METHOD AND APPARATUS FOR DETERMINING TRANSMIT POWER

FIELD OF THE INVENTION

The present invention relates to communications technologies, and in particular, to a method and an apparatus for determining transmit power.

BACKGROUND OF THE INVENTION

In a Wideband Code Division Multiple Access (WCDMA) system, the transmit power required by an Enhanced Dedicated Channel Dedicated Physical Data Channel (E-DPDCH) can be obtained according to an E-DPDCH gain factor. The E-DPDCH gain factor may be calculated by an extrapolation formula using one reference Enhanced Dedicated Channel Transport Format Combination (E-TFC). The extrapolation formula is as follows:

$$\beta_{ed,i,harq} = \beta_{ed,ref} \sqrt{\frac{L_{e,ref}}{L_{e,i}}} \sqrt{\frac{K_{e,i}}{K_{e,ref}}} \cdot 10^{\left(\frac{\Delta harq}{20}\right)} \quad (1)$$

In the formula above, $\beta_{ed,ref}$ denotes the E-DPDCH gain factor of the reference E-TFC; $L_{e,ref}$ denotes the number of E-DPDCH used for the reference E-TFC; $L_{e,I}$ denotes the number of E-DPDCH used for the i:th E-TFC (that is, the i:th E-TFC is corresponding to the E-DPDCH whose the E-DPDCH gain factor is currently to be obtained); if a spreading factor of E-DPDCH is 2, $L_{e,i}$ and $L_{e,ref}$ denote the number of channels assuming a spreading factor of

E-DPDCH is 4; $K_{e,ref}$ denotes the transport block size of the reference E-TFC; $K_{e,i}$ denotes the transport block size of the i:th E-TFC; and $\Delta harq$ denotes an offset of a Hybrid Automatic Repeat Request (HARQ), and is specified by the upper layer. Table 1 lists the values of $\Delta harq$.

Table 1

$\Delta harq$ Signal Value	$\Delta harq$ Power Offset (dB)
6	6
5	5
4	4
3	3
2	2
1	1
0	0

After the uplink 16 Quadrature Amplitude Modulation (16QAM) mode is introduced into the WCDMA system, the uplink service rate increases to 11.52 Mbps. With the increase of the service rate, a formula is put forward for calculating the E-DPDCH gain factor under high rate services. This formula uses two reference E-TFCs, and is called an interpolation formula. The interpolation formula is as follows:

$$\beta_{ed,i,harq} = \sqrt{\frac{L_{e,ref,1}}{L_{e,i}}} \cdot \sqrt{\left(\frac{\frac{L_{e,ref,2}}{L_{e,ref,1}}\beta_{ed,ref,2}^2 - \beta_{ed,ref,1}^2}{K_{e,ref,2} - K_{e,ref,1}}\right)\left(K_{e,i} - K_{e,ref,1}\right) + \beta_{ed,ref,1}^2} \cdot 10^{\left(\frac{\Delta harq}{20}\right)}$$

In the formula above, $\beta_{ed,i,harq}$ denotes the E-DPDCH gain factor; $L_{e,i}$ denotes the number of E-DPDCH in non-compressed mode; $\beta_{ed,ref,1}$ and $\beta_{ed,ref,2}$ denote the E-DPDCH gain factors of the first and second reference E-TFCs respectively; $L_{e,ref,1}$ and $L_{e,ref,2}$ denote the number of E-DPDCHs used for the first and second reference E-TFCs; if the spreading factor

of E-DPDCH is 2, $L_{e,ref,1}$ and $L_{e,ref,2}$ denote the number of channels assuming the spreading factor of E-DPDCH is 4; $K_{e,ref,1}$ and $K_{e,ref,2}$ denote the transport block sizes of the first and second reference E-TFCs; $K_{e,i}$ denotes the transport block size of the i:th E-TFC; and Δ_{harq} denotes the offset of the HARQ, and is specified by the upper layer.

In the prior art, if the Transmission Time Interval (TTI) is 10 ms in the compressed mode, the calculation of the E-DPDCH gain factor comes in two scenarios: the current frame is a compressed frame, and the current frame is a normal frame.

At least the following problems are found in the prior art:

The E-DPDCH gain factor calculated out in compressed mode in the prior art does not reflect the transmit power required by the E-DPDCH accurately, and the transmit power required by the E-DPDCH which is determined according to the E-DPDCH gain factor is not accurate either. Consequently, part of the transmit power of E-DPDCH is wasted and therefore the system capacity is reduced.

SUMMARY OF THE INVENTION

The embodiments of the present invention provide a method and an apparatus for determining transmit power so as to determine the transmit power of E-DPDCH accurately and improve the system capacity.

To fulfill the foregoing objectives, a method for determining transmit power is provided in an embodiment of the present invention. The method includes:

determining an E-DPDCH gain factor in compressed mode according to the number of E-DPDCH required for initial transmission of data; and

determining transmit power of E-DPDCH according to the E-DPDCH gain factor in compressed mode.

Further, an apparatus for determining transmit power is provided in an embodiment of the present invention. The apparatus includes:

a gain factor determining module, configured to determine an E-DPDCH gain factor in compressed mode according to the number of E-DPDCH required for initial transmission of data; and

a power determining module, configured to determine transmit power of E-DPDCH according to the E-DPDCH gain factor determined by the gain determining module.

Further still, a base station is provided in an embodiment of the present invention, and the base station includes the foregoing apparatus for determining transmit power.

Further still, a terminal is provided in an embodiment of the present invention, and the terminal includes the foregoing apparatus for determining transmit power.

Compared with the prior art, the present invention brings at least the following benefits: The E-DPDCH gain factor in compressed mode is determined according to the number of E-DPDCH required for initial transmission of data, and therefore, the E-DPDCH gain factor in compressed mode is determined accurately, the transmit power of E-DPDCH is determined accurately according to the E-DPDCH gain factor, the waste of transmit power of E-DPDCH is reduced, and therefore the system capacity is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

To describe the technical solution under the present invention more clearly, the following describes the accompanying drawings involved in the embodiments of the present invention. Apparently, the accompanying drawings outlined below are not exhaustive and shall not constitute any limitation to the scope of the present invention.

FIG. 1 is a flowchart of a method for determining transmit power in an embodiment of the present invention;

FIG. 2 shows a structure of an apparatus for determining transmit power in an embodiment of the present invention; and

FIG. 3 shows a structure of another apparatus for determining transmit power in an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The following detailed description is provided with reference to the accompanying drawings to provide a thorough understanding of the present invention. Evidently, the

drawings and the detailed description are merely representative of particular embodiments of the present invention, and the embodiments are illustrative in nature rather than exhaustive, and shall not constitute any limitation to the scope of the present invention. All other embodiments, which can be derived by those skilled in the art from the embodiments given herein without any creative efforts, fall within the scope of the present invention.

A method for determining transmit power is provided in an embodiment of the present invention. The E-DPDCH gain factor in compressed mode is determined according to the number of E-DPDCH required for initial transmission of data, and the transmit power of E-DPDCH is determined according to the E-DPDCH gain factor. This method determines the E-DPDCH gain factor in compressed mode accurately. Because the transmit power of E-DPDCH is determined according to the E-DPDCH gain factor, the waste of transmit power of E-DPDCH is reduced, and therefore the system capacity is improved.

FIG. 1 is a flowchart of a method for determining transmit power in an embodiment of the present invention. The method includes the following steps:

Step 101: Determine the E-DPDCH gain factor in compressed mode according to the number of E-DPDCH required for initial transmission of data.

In this embodiment, when a TTI is 10ms, the E-DPDCH gain factor in compressed mode is calculated according to the number of E-DPDCH required for initial transmission of data, and interpolation formulas (2) and (3) are put forward.

Assuming $L_{e,I,i}$ denotes the number of E-DPDCH required for initial transmission of data, $\beta_{ed,C,i}$ denotes the E-DPDCH gain factor, and the current frame is a compressed frame,

$$\beta_{ed,C,i}=\beta_{e,C,j}\cdot\sqrt{\frac{L_{e,ref,1}}{L_{e,I,i}}}\cdot\sqrt{\left(\frac{\frac{L_{e,ref,2}}{L_{e,ref,1}}A_{ed,ref,2}^2-A_{ed,ref,1}^2}{K_{e,ref,2}-K_{e,ref,1}}\right)\left(K_{e,i}-K_{e,ref,1}\right)+A_{ed,ref,1}^2}\cdot 10^{\left(\frac{\Delta harq}{20}\right)}\cdot\sqrt{\frac{15\cdot N_{pilot,C}}{N_{slots,I}\cdot N_{pilot,N}}} \quad (2)$$

Assuming $L_{e,I,i}$ denotes the number of E-DPDCH required for initial transmission of data, $\beta_{ed,R,i}$ denotes the E-DPDCH gain factor, and the current frame is a non-compressed frame,

$$\beta_{ed,R,i}=\sqrt{\frac{L_{e,ref,1}}{L_{e,I,i}}}\cdot\sqrt{\left(\frac{\frac{L_{e,ref,2}}{L_{e,ref,1}}\beta_{ed,ref,2}^2-\beta_{ed,ref,1}^2}{K_{e,ref,2}-K_{e,ref,1}}\right)\left(K_{e,i}-K_{e,ref,1}\right)+\beta_{ed,ref,1}^2}\sqrt{\frac{15}{N_{slots,I}}}\cdot 10^{\left(\frac{\Delta_{harq}}{20}\right)} \quad (3)$$

In formula (2) and formula (3), $\beta_{c,C,j}$ denotes a Dedicated Physical Control Channel (DPCCH) gain factor used for a j:th Transport Format Combination (TFC) in compressed mode; $A_{ed,ref,1} = \frac{\beta_{ed,ref,1}}{\beta_c}$, $A_{ed,ref,2} = \frac{\beta_{ed,ref,2}}{\beta_c}$, and β_c is a DPCCH gain factor in non-compressed mode; $\beta_{ed,ref,1}$ and $\beta_{ed,ref,2}$ denote the E-DPDCH gain factors of the first and second reference E-TFCs respectively; $L_{e,ref,1}$ and $L_{e,ref,2}$ denote the number of E-DPDCHs used for the first and second reference E-TFCs respectively; if the spreading factor of E-DPDCH is 2, $L_{e,ref,1}$ and $L_{e,ref,2}$ denote the number of channels assuming the spreading factor of E-DPDCH is 4; $K_{e,ref,1}$ and $K_{e,ref,2}$ denote the transport block sizes of the first and second reference E-TFCs respectively; $K_{e,i}$ denotes the transport block size of the i:th E-TFC; Δ_{harq} denotes the offset of the HARQ, and is specified by the upper layer; $N_{pilot,C}$ is the number of pilot bits per slot on the DPCCH in compressed frames; $N_{pilot,N}$ is the number of pilot bits per slot on the DPCCH in non-compressed frames; $N_{slots,I}$ is the number of non Discontinuous Transmission (DTX) slots in a frame used for initial transmission of data.

Step 102: Determine transmit power of E-DPDCH according to the E-DPDCH gain factor in compressed mode.

One of the methods for determining the transmit power of E-DPDCH is: Obtain a power offset according to the ratio of the E-DPDCH gain factor to the DPCCH gain factor, and then obtain the transmit power of E-DPDCH according to the power offset and absolute power of the DPCCH.

In the method for determining the transmit power in the foregoing embodiment, the E-DPDCH gain factor in compressed mode is determined according to the number of E-DPDCH required for initial transmission of data, and therefore, the E-DPDCH gain factor in compressed mode is determined accurately, the transmit power of E-DPDCH is determined according to the E-DPDCH gain factor, the waste of transmit power of E-DPDCH is reduced, and therefore the system capacity is improved.

As shown in FIG. 2, an apparatus for determining transmit power in an embodiment of the present invention includes:

a gain factor determining module 21, configured to determine the E-DPDCH gain factor in compressed mode according to the number of E-DPDCH required for initial transmission of data; and

a power determining module 22, configured to determine the transmit power of E-DPDCH according to the E-DPDCH gain factor determined by the E-DPDCH gain factor determining module 21.

As shown in FIG. 3, the gain factor determining module 21 may include a first determining submodule 211 and a second determining submodule 212.

The first determining submodule 211 is configured to determine the E-DPDCH gain factor when $L_{e,I,i}$ denotes the number of E-DPDCH required for initial transmission of data, $\beta_{ed,C,i}$ denotes the E-DPDCH gain factor, and the current frame is a compressed frame:

$$\beta_{ed,C,i}=\beta_{c,C,j}\cdot\sqrt{\frac{L_{e,ref,1}}{L_{e,I,i}}}\cdot\sqrt{\left(\frac{\frac{L_{e,ref,2}}{L_{e,ref,1}}A_{ed,ref,2}^2-A_{ed,ref,1}^2}{K_{e,ref,2}-K_{e,ref,1}}\right)\left(K_{e,i}-K_{e,ref,1}\right)+A_{ed,ref,1}^2}\cdot 10^{\left(\frac{\Delta harq}{20}\right)}\cdot\sqrt{\frac{15\cdot N_{pilot,C}}{N_{slots,I}\cdot N_{pilot,N}}}$$

The second determining submodule 212 is configured to determine the E-DPDCH gain factor when $L_{e,I,i}$ denotes the number of E-DPDCH required for initial transmission of data, $\beta_{ed,R,i}$ denotes the E-DPDCH gain factor, and the current frame is a non-compressed frame:

$$\beta_{ed,R,i}=\sqrt{\frac{L_{e,ref,1}}{L_{e,I,i}}}\cdot\sqrt{\left(\frac{\frac{L_{e,ref,2}}{L_{e,ref,1}}\beta_{ed,ref,2}^2-\beta_{ed,ref,1}^2}{K_{e,ref,2}-K_{e,ref,1}}\right)\left(K_{e,i}-K_{e,ref,1}\right)+\beta_{ed,ref,1}^2}\sqrt{\frac{15}{N_{slots,I}}}\cdot 10^{\left(\frac{\Delta_{harq}}{20}\right)}$$

In the formula above, $\beta_{c,C,j}$ denotes the DPCCH gain factor used for the j:th TFC in compressed mode; $A_{ed,ref,1}=\frac{\beta_{ed,ref,1}}{\beta_c}$, $A_{ed,ref,2}=\frac{\beta_{ed,ref,2}}{\beta_c}$, and β_c is the DPCCH gain factor in non-compressed mode; $\beta_{ed,ref,1}$ and $\beta_{ed,ref,2}$ denote the E-DPDCH gain factors of the first and second reference E-TFCs; $L_{e,ref,1}$ and $L_{e,ref,2}$ denote the number of E-DPDCHs used for the first and second reference E-TFCs; $K_{e,ref,1}$ and $K_{e,ref,2}$ denote the transport block sizes of the first and second reference E-TFCs; $K_{e,i}$ denotes the transport block size of the i:th E-TFC; Δ_{harq} denotes the offset of the HARQ; $N_{pilot,C}$ is the number of pilot bits per slot on

of the DPCCH in compressed frames; $N_{pilot,N}$ is the number of pilot bits per slot of the DPCCH in non-compressed frames; and $N_{slots,I}$ is the number of non DTX slots in a frame used for initial transmission of data.

In the apparatus for determining the transmit power in the foregoing embodiment, the gain factor determining module 21 determines the E-DPDCH gain factor in compressed mode according to the number of E-DPDCH required for initial transmission of data. Therefore, the E-DPDCH gain factor in compressed mode is determined accurately, the power determining module 22 determines the transmit power of E-DPDCH according to the E-DPDCH gain factor, the waste of transmit power of E-DPDCH is reduced, and therefore the system capacity is improved.

Further, a base station is provided in an embodiment of the present invention, and the base station includes the foregoing apparatus for determining transmit power. The base station may include all or part of the modules of the foregoing apparatus for determining transmit power.

Further, a terminal is provided in an embodiment of the present invention, and the terminal includes the foregoing apparatus for determining transmit power. The terminal may include all or part of the modules of the foregoing apparatus for determining transmit power.

After reading the foregoing embodiments, those skilled in the art are clearly aware that the present invention may be implemented through hardware, or through software in addition to a necessary universal hardware platform. Based on such understanding, the technical solution under the present invention may be embodied in a software product. The software product may be stored in a nonvolatile storage medium (such as a Compact Disk-Read Only Memory (CD-ROM), a Universal Serial Bus (USB) disk, or a mobile hard disk), and may include several instructions that enable a computer device (such as a personal computer, a server, or a network device) to perform the method according to any embodiment of the present invention.

It is understandable to those skilled in the art that the accompanying drawings are only schematic diagrams of the exemplary embodiments, and the modules or processes in the accompanying drawings are not mandatory for implementing the present invention.

It is understandable to those skilled in the art that the modules in an apparatus provided in an embodiment of the present invention may be distributed in the apparatus described herein, or may be located in one or more apparatuses different from the apparatus described herein. The modules may be combined into one module, or split into multiple submodules.

The sequence number of the embodiment above is designed to facilitate description only, and does not represent the order of preference.

Detailed above are several exemplary embodiments of the present invention, and the scope of the present invention is not limited thereto. Any modifications or variations that can be derived by those skilled in the art shall fall within the scope of the present invention.

CLAIMS

1. A terminal comprising:

a gain factor determiner, configured to determine an Enhanced Dedicated Channel Dedicated Physical Data Channel (E-DPDCH) gain factor in compressed mode, according to the number of E-DPDCHs for an initial transmission of data,

wherein, when a current frame is a compressed frame, the gain factor determiner is configured to determine the E-DPDCH gain factor as follows:

$$\beta_{ed,C,i} = \beta_{c,C,j} \cdot \sqrt{\frac{L_{e,ref,1}}{L_{e,I,i}}} \cdot \sqrt{\left(\frac{\frac{L_{e,ref,2}}{L_{e,ref,1}} A_{ed,ref,2}^2 - A_{ed,ref,1}^2}{K_{e,ref,2} - K_{e,ref,1}} \left(K_{e,i} - K_{e,ref,1} \right) + A_{ed,ref,1}^2 \right)} \cdot 10^{\left(\frac{\Delta harq}{20} \right)} \cdot \sqrt{\frac{15 \cdot N_{pilot,C}}{N_{slots,I} \cdot N_{pilot,N}}}$$

wherein,

$\beta_{ed,C,i}$ denotes the E-DPDCH gain factor in the compressed mode,

$L_{e,I,i}$ denotes the number of the E-DPDCHs for the initial transmission of data,

$\beta_{c,C,j}$ denotes a Dedicated Physical Control Channel (DPCCH) gain factor used for the j:th TFC in the compressed mode,

$A_{ed,ref,1} = \frac{\beta_{ed,ref,1}}{\beta_c}$, and $A_{ed,ref,2} = \frac{\beta_{ed,ref,2}}{\beta_c}$, where β_c is a DPCCH gain factor in non-compressed mode,

$\beta_{ed,ref,1}$ and $\beta_{ed,ref,2}$ denote the E-DPDCH gain factors of a first and a second reference E-TFCs respectively,

$L_{e,ref,1}$ and $L_{e,ref,2}$ denote the number of E-DPDCHs used for the first and second reference E-TFCs respectively,

$K_{e,ref,1}$ and $K_{e,ref,2}$ denote transport block sizes of the first and second reference E-TFCs respectively,

$K_{e,i}$ denotes the transport block size of the i:th E-TFC,

Δ_{harq} denotes an offset of a Hybrid Automatic Repeat Request (HARQ),

$N_{pilot,C}$ is the number of pilot bits per slot on a DPCCH in the compressed mode,

$N_{pilot,N}$ is the number of pilot bits per slot on the DPCCH in the non-compressed mode, and

$N_{slots,I}$ is the number of non Discontinuous Transmission (DTX) slots in a frame used for the initial transmission of data.

2. The terminal according to claim 1, further comprising:

a power determiner, configured to determine a transmit power of the E-DPDCH according to the determined E-DPDCH gain factor.

3. The apparatus according to claim 2, wherein the power determiner is further configured to determine a power offset according to a ratio of the E-DPDCH gain factor to the DPCCH gain factor in the compressed mode, and is configured to determine the transmit power of the E-DPDCH according to the determined power offset and an absolute power of the DPCCH.

4. A terminal comprising:

a gain factor determiner, configured to determine an Enhanced Dedicated Channel Dedicated Physical Data Channel (E-DPDCH) gain factor in compressed mode according to the number of E-DPDCH for an initial transmission of data,

wherein, when a current frame is a non-compressed frame, the gain factor determiner is configured to determine the E-DPDCH gain factor as follows:

$$\beta_{ed,R,i} = \sqrt{\frac{L_{e,ref,1}}{L_{e,I,i}}} \cdot \sqrt{\left(\frac{\frac{L_{e,ref,2}}{L_{e,ref,1}}\beta_{ed,ref,2}^2 - \beta_{ed,ref,1}^2}{K_{e,ref,2} - K_{e,ref,1}}\right)\left(K_{e,i} - K_{e,ref,1}\right) + \beta_{ed,ref,1}^2} \sqrt{\frac{15}{N_{slots,I}}} \cdot 10^{\left(\frac{\Delta_{harq}}{20}\right)}$$

,

wherein,

$\beta_{ed,R,i}$ denotes the E-DPDCH gain factor in the compressed mode,

$L_{e,I,i}$ denotes the number of the E-DPDCH used for the initial transmission of data, $\beta_{ed,ref,1}$ and $\beta_{ed,ref,2}$ denote the E-DPDCH gain factors of first and second reference E-TFCs respectively,

$L_{e,ref,1}$ and $L_{e,ref,2}$ denote the number of the E-DPDCHs used for the first and second reference E-TFCs respectively,

$K_{e,ref,1}$ and $K_{e,ref,2}$ denote transport block sizes of the first and second reference E-TFCs respectively,

$K_{e,i}$ denotes transport block size of the i:th E-TFC,

Δ_{harq} is an offset of a Hybrid Automatic Repeat Request (HARQ), and

$N_{slots,I}$ is the number of non Discontinuous Transmission (DTX) slots in a frame used for the initial transmission of data.

5. The terminal according to claim 4, further comprising:

a power determiner, configured to determine a transmit power of the E-DPDCH according to the determined E-DPDCH gain factor.

6. The terminal apparatus of claim 4, wherein the power determiner is further configured to determine a power offset according to a ratio of the E-DPDCH gain factor to a Dedicated Physical Control Channel (DPCCH) gain factor, and determine the transmit power of the E-DPDCH according to the determined power offset and an absolute power of a DPCCH.