

METHOD FOR REPORTING SRS POWER HEADROOM, TERMINAL DEVICE, AND COMPUTER STORAGE MEDIUM

Technical Field

5 The present invention relates to the field of information processing technologies, and in particular, to a method for reporting power headroom (PH) for a sounding reference signal (SRS), a terminal device, and a computer storage medium.

Related Art

Power headroom (PH) for sounding reference signal (SRS) is a difference between
10 an allowed maximum transmit power of UE and a transmit power of an SRS currently obtained through calculation. In new radio (NR), a terminal device needs to separately perform power headroom report (PHR) for a physical uplink shared channel (PUSCH) and an SRS. The terminal device needs to not only report PH for a carrier that currently transmits the PUSCH or the SRS, but also report PH for a carrier that does not transmit
15 the PUSCH or the SRS, so as to provide reference for scheduling or power control of a network side on the carrier.

If the terminal device transmits an SRS on a particular carrier at a particular moment, corresponding PH may be represented as:

$$PH_{\text{type3},f,c}(i, q_s, l) = P_{\text{CMAX},f,c}(i) - \left\{ P_{\text{O_SRS},f,c}(q_s) + 10 \log_{10}(2^{\mu} \cdot M_{\text{SRS},f,c}(i)) + \alpha_{\text{SRS},f,c}(q_s) \cdot PL_{f,c}(q_s) + h_{f,c}(i, l) \right\},$$

20 where $P_{\text{CMAX},f,c}(i)$ is a maximum transmit power of the terminal device, and a calculation result in braces is an expected transmit power obtained by the terminal device through calculation according to an actual SRS transmission parameter on the particular carrier at the particular moment.

If the terminal device does not transmit an SRS on a particular carrier at a particular
25 moment, corresponding PH may be represented as:

$$PH_{\text{type3},f,c}(i, q_s, l) = \tilde{P}_{\text{CMAX},f,c}(i) - \left\{ P_{\text{O_SRS},f,c}(q_{s0}) + \alpha_{\text{SRS},f,c}(q_{s0}) \cdot PL_{f,c}(q_{s0}) + h_{f,c}(i, l) \right\}$$

$\tilde{P}_{\text{CMAX},f,c}(i)$ is a maximum transmit power assumed by the terminal device on the

particular carrier, and a calculation result in braces is an expected transmit power of the terminal device on the particular carrier (no SRS transmission parameter).

The foregoing PH is separately calculated for each SRS resource set q_s , and corresponds to each SRS resource in the SRS resource set. However, a plurality of SRS resources in an SRS resource set may perform transmission on different orthogonal frequency division multiplexing (OFDM) symbols (referred to as time division multiplexing (TDM)), or may perform transmission simultaneously on a same OFDM symbol (referred to as frequency division multiplexing (FDM)). This process may be FDM in one resource subset or TDM between resource subsets. In this case, different PH calculation methods need to be used for the two multiplexing manners, namely, TDM and FDM, so as to obtain a correct PHR. In addition, allowed maximum transmit powers of different antenna array groups (Panel) may be different, and a current PHR does not support separate PH reporting for each antenna array group Panel.

SUMMARY

To resolve the foregoing technical problems, embodiments of the present invention provide a method for reporting power headroom (PH) for a sounding reference signal (SRS), a terminal device, and a computer storage medium.

An embodiment of the present invention provides a method for reporting power headroom (PH) for an SRS, applied to a terminal device. The method includes:

calculating at least one expected SRS transmit power on at least one SRS resource included in a target SRS resource set, where the target SRS resource set is an SRS resource set on a target carrier or a target bandwidth part BWP;

obtaining power headroom PH of the target SRS resource set through calculation according to the at least one expected SRS transmit power on the at least one SRS resource; and

reporting the PH of the target SRS resource set obtained through calculation.

An embodiment of the present invention provides a terminal device, including:

a processing unit, configured to: calculate at least one expected SRS transmit power on at least one SRS resource included in a target SRS resource set, where the target SRS resource set is an SRS resource set on a target carrier or a target bandwidth part BWP;

and obtain power headroom PH of the target SRS resource set through calculation according to the at least one expected SRS transmit power on the at least one SRS resource; and

5 a communications unit, configured to report the PH of the target SRS resource set obtained through calculation.

A terminal device provided in an embodiment of the present invention includes: a processor, and a memory, configured to store a computer program executable on the processor, where

10 the processor is configured to perform, when running the computer program, steps of the method.

An embodiment of the present invention provides a computer storage medium, where the computer storage medium stores a computer-executable instruction, and when being executed, the computer-executable instruction performs steps of the foregoing method.

15 In the technical solutions of the embodiments of the present invention, the PH of the target SRS resource set can be obtained through calculation for an SRS resource in the target SRS resource set on the target carrier or the target bandwidth part, and the PH is reported to a network side, so that the network side can obtain accurate SRS power headroom information, and then perform subsequent SRS scheduling and power
20 control.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic flowchart of a method for reporting power headroom (PH) for a sounding reference signal (SRS) according to an embodiment of the present invention;

FIG. 2 is a schematic structural diagram of composition of a terminal device
25 according to an embodiment of the present invention; and

FIG. 3 is a schematic diagram of a hardware architecture according to an embodiment of the present invention.

DETAILED DESCRIPTION

To make the features and technical content of the embodiments of the present

invention more comprehensive, the following describes implementations of the embodiments of the present invention in detail with reference to the accompanying drawings. The accompanying drawings are intended only for reference, and not intended to limit the embodiments of the present invention.

5 Embodiment 1

An embodiment of the present invention provides a method for reporting power headroom (PH) for a sounding reference signal (SRS), applied to a terminal device. As shown in FIG. 1, the method includes the following steps:

Step 101: Calculate at least one expected SRS transmit power on at least one SRS
10 resource included in a target SRS resource set, where the target SRS resource set is an SRS resource set on a target carrier or a target bandwidth part BWP.

Step 102: Obtain power headroom PH of the target SRS resource set through calculation according to the at least one expected SRS transmit power on the at least one SRS resource.

15 Step 103: Report the PH of the target SRS resource set obtained through calculation.

Specifically, in step 101, that at least one expected SRS transmit power on at least one SRS resource included in a target SRS resource set is calculated includes:

if the terminal device transmits an SRS on an SRS resource at a moment of
20 calculating the PH, calculating an expected SRS transmit power on the SRS resource based on a transmission parameter of the transmitted SRS and a power control parameter configured for the SRS resource or the target SRS resource set.

In other words, if the terminal device transmits the SRS on the SRS resource at the moment of calculating the PH, the terminal device calculates the expected SRS transmit
25 power on the SRS resource based on the transmission parameter of the transmitted SRS and the power control parameter configured for the SRS resource or the target SRS resource set in which the SRS resource is located. Herein, the power control parameter may include an open-loop power control parameter and a closed-loop power control parameter.

30 For example, if the terminal device transmits the SRS on a particular SRS resource

at the moment of calculating the PH, the expected SRS transmit power is:

$$P_{\text{exp},f,c}(i, q_s, l) = \{ P_{\text{O_SRS},f,c}(q_s) + 10 \log_{10}(2^{\mu} \cdot M_{\text{SRS},f,c}(i)) + \alpha_{\text{SRS},f,c}(q_s) \cdot PL_{f,c}(q_s) + h_{f,c}(i, l) \}$$

Parameters in the formula are the transmission parameter of the SRS transmitted on the SRS resource and the power control parameter configured for the SRS resource set q_s in which the SRS resource is located, where $M_{\text{SRS},f,c}(i)$ indicates a transmission bandwidth of the SRS, μ is a subcarrier spacing of SRS transmission, $P_{\text{O_SRS},f,c}(q_s)$ is a target receive power, $\alpha_{\text{SRS},f,c}(q_s)$ is a path loss factor, $PL_{f,c}(q_s)$ is an estimated value of a path loss, and $h_{f,c}(i, l)$ is an SRS closed-loop power adjustment factor.

Specifically, in step 101, that at least one expected SRS transmit power on at least one SRS resource included in a target SRS resource set is calculated further includes:

if the terminal device does not transmit an SRS on an SRS resource at a moment of calculating the PH, calculating an expected SRS transmit power on the SRS resource based on a power control parameter configured for the SRS resource or the target SRS resource set.

In other words, if the terminal device does not transmit the SRS on a particular SRS resource at the moment of calculating the PH, the terminal device calculates the expected SRS transmit power on the SRS resource based on the power control parameter configured for the SRS resource or the target SRS resource set in which the SRS resource is located. Herein, the power control parameter usually includes only an open-loop power control parameter.

For example, if the terminal device does not transmit the SRS on the particular SRS resource at the moment of calculating the PH, the expected SRS transmit power is:

$$P_{\text{exp},f,c}(i, q_s, l) = \{ P_{\text{O_SRS},f,c}(q_{s0}) + \alpha_{\text{SRS},f,c}(q_{s0}) \cdot PL_{f,c}(q_{s0}) + h_{f,c}(i, l) \}$$

A parameter in the formula is the power control parameter configured for the SRS resource set q_{s0} in which the SRS resource is located, where $P_{\text{O_SRS},f,c}(q_{s0})$ is a target receive power, $\alpha_{\text{SRS},f,c}(q_{s0})$ is a path loss factor, $PL_{f,c}(q_{s0})$ is an estimated value of a path loss, and $h_{f,c}(i, l)$ is an SRS closed-loop power adjustment factor.

The at least one SRS resource is one of the following:

at least one SRS resource occupying a same OFDM symbol in the target SRS resource set;

5 at least one SRS resource occupying different OFDM symbols in the target SRS resource set;

at least one SRS resource occupying different bandwidths in the target SRS resource set;

at least one SRS resource using different antenna array groups to transmit an SRS in the target SRS resource set; and

10 at least one SRS resource using a same antenna array group to transmit an SRS in the target SRS resource set.

When the target SRS resource set is used for uplink non-codebook transmission, the at least one SRS resource is all SRS resources in the target SRS resource set.

15 The method includes that when the target SRS resource set is used for uplink codebook transmission, beam management, or antenna switching, the at least one SRS resource is any SRS resource in the target SRS resource set.

Whether the target SRS resource set is used for the uplink non-codebook transmission, the uplink codebook transmission, the beam management, or the antenna switching may be separately configured for each SRS resource set by using higher layer signaling.

20 When the terminal device transmits an SRS on the target carrier or the target BWP at a moment of calculating the PH, or the target carrier or the target BWP is a currently activated carrier or BWP, the target SRS resource set is an SRS resource set currently used for SRS transmission on the target carrier or the target BWP, or the target SRS resource set is an SRS resource set associated with current PUSCH transmission.

When the terminal device does not transmit an SRS on the target carrier or the target BWP at a moment of calculating the PH, or the target carrier or the target BWP is not an activated carrier or BWP, the target SRS resource set is an SRS resource set with a lowest set index on the target carrier or the target BWP, or the target SRS resource set

is an SRS resource set with a lowest set index on a recently activated BWP on the target carrier.

In other words, if the terminal device transmits the SRS on the target carrier or the target BWP at the moment of calculating the PH, or the target carrier or the target BWP is the currently activated carrier or BWP, the target SRS resource set is the SRS resource set currently used for the SRS transmission on the target carrier or the target BWP, or the target SRS resource set is the SRS resource set associated with the current PUSCH transmission.

Specifically, if the current PUSCH transmission is codebook-based PUSCH transmission, the target SRS resource set is an SRS resource set used for codebook transmission. If the current PUSCH transmission is non-codebook-based PUSCH transmission, the target SRS resource set is an SRS resource set used for non-codebook transmission. If the current PUSCH transmission is antenna switching-based PUSCH transmission, the target SRS resource set is an SRS resource set used for the antenna switching.

If the terminal device does not transmit the SRS on the target carrier or the target BWP at the moment of calculating the PH, or the target carrier or the target BWP is not the activated carrier or BWP, the target SRS resource set is the SRS resource set with the minimum set index on the target carrier or the target BWP, or the target SRS resource set is the SRS resource set with the minimum set index on the recently activated BWP on the target carrier.

The SRS resource set with the minimum set index may be an SRS resource set whose SRS resource set ID equals 0 on the target carrier or the target BWP. If a minimum ID in a current SRS resource set is 3 instead of 0, an SRS resource set whose ID is 3 may be selected.

In step 102, that power headroom PH of the target SRS resource set is obtained through calculation according to the at least one expected SRS transmit power on the at least one SRS resource may have the following scenarios:

Scenario 1

A difference between a maximum transmit power and a sum of the at least one

expected SRS transmit power on the at least one SRS resource is used as the PH of the target SRS resource set.

In other words, the terminal device uses the difference between the maximum transmit power and a first power as the PH of the target SRS resource set, and the first power herein is the sum of the at least one expected SRS transmit power on the at least one SRS resource.

The maximum transmit power is a maximum transmit power supported by the terminal device, or a maximum transmit power supported by the terminal device on a carrier on which the target SRS resource set is located, or a maximum transmit power supported by the terminal device on an antenna array group that is used to transmit an SRS on the target SRS resource set.

For example, $PH_{\text{type3},f,c}(i, q_s, l) = P_{\text{CMAX},f,c}(i) - \sum_{k=1}^K P_{\text{exp},f,c,k}(i, q_s, l)$, where $P_{\text{CMAX},f,c}(i)$ is an allowed maximum transmit power of the terminal device on a carrier c, and K is a quantity of the at least one SRS resource.

The at least one SRS resource occupies a same OFDM symbol; or the at least one SRS resource uses a same antenna array group to transmit an SRS.

In other words, the method may be used for a case in which the at least one SRS resource occupies the same OFDM symbol, or a case in which the at least one SRS resource uses the same antenna array group to transmit the SRS. In the former case, power headroom may be accurately calculated by using the method when the terminal device simultaneously transmits a plurality of SRSs. In the latter case, total power headroom on an antenna array group may be accurately calculated by using the method.

If different target SRS resource sets correspond to different antenna array groups (panel), the method can support separate PH reporting for each target SRS resource set according to a respective maximum transmit power of each antenna array group.

Scenario 2

A difference between a maximum transmit power and a maximum or minimum expected transmit power in the at least one expected SRS transmit power on the at least one SRS resource is used as the PH of the target SRS resource set.

In other words, in this scenario, the terminal device uses the difference between the maximum transmit power and a second power as the PH of the target SRS resource set, and the second power herein is the maximum or minimum expected SRS transmit power in the at least one expected SRS transmit power on the at least one SRS resource.

5 The maximum transmit power is one of the following:

a maximum transmit power supported by the terminal device;

a maximum transmit power supported by the terminal device on a carrier on which the target SRS resource set is located; and

10 a maximum transmit power supported by the terminal device on an antenna array group that is used to transmit an SRS on the target SRS resource set.

For example, $PH_{\text{type3},f,c}(i, q_s, l) = P_{\text{CMAX},f,c}(i) - \min_{k \in \{1, 2, \dots, K\}} (P_{\text{exp},f,c,k}(i, q_s, l))$, where $P_{\text{CMAX},f,c}(i)$ is the maximum transmit power of the terminal device, and K is a quantity of the at least one SRS resource.

15 If expected SRS transmit powers on all SRS resources in the target SRS resource set are the same, any SRS resource may be used to calculate the PH.

The at least one SRS resource occupies different OFDM symbols; or occupies different bandwidths. In other words, the method may be used for a case in which the at least one SRS resource occupies the different OFDM symbols, or a case in which the at least one SRS resource occupies the different bandwidths. In this case, the terminal device reports PH of only one of the SRS resources, and the terminal device may obtain PH of another SRS resource according to the PH of the only one of the SRS resources.

20

Different target SRS resource sets correspond to different antenna array groups.

Correspondingly, that the PH of the target SRS resource set obtained through calculation is reported includes:

25 separately reporting PH of each target SRS resource set according to a maximum transmit power of each antenna array group.

In other words, if the different target SRS resource sets correspond to different panels, the solution provided in this scenario can also support separate PH reporting for

each target SRS resource set according to the respective maximum transmit power of each antenna array group.

Scenario 3: A difference between a maximum transmit power on a first SRS resource in the at least one SRS resource and an expected SRS transmit power of the first SRS resource is used as PH of the first SRS resource.

The PH of the first SRS resource is added to the PH of the target SRS resource set.

In this scenario, the terminal device uses the difference between the maximum transmit power on the first SRS resource in the at least one SRS resource and the at least one expected SRS transmit power of the first SRS resource as the PH of the first SRS resource, and the PH of the target SRS resource set includes the PH of the first SRS resource.

The maximum transmit power on the first SRS resource may be a maximum transmit power supported by an antenna array group that is used to transmit an SRS on the first SRS resource. In other words, the maximum transmit power on the first SRS resource is the maximum transmit power supported on the antenna array group that is used to transmit the SRS on the first SRS resource.

In addition, the maximum transmit power on the first SRS resource may alternatively be a maximum transmit power supported by the terminal device or a maximum transmit power supported by the terminal device on a carrier on which the target SRS resource set is located.

The method further includes: separately using each SRS resource in the target SRS resource set as the first SRS resource. To be specific, the PH of each (in other words, each SRS resource in the target SRS resource set is separately used as the first SRS resource) of the at least one SRS resource is calculated, and the PH separately obtained for the at least one SRS resource is used as the PH of the target SRS resource set for PH reporting. Herein, the PH of the target SRS resource set is actually a set including a plurality of PH values (respectively corresponding to different SRS resources).

If the target SRS resource set includes a plurality of SRS resources corresponding to a plurality of panels, the method can support separate PH reporting for SRS resources on different panels.

The method may be used for a case in which the at least one SRS resource uses the different antenna array groups to transmit the SRS.

Based on the foregoing description, step 103 is described below:

That the PH of the target SRS resource set obtained through calculation is reported
5 includes: reporting the PH of the target SRS resource set as PH of an SRS on the target carrier or the target BWP, and skipping reporting PH corresponding to another SRS resource on the target carrier or the target BWP.

That the PH of the target SRS resource set obtained through calculation is reported
10 includes: reporting PH corresponding to each SRS resource set configured on the target carrier or the target BWP.

It can be seen that through the foregoing solution, the PH of the target SRS resource set can be obtained through calculation for the SRS resource in the target SRS resource set on the target carrier or the target bandwidth part, and the PH is reported to a network side, so that the network side can obtain accurate SRS power headroom information,
15 and then perform subsequent SRS scheduling and power control.

In addition, the present invention can also support a separate PHR for different panels.

Embodiment 2

An embodiment of the present invention provides a terminal device. As shown in
20 FIG. 2, the terminal device includes:

a processing unit 21, configured to: calculate at least one expected SRS transmit power on at least one SRS resource included in a target SRS resource set, where the target SRS resource set is an SRS resource set on a target carrier or a target bandwidth part BWP; and obtain power headroom PH of the target SRS resource set through
25 calculation according to the at least one expected SRS transmit power on the at least one SRS resource; and

a communications unit 22, configured to report the PH of the target SRS resource set obtained through calculation.

Specifically, if the terminal device transmits an SRS on an SRS resource at a

moment of calculating the PH, the processing unit 21 calculates an expected SRS transmit power on the SRS resource based on a transmission parameter of the transmitted SRS and a power control parameter configured for the SRS resource or the target SRS resource set.

5 In other words, if the terminal device transmits the SRS on the SRS resource at the moment of calculating the PH, the terminal device calculates the expected SRS transmit power on the SRS resource based on the transmission parameter of the transmitted SRS and the power control parameter configured for the SRS resource or the target SRS resource set in which the SRS resource is located. Herein, the power control parameter
10 may include an open-loop power control parameter and a closed-loop power control parameter.

For example, if the terminal device transmits the SRS on a particular SRS resource at the moment of calculating the PH, the expected SRS transmit power is:

$$P_{\text{exp},f,c}(i, q_s, l) = \{ P_{\text{O_SRS},f,c}(q_s) + 10 \log_{10}(2^{\mu} \cdot M_{\text{SRS},f,c}(i)) + \alpha_{\text{SRS},f,c}(q_s) \cdot PL_{f,c}(q_s) + h_{f,c}(i, l) \}$$

15 Parameters in the formula are the transmission parameter of the SRS transmitted on the SRS resource and the power control parameter configured for the SRS resource set q_s in which the SRS resource is located, where $M_{\text{SRS},f,c}(i)$ indicates a transmission bandwidth of the SRS, μ is a subcarrier spacing of SRS transmission, $P_{\text{O_SRS},f,c}(q_s)$ is a target receive power, $\alpha_{\text{SRS},f,c}(q_s)$ is a path loss factor, $PL_{f,c}(q_s)$ is an estimated
20 value of a path loss, and $h_{f,c}(i, l)$ is an SRS closed-loop power adjustment factor.

Specifically, if the terminal device does not transmit an SRS on an SRS resource at a moment of calculating the PH, the processing unit 21 calculates an expected SRS transmit power on the SRS resource based on a power control parameter configured for the SRS resource or the target SRS resource set.

25 In other words, if the terminal device does not transmit the SRS on a particular SRS resource at the moment of calculating the PH, the terminal device calculates the expected SRS transmit power on the SRS resource based on the power control parameter configured for the SRS resource or the target SRS resource set in which the SRS resource is located. Herein, the power control parameter usually includes only an

open-loop power control parameter.

For example, if the terminal device does not transmit the SRS on the particular SRS resource at the moment of calculating the PH, the expected SRS transmit power is:

$$P_{\text{exp},f,c}(i, q_s, l) = \{ P_{\text{O_SRS},f,c}(q_{s0}) + \alpha_{\text{SRS},f,c}(q_{s0}) \cdot PL_{f,c}(q_{s0}) + h_{f,c}(i, l) \}$$

- 5 A parameter in the formula is the power control parameter configured for the SRS resource set q_{s0} in which the SRS resource is located, where $P_{\text{O_SRS},f,c}(q_{s0})$ is a target receive power, $\alpha_{\text{SRS},f,c}(q_{s0})$ is a path loss factor, $PL_{f,c}(q_{s0})$ is an estimated value of a path loss, and $h_{f,c}(i, l)$ is an SRS closed-loop power adjustment factor.

The at least one SRS resource is one of the following:

- 10 at least one SRS resource occupying a same OFDM symbol in the target SRS resource set;
- at least one SRS resource occupying different OFDM symbols in the target SRS resource set;
- at least one SRS resource occupying different bandwidths in the target SRS resource set;
- 15 at least one SRS resource using different antenna array groups to transmit an SRS in the target SRS resource set; and
- at least one SRS resource using a same antenna array group to transmit an SRS in the target SRS resource set.

- 20 When the target SRS resource set is used for uplink non-codebook transmission, the at least one SRS resource is all SRS resources in the target SRS resource set.

- When the target SRS resource set is used for uplink codebook transmission, beam management, or antenna switching, the at least one SRS resource is any SRS resource in the target SRS resource set. In other words, if the target SRS resource set is used for the
- 25 uplink codebook transmission, the beam management, or the antenna switching, the at least one SRS resource is any SRS resource in the target SRS resource set.

Whether the target SRS resource set is used for the uplink non-codebook transmission, the uplink codebook transmission, the beam management, or the antenna

switching may be separately configured for each SRS resource set by using higher layer signaling.

When the terminal device transmits an SRS on the target carrier or the target BWP at a moment of calculating the PH, or the target carrier or the target BWP is a currently
5 activated carrier or BWP, the target SRS resource set is an SRS resource set currently used for SRS transmission on the target carrier or the target BWP, or the target SRS resource set is an SRS resource set associated with current PUSCH transmission.

When the terminal device does not transmit an SRS on the target carrier or the target BWP at a moment of calculating the PH, or the target carrier or the target BWP is
10 not an activated carrier or BWP, the target SRS resource set is an SRS resource set with a lowest set index on the target carrier or the target BWP, or the target SRS resource set is an SRS resource set with a lowest set index on a recently activated BWP on the target carrier.

In other words, if the terminal device transmits the SRS on the target carrier or the target BWP at the moment of calculating the PH, or the target carrier or the target BWP
15 is the currently activated carrier or BWP, the target SRS resource set is the SRS resource set currently used for the SRS transmission on the target carrier or the target BWP, or the target SRS resource set is the SRS resource set associated with the current PUSCH transmission.

Specifically, if the current PUSCH transmission is codebook-based PUSCH transmission, the target SRS resource set is an SRS resource set used for codebook
20 transmission. If the current PUSCH transmission is non-codebook-based PUSCH transmission, the target SRS resource set is an SRS resource set used for non-codebook transmission. If the current PUSCH transmission is antenna switching-based PUSCH
25 transmission, the target SRS resource set is an SRS resource set used for the antenna switching.

If the terminal device does not transmit the SRS on the target carrier or the target BWP at the moment of calculating the PH, or the target carrier or the target BWP is not
the activated carrier or BWP, the target SRS resource set is the SRS resource set with
30 the minimum set index on the target carrier or the target BWP, or the target SRS resource set is the SRS resource set with the minimum set index on the recently

activated BWP on the target carrier.

The SRS resource set with the minimum set index may be an SRS resource set whose SRS resource set ID equals 0 on the target carrier or the target BWP. If a minimum ID in a current SRS resource set is 3 instead of 0, an SRS resource set whose ID is 3 may be selected.

That power headroom PH of the target SRS resource set is obtained through calculation according to the at least one expected SRS transmit power on the at least one SRS resource may have the following scenarios:

Scenario 1

The processing unit 21 uses a difference between a maximum transmit power and a sum of the at least one expected SRS transmit power on the at least one SRS resource as the PH of the target SRS resource set.

In other words, the terminal device uses the difference between the maximum transmit power and a first power as the PH of the target SRS resource set, and the first power herein is the sum of the at least one expected SRS transmit power on the at least one SRS resource.

The maximum transmit power is a maximum transmit power supported by the terminal device, or a maximum transmit power supported by the terminal device on a carrier on which the target SRS resource set is located, or a maximum transmit power supported by the terminal device on an antenna array group that is used to transmit an SRS on the target SRS resource set.

For example, $PH_{type3,f,c}(i, q_s, l) = P_{CMAX,f,c}(i) - \sum_{k=1}^K P_{exp,f,c,k}(i, q_s, l)$, where $P_{CMAX,f,c}(i)$ is an allowed maximum transmit power of the terminal device on a carrier c, and K is a quantity of the at least one SRS resource.

The at least one SRS resource occupies a same OFDM symbol; or the at least one SRS resource uses a same antenna array group to transmit an SRS.

In other words, the foregoing processing may be used for a case in which the at least one SRS resource occupies the same OFDM symbol, or a case in which the at least one SRS resource uses the same antenna array group to transmit the SRS. In the former

case, power headroom may be accurately calculated through the foregoing processing when the terminal device simultaneously transmits a plurality of SRS resources. In the latter case, total power headroom on an antenna array group may be accurately calculated through the foregoing processing.

- 5 If different target SRS resource sets correspond to different antenna array groups (panel), the foregoing processing can support separate PH reporting for each target SRS resource set according to a respective maximum transmit power of each antenna array group.

Scenario 2

- 10 The processing unit 21 uses a difference between a maximum transmit power and a maximum or minimum expected transmit power in the at least one expected SRS transmit power on the at least one SRS resource as the PH of the target SRS resource set.

- 15 In other words, in this scenario, the terminal device uses the difference between the maximum transmit power and a second power as the PH of the target SRS resource set, and the second power herein is the maximum or minimum expected SRS transmit power in the at least one expected SRS transmit power on the at least one SRS resource.

The maximum transmit power is one of the following:

- a maximum transmit power supported by the terminal device;
- 20 a maximum transmit power supported by the terminal device on a carrier on which the target SRS resource set is located; and

a maximum transmit power supported by the terminal device on an antenna array group that is used to transmit an SRS on the target SRS resource set.

- For example, $PH_{\text{type3},f,c}(i, q_s, l) = P_{\text{CMAX},f,c}(i) - \min_{k \in \{1, 2, \dots, K\}} (P_{\text{exp},f,c,k}(i, q_s, l))$, where
- 25 $P_{\text{CMAX},f,c}(i)$ is the maximum transmit power of the terminal device, and K is a quantity of the at least one SRS resource.

If expected SRS transmit powers on all SRS resources in the target SRS resource set are the same, any SRS resource may be used to calculate the PH.

The at least one SRS resource occupies different OFDM symbols; or occupies different bandwidths. In other words, the foregoing processing may be used for a case in which the at least one SRS resource occupies the different OFDM symbols, or a case in which the at least one SRS resource occupies the different bandwidths. In this case, the terminal device reports PH of only one of the SRS resources, and the terminal device may obtain PH of another SRS resource according to the PH of the only one of the SRS resources.

Different target SRS resource sets correspond to different antenna array groups.

Correspondingly, that the PH of the target SRS resource set obtained through calculation is reported includes:

separately reporting PH of each target SRS resource set according to a maximum transmit power of each antenna array group.

In other words, if the different target SRS resource sets correspond to different panels, the solution provided in this scenario can also support separate PH reporting for each target SRS resource set according to the respective maximum transmit power of each antenna array group.

Scenario 3: The processing unit 21 uses a difference between a maximum transmit power on a first SRS resource in the at least one SRS resource and an expected SRS transmit power of the first SRS resource as PH of the first SRS resource; and adds the PH of the first SRS resource to the PH of the target SRS resource set.

In this scenario, the terminal device uses the difference between the maximum transmit power on the first SRS resource in the at least one SRS resource and the at least one expected SRS transmit power of the first SRS resource as the PH of the first SRS resource, and the PH of the target SRS resource set includes the PH of the first SRS resource.

The maximum transmit power on the first SRS resource may be a maximum transmit power supported by an antenna array group that is used to transmit an SRS on the first SRS resource. In other words, the maximum transmit power on the first SRS resource is the maximum transmit power supported on the antenna array group that is used to transmit the SRS on the first SRS resource.

In addition, the maximum transmit power on the first SRS resource may alternatively be a maximum transmit power supported by the terminal device or a maximum transmit power supported by the terminal device on a carrier on which the target SRS resource set is located.

5 The processing unit 21 separately uses each SRS resource in the target SRS resource set as the first SRS resource. To be specific, the PH of each (in other words, each SRS resource in the target SRS resource set is separately used as the first SRS resource) of the at least one SRS resource is calculated, and the PH separately obtained for the at least one SRS resource is used as the PH of the target SRS resource set for PH
10 reporting. Herein, the PH of the target SRS resource set is actually a set including a plurality of PH values (respectively corresponding to different SRS resources).

If the target SRS resource set includes a plurality of SRS resources corresponding to a plurality of panels, the foregoing processing can support separate PH reporting for SRS resources on different panels.

15 The foregoing processing may be used for a case in which the at least one SRS resource uses the different antenna array groups to transmit the SRS.

Based on the foregoing description, a reporting processing manner is described below:

20 The communications unit 22 reports the PH of the target SRS resource set as PH of an SRS on the target carrier or the target BWP, and skips reporting PH corresponding to another SRS resource on the target carrier or the target BWP.

That the PH of the target SRS resource set obtained through calculation is reported includes: reporting PH corresponding to each SRS resource set configured on the target carrier or the target BWP.

25 It can be seen that through the foregoing solution, the PH of the target SRS resource set can be obtained through calculation for the SRS resource in the target SRS resource set on the target carrier or the target bandwidth part, and the PH is reported to a network side, so that the network side can obtain accurate SRS power headroom information, and then perform subsequent SRS scheduling and power control.

30 In addition, the present invention can also support a separate PHR for different

panels.

An embodiment of the present invention further provides a hardware composition architecture of a terminal device, as shown in FIG. 3, including at least one processor 31, a memory 32, and at least one network interface 33. All the components are coupled together by using a bus system 34. It may be understood that, the bus system 34 is configured to implement connection and communication between the components. The bus system 34 further includes a power supply bus, a control bus, and a status signal bus in addition to a data bus. However, for clear description, all buses are marked as the bus system 34 in FIG. 3.

It may be understood that the memory 32 in this embodiment of the present invention may be a volatile memory or a nonvolatile memory, or may include both a volatile memory and a nonvolatile memory.

In some implementations, the memory 32 stores the following elements: an executable module or a data structure, or a subset thereof, or an extension set thereof:

an operating system 321 and an application program 322.

The processor 31 is configured to be capable of processing steps of the method in Embodiment 1, and details are not described herein again.

An embodiment of the present invention provides a computer storage medium, where the computer storage medium stores a computer-executable instruction, and when being executed, the computer-executable instruction performs steps of the method in Embodiment 1.

When the foregoing apparatus in this embodiment of the present invention is implemented in a form of a software functional module and sold or used as an independent product, the foregoing apparatus may alternatively be stored in a computer-readable storage medium. Based on such an understanding, the technical solutions in the embodiments of the present invention essentially, or a part contributing to the prior art may be implemented in a form of a software product. The computer software product is stored in a storage medium, and includes several instructions for instructing a computer device (which may be a personal computer, a server, a network device, or the like) to perform all or a part of the method in the embodiments of the

present invention. The foregoing storage medium includes: any medium that can store program code, such as a USB flash drive, a removable hard disk, a read-only memory (ROM), a magnetic disk, or an optical disc. In this way, the embodiments of the present invention are not limited to any specific combination of hardware and software.

- 5 Correspondingly, an embodiment of the present invention further provides a computer storage medium storing a computer program, and the computer program is configured to perform the method for reporting the power headroom (PH) for the sounding reference signal (SRS) in the embodiments of the present invention.

- 10 Although the embodiments of the present invention have been disclosed for purpose of illustration, a person skilled in the art shall realize that various improvements, additions, and substitutions are also possible. Therefore, the scope of the present invention should not be limited to the foregoing embodiments.

CLAIMS

What is claimed is:

1. A method for reporting power headroom (PH) for a sounding reference signal (SRS), applied to a terminal device, the method comprising:
 - 5 calculating at least one expected SRS transmit power on at least one SRS resource comprised in a target SRS resource set, wherein the target SRS resource set is an SRS resource set on a target carrier or a target bandwidth part (BWP);
obtaining PH of the target SRS resource set through calculation according to the at least one expected SRS transmit power on the at least one SRS resource; and
 - 10 reporting the PH of the target SRS resource set obtained through calculation.
2. The method according to claim 1, wherein the calculating at least one expected SRS transmit power on at least one SRS resource comprised in a target SRS resource set comprises:
 - 15 if the terminal device transmits an SRS on an SRS resource at a moment of calculating the PH, calculating an expected SRS transmit power on the SRS resource based on a transmission parameter of the transmitted SRS and a power control parameter configured for the SRS resource or the target SRS resource set.
- 20 3. The method according to claim 1, wherein the calculating at least one expected SRS transmit power on at least one SRS resource comprised in a target SRS resource set comprises:
if the terminal device does not transmit an SRS on an SRS resource at a moment of calculating the PH, calculating an expected SRS transmit power on the SRS resource
25 based on a power control parameter configured for the SRS resource or the target SRS resource set.
4. The method according to claim 1, wherein the at least one SRS resource is one of the following:
at least one SRS resource occupying a same orthogonal frequency division

multiplexing (OFDM) symbol in the target SRS resource set;

at least one SRS resource occupying different OFDM symbols in the target SRS resource set;

5 at least one SRS resource occupying different bandwidths in the target SRS resource set;

at least one SRS resource using different antenna array groups to transmit an SRS in the target SRS resource set; and

at least one SRS resource using a same antenna array group to transmit an SRS in the target SRS resource set.

10

5. The method according to claim 1, wherein:

when the target SRS resource set is used for uplink non-codebook transmission, the at least one SRS resource is all SRS resources in the target SRS resource set.

15 6. The method according to claim 1, wherein:

when the target SRS resource set is used for uplink codebook transmission, beam management, or antenna switching, the at least one SRS resource is any SRS resource in the target SRS resource set.

20 7. The method according to claim 1, wherein:

when the terminal device transmits an SRS on the target carrier or the target BWP at a moment of calculating the PH, or the target carrier or the target BWP is a currently activated carrier or BWP, the target SRS resource set is an SRS resource set currently used for SRS transmission on the target carrier or the target BWP, or the target SRS
25 resource set is an SRS resource set associated with current physical uplink shared channel (PUSCH) transmission.

8. The method according to claim 1, wherein:

when the terminal device does not transmit an SRS on the target carrier or the target BWP at a moment of calculating the PH, or the target carrier or the target BWP is not an activated carrier or BWP, the target SRS resource set is an SRS resource set with a lowest set index on the target carrier or the target BWP, or the target SRS resource set
5 is an SRS resource set with a lowest set index on a recently activated BWP on the target carrier.

9. The method according to claim 1, wherein the obtaining PH of the target SRS resource set through calculation according to the at least one expected SRS transmit
10 power on the at least one SRS resource comprises:

using a difference between a maximum transmit power and a sum of the at least one expected SRS transmit power on the at least one SRS resource as the PH of the target SRS resource set.

15 10. The method according to claim 9, wherein:

the at least one SRS resource occupies a same orthogonal frequency division multiplexing (OFDM) symbol; or the at least one SRS resource uses a same antenna array group to transmit an SRS.

20 11. The method according to claim 1, wherein the obtaining PH of the target SRS resource set through calculation according to the at least one expected SRS transmit power on the at least one SRS resource comprises:

using a difference between a maximum transmit power and a maximum or minimum expected transmit power in the at least one expected SRS transmit power on
25 the at least one SRS resource as the PH of the target SRS resource set.

12. The method according to claim 9 or 11, wherein the maximum transmit power is one of the following:

a maximum transmit power supported by the terminal device;

a maximum transmit power supported by the terminal device on a carrier on which the target SRS resource set is located; and

a maximum transmit power supported by the terminal device on an antenna array group that is used to transmit an SRS on the target SRS resource set.

5

13. The method according to claim 11, wherein:

the at least one SRS resource occupies different orthogonal frequency division multiplexing (OFDM) symbols; or occupies different bandwidths.

10 14. The method according to claim 9 or 11, wherein different target SRS resource sets correspond to different antenna array groups; and

correspondingly, the reporting the PH of the target SRS resource set obtained through calculation comprises:

15 separately reporting PH of each target SRS resource set according to a maximum transmit power of each antenna array group.

15. The method according to claim 1, wherein the obtaining PH of the target SRS resource set through calculation according to the at least one expected SRS transmit power on the at least one SRS resource comprises:

20 using a difference between a maximum transmit power on a first SRS resource in the at least one SRS resource and an expected SRS transmit power of the first SRS resource as PH of the first SRS resource; and

adding the PH of the first SRS resource to the PH of the target SRS resource set.

25 16. The method according to claim 15, wherein the maximum transmit power on the first SRS resource is a maximum transmit power supported by an antenna array group that is used to transmit an SRS on the first SRS resource.

17. The method according to claim 15, wherein the method further comprises:
separately using each SRS resource in the target SRS resource set as the first SRS resource.

5 18. The method according to claim 1, wherein the reporting the PH of the target SRS resource set obtained through calculation comprises:

reporting the PH of the target SRS resource set as PH of an SRS on the target carrier or the target BWP, and skipping reporting PH corresponding to another SRS resource on the target carrier or the target BWP.

10

19. The method according to claim 1, wherein the reporting the PH of the target SRS resource set obtained through calculation comprises:

reporting PH corresponding to each SRS resource set configured on the target carrier or the target BWP.

15

20. A terminal device, comprising:

a processing unit, configured to: calculate at least one expected sounding reference signal (SRS) transmit power on at least one SRS resource comprised in a target SRS resource set, wherein the target SRS resource set is an SRS resource set on a target carrier or a target bandwidth part (BWP); and obtain power headroom (PH) of the target SRS resource set through calculation according to the at least one expected SRS transmit power on the at least one SRS resource; and

20

a communications unit, configured to report the PH of the target SRS resource set obtained through calculation.

25

21. The terminal device according to claim 20, wherein if the terminal device transmits an SRS on an SRS resource at a moment of calculating the PH, the processing unit calculates an expected SRS transmit power on the SRS resource based on a transmission parameter of the transmitted SRS and a power control parameter

configured for the SRS resource or the target SRS resource set.

22. The terminal device according to claim 20, wherein if the terminal device does not transmit an SRS on an SRS resource at a moment of calculating the PH, the
5 processing unit calculates an expected SRS transmit power on the SRS resource based on a power control parameter configured for the SRS resource or the target SRS resource set.

23. The terminal device according to claim 20, wherein the at least one SRS
10 resource is one of the following:

at least one SRS resource occupying a same orthogonal frequency division multiplexing (OFDM) symbol in the target SRS resource set;

at least one SRS resource occupying different OFDM symbols in the target SRS resource set;

15 at least one SRS resource occupying different bandwidths in the target SRS resource set;

at least one SRS resource using different antenna array groups to transmit an SRS in the target SRS resource set; and

at least one SRS resource using a same antenna array group to transmit an SRS in
20 the target SRS resource set.

24. The terminal device according to claim 20, wherein when the target SRS resource set is used for uplink non-codebook transmission, the at least one SRS resource is all SRS resources in the target SRS resource set.

25

25. The terminal device according to claim 20, wherein when the target SRS resource set is used for uplink codebook transmission, beam management, or antenna switching, the at least one SRS resource is any SRS resource in the target SRS resource set.

26. The terminal device according to claim 20, wherein when the terminal device transmits an SRS on the target carrier or the target BWP at a moment of calculating the PH, or the target carrier or the target BWP is a currently activated carrier or BWP, the target SRS resource set is an SRS resource set currently used for SRS transmission on the target carrier or the target BWP, or the target SRS resource set is an SRS resource set associated with current physical uplink shared channel (PUSCH) transmission.

27. The terminal device according to claim 20, wherein when the terminal device does not transmit an SRS on the target carrier or the target BWP at a moment of calculating the PH, or the target carrier or the target BWP is not an activated carrier or BWP, the target SRS resource set is an SRS resource set with a lowest set index on the target carrier or the target BWP, or the target SRS resource set is an SRS resource set with a lowest set index on a recently activated BWP on the target carrier.

15

28. The terminal device according to claim 20, wherein the processing unit uses a difference between a maximum transmit power and a sum of the at least one expected SRS transmit power on the at least one SRS resource as the PH of the target SRS resource set.

20

29. The terminal device according to claim 28, wherein:

the at least one SRS resource occupies a same orthogonal frequency division multiplexing (OFDM) symbol; or the at least one SRS resource uses a same antenna array group to transmit an SRS.

25

30. The terminal device according to claim 20, wherein the processing unit uses a difference between a maximum transmit power and a maximum or minimum expected transmit power in the at least one expected SRS transmit power on the at least one SRS resource as the PH of the target SRS resource set.

31. The terminal device according to claim 28 or 30, wherein the maximum transmit power is one of the following:

a maximum transmit power supported by the terminal device;

5 a maximum transmit power supported by the terminal device on a carrier on which the target SRS resource set is located; and

a maximum transmit power supported by the terminal device on an antenna array group that is used to transmit an SRS on the target SRS resource set.

10 32. The terminal device according to claim 30, wherein:

the at least one SRS resource occupies different orthogonal frequency division multiplexing (OFDM) symbols; or occupies different bandwidths.

33. The terminal device according to claim 28 or 30, wherein different target SRS
15 resource sets correspond to different antenna array groups; and

correspondingly, the communications unit separately reports PH of each target SRS resource set according to a maximum transmit power of each antenna array group.

34. The terminal device according to claim 20, wherein the processing unit uses a
20 difference between a maximum transmit power on a first SRS resource in the at least one SRS resource and an expected SRS transmit power of the first SRS resource as PH of the first SRS resource; and adds the PH of the first SRS resource to the PH of the target SRS resource set.

25 35. The terminal device according to claim 34, wherein the maximum transmit power on the first SRS resource is a maximum transmit power supported by an antenna array group that is used to transmit an SRS on the first SRS resource.

36. The terminal device according to claim 34, wherein the processing unit separately uses each SRS resource in the target SRS resource set as the first SRS resource.

5 37. The terminal device according to claim 20, wherein the communications unit reports the PH of the target SRS resource set as PH of an SRS on the target carrier or the target BWP, and skips reporting PH corresponding to another SRS resource on the target carrier or the target BWP.

10 38. The terminal device according to claim 20, wherein the communications unit reports PH corresponding to each SRS resource set configured on the target carrier or the target BWP.

39. A terminal device, comprising: a processor, and a memory, configured to store a computer program executable on the processor, wherein

15 the processor is configured to perform, when running the computer program, steps of the method according to any one of claims 1 to 19.

40. A computer storage medium, wherein the computer storage medium stores a computer-executable instruction, and when being executed, the computer-executable
20 instruction performs steps of the method according to any one of claims 1 to 19.