second subframe located in the overlap region, wherein the first configured maximum transmit power is a minimum value of the first maximum transmit power and the second maximum transmit power; or
performing, according to a first configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe and power of a symbol forming the overlap region in the second subframe, wherein the first configured maximum transmit power is a minimum value of the first maximum transmit power and the second maximum transmit power.

3. The method according to claim 1, further comprising:

acquiring an upper limit $P_{CMAX\_H\_CA\_1}$ of the first maximum transmit power by using a formula $P_{CMAX\_H\_CA\_1}=\min\{10\log_{10}\Sigma P_{EMAX.C}, P_{PowerClass}\}$ and according to maximum transmit power $P_{EMAX.1}$ of a first carrier delivered by a network in the first subframe forming the overlap region, and maximum transmit power $P_{EMAX.2}$ of a second carrier delivered by the network in the second subframe located in the overlap region, wherein exceeding the maximum transmit power $P_{EMAX.1}$ or the maximum transmit power $P_{EMAX.2}$ is not allowed;
acquiring a lower limit $P_{CMAX\_L\_CA\_1}$ of the first maximum transmit power according to the $P_{EMAX.1}$ and the $P_{EMAX.2}$ by using a formula $P_{CMAX\_L\_CA\_1} = \min\{10\log_{10}\Sigma P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max(MPR+A\text{-}MPR, P\text{-}MPR) - \Delta T_c\}$; and
acquiring first reference transmit power P_{CMAX_O1} according to the $P_{CMAX\_H\_CA\_1}$ and the $P_{CMAX\_L\_CA\_1}$, so that the P_{CMAX_O1} satisfies $P_{CMAX\_L\_CA\_1} \le P_{CMAX\_O1} \le P_{CMAX\_H\_CA\_1}$, wherein
the performing power control over transmit power of multiple carriers in an overlap region comprises:

performing power control over transmit power of the first carrier and the second carrier in the overlap region by using the first reference transmit power;
wherein, the first carrier is located in a first timing advance group; the second carrier is located in a second timing advance group; timing advance values of the first timing advance group and the second timing advance group are different; C in the $P_{EMAX.C}$ is {1, 2}; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the *MPR,* the *A-MPR,* and the *P-MPR* all indicate maximum power back-off; and $\Delta T_c = 1.5dB$ or $\Delta T_c = 0dB$.

4. The method according to claim 3, wherein the performing power control over the first carrier and the second carrier in the multiple carriers in the overlap region by using the first reference transmit power comprises:

using a minimum value of the first maximum transmit power and the first reference transmit power as second configured maximum transmit power, and performing, according to the second configured maximum transmit power, power control over power of the first subframe located in the overlap region in the first carrier; and
using a minimum value of the second maximum transmit power and the first reference transmit power as third configured maximum transmit power, and performing, according to the third configured maximum transmit power, power control over power of the second subframe located in the overlap region in the second carrier.

5. The method according to claim 3, wherein the performing power control over the first carrier and the second carrier in the multiple carriers in the overlap region by using the first reference transmit power comprises:

using a minimum value of the first maximum transmit power and the first reference transmit power as second configured maximum transmit power, and performing, according to the second configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the first carrier; and
using a minimum value of the second maximum transmit power and the first reference transmit power as third configured maximum transmit power, and performing, according to the third configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the second carrier.

6. The method according to claim 3, wherein the performing power control over the first carrier and the second carrier in the multiple carriers in the overlap region by using the first reference transmit power comprises:
performing power control over transmit power of samples in the overlap region according to the first reference transmit power.

7. The method according to claim 1, further comprising:

acquiring an upper limit $P_{CMAX\_H\_CA\_2}$ of the second maximum transmit power by using a formula $P_{CMAX\_H\_CA\_2}=\min\{10\log_{10}\Sigma P_{EMAX.C}, P_{Powerclass}\}$ and according to maximum transmit power $P_{EMAX.1}$ of a first carrier delivered by a network in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.2}$ of a second carrier delivered by the network in the first subframe located in the overlap region, and maximum transmit power $P_{EMAX.3}$ of a third carrier delivered by the network in the second subframe located in the overlap region, wherein exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.2}$, or the maximum transmit power $P_{EMAX.3}$ is not allowed;
acquiring an upper limit $P_{CMAX\_H\_CA\_3}$ of third maximum transmit power by using a formula $P_{CMAX\_H\_CA\_3} = \min\{10\log_{10} \Sigma P_{EMAX.N}, P_{PowerClass}\}$ and according to the maximum transmit power $P_{EMAX.1}$ of the first carrier in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.4}$ of the second carrier in the second subframe located in the overlap region, and the maximum transmit power $P_{EMAX.3}$ of the third carrier delivered by the network in the second subframe located in the overlap region, wherein exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.4}$, or the maximum transmit power $P_{EMAX.3}$ is not allowed;
acquiring a lower limit $P_{CMAX\_L\_CA\_2}$ of the second maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.2}$, and the $P_{EMAX.3}$ by using a formula $P_{CMAX\_L\_CA\_2} = \min\{10\log_{10} \Sigma P_{EMAX.C} - \Delta T_c, P_{PowerClass}\text{-max}(MPR+A\text{-}MPR, P\text{-}MPR)\text{-}\Delta T_c\}$
acquiring a lower limit $P_{CMAX\_L\_CA\_3}$ of the third maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.4}$, and the $P_{EMAX.3}$ by using a formula $P_{CMAX\_L\_CA\_3}=\min\{10\log_{10}\Sigma P_{EMAX.N}\text{-}\Delta T_N, P_{PowerClass}\ \text{-}max(MPR+A\text{-}MPR, P\text{-}MPR)\text{-}\Delta T_N\}$;
acquiring second reference transmit power P_{CMAX_O2} according to the $P_{CMAX\_H\_CA\_2}$ and the $P_{CMAX\_L\_CA\_2}$, so that the P_{CMAX_O2} satisfies $P_{CMAX\_L\_CA\_2} \leq P_{CMAX\_O2} \leq P_{CMAX\_H\_CA\_2}$; and

acquiring third reference transmit power P_{CMAX_O3} according to the $P_{CMAX\_H\_CA\_3}$ and the $P_{CMAX\_L\_CA\_3}$, so that the P_{CMAX_O3} satisfies $P_{CMAX\_L\_CA\_3} \le P_{CMAX\_O3} \le P_{CMAX\_H\_CA\_3}$, wherein
the performing power control over transmit power of multiple carriers in an overlap region comprises:

performing power control over transmit power of the first carrier, the second carrier, and the third carrier in the overlap region by using the second reference transmit power and the third reference transmit power;
wherein, the first carrier is located in a first timing advance group; the second carrier is located in a second timing advance group; the third carrier is located in a third timing advance group; timing advance values of the first timing advance group, the second timing advance group, and the third timing advance group are different; C in the $P_{EMAX.C}$ is {1,2,3}; N in the $P_{EMAX.N}$ is {1,4,3} ; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the *MPR,* the *A-MPR,* and the *P-MPR* all indicate maximum power back-off; and $\Delta T_c = 1.5dB$ or $\Delta T_c = 0dB$.

8. An user equipment for controlling uplink power in a carrier aggregation scenario, comprising:

an acquiring module (11), configured to acquire first maximum transmit power of the user equipment corresponding to a first subframe and second maximum transmit power of the user equipment corresponding to a second subframe, wherein the first maximum transmit power and the second maximum transmit power are different; and
a power control module (12), configured to perform power control over transmit power of multiple carriers in an overlap region, so that total transmit power of the multiple carriers in the overlap region after the power control is lower than or equal to a minimum value of the first maximum transmit power and the second maximum transmit power;
wherein, the first subframe and the second subframe are adjacent subframes, and the overlap region is a portion in which the first subframe and the second subframe overlap due to a difference in timing advance values of the multiple carriers.

9. The apparatus according to claim 8, wherein the power control unit is specifically configured to perform, according to a first configured maximum transmit power, power control over transmit power of the first subframe located in the overlap region and transmit power of the second subframe located in the overlap region, wherein the first configured maximum transmit power is a minimum value of the first maximum transmit power and the second maximum transmit power; or
the power control unit is specifically configured to perform, according to a first configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe and power of a symbol forming the overlap region in the second subframe, wherein the first configured maximum transmit power is a minimum value of the first maximum transmit power and the second maximum transmit power.

10. The apparatus according to claim 8, further comprising:

an upper limit calculating module, configured to acquire an upper limit $P_{CMAX\_H\_CA\_1}$ of the first maximum transmit power by using a formula $P_{CMAX\_H\_CA\_1}=\min\{10\log_{10}\sum P_{EMAX.C}, P_{Powerclass}\}$ and according to maximum transmit power $P_{EMAX.1}$ of a first carrier delivered by a network in the first subframe located in the overlap region, and maximum transmit power $P_{EMAX.2}$ of a second carrier delivered by the network in the second subframe located in the overlap region, wherein exceeding the maximum transmit power $P_{EMAX.1}$ or the maximum transmit power $P_{EMAX.2}$ is not allowed; and
a lower limit calculating module, configured to acquire a lower limit $P_{CMAX\_L\_CA\_1}$ of the first maximum transmit power according to the $P_{EMAX.1}$ and the $P_{EMAX.2}$ by using a formula $P_{CMAX\_L\_CA\_1}=\min\{10\log_{10}\sum P_{EMAX.C}-\Delta T_c, P_{PowerClass}-\max(MPR+A\text{-}MPR, P\text{-}MPR)-\Delta T_c\}$, wherein
the acquiring module is further configured to acquire first reference transmit power P_{CMAX_O1} according to the $P_{CMAX\_H\_CA\_1}$ acquired by the upper limit calculating module and the $P_{CMAX\_L\_CA\_1}$ acquired by the lower limit calculating module, so that the P_{CMAX_O1} satisfies $P_{CMAX\_L\_CA\_1} \le P_{CMAX\_O1} \le P_{CMAX\_H\_CA\_1}$; and
the power control module is specifically configured to perform power control over transmit power of the first carrier and the second carrier in the overlap region by using the first reference transmit power;
wherein, the first carrier is located in a first timing advance group; the second carrier is located in a second timing advance group; timing advance values of the first timing advance group and the second timing advance group are different; C in the $P_{EMAX.C}$ is {1,2}; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the *MPR,* the *A-MPR,* and the *P-MPR* all indicate maximum power back-off; and $\Delta T_c = 1.5dB$ or $\Delta T_c = 0dB$.

11. The apparatus according to claim 10, wherein the power control module comprises:

a configuring unit, configured to use a minimum value of the first maximum transmit power and the first reference transmit power as second configured maximum transmit power; and
a power control unit, configured to perform, according to the second configured maximum transmit power, power control over power of the first subframe located in the overlap region in the first carrier, wherein
the configuring unit is further configured to use a minimum value of the second maximum transmit power and the first reference transmit power as third configured maximum transmit power; and
the power control unit is further configured to perform, according to the third configured maximum transmit power, power control over power of the second subframe located in the overlap region in the second carrier.

12. The apparatus according to claim 10, wherein the power control module comprises:

a configuring unit, configured to use a minimum value of the first maximum transmit power and the first reference transmit power as second configured maximum transmit power; and
a power control unit, configured to perform, according to the second configured maximum transmit power, power control over power of a symbol forming the overlap region in the first subframe in the first carrier, wherein
the configuring unit is further configured to use a minimum value of the second maximum transmit power and the first reference transmit power as third configured maximum transmit power; and
the power control unit is further configured to perform, according to the third configured maximum transmit power, power control over power of a symbol forming the overlap region in the second subframe in the second carrier.

13. The apparatus according to claim 10, wherein the power control module is specifically configured to perform power control over transmit power of samples in the overlap region according to the first reference transmit power.

14. The apparatus according to claim 8, further comprising:

an upper limit calculating module, configured to acquire an upper limit $P_{CMAX\_H\_CA\_2}$ of the second maximum transmit power by using a formula $P_{CMAX\_H\_CA\_2}$ = min $\{10\log_{10} \Sigma\ P_{EMAY.C}, P_{PowerClass}\}$ and according to maximum transmit power $P_{EMAX.1}$ of a first carrier delivered by a network in the first subframe located in the overlap region, maximum transmit power $P_{EMAX\cdot 2}$ of a second carrier delivered by the network in the first subframe located in the overlap region, and maximum transmit power $P_{EMAX.3}$ of a third carrier delivered by the network in the second subframe located in the overlap region, wherein exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.2}$, or the maximum transmit power $P_{EMAX.3}$ is not allowed, wherein
the upper limit calculating module is further configured to acquire an upper limit $P_{CMAX\_H\_CA\_3}$ of third maximum transmit power by using a formula $P_{CMAX\_H\_CA\_3}$ = min $\{10\log_{10} \Sigma P_{EMAX.N}, P_{PowerClass}\}$ and according to the maximum transmit power $P_{EMAX.1}$ of the first carrier in the first subframe located in the overlap region, maximum transmit power $P_{EMAX.4}$ of the second carrier in the second subframe located in the overlap region, and the maximum transmit power $P_{EMAX.3}$ of the third carrier delivered by the network in the second subframe located in the overlap region, wherein exceeding the maximum transmit power $P_{EMAX.1}$, the maximum transmit power $P_{EMAX.4}$, or the maximum transmit power $P_{EMAX.3}$ is not allowed; and
a lower limit calculating module, configured to acquire a lower limit $P_{CMAX\_L\_CA\_2}$ of the second maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.2}$, and the $P_{EMAX.3}$ by using a formula $P_{CMAX\_L\_CA\_2}$ = min$\{10\log_{10}\Sigma_{PEMAX.C}\ \text{-}\Delta T_c, P_{PowerClass}$ -max $(MPR + A - MPR, P - MPR)\ \Delta T_c\}$, wherein
the lower limit calculating module is further configured to acquire a lower limit $P_{CM4X\_L\_CA\_3}$ of the third maximum transmit power according to the $P_{EMAX.1}$, the $P_{EMAX.4}$, and the $P_{EMAX.3}$ by using a formula $P_{CMAX\_L\_CA\_3}$ = min $\{10\log_{10} \Sigma P_{EMAX.N}\ \text{-}\Delta T_N, P_{PowerClass}$ -max $(MPR + A - MPR, P - MPR)\text{-}\Delta T_N\}$;
the acquiring module is further configured to acquire second reference transmit power P_{CMAX_O2} according to the $P_{CMAX\_H\_CA\_2}$ acquired by the upper limit calculating module and the $P_{CMAX\_L\_CA\_2}$ acquired by the lower limit calculating module, so that the P_{CMAX_O2} satisfies $P_{CMAX\_L\_CA\_2} \leq P_{CAMX\_O2} \leq P_{CAMX\_H\_CA\_2}$;
the acquiring module is further configured to acquire third reference transmit power P_{CMAX_O3} according to the $P_{CMAX\_H\_CA\_3}$ acquired by the upper limit calculating module and the $P_{CMAX\_L\_CA\_3}$ acquired by the lower limit calculating module, so that the P_{CMAX_O3} satisfies $P_{CMAX\_L\_CA\_3} \leq P_{CMAX\_O3} \leq P_{CMAX\_H\_CA\_3}$; and
the power control module is specifically configured to perform power control over transmit power of the first carrier, the second carrier, and the third carrier in the overlap region by using the second reference transmit power and the third reference transmit power;

wherein, the first carrier bearer is located in a first timing advance group; the second carrier is located in a second timing advance group; the third carrier is located in a third timing advance group; timing advance values of the first timing advance group, the second timing advance group, and the third timing advance group are different; C in the $P_{IMAX.C}$ is {1, 2,3} ; N in the $P_{EWAX.N}$ is {1, 4,3} ; the $P_{PowerClass}$ indicates a maximum power transmit capability of the UE; the MPR, the A - MPR, and the P - MPR all indicate maximum power back-off; and $\Delta T_c = 1.5dB$ or $\Delta T_c = 0dB$.

15. Computer readable storage medium, comprising computer program codes which when executed by a computer processor cause the compute processor to execute the steps according to any one of the claims 1 to 7.

Patentansprüche

1. Verfahren zur Steuerung der Uplink-Leistung eines Benutzergerätes in einem Trägeraggregationsszenario, umfassend:

Erfassen (101) durch das Benutzergerät einer ersten maximalen Sendeleistung des Benutzergerätes entsprechend einem ersten Teilrahmen und einer zweiten maximalen Sendeleistung des Benutzergerätes entsprechend einem zweiten Teilrahmen, wobei die erste maximale Sendeleistung und die zweite maximale Sendeleistung verschieden sind; und
Durchführen (102) einer Leistungssteuerung über die Sendeleistung mehrerer Träger in einem Überlappungsbereich durch das Benutzergerät, sodass die Gesamtsendeleistung der mehreren Träger in dem Überlappungsbereich nach der Leistungssteuerung kleiner oder gleich einem Minimalwert der ersten maximalen Sendeleistung und der zweiten maximalen Sendeleistung ist;
wobei der erste Teilrahmen und der zweite Teilrahmen angrenzende Teilrahmen sind und der Überlappungsbereich ein Abschnitt ist, in dem sich der erste Teilrahmen und der zweite Teilrahmen aufgrund einer Differenz in den Zeitvorlaufwerten der mehreren Träger überlappen.

2. Verfahren gemäß Anspruch 1, wobei das Durchführen einer Leistungssteuerung über die Sendeleistung mehrerer Träger in einem Überlappungsbereich umfasst:

Durchführen einer Leistungssteuerung über die Sendeleistung des ersten Teilrahmens, der sich im Überlappungsbereich befindet, und die Sendeleistung des zweiten Teilrahmens, der sich im Überlappungsbereich befindet, gemäß einer ersten ausgelegten maximalen Sendeleistung, wobei die erste ausgelegte maximale Sendeleistung ein Minimalwert der ersten maximalen Sendeleistung und der zweiten maximalen Sendeleistung ist; oder
Durchführen einer Leistungssteuerung über die Leistung eines Symbols, das den Überlappungsbereich im ersten Teilrahmen bildet, und die Leistung eines Symbols,
das den Überlappungsbereich im zweiten Teilrahmen bildet, gemäß einer ersten ausgelegten maximalen Sendeleistung, wobei die erste ausgelegte maximale Sendeleistung ein Minimalwert der ersten maximalen Sendeleistung und der zweiten maximalen Sendeleistung ist.

3. Verfahren gemäß Anspruch 1, ferner umfassend:

Erfassen eines oberen Grenzwertes $P_{CMAX\_H\_CA\_1}$ der ersten maximalen Sendeleistung durch Verwendung einer Formel $P_{CMAX\_H\_CA\_1} = \min\{10 \log_{10} \sum P_{EMAX.C}, P_{PowerClass}\}$ und gemäß der maximalen Sendeleistung $P_{EMAX.1}$ eines ersten Trägers, der durch ein Netzwerk im ersten Teilrahmen, der den Überlappungsbereich bildet, geliefert wird, und der maximalen Sendeleistung $P_{EMAX.2}$ eines zweiten Trägers, der durch das Netzwerk im zweiten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, wobei ein Überschreiten der maximalen Sendeleistung $P_{EMAX.1}$ oder der maximalen Sendeleistung $P_{EMAX.2}$ unzulässig ist;
Erfassen eines unteren Grenzwertes $P_{CMAX\_L\_CA\_1}$ der ersten maximalen Sendeleistung gemäß $P_{EMAX.1}$ und $P_{EMAX.2}$ durch Verwendung einer Formel $P_{CMAX\_L\_CA\_1} = \min\{10\log_{10} \sum P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max(MPR + A - MPR, P - MPR) - \Delta T_c\}$ und
Erfassen einer ersten Referenzsendeleistung P_{CMAX_O1} gemäß $P_{CMAX\_H\_CA\_1}$ und $P_{CMAX\_L\_CA\_1}$, sodass P_{CMAX_O1} $P_{CMAX\_L\_CA\_1} \le P_{CMAX\_O1} \le P_{CMAX\_H\_CA\_1}$ erfüllt, wobei das Durchführen einer Leistungssteuerung über die Sendeleistung mehrerer Träger in einem Überlappungsbereich umfasst:

Durchführen einer Leistungssteuerung über die Sendeleistung des ersten Trägers und des zweiten Trägers

im Überlappungsbereich durch Verwendung der ersten Referenzsendeleistung;
wobei sich der erste Träger in einer ersten Zeitvorlaufgruppe befindet; der zweite Träger sich in einer zweiten Zeitvorlaufgruppe befindet; die Zeitvorlaufwerte der ersten Zeitvorlaufgruppe und der zweiten Zeitvorlaufgruppe verschieden sind; C in $P_{EMAX.C}$ {1, 2} ist; $P_{PowerClass}$ eine maximale Leistungsübertragungsfähigkeit des UE anzeigt; *MPR, A-MPR* und *P - MPR* sämtlich eine maximale Leistungsrücknahme angeben; und ΔT_C=1,5dB oder ΔT_C=0dB ist.

4. Verfahren gemäß Anspruch 3, wobei das Durchführen einer Leistungssteuerung über den ersten Träger und den zweiten Träger in den mehreren Trägern im Überlappungsbereich durch Verwendung der ersten Referenzsendeleistung umfasst:

Verwenden eines Minimalwertes der ersten maximalen Sendeleistung und der ersten Referenzsendeleistung als zweite ausgelegte maximale Sendeleistung und Durchführen einer Leistungssteuerung über die Leistung des ersten Teilrahmens, der sich im Überlappungsbereich im ersten Träger befindet, gemäß der zweiten ausgelegten maximalen Sendeleistung; und
Verwenden eines Minimalwertes der zweiten maximalen Sendeleistung und der ersten Referenzsendeleistung als dritte ausgelegte maximale Sendeleistung und Durchführen einer Leistungssteuerung über die Leistung des zweiten Teilrahmens, der sich im Überlappungsbereich im zweiten Träger befindet, gemäß der dritten ausgelegten maximalen Sendeleistung.

5. Verfahren gemäß Anspruch 3, wobei das Durchführen einer Leistungssteuerung über den ersten Träger und den zweiten Träger in den mehreren Trägern im Überlappungsbereich durch Verwendung der ersten Referenzsendeleistung umfasst:

Verwenden eines Minimalwertes der ersten maximalen Sendeleistung und der ersten Referenzsendeleistung als zweite ausgelegte maximale Sendeleistung und Durchführen einer Leistungssteuerung über die Leistung eines Symbols, das den Überlappungsbereich im ersten Teilrahmen im ersten Träger bildet, gemäß der zweiten ausgelegten maximalen Sendeleistung; und
Verwenden eines Minimalwertes der zweiten maximalen Sendeleistung und der ersten Referenzsendeleistung als dritte ausgelegte maximale Sendeleistung und Durchführen einer Leistungssteuerung über die Leistung eines Symbols, das den Überlappungsbereich im zweiten Teilrahmen bildet, gemäß der dritten ausgelegten maximalen Sendeleistung im zweiten Träger.

6. Verfahren gemäß Anspruch 3, wobei das Durchführen einer Leistungssteuerung über den ersten Träger und den zweiten Träger in den mehreren Trägern im Überlappungsbereich durch Verwendung der ersten Referenzsendeleistung umfasst:
Durchführen einer Leistungssteuerung über die Sendeleistung von Abtastwerten im Überlappungsbereich gemäß der ersten Referenzsendeleistung.

7. Verfahren gemäß Anspruch 1, ferner umfassend:

Erfassen eines oberen Grenzwertes $P_{CMAX\_H\_CA\_2}$ der zweiten maximalen Sendeleistung durch Verwendung einer Formel $P_{CMAX\_H\_CA\_2} = \min\{10 \log_{10} \sum P_{EMAX.C}, P_{PowerClass}\}$ und gemäß der maximalen Sendeleistung $P_{EMAX.1}$ eines ersten Trägers, der durch ein Netzwerk im ersten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, einer maximalen Sendeleistung $P_{EMAX.2}$ eines zweiten Trägers, der durch das Netzwerk im ersten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, und einer maximalen Sendeleistung $P_{EMAX.3}$ eines dritten Trägers, der durch das Netzwerk im zweiten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, wobei ein Überschreiten der maximalen Sendeleistung $P_{EMAX.1}$, der maximalen Sendeleistung $P_{EMAX.2}$ oder der maximalen Sendeleistung $P_{EMAX.3}$ unzulässig ist;
Erfassen eines oberen Grenzwertes $P_{CMAX\_H\_CA\_3}$ der dritten maximalen Sendeleistung durch Verwendung einer Formel $P_{CMAX\_H\_CA\_3} = \min\{10 \log_{10} \sum P_{EMAX.N}, P_{PowerClass}\}$ und gemäß der maximalen Sendeleistung $P_{EMAX.1}$ des ersten Trägers im ersten Teilrahmen, der sich im Überlappungsbereich befindet, der maximalen Sendeleistung $P_{EMAX.4}$ des zweiten Trägers im zweiten Teilrahmen, der sich im Überlappungsbereich befindet, und der maximalen Sendeleistung $P_{EMAX.3}$ des dritten Trägers, der durch das Netzwerk im zweiten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, wobei ein Überschreiten der maximalen Sendeleistung $P_{EMAX.1}$, der maximalen Sendeleistung $P_{EMAX.4}$ oder der maximalen Sendeleistung $P_{EMAX.3}$ unzulässig ist;
Erfassen eines unteren Grenzwertes $P_{CMAX\_L\_CA\_2}$ der zweiten maximalen Sendeleistung gemäß $P_{EMAX.1}$, $P_{EMAX.2}$ und $P_{EMAX.3}$ durch Verwendung einer Formel;

$P_{CMAX\_L\_CA\_2}$ = min {10log$_{10}$ $\Sigma P_{EMAX.C}$ -ΔT_c, $P_{PowerClass}$ - max (MPR + A - MPR, P-MPR) -ΔT_c}
Erfassen eines unteren Grenzwertes $P_{CMAX\_L\_CA\_3}$ der dritten maximalen Sendeleistung gemäß $P_{EMAX.1}$, $P_{EMAX.4}$ und $P_{EMAX.3}$ durch Verwendung einer Formel;
$P_{CM4X\_L\_CA\_3}$ = min {10log$_{10}$$\Sigma P_{EMAX.N}$ -ΔT_N, $P_{PowerClass}$ - max (MPR + A - MPR, P - MPR) -ΔT_N} Erfassen der zweiten Referenzsendeleistung P_{CMAX_O2} gemäß $P_{CMAX\_H\_CA\_2}$ und $P_{CMAX\_L\_CA\_2}$, sodass P_{CMAX_O2} $P_{CMAX\_L\_CA\_2} \leq P_{CMAX\_O2} \leq P_{CMAX\_H\_CA\_2}$ erfüllt; und
Erfassen der dritten Referenzsendeleistung P_{CMAX_O3} gemäß $P_{CMAX\_H\_CA\_3}$ und $P_{CMAX\_L\_CA\_3}$, sodass P_{CMAX_03} $P_{CMAX\_L\_CA\_3} \leq P_{CMAX\_03} \leq P_{CMAX\_H\_CA\_3}$ erfüllt, wobei das Durchführen einer Leistungssteuerung über die Sendeleistung mehrerer Träger in einem Überlappungsbereich umfasst:

Durchführen einer Leistungssteuerung über die Sendeleistung des ersten Trägers, des zweiten Trägers und des dritten Trägers im Überlappungsbereich durch Verwendung der zweiten Referenzsendeleistung und der dritten Referenzsendeleistung;
wobei sich der erste Träger in einer ersten Zeitvorlaufgruppe befindet; der zweite Träger sich in einer zweiten Zeitvorlaufgruppe befindet; der dritte Träger sich in einer dritten Zeitvorlaufgruppe befindet; die Zeitvorlaufwerte der ersten Zeitvorlaufgruppe,
der zweiten Zeitvorlaufgruppe und der dritten Zeitvorlaufgruppe verschieden sind; C in $P_{EMAX,C}$ {1, 2, 3} ist; N in $P_{EMAX.N}$ {1, 4, 3} ist; $P_{PowerClass}$eine maximale Leistungsübertragungsfähigkeit des UE angibt; MPR, A-MPR und P-MPR sämtlich die maximale Leistungsrücknahme angeben; und ΔT_C =1,5 dB oder ΔT_C=0dB ist.

8. Benutzergerät zur Steuerung der Uplink-Leistung in einem Trägeraggregationsszenario, umfassend

ein Erfassungsmodul (11), das dazu ausgelegt ist, eine erste maximale Sendeleistung des Benutzergerätes entsprechend einem ersten Teilrahmen und eine zweite maximale Sendeleistung des Benutzergerätes entsprechend einem zweiten Teilrahmen zu erfassen, wobei die erste maximale Sendeleistung und die zweite maximale Sendeleistung verschieden sind; und
ein Leistungssteuermodul (12), das dazu ausgelegt ist, eine Leistungssteuerung über die Sendeleistung mehrerer Träger in einem Überlappungsbereich durchzuführen, sodass die Gesamtsendeleistung der mehreren Träger im Überlappungsbereich nach der Leistungssteuerung kleiner oder gleich einem Minimalwert der ersten maximalen Sendeleistung und der zweiten maximalen Sendeleistung ist;
wobei der erste Teilrahmen und der zweite Teilrahmen angrenzende Teilrahmen sind und der Überlappungsbereich ein Abschnitt ist, in dem sich der erste Teilrahmen und der zweite Teilrahmen aufgrund einer Differenz in den Zeitvorlaufwerten der mehreren Träger überlappen.

9. Vorrichtung gemäß Anspruch 8, wobei die Leistungssteuereinheit speziell dazu ausgelegt ist, gemäß einer ersten ausgelegten maximalen Sendeleistung eine Leistungssteuerung über die Sendeleistung des ersten Teilrahmens, der sich im Überlappungsbereich befindet, und die Sendeleistung des zweiten Teilrahmens, der sich im Überlappungsbereich befindet, durchzuführen, wobei die erste ausgelegte maximale Sendeleistung ein Minimalwert der ersten maximalen Sendeleistung und der zweiten maximalen Sendeleistung ist; oder
die Leistungssteuereinheit speziell dazu ausgelegt ist, gemäß einer ersten ausgelegten maximalen Sendeleistung eine Leistungssteuerung über die Leistung eines Symbols, das den Überlappungsbereich im ersten Teilrahmen bildet, und die Leistung eines Symbols, das den Überlappungsbereich im zweiten Teilrahmen bildet, durchzuführen, wobei die erste ausgelegte maximale Sendeleistung ein Minimalwert der ersten maximalen Sendeleistung und der zweiten maximalen Sendeleistung ist.

10. Vorrichtung gemäß Anspruch 8, ferner umfassend:

ein Modul zum Berechnen eines oberen Grenzwertes, das dazu ausgelegt ist, einen oberen Grenzwert $P_{CMAX\_H\_CA\_1}$ der ersten maximalen Sendeleistung durch Verwendung einer Formel $P_{CMAX\_H\_CA\_1}$ = min{10 log$_{10}$ Σ $P_{EMAX.C}$, $P_{PowerClass}$} und gemäß der maximalen Sendeleistung $P_{EMAX.1}$ eines ersten Trägers, der durch ein Netzwerk im ersten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, und der maximalen Sendeleistung $P_{EMAX.2}$ eines zweiten Trägers, der durch das Netzwerk im zweiten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, zu erfassen, wobei ein Überschreiten der maximalen Sendeleistung $P_{EMAX.1}$ oder der maximalen Sendeleistung $P_{EMAX.2}$ unzulässig ist; und
ein Modul zum Berechnen eines unteren Grenzwertes, das dazu ausgelegt ist, einen $P_{CMAX\_L\_CA\_1}$ = min {10log$_{10}$ $\Sigma P_{EMAX.C}$ -ΔT_c, $P_{PowerClass}$ - max (MPR + A - MPR, P - MPR) -ΔT_c} unteren Grenzwert $P_{CMAX\_L\_CA\_1}$ der ersten maximalen Sendeleistung gemäß $P_{EMAX.1}$ und $P_{EMAX.2}$ durch Verwendung einer Formel zu erfassen,

wobei
das Erfassungsmodul ferner dazu ausgelegt ist, die erste Referenzsendeleistung P_{CMAX_O1} gemäß dem durch das Modul zum Berechnen eines oberen Grenzwertes erfassten $P_{CMAX\_H\_CA\_1}$ und dem durch das Modul zum Berechnen eines unteren Grenzwertes erfassten $P_{CMAX\_L\_CA\_1}$ zu erfassen, sodass P_{CMAX_O1} $P_{CMAX\_L\_CA\_1} \leq P_{CMAX\_O1} \leq P_{CMAX\_H\_CA\_1}$ erfüllt; und
das Leistungssteuermodul speziell dazu ausgelegt ist, eine Leistungssteuerung über die Sendeleistung des ersten Trägers und des zweiten Trägers im Überlappungsbereich durch Verwendung der ersten Referenzsendeleistung durchzuführen;
wobei sich der erste Träger in einer ersten Zeitvorlaufgruppe befindet; der zweite Träger sich in einer zweiten Zeitvorlaufgruppe befindet; die Zeitvorlaufwerte der ersten Zeitvorlaufgruppe und der zweiten Zeitvorlaufgruppe verschieden sind; C in $P_{EMAX.C}$ {1, 2} ist; $P_{PowerClass}$ eine maximale Leistungsübertragungsfähigkeit des UE anzeigt; *MPR, A-MPR* und *P - MPR* sämtlich eine maximale Leistungsrücknahme angeben; und ΔT_C =1,5 *dB* oder ΔT_C=0*dB* ist.

11. Vorrichtung gemäß Anspruch 10, wobei das Leistungssteuermodul umfasst:

eine Auslegungseinheit, die dazu ausgelegt ist, einen Minimalwert der ersten maximalen Sendeleistung und der ersten Referenzsendeleistung als zweite ausgelegte maximale Sendeleistung zu verwenden; und
eine Leistungssteuereinheit, die dazu ausgelegt ist, gemäß der zweiten ausgelegten maximalen Sendeleistung eine Leistungssteuerung über die Leistung des ersten Teilrahmens, der sich im Überlappungsbereich im ersten Träger befindet, durchzuführen, wobei
die Auslegungseinheit ferner dazu ausgelegt ist, einen Minimalwert der zweiten maximalen Sendeleistung und der ersten Referenzsendeleistung als dritte ausgelegte maximale Sendeleistung zu verwenden; und
die Leistungssteuereinheit ferner dazu ausgelegt ist, gemäß der dritten ausgelegten maximalen Sendeleistung eine Leistungssteuerung über die Leistung des zweiten Teilrahmens, der sich im Überlappungsbereich im zweiten Träger befindet, durchzuführen.

12. Vorrichtung gemäß Anspruch 10, wobei das Leistungssteuermodul umfasst:

eine Auslegungseinheit, die dazu ausgelegt ist, einen Minimalwert der ersten maximalen Sendeleistung und der ersten Referenzsendeleistung als zweite ausgelegte maximale Sendeleistung zu verwenden; und
eine Leistungssteuereinheit, die dazu ausgelegt ist, gemäß der zweiten ausgelegten maximalen Sendeleistung eine Leistungssteuerung über die Leistung eines Symbols durchzuführen, das den Überlappungsbereich im ersten Teilrahmen im ersten Träger bildet, wobei
die Auslegungseinheit ferner dazu ausgelegt ist, einen Minimalwert der zweiten maximalen Sendeleistung und der ersten Referenzsendeleistung als dritte ausgelegte maximale Sendeleistung zu verwenden; und
die Leistungssteuereinheit ferner dazu ausgelegt ist, gemäß der dritten ausgelegten maximalen Sendeleistung eine Leistungssteuerung über die Leistung eines Symbols durchzuführen, das den Überlappungsbereich im zweiten Teilrahmen im zweiten Träger bildet.

13. Vorrichtung gemäß Anspruch 10, wobei das Leistungssteuermodul speziell dazu ausgelegt ist, eine Leistungssteuerung über die Sendeleistung von Abtastwerten im Überlappungsbereich gemäß der ersten Referenzsendeleistung durchzuführen.

14. Vorrichtung gemäß Anspruch 8, ferner umfassend:

ein Modul zum Berechnen eines oberen Grenzwertes, das dazu ausgelegt ist, einen oberen Grenzwert $P_{CMAX\_H\_CA\_2}$ der zweiten maximalen Sendeleistung durch Verwendung einer Formel $P_{CMAX\_H\_CA\_2} = \min\{10 \log_{10} \sum P_{EMAX.C}, P_{PowerClass}\}$ und gemäß der maximalen Sendeleistung $P_{EMAX.1}$ eines ersten Trägers, der durch ein Netzwerk im ersten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, die maximale Sendeleistung $P_{EMAX.2}$ eines zweiten Trägers, der durch das Netzwerk im ersten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, und der maximalen Sendeleistung $P_{EMAX.3}$ eines dritten Trägers, der durch das Netzwerk im zweiten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, zu erfassen, wobei das Überschreiten der maximalen Sendeleistung $P_{EMAX.1}$, der maximalen Sendeleistung $P_{EMAX.2}$ oder der maximalen Sendeleistung $P_{EMAX.3}$ unzulässig ist, wobei
das Modul zum Berechnen eines oberen Grenzwertes ferner dazu ausgelegt ist, einen oberen Grenzwert $P_{CMAX\_H\_CA\_3}$ der dritten maximalen Sendeleistung durch Verwendung einer Formel $P_{CMAX\_H\_CA\_3} = \min\{10 \log_{10} \sum P_{EMAX.N}, P_{PowerClass}\}$ und gemäß der maximalen Sendeleistung $P_{EMAX.1}$ des ersten Trägers im ersten

Teilrahmen, der sich im Überlappungsbereich befindet, der maximalen Sendeleistung $P_{EMAX.4}$ des zweiten Trägers im zweiten Teilrahmen, der sich im Überlappungsbereich befindet, und der maximalen Sendeleistung $P_{EMAX.3}$ des dritten Trägers, der durch das Netzwerk im zweiten Teilrahmen, der sich im Überlappungsbereich befindet, geliefert wird, zu erfassen, wobei ein Überschreiten der maximalen Sendeleistung $P_{EMAX.1}$, der maximalen Sendeleistung $P_{EMAX.4}$ oder der maximalen Sendeleistung $P_{EMAX.3}$ unzulässig ist; und
ein Modul zum Berechnen eines unteren Grenzwertes, das dazu ausgelegt ist, einen unteren Grenzwert $P_{CMAXL\text{-}CA\_2}$ der zweiten maximalen Sendeleistung gemäß $P_{EMAX.1}$, $P_{EMAX.2}$ und $P_{EMAX.3}$ durch Verwendung einer Formel

$$P_{CMAX\_L\_CA\_2} = \min\left\{10\log_{10}\sum P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max\left(MPR + A - MPR, P - MPR\right) - \Delta T_c\right\}$$

zu erfassen, wobei
das Modul zum Berechnen eines unteren Grenzwertes ferner dazu ausgelegt ist, einen unteren Grenzwert $P_{CMAX\_L\_CA\_3}$ der dritten maximalen Sendeleistung gemäß $P_{EMAX.1}$, $P_{EMAX.4}$ und $P_{EMAX.3}$ durch Verwendung einer Formel

$$P_{CMAX\_L\_CA\_3} = \min\left\{10\log_{10}\sum P_{EMAX.N} - \Delta T_N, P_{PowerClass} - \max\left(MPR + A - MPR, P - MPR\right) - \Delta T_N\right\}$$

zu erfassen;
das Erfassungsmodul ferner dazu ausgelegt ist, die zweite Referenzsendeleistung P_{CMAX_O2} gemäß dem durch das Modul zum Berechnen eines oberen Grenzwertes erfassten $P_{CMAX\_H\_CA\_2}$ und dem durch das Modul zum Berechnen eines unteren Grenzwertes erfassten $P_{CMAX\_L\_CA\_2}$ zu erfassen, sodass P_{CMAX_O2} $P_{CMAX\_L\_CA\_2} \leq P_{CMAX\_O2} \leq P_{CMAX\_H\_CA\_2}$ erfüllt;
das Erfassungsmodul ferner dazu ausgelegt ist, die dritte Referenzsendeleistung P_{CMAX_03} gemäß dem durch das Modul zum Berechnen eines oberen Grenzwertes erfassten $P_{CMAX\_H\_CA\_3}$ und dem durch das Modul zum Berechnen eines unteren Grenzwertes erfassten $P_{CMAX\_L\_CA\_3}$ zu erfassen, sodass P_{CMAX_O3} $P_{CMAX\_L\_CA\_3} \leq P_{CMAX\_03} \leq P_{CMAX\_H\_CA\_3}$ erfüllt; und
das Leistungssteuermodul speziell dazu ausgelegt ist, eine Leistungssteuerung über die Sendeleistung des ersten Trägers, des zweiten Trägers und des dritten Trägers im Überlappungsbereich durch Verwendung der zweiten Referenzsendeleistung und der dritten Referenzsendeleistung durchzuführen;
wobei sich der erste Träger in einer ersten Zeitvorlaufgruppe befindet; der zweite Träger sich in einer zweiten Zeitvorlaufgruppe befindet; der dritte Träger sich in einer dritten Zeitvorlaufgruppe befindet; die Zeitvorlaufwerte der ersten Zeitvorlaufgruppe,
der zweiten Zeitvorlaufgruppe und der dritten Zeitvorlaufgruppe verschieden sind; C in $P_{EMAX,C}$ {1, 2, 3} ist; *N* in $P_{EMAX.N}$ {1, 4, 3} ist; $P_{PowerClass}$ eine maximale Leistungsübertragungsfähigkeit des UE angibt; *MPR, A-MPR* und *P-MPR* sämtlich die maximale Leistungsrücknahme angeben; und ΔT_C =1,5 *dB* oder ΔT_C=0*dB* ist.

15. Computerlesbares Speichermedium, umfassend Computerprogrammcodes, die beim Ausführen durch einen Computerprozessor den Computerprozessor veranlassen, die Schritte gemäß einem der Ansprüche 1 bis 7 auszuführen.

Revendications

1. Procédé de commande de puissance de liaison montante d'un équipement utilisateur dans un scénario d'agrégation de porteuses, comprenant :

l'acquisition (101), par l'équipement utilisateur, d'une première puissance de transmission maximum de l'équipement utilisateur correspondant à une première sous-trame et d'une deuxième puissance de transmission maximum de l'équipement utilisateur correspondant à une seconde sous-trame, dans lequel la première puissance de transmission maximum et la deuxième puissance de transmission maximum sont différentes ; et
l'exécution (102), par l'équipement utilisateur, d'une commande de puissance sur une puissance de transmission de multiples porteuses dans une région de chevauchement, de sorte qu'une puissance de transmission totale des multiples porteuses dans la région de chevauchement après la commande de puissance est inférieure ou égale à une valeur minimum de la première puissance de transmission maximum et de la deuxième puissance de transmission maximum ;
dans lequel, la première sous-trame et la seconde sous-trame sont des sous-trames adjacentes, et la région

de chevauchement est une partie dans laquelle la première sous-trame et la seconde sous-trame se chevauchent en raison d'une différence dans des valeurs d'avance de synchronisation des multiples porteuses.

2. Procédé selon la revendication 1, dans lequel l'exécution d'une commande de puissance sur une puissance de transmission de multiples porteuses dans une région de chevauchement comprend :

l'exécution, en fonction d'une première puissance de transmission maximum configurée, d'une commande de puissance sur une puissance de transmission de la première sous-trame située dans la région de chevauchement et une puissance de transmission de la seconde sous-trame située dans la région de chevauchement, dans lequel la première puissance de transmission maximum configurée est une valeur minimum de la première puissance de transmission maximum et de la deuxième puissance de transmission maximum ; ou
l'exécution, en fonction d'une première puissance de transmission maximum configurée, d'une commande de puissance sur une puissance d'un symbole formant la région de chevauchement dans la première sous-trame et une puissance d'un symbole formant la région de chevauchement dans la seconde sous-trame, dans lequel la première puissance de transmission maximum configurée est une valeur minimum de la première puissance de transmission maximum et de la deuxième puissance de transmission maximum.

3. Procédé selon la revendication 1, comprenant en outre :

l'acquisition d'une limite supérieure $P_{CMAX\_H\_CA\_1}$ de la première puissance de transmission maximum en utilisant une formule $P_{CMAX\_H\_CA\_1}$ = mis $\{10\log_{10} \Sigma P_{EMAX.C}, P_{PowerClass}\}$
et en fonction d'une puissance de transmission maximum $P_{EMAX.1}$ d'une première porteuse délivrée par un réseau dans la première sous-trame formant la région de chevauchement, et d'une puissance de transmission maximum $P_{EMAX.2}$ d'une deuxième porteuse délivrée par le réseau dans la seconde sous-trame située dans la région de chevauchement, dans lequel dépasser la puissance de transmission maximum $P_{EMAX.1}$ ou la puissance de transmission maximum $P_{EMAX.2}$ n'est pas autorisé ;
l'acquisition d'une limite inférieure $P_{CMAX\_L\_CA\_1}$ de la première puissance de transmission maximum en fonction de $P_{EMAX.1}$ et de $P_{EMAX\cdot 2}$ en utilisant une formule $P_{CMAX\_L\_CA\_1} = \min\{10\log_{10} \Sigma P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max(MPR + A - MPR, P - MPR) - \Delta T_c\}$ et
l'acquisition d'une première puissance de transmission de référence P_{CMAX_01} en fonction de $P_{CMAX\_HCA\_1}$ et de $P_{CMAX\_L\_CA\_1}$, de sorte que P_{CMAX_01} satisfait $P_{CMAX\_L\_CA\_1} \leq P_{CMAX\_01} \leq P_{CMAX\_H\_CA\_1}$, dans lequel l'exécution d'une commande de puissance sur une puissance de transmission de multiples porteuses dans une région de chevauchement comprend :

l'exécution d'une commande de puissance sur une puissance de transmission de la première porteuse et de la deuxième porteuse dans la région de chevauchement en utilisant la première puissance de transmission de référence ;
dans lequel la première porteuse est située dans un premier groupe d'avance de synchronisation ; la deuxième porteuse est située dans un deuxième groupe d'avance de synchronisation ; des valeurs d'avance de synchronisation du premier groupe d'avance de synchronisation et du deuxième groupe d'avance de synchronisation sont différentes; C dans $P_{EMAX.C}$ est {1, 2}; $P_{PowerClass}$ indique une capacité de transmission de puissance maximum de l'UE ; *MPR, A-MPR* et *P-MPR* indiquent tous une réduction de puissance maximum ; et ΔT_C=1,5dB ou ΔT_C=0dB.

4. Procédé selon la revendication 3, dans lequel l'exécution d'une commande de puissance sur la première porteuse et la deuxième porteuse dans les multiples porteuses dans la région de chevauchement en utilisant la première puissance de transmission de référence comprend :

l'utilisation d'une valeur minimum de la première puissance de transmission maximum et de la première puissance de transmission de référence en tant que deuxième puissance de transmission maximum configurée, et l'exécution, en fonction de la deuxième puissance de transmission maximum configurée, d'une commande de puissance sur une puissance de la première sous-trame située dans la région de chevauchement dans la première porteuse ; et
l'utilisation d'une valeur minimum de la deuxième puissance de transmission maximum et de la première puissance de transmission de référence en tant que troisième puissance de transmission maximum configurée, et l'exécution, en fonction de la troisième puissance de transmission maximum configurée, d'une commande de puissance sur une puissance de la seconde sous-trame située dans la région de chevauchement dans la deuxième porteuse.

5. Procédé selon la revendication 3, dans lequel l'exécution d'une commande de puissance sur la première porteuse et la deuxième porteuse dans les multiples porteuses dans la région de chevauchement en utilisant la première puissance de transmission de référence comprend :

l'utilisation d'une valeur minimum de la première puissance de transmission maximum et de la première puissance de transmission de référence en tant que deuxième puissance de transmission maximum configurée, et l'exécution, en fonction de la deuxième puissance de transmission maximum configurée, d'une commande de puissance sur une puissance d'un symbole formant la région de chevauchement dans la première sous-trame dans la première porteuse ; et
l'utilisation d'une valeur minimum de la deuxième puissance de transmission maximum et de la première puissance de transmission de référence en tant que troisième puissance de transmission maximum configurée, et l'exécution, en fonction de la troisième puissance de transmission maximum configurée, d'une commande de puissance sur une puissance d'un symbole formant la région de chevauchement dans la seconde sous-trame dans la deuxième porteuse.

6. Procédé selon la revendication 3, dans lequel l'exécution d'une commande de puissance sur la première porteuse et la deuxième porteuse dans les multiples porteuses dans la région de chevauchement en utilisant la première puissance de transmission de référence comprend :
l'exécution d'une commande de puissance sur une puissance de transmission d'échantillons dans la région de chevauchement en fonction de la première puissance de transmission de référence.

7. Procédé selon la revendication 1, comprenant en outre :

l'acquisition d'une limite supérieure $P_{CMAX\_HCA\_2}$ de la deuxième puissance de transmission maximum en utilisant une formule $P_{CMAX\_H\_CA\_2} = \min\{10\log_{10} \sum P_{EMAX.C}, P_{PowerClass}\}$ et en fonction d'une puissance de transmission maximum $P_{EMAX.1}$ d'une première porteuse délivrée par un réseau dans la première sous-trame située dans la région de chevauchement, d'une puissance de transmission maximum $P_{EMAX.2}$ d'une deuxième porteuse délivrée par le réseau dans la première sous-trame située dans la région de chevauchement, et d'une puissance de transmission maximum $P_{EMAX.3}$ d'une troisième porteuse délivrée par le réseau dans la seconde sous-trame située dans la région de chevauchement, dans lequel dépasser la puissance de transmission maximum $P_{EMAX.1}$, la puissance de transmission maximum $P_{EMAX.2}$, ou la puissance de transmission maximum $P_{EMAX.3}$ n'est pas autorisé ;
l'acquisition d'une limite supérieure $P_{CMAX\_H\_C4\_3}$ d'une troisième puissance de transmission maximum en utilisant une formule

$$P_{CMAX\_H\_CA\_3} = \min\left\{10\log_{10} \sum P_{EMAX.N}, P_{PowerClass}\right\}$$

et en fonction de la puissance de transmission maximum $P_{EMAX.1}$ de la première porteuse dans la première sous-trame située dans la région de chevauchement, d'une puissance de transmission maximum $P_{EMAX.4}$ de la deuxième porteuse dans la seconde sous-trame située dans la région de chevauchement, et de la puissance de transmission maximum $P_{EMAX.3}$ de la troisième porteuse délivrée par le réseau dans la seconde sous-trame située dans la région de chevauchement, dans lequel dépasser la puissance de transmission maximum $P_{EMAX.1}$, la puissance de transmission maximum $P_{EMAX.4}$, ou la puissance de transmission maximum $P_{EMAX.3}$ n'est pas autorisé, l'acquisition d'une limite inférieure $P_{CMAX\_L\_CA\_2}$ de la deuxième puissance de transmission maximum en fonction de $P_{EMAX.1}$, de $P_{EMAX.2}$ et de $P_{EMAX.3}$ en utilisant une formule

$$P_{CMAX\_L\_CA\_2} = \min\left\{10\log_{10} \sum P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max\left(MPR + A - MPR, P - MPR\right) - \Delta T_c\right\}$$

;
l'acquisition d'une limite inférieure $P_{CMAX\_L\_CA\_3}$ de la troisième puissance de transmission maximum en fonction de $P_{EMAX.1}$, de $P_{EMAX.4}$ et de $P_{EMAX.3}$ en utilisant une formule

$$P_{CMAX\_L\_CA\_3} = \min\left\{10\log_{10} \sum P_{EMAX.N} - \Delta T_N, P_{PowerClass} - \max\left(MPR + A - MPR, P - MPR\right) - \Delta T_N\right\}$$

;

l'acquisition d'une deuxième puissance de transmission de référence P_{CMAX_02} en fonction de $P_{CMAX\_H\_CA\_2}$ et de $P_{CMAX\_L\_CA\_2}$, de sorte que P_{CM4X_02} satisfait $P_{CMAX\_L\_\ CA\_2} \leq P_{CMAX\_02} \leq P_{CMAX\_H\_CA\_2}$; et l'acquisition d'une troisième puissance de transmission de référence P_{CMAX_03} en fonction de $P_{CMAX\_H\_CA\_3}$ et de $P_{CMAX\_L\_CA\_3}$, de sorte que P_{CMAX_03} satisfait $P_{CMAX\_L\_CA\_3} \leq P_{CMAX\_03} \leq P_{CMAX\_H\_CA\_3}$, dans lequel l'exécution d'une commande de puissance sur une puissance de transmission de multiples porteuses dans une région de chevauchement comprend :

l'exécution d'une commande de puissance sur une puissance de transmission de la première porteuse, la deuxième porteuse et la troisième porteuse dans la région de chevauchement en utilisant la deuxième puissance de transmission de référence et la troisième puissance de transmission de référence ;
dans lequel, la première porteuse est située dans un premier groupe d'avance de synchronisation ; la deuxième porteuse est située dans un deuxième groupe d'avance de synchronisation ; la troisième porteuse est située dans un troisième groupe d'avance de synchronisation ; des valeurs d'avance de synchronisation du premier groupe d'avance de synchronisation, du deuxième groupe d'avance de synchronisation et du troisième groupe d'avance de synchronisation sont différentes ;
C dans $P_{EMAX.C}$ est {1, 2, 3} ; *N* dans $P_{EMAX.N}$ est {1, 4, 3} ; $P_{PowerClass}$ indique une capacité de transmission de puissance maximum de l'UE ; *MPR, A-MPR* et *P-MPR* indiquent tous une réduction de puissance maximum ; et ΔT_C=1,5*dB* ou ΔT_C=0*dB*.

8. Équipement utilisateur permettant de commander une puissance de liaison montante dans un scénario d'agrégation de porteuses, comprenant :

un module d'acquisition (11), configuré pour acquérir une première puissance de transmission maximum de l'équipement utilisateur correspondant à une première sous-trame et une deuxième puissance de transmission maximum de l'équipement utilisateur correspondant à une seconde sous-trame, dans lequel la première puissance de transmission maximum et la deuxième puissance de transmission maximum sont différentes ; et
un module de commande de puissance (12), configuré pour exécuter une commande de puissance sur une puissance de transmission de multiples porteuses dans une région de chevauchement, de sorte qu'une puissance de transmission totale des multiples porteuses dans la région de chevauchement après la commande de puissance est inférieure ou égale à une valeur minimum de la première puissance de transmission maximum et de la deuxième puissance de transmission maximum ;
dans lequel la première sous-trame et la seconde sous-trame sont des sous-trames adjacentes, et la région de chevauchement est une partie dans laquelle la première sous-trame et la seconde sous-trame se chevauchent en raison d'une différence dans des valeurs d'avance de synchronisation des multiples porteuses.

9. Appareil selon la revendication 8, dans lequel l'unité de commande de puissance est configurée spécifiquement pour exécuter, en fonction d'une première puissance de transmission maximum configurée, une commande de puissance sur une puissance de transmission de la première sous-trame située dans la région de chevauchement et une puissance de transmission de la seconde sous-trame située dans la région de chevauchement, dans lequel la première puissance de transmission maximum configurée est une valeur minimum de la première puissance de transmission maximum et de la deuxième puissance de transmission maximum ; ou
l'unité de commande de puissance est configurée spécifiquement pour exécuter, en fonction d'une première puissance de transmission maximum configurée, une commande de puissance sur une puissance d'un symbole formant la région de chevauchement dans la première sous-trame et une puissance d'un symbole formant la région de chevauchement dans la seconde sous-trame, dans lequel la première puissance de transmission maximum configurée est une valeur minimum de la première puissance de transmission maximum et de la deuxième puissance de transmission maximum.

10. Appareil selon la revendication 8, comprenant en outre :

un module de calcul de limite supérieure, configuré pour acquérir une limite supérieure $P_{CMAX\_H\_CA\_1}$ de la première puissance de transmission maximum en utilisant une formule $P_{CMAX\_H\_CA\_1} = \min\{10\log_{10}\sum P_{EMAX.C}, P_{PowerClass}\}$ et en fonction d'une puissance de transmission maximum $P_{EMAX.1}$ d'une première porteuse délivrée par un réseau dans la première sous-trame située dans la région de chevauchement, et d'une puissance de transmission maximum $P_{EMAX.2}$ d'une deuxième porteuse délivrée par le réseau dans la seconde sous-trame située dans la région de chevauchement, dans lequel dépasser la puissance de transmission maximum $P_{EMAX.1}$ ou la puissance de transmission maximum $P_{EMAX.2}$ n'est pas autorisé ; et
un module de calcul de limite inférieure, configuré pour acquérir une limite inférieure $P_{CMAX\_L\_CA\_1}$ de la première

puissance de transmission maximum en fonction de $P_{EMAX.1}$ et de $P_{EMAX.2}$ en utilisant une formule

$$P_{CMAX\_L\_CA\_1} = \min\left\{10\log_{10}\sum P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max\left(MPR + A - MPR, P - MPR\right) - \Delta T_c\right\}$$

dans lequel
le module d'acquisition est configuré en outre pour acquérir une première puissance de transmission de référence P_{CMAX_01} en fonction de $P_{CMAX\_H\_CA\_1}$ acquis par le module de calcul de limite supérieure et de $P_{CMAX\_L\_CA\_1}$ acquis par le module de calcul de limite inférieure, de sorte que P_{CMAX_01} satisfait $P_{CMAX\_L\_CA\_1} \leq P_{CMAX\_01} \leq P_{CMAX\_H\_CA\_1}$; et
le module de commande de puissance est configuré spécifiquement pour exécuter une commande de puissance sur une puissance de transmission de la première porteuse et de la deuxième porteuse dans la région de chevauchement en utilisant la première puissance de transmission de référence ;
dans lequel la première porteuse est située dans un premier groupe d'avance de synchronisation ; la deuxième porteuse est située dans un deuxième groupe d'avance de synchronisation ; des valeurs d'avance de synchronisation du premier groupe d'avance de synchronisation et du deuxième groupe d'avance de synchronisation sont différentes; C dans le $P_{EMAX.C}$ est {1, 2}; $P_{PowerClass}$ indique une capacité de transmission de puissance maximum de l'UE ; *MPR, A-MPR* et *P-MPR* indiquent tous une réduction de puissance maximum ; et ΔT_C=1,5dB ou ΔT_C=0dB.

11. Appareil selon la revendication 10, dans lequel le module de commande de puissance comprend :

une unité de configuration, configurée pour utiliser une valeur minimum de la première puissance de transmission maximum et de la première puissance de transmission de référence en tant que deuxième puissance de transmission maximum configurée ; et
une unité de commande de puissance, configurée pour exécuter, en fonction de la deuxième puissance de transmission maximum configurée, une commande de puissance sur une puissance de la première sous-trame située dans la région de chevauchement dans la première porteuse, dans lequel
l'unité de configuration est configurée en outre pour utiliser une valeur minimum de la deuxième puissance de transmission maximum et de la première puissance de transmission de référence en tant que troisième puissance de transmission maximum configurée ; et
l'unité de commande de puissance est configurée en outre pour exécuter, en fonction de la troisième puissance de transmission maximum configurée, une commande de puissance sur une puissance de la seconde sous-trame située dans la région de chevauchement dans la deuxième porteuse.

12. Appareil selon la revendication 10, dans lequel le module de commande de puissance comprend :

une unité de configuration, configurée pour utiliser une valeur minimum de la première puissance de transmission maximum et de la première puissance de transmission de référence en tant que deuxième puissance de transmission maximum configurée ; et
une unité de commande de puissance, configurée pour exécuter, en fonction de la deuxième puissance de transmission maximum configurée, une commande de puissance sur une puissance d'un symbole formant la région de chevauchement dans la première sous-trame dans la première porteuse, dans lequel l'unité de configuration est configurée en outre pour utiliser une valeur minimum de la deuxième puissance de transmission maximum et de la première puissance de transmission de référence en tant que troisième puissance de transmission maximum configurée ; et
l'unité de commande de puissance est configurée en outre pour exécuter, en fonction de la troisième puissance de transmission maximum configurée, une commande de puissance sur une puissance d'un symbole formant la région de chevauchement dans la seconde sous-trame dans la deuxième porteuse.

13. Appareil selon la revendication 10, dans lequel le module de commande de puissance est configuré spécifiquement pour exécuter une commande de puissance sur une puissance de transmission d'échantillons dans la région de chevauchement en fonction de la première puissance de transmission de référence.

14. Appareil selon la revendication 8, comprenant en outre :

un module de calcul de limite supérieure, configuré pour acquérir une limite supérieure $P_{CMAX\_H\_CA\_2}$ de la deuxième puissance de transmission maximum en utilisant une formule $P_{CMAX\_H\_CA\_2}$ = min {10log$_{10}$ $\sum P_{EMAX.C}$,

$P_{PowerClass}$} et en fonction d'une puissance de transmission maximum $P_{EMAX.1}$ d'une première porteuse délivrée par un réseau dans la première sous-trame située dans la région de chevauchement, d'une puissance de transmission maximum $P_{EMAX.2}$ d'une deuxième porteuse délivrée par le réseau dans la première sous-trame située dans la région de chevauchement, et d'une puissance de transmission maximum $P_{EMAX.3}$ d'une troisième porteuse délivrée par le réseau dans la seconde sous-trame située dans la région de chevauchement, dans lequel dépasser la puissance de transmission maximum $P_{EMAX.1}$, la puissance de transmission maximum $P_{EMAX.2}$, ou la puissance de transmission maximum $P_{EMAX.3}$ n'est pas autorisé, dans lequel le module de calcul de limite supérieure est configuré en outre pour acquérir une limite supérieure $P_{CMAX\_H\_C4\_3}$ d'une troisième puissance de transmission maximum en utilisant une formule

$$P_{CMAX\_H\_CA\_3} = \min\left\{10\log_{10}\sum P_{EMAX.N}, P_{PowerClass}\right\}$$

et en fonction de la puissance de transmission maximum $P_{EMAX.1}$ de la première porteuse dans la première sous-trame située dans la région de chevauchement, d'une puissance de transmission maximum $P_{EMAX.4}$ de la deuxième porteuse dans la seconde sous-trame située dans la région de chevauchement, et de la puissance de transmission maximum $P_{EMAX.3}$ de la troisième porteuse délivrée par le réseau dans la seconde sous-trame située dans la région de chevauchement, dans lequel dépasser la puissance de transmission maximum $P_{EMAX.1}$, la puissance de transmission maximum $P_{EMAX.4}$, ou la puissance de transmission maximum $P_{EMAX.3}$ n'est pas autorisé ; et
un module de calcul de limite inférieure, configuré pour acquérir une limite inférieure $P_{CMAXL\_CA\_2}$ de la deuxième puissance de transmission maximum en fonction de $P_{EMAX.1}$, de $P_{EMAX.2}$ et de $P_{EMAX.3}$ en utilisant une formule

$$P_{CMAX\_L\_CA\_2} = \min\left\{10\log_{10}\sum P_{EMAX.C} - \Delta T_c, P_{PowerClass} - \max\left(MPR + A - MPR, P - MPR\right) - \Delta T_c\right\}$$

, dans lequel
le module de calcul de limite inférieure est configuré en outre pour acquérir une limite inférieure $P_{CMAX\_L\_CA\_3}$ de la troisième puissance de transmission maximum en fonction de $P_{EMAX.1}$, de $P_{EMAX.4}$ et de $P_{EMAX.3}$ en utilisant une formule

$$P_{CMAX\_L\_CA\_3} = \min\left\{10\log_{10}\sum P_{EMAX.N} - \Delta T_N, P_{PowerClass} - \max\left(MPR + A - MPR, P - MPR\right) - \Delta T_N\right\};$$

le module d'acquisition est configuré en outre pour acquérir une deuxième puissance de transmission de référence P_{CMAX_02} en fonction de $P_{CMAX8H\_CA\_2}$ acquis par le module de calcul de limite supérieure et de $P_{CMAX\_L\_CA\_2}$ acquis par le module de calcul de limite inférieure, de sorte que P_{CMAX_02} satisfait $P_{CMAX\_L\_CA\_2} \le P_{CMAX\_02} \le P_{CMAX\_H\_CA\_2}$,
le module d'acquisition est configuré en outre pour acquérir une troisième puissance de transmission de référence P_{CMAX_03} en fonction de $P_{CMAX\_H\_CA\_3}$ acquis par le module de calcul de limite supérieure et de $P_{CMAX\_L\_CA\_3}$ acquis par le module de calcul de limite inférieure, de sorte que P_{CMAX_03} satisfait $P_{CMAX\_L\_CA\_3} \le P_{CMAX\_03} \le P_{CMAX\_H\_CA\_3}$; et
le module de commande de puissance est configuré spécifiquement pour exécuter une commande de puissance sur une puissance de transmission de la première porteuse, la deuxième porteuse et la troisième porteuse dans la région de chevauchement en utilisant la deuxième puissance de transmission de référence et la troisième puissance de transmission de référence ;
dans lequel la première porteuse est situé dans un premier groupe d'avance de synchronisation ; la deuxième porteuse est située dans un deuxième groupe d'avance de synchronisation ; la troisième porteuse est située dans un troisième groupe d'avance de synchronisation ; des valeurs d'avance de synchronisation du premier groupe d'avance de synchronisation, du deuxième groupe d'avance de synchronisation et du troisième groupe d'avance de synchronisation sont différentes ;
C dans $P_{EMAX.C}$ est {1, 2, 3} ; N dans $P_{EMAX.N}$ est {1, 4, 3} ; $P_{PowerClass}$ indique une capacité de transmission de puissance maximum de l'UE ; *MPR, A-MPR* et *P-MPR* indiquent tous une réduction de puissance maximum ; et ΔT_C=1,5*dB* ou ΔT_C=0*dB*.

15. Support de stockage lisible par ordinateur, comprenant des codes de programme informatique qui, lorsqu'ils sont exécutés par un processeur informatique, amènent le processeur informatique à exécuter les étapes selon l'une quelconque des revendications 1 à 7.

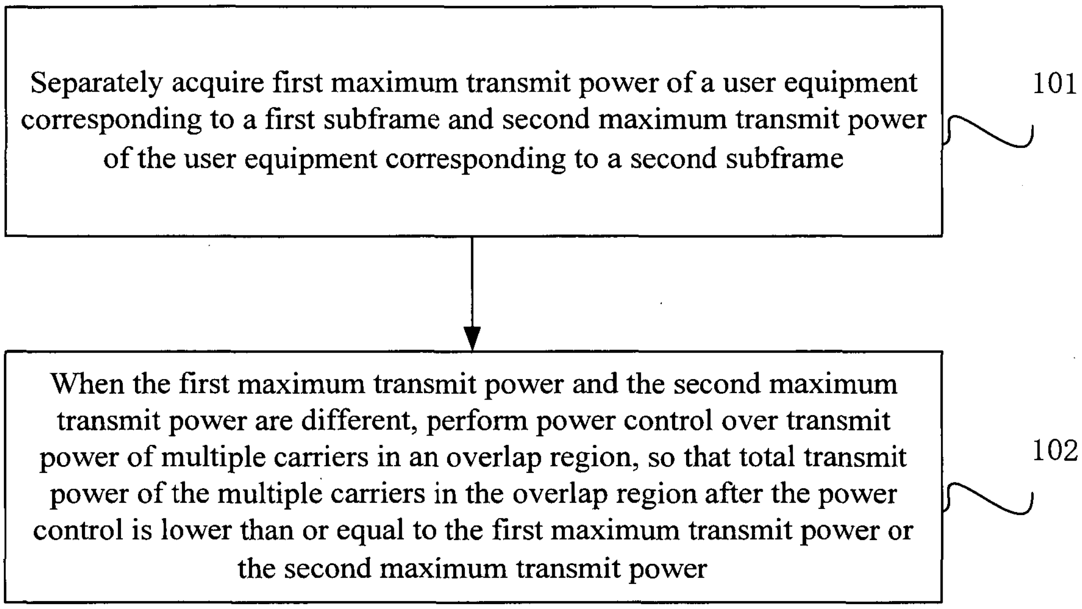
Separately acquire first maximum transmit power of a user equipment corresponding to a first subframe and second maximum transmit power of the user equipment corresponding to a second subframe
101
When the first maximum transmit power and the second maximum transmit power are different, perform power control over transmit power of multiple carriers in an overlap region, so that total transmit power of the multiple carriers in the overlap region after the power control is lower than or equal to the first maximum transmit power or the second maximum transmit power
102

FIG. 1

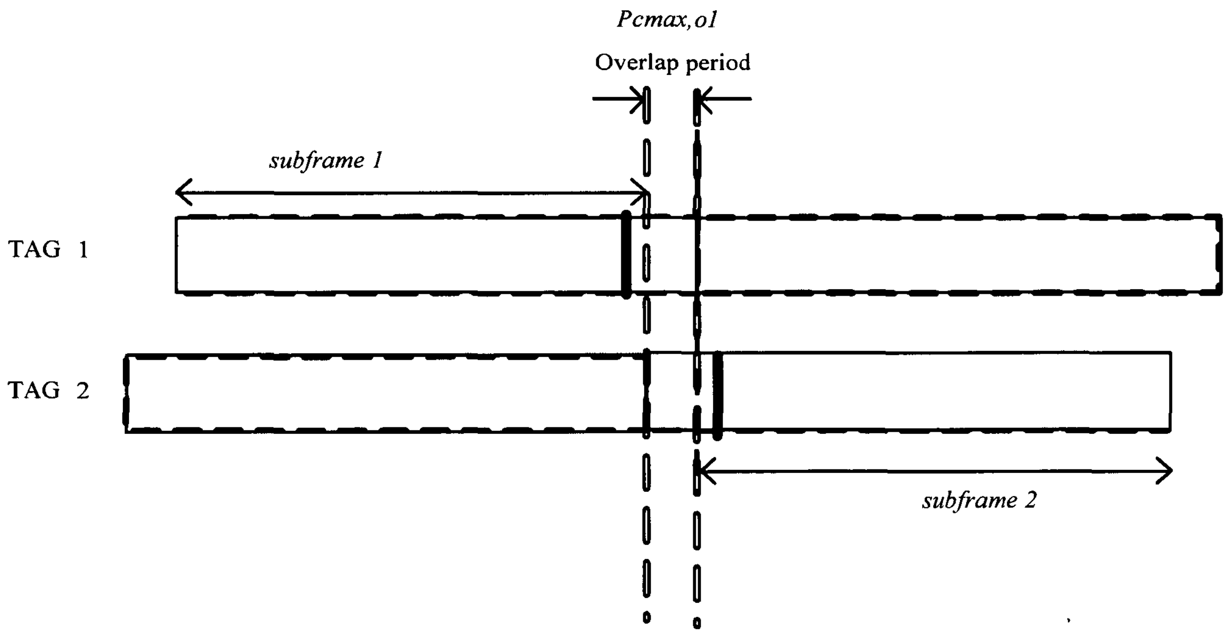
Pcmax,ol
Overlap period
subframe 1
TAG 1
TAG 2
subframe 2

FIG. 2

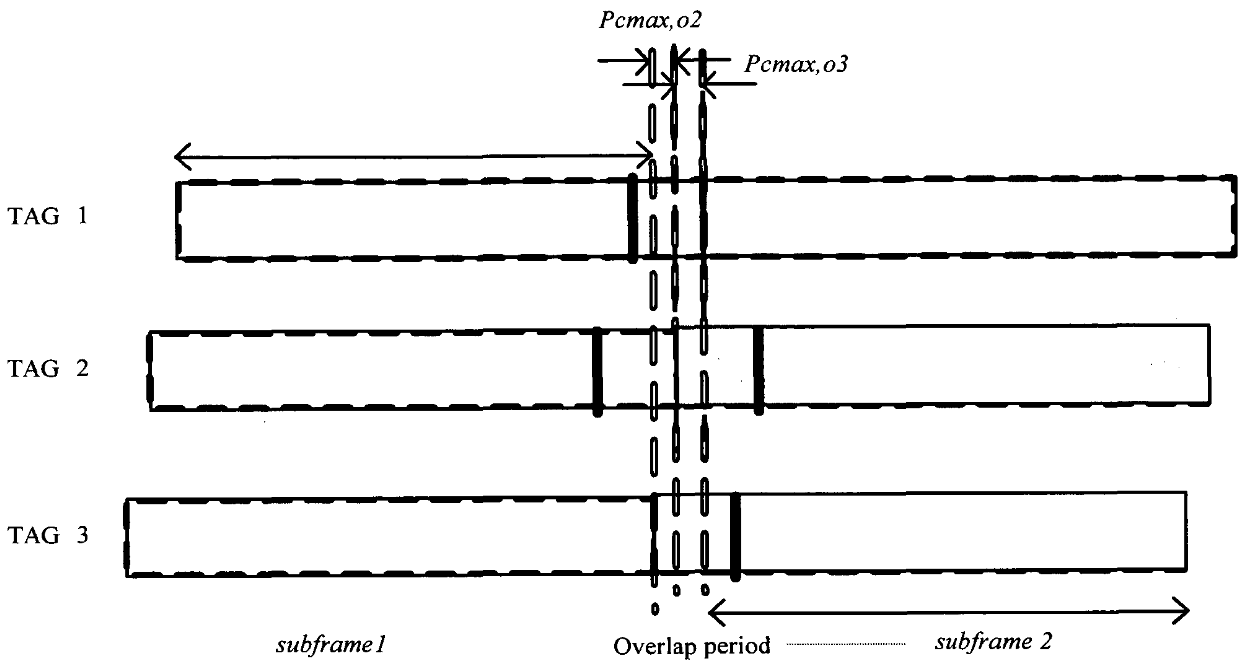
Pcmax,o2
Pcmax,o3
TAG 1
TAG 2
TAG 3
subframe1
Overlap period
subframe 2

FIG. 3

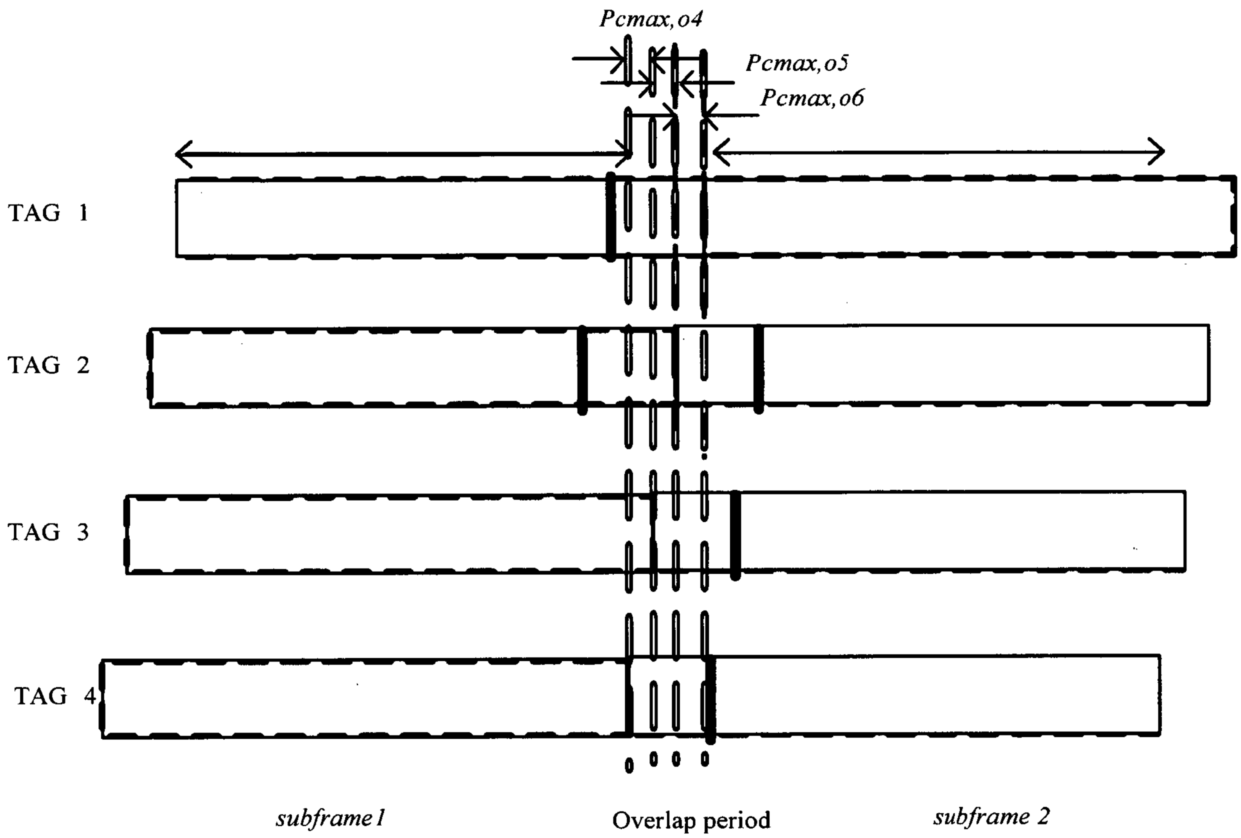
Pcmax,o4
Pcmax,o5
Pcmax,o6
TAG 1
TAG 2
TAG 3
TAG 4
subframe1
Overlap period
subframe 2

FIG. 4

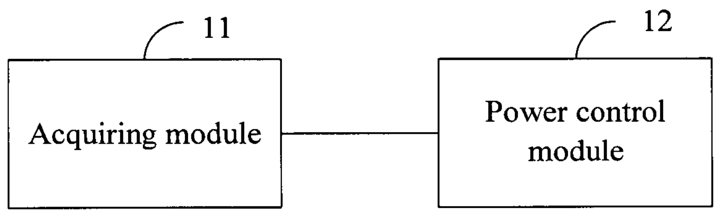
11
12
Acquiring module
Power control module

FIG. 5

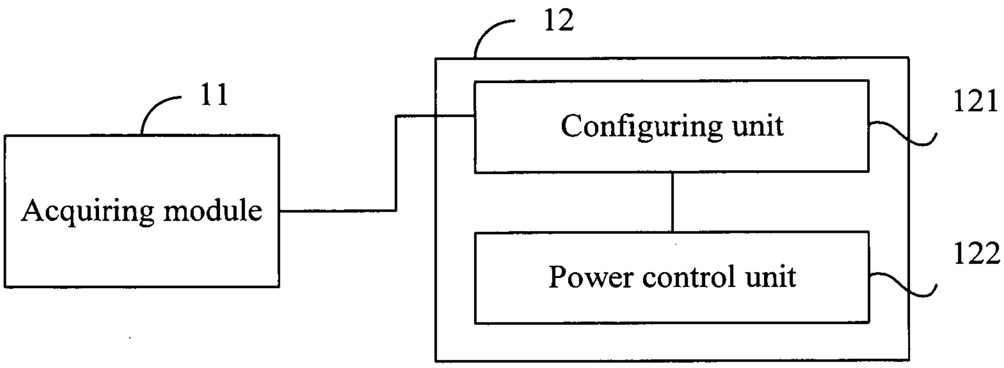
12
11
121
Configuring unit
Acquiring module
122
Power control unit

FIG. 6

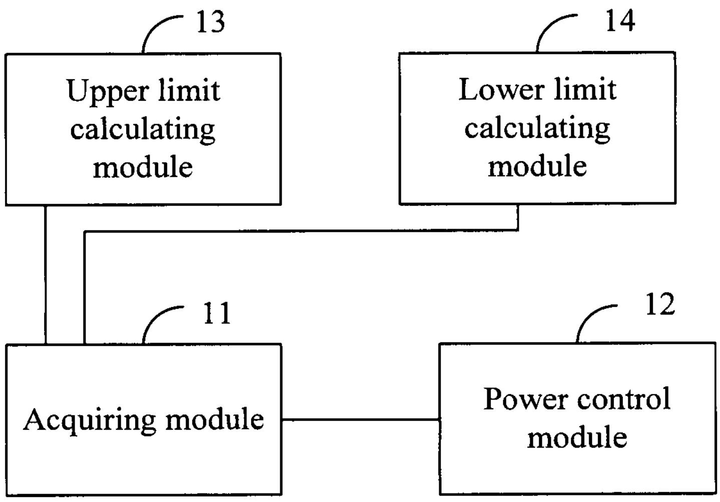
13
14
Upper limit calculating module
Lower limit calculating module
11
12
Acquiring module
Power control module

FIG. 7

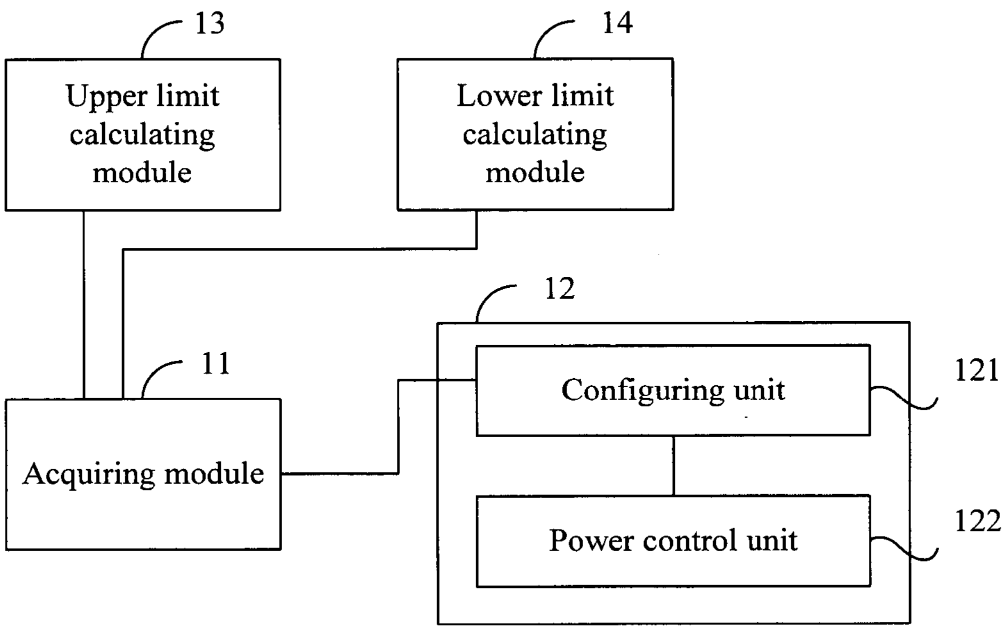
13
Upper limit calculating module
14
Lower limit calculating module
12
11
Acquiring module
Configuring unit
121
Power control unit
122

FIG. 8

REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- Simultaneous transmissions in multiple TA groups. **LG ELECTRONICS.** 3GPP DRAFT; R1-120424 MULTIPLE TA_SIMULTANEOUS TX, 3RD GENERATION PARTNERSHIP PROJECT (3GPP). MOBILE COMPETENCE CENTRE, 31 January 2012 **[0003]**