COMMUNICATION METHOD AND APPARATUS IN WIRELESS COMMUNICATION SYSTEM

[0001] ~~This application claims priority to Chinese Patent Application No. 202010381950.9, filed with the China National Intellectual Property Administration on May 8, 2020 and entitled "COMMUNICATION METHOD AND APPARATUS IN WIRELESS COMMUNICATION SYSTEM", which is incorporated herein by reference in its entirety.~~

TECHNICAL FIELD

[0002] This application relates to the wireless communication field, and in particular, to a communication method and apparatus in a wireless communication system.

BACKGROUND

[0003] With continuous development of wireless communication technologies, products having a short-range wireless transmission capability are increasingly diversified, and a quantity of users of these products is also continuously increasing. Currently, most of these products use a Bluetooth technology or a derived Bluetooth technology for information transmission. However, because the Bluetooth technology shares a spectrum with a Wi-Fi technology or a ZigBee technology, wireless communication interference occurs. To reduce such interference, a frequency hopping technology is proposed. The frequency hopping technology means that carrier frequencies used by two devices (assumed to be a primary device and a secondary device) that perform short-distance wireless communication hop (in other words, a used radio channel changes regularly) according to a specific rule within a specific range in a communication process. During specific implementation, a frequency hopping map is used between the primary device and the secondary device (the frequency hopping map is usually designed for the primary device). The frequency hopping map indicates at least one available channel in all operating channels between the primary device and the secondary device in a current case. The primary device and the secondary device randomly select, within a specific period of time, an available channel from these available

indication information, that the second terminal device should send the first channel quality reporting information at a specific time (for example, at the target moment or within the first time interval). This ensures effectiveness of the first channel quality reporting information.

[0012] With reference to the first aspect, the at least one available channel indicated by the first frequency hopping map is the same as the at least one target channel indicated by target channel indication information, and the reporting mode indication information further indicates that the second terminal device updates a second frequency hopping map based on the at least one target channel. The second frequency hopping map is used by the second terminal device to determine the at least one available channel between the first terminal device and the second terminal device. This is equivalent to that the first terminal device reuses the first frequency hopping map and the target channel indication information, so that the first terminal device can not only indicate, by using the target channel indication information, the second terminal device to report the channel quality parameter of the at least one target channel, but also notify the second terminal device that the at least one target channel is also the available channel determined by the second terminal device, so that the second terminal device can update the second frequency hopping map based on the at least one target channel. In this way, the first terminal device does not need to separately send a first frequency hopping map to trigger the second terminal device to update the second frequency hopping map. This reduces communication resources between the first terminal device and the second terminal device.

[0013] With reference to the first aspect, before the first terminal device sends the channel quality assessment request to the second terminal device, the method further includes: The first terminal device receives second channel quality ~~indicator~~ reporting information from the second terminal device. The first terminal device determines at least one first channel indicated by the second channel quality indication information. Herein, a channel quality parameter of the first channel is less than or equal to a first preset parameter. Alternatively, a channel quality parameter of the first channel is greater than a channel quality parameter of a channel other than the first channel in all channels indicated by the second channel quality ~~indicator~~ reporting information. The first terminal device determines the at least one available channel indicated by the first frequency hopping map. The first terminal device determines a first quantity of channels that do not coexist in the at least one available channel and the at least one first channel. The first terminal device determines, based on the first quantity, to perform an operation of sending the channel quality assessment request to the second

[0054] In actual application, the frequency hopping map indicates which channels are available channels and which channels are unavailable channels in a plurality of channels between two terminal devices. The two terminal devices share a same frequency hopping map. FIG. 2 is a schematic diagram of a frequency hopping map according to an embodiment of this application. It should be noted that, in this embodiment of this application, it is assumed that there are N1 channels between a first terminal device and a second terminal device. Herein, N1 is a positive integer. Each channel corresponds to one channel identifier, and a channel number is used as a channel identifier of each channel in the following description. For example, the N1 channels may include a plurality of channels identified as a channel 0, a channel 1, and a channel 2. FIG. 2 is a schematic diagram of a frequency hopping map according to an embodiment of this application. As shown in FIG. 2, the frequency hopping map includes a channel identifier of each of the N1 channels and an availability indication identifier corresponding to each channel. In this application, it is assumed that the availability indication identifier has two values: 0 and 1. If the availability indication identifier is 0, it indicates that a corresponding channel is an unavailable channel. If the value of the availability indication identifier is 1, it indicates that a corresponding channel is an available channel. As shown in FIG. 2, the frequency hopping map indicates that a channel 0, a channel 2, and a channel N1–1 are available channels, and a channel 1 and a channel N1–2 are unavailable channels.

[0055] FIG. 3a is a schematic flowchart of a communication method according to an embodiment of this application. As shown in FIG 3a, the communication method provided in this embodiment of this application includes but is not limited to the following steps.

[0056] S101: A second terminal device determines first channel quality ~~indicator~~ reporting information.

[0057] S102: The second terminal device sends first channel quality reporting information to a first terminal device.

[0058] S103: The first terminal device receives and parses the first channel quality reporting information, to obtain a channel quality parameter of at least one target channel.

[0059] Optionally, S104: The first terminal device updates a first frequency hopping map based on the channel quality parameter of the at least one target channel. It may be understood herein that the first terminal device may alternatively use the channel quality parameter of the at least one target channel for another purpose. This is not specifically limited in this application.

[0060] In some feasible implementations, after determining that the second terminal device

levels.

[0070] It should be noted herein that, as shown in the foregoing four formats, if the quantity of target channels indicated in the first channel quality reporting information or quantization precision of a channel quality parameter of each target channel is different, more formats of the first channel quality reporting information may be provided in this embodiment of this application. Details are not described herein again.

[0071] The following further describes specific implementations of the first channel quality reporting information in the foregoing four formats with reference to a Bluetooth (basic rate/enhanced data rate, BR/EDR) version. In actual application, it is specified in the Bluetooth BR/EDR version that there are 79 channels between the first terminal device and the second terminal device.

Table 1-1 Format comparison table of first channel quality reporting information

Field name	Field length (Byte)	Format	Data format
First channel quality reporting information	10	Format 1	u_int2[40], namely, an integer array containing 40 elements
		Format 2	u_int[80], namely, an integer array containing 80 elements
		Format 3	u_int2[40], namely, an integer array containing 40 elements
		Format 4	u_int2[20], namely, an integer array containing 20 elements

[0072] Refer to the table 1-1. The table 1-1 is a format comparison table of the first channel quality reporting information according to an embodiment of this application. As shown in the table 1-1, a field length of the first channel quality ~~indicator~~ reporting information in the format 1 is 10 bytes. The first channel quality ~~indicator~~ reporting information may be specifically an integer array including 40 elements (namely, elements 0 to 39). One element corresponds to one channel quality parameter. The n^{th} channel quality parameter indicates channel quality of the channel 2n and the channel 2n+1, and a 39^{th} channel quality parameter indicates channel quality of a channel 79. Herein, each channel quality parameter occupies 2 bits, which may have four values: 0, 1, 2, and 3. For example,

0 is the first quantized value in the format 1 described above, 1 is the second quantized value, and 3 is the third quantized value. A value of 2 of the 2 bits may be used as a reserved value for future design. When values of the 2 bits are 0, the channel quality parameter indicates that channel quality of a channel is unknown. When values of the 2 bits are 1, the channel quality parameter indicates that channel quality of a channel is good. When values of the 2 bits are 3, the channel quality parameter indicates that channel quality of a channel is poor.

[0073] A field length of the first channel quality ~~indicator~~ reporting information in the format 2 is 10 bytes. The first channel quality ~~indicator~~ reporting information may be specifically an integer array including 80 elements (namely, elements 0 to 79). One element corresponds to one channel quality parameter. The n^{th} channel quality parameter indicates the channel quality of the channel n, and a 79^{th} element is used as a reserved element for future design. Herein, each channel quality parameter occupies 1 bit, which have two values in total: 0 and 1. For example, 1 is the first quantized value in the format 2 described above, and 0 is the second quantized value. When a value of the bit is 0, the channel quality parameter indicates that channel quality of a channel is poor. When a value of the bit is 1, the channel quality parameter indicates that channel quality of a channel is good.

[0074] A field length of the first channel quality ~~indicator~~ reporting information in the format 3 is 10 bytes. The first channel quality ~~indicator~~ reporting information may be specifically an integer array including 40 elements (namely, elements 0 to 39), which correspondingly indicates channel quality of 40 channels in the 79 channels. One element corresponds to one channel quality parameter. The nth channel quality parameter indicates channel quality of the n^{th} channel in the foregoing 40 channels. Herein, each channel quality parameter occupies 2 bits, which have four values in total: 0, 1, 2, and 3. For example, 0 is the first quantized value in the foregoing format 3 described above, 1 is the second quantized value, 3 is the third quantized value, and 4 is the fourth quantized value. When values of the 2 bits are 0, the channel quality parameter indicates that channel quality of a channel is unknown. When values of the 2 bits are 1, the channel quality parameter indicates that channel quality of a channel is good. When values of the 2 bits are 2, the channel quality parameter indicates that channel quality of a channel is applicable. When values of the 2 bits are 3, the channel quality parameter indicates that channel quality of a channel is poor.

[0075] A field length of the first channel quality ~~indicator~~ reporting information in the format 4 is 10 bytes. The first channel quality ~~indicator~~ reporting information may be specifically an integer array including 20 elements (namely, elements 0 to 19), which correspondingly indicates channel quality of 20

[0082] If the second terminal device determines to send the first channel quality reporting information, the second terminal device may first generate first channel quality reporting information in any one of the foregoing format 1, format 2, format 3, or format 4 based on the channel quality measurement value of each of the N1 channels. It should be noted herein that a format of the first channel quality reporting information (for ease of understanding, the format is replaced with a target format below for description) may be predefined in a communication protocol between the first terminal device and the second terminal device, and the format 3 or the format 4 is preferred. During specific implementation, the second terminal device may select N2 target channels from the N1 channels based on the target format of the to-be-generated first channel quality reporting information. For example, if the target format is the format 1 or the format 2, the N2 target channels are the N1 channels. If the target format is the format 3 or the format 4, the N2 target channels are N2 channels whose channel quality measurement values rank top or N2 channels whose channel quality measurement values rank bottom in the N1 channels. Then, the second terminal device may quantize the channel quality measurement values of the N2 target channels by using different quantization rules corresponding to different formats, to obtain channel quality parameters of the target channels. It should be noted herein that different quantization rules correspond to different quantization precision. In other words, channel quality parameters in different formats correspond to different quantization levels. More quantization levels indicate higher quantization precision of the channel quality parameters. For example, quantization precision of channel quality parameters corresponding to the format 1 and the format 2 are the same. There are only three quantization levels, which can indicate that channel quality of a channel is good, poor, or unknown. Quantization precision of a channel quality parameter corresponding to the format 3 is higher than that of the format 1 and the format 2. A quantized value of the channel quality parameter corresponding to the format 3 has four levels, which can indicate that channel quality of a channel is good, applicable, poor, or unknown. Quantization precision of a channel quality parameter corresponding to the format 4 is higher than that of the format 1, the format 2, and the format 3. A quantized value of the channel quality parameter corresponding to the format 4 has five or more levels, so that channel quality of each channel can be more accurately indicated. Then, the second terminal device may determine first channel quality reporting information in the target format based on the channel quality parameters of the target channels.

[0083] With reference to specific implementations of the four formats described in the table 1-

parameter is equal to 2 in the N1 channels as the second channel. Alternatively, the second terminal device may sort the N1 channels based on values of the channel quality parameters, and extract N3 channels that rank bottom as second channels. Then, the second terminal device may determine, based on ~~N2~~ N3 available channels indicated by the second frequency hopping map and the ~~N2~~ N3 second channels, whether to actively send the first channel quality reporting channel to the first terminal device, and generate first channel quality reporting information in the target format if determining that the second terminal device needs to actively generate and send the first channel quality reporting information. Herein, for a process in which the second terminal device determines whether to generate and send the first channel quality reporting information in the target format, refer to the foregoing process in which the second terminal device determines whether to generate and send the first channel quality reporting information in the target format. Details are not described herein again.

[0089] Herein, the second terminal device determines, based on a difference between the at least one available channel indicated by the current second frequency hopping map of the second terminal device and the at least one second channel whose channel quality is good and that is determined by the second terminal device through channel quality assessment, whether to actively send the first channel quality reporting information to the first terminal device. The method is simple and easy to implement. In addition, when finding that there is a large difference between the at least one available channel and the at least one second channel (in other words, when finding that the second frequency hopping map is inaccurate), the second terminal device actively sends the first channel quality reporting information to the first terminal device. This can improve effectiveness of channel quality reporting. Further, the second terminal device can also trigger, in a timely manner by using the first channel quality reporting information, the first terminal device to adjust the first frequency hopping map. This can ensure accuracy of the first frequency hopping map and the second frequency hopping map, and improve an anti-interference capability of a frequency hopping technology.

[0090] Scenario 2 (The second terminal device reports the first channel quality reporting information based on the request of the first terminal device):

[0091] FIG. 4 is another schematic flowchart of a communication method according to an embodiment of this application. It can be learned from FIG. 4 that in the scenario in which the second terminal device reports the first channel quality reporting information based on the request

of the first terminal device, before step S101, the communication method provided in this embodiment of this application further includes the following steps.

[0092] S1011: The first terminal device generates a channel quality assessment request.

[0093] S1012: The first terminal device sends the channel quality assessment request to the second terminal device.

[0094] S1013: The second terminal device receives the channel quality assessment request from the first terminal device.

[0095] In some feasible implementations, if the first terminal device determines that the first terminal device needs to actively request the second terminal device to report the first channel quality reporting information, the first terminal device may generate a channel quality assessment request. Herein, the channel quality assessment request may include reporting mode indication information. The reporting mode indication information may indicate a format of the first channel quality reporting information sent by the second device (the format is the same as the target format described in the scenario 1, and the following continues to use the target format for description). Herein, the target format may be any one of the foregoing format 1 to format 4.

[0096] Further, in an optional implementation, the channel quality assessment request may further include a first time interval and a second time interval. Herein, the first time interval and the second time interval may be empirical values obtained by the first terminal device through a plurality of communication experiments. The reporting mode indication information may further indicate how the second terminal device sends the first channel quality reporting information based on the first time interval and/or the second time interval. Specifically, the reporting mode indication information may further indicate that the second terminal device sends first channel quality reporting information to the first terminal device for one or more times within the first time interval. Alternatively, the reporting mode indication information may further indicate that the second terminal device sends first channel quality reporting information to the first terminal device for one or more times within the second time interval. Alternatively, the reporting mode indication information may indicate that the second terminal device sends the first channel quality ~~indicator~~ reporting information to the first terminal device within the second time interval by using the first time interval as a sending interval. Alternatively, the reporting mode indication information may indicate that the second terminal device sends first channel quality ~~indicator~~ reporting information to the first terminal device for a plurality of times within the second time interval. In addition, a time interval

between each time the first channel quality reporting information is sent and last time first channel quality reporting information is sent needs to be less than or equal to the first time interval.

[0097] In another optional implementation, the channel quality assessment request may further include a target moment. Herein, the target moment may be determined by the first terminal device based on a current moment and a communication delay between the first terminal device and the second device. The reporting mode indication information may further indicate how the second terminal device sends the first channel quality ~~indicator~~ reporting information based on the target moment. For example, the reporting mode indication information may indicate that the second terminal device sends first channel quality ~~indicator~~ reporting information for one or more times before the target moment. For another example, the reporting mode indication information may indicate that the second terminal device sends the first channel quality ~~indicator~~ reporting information once at the target moment.

[0098] In addition, the channel quality assessment request may further include one piece of target channel indication information (which may also be referred to as a channel map). The target channel indication information indicates at least one channel whose channel quality parameter needs to be determined and reported by the second terminal device. At least one channel indicated by the target channel indication information includes the at least one target channel. During specific implementation, the target channel indication information includes a channel identifier of each of the N1 channels and a report indication identifier corresponding to each channel. Herein, the indication identifier has two values: 0 and 1. When a report indication identifier corresponding to a channel is 1, it indicates that the second terminal device needs to determine and report a channel quality parameter of the channel. When the reporting indication identifier of the channel is 0, it indicates that the second terminal device does not need to report the channel quality identifier of the channel. Herein, the first terminal device may specify only a channel quality parameter of at least one target channel required by the second terminal device to be determined and reported by the second terminal device. On one hand, the second terminal device does not need to determine channel quality parameters of all channels. This reduces a data processing amount of the second terminal device. On the other hand, the first terminal device does not need to subsequently extract a channel quality parameter from another channel other than the target channel. This also reduces a data processing amount of the first terminal device.

[0099] The following describes three specific implementations of the channel quality

using different values, a plurality of events that the second terminal device sends the first channel quality reporting information in the format 1, the format 2, the format 3, or the format 4 at the target moment or before the target moment. For another example, the reporting mode indication information may indicate, by using different values, a plurality of events that the second terminal device sends the first channel quality reporting information in the format 1, the format 2, the format 3, or the format 4 at the target moment or before the target moment, and at least one channel corresponding to the first channel quality reporting information is ~~a plurality of events~~ indicated by the target channel indication information. For another example, the reporting mode indication information may indicate, by using different values, a plurality of events that the second terminal device sends the first channel quality reporting information in the format 1, the format 2, the format 3, or the format 4 at the target moment or before the target moment, at least one channel corresponding to the first channel quality reporting information is indicated by the target channel indication information. In addition, the reporting mode indication information also indicates a plurality of events that the second terminal device updates the second frequency hopping map based on at least one target channel indicated by the target indication information. It should be noted that the scenario of indicating to update the second frequency hopping map is a case of reusing the target channel indication information and the first frequency hopping map of the first terminal device. In other words, the at least one target channel indicated by the target channel indication information is the at least one available channel indicated by the first frequency hopping map. Therefore, the second terminal device can adjust an availability indication identifier that is of the at least one target channel and that is included in the second frequency hopping map to 1, to complete updating of the second frequency hopping map. It may be understood that events that can be indicated by the first terminal device by using the reporting mode indication information is not limited to the foregoing types, and there may be more events. This is not specifically limited in this application.

[00106] Optionally, the channel quality assessment request may be implemented in a form of an LMP_set_AFH packet specified in a Bluetooth standard. For details, see the table 1-4. Table 1-4 is a format description table of an LMP_set_AFH packet is according to an embodiment of this application. As shown in the table 1-4, a length of the LMP_set_AFH packet is 16 bytes. A packet type of the packet may be DM1. An operation code corresponding to the packet may be an operation code 60 that has been allocated for use, or may be any operation code that is not allocated

need to adjust the frequency hopping map immediately. Therefore, the first terminal device may require the second terminal device to send the first channel quality ~~indicator~~ reporting information within the second time interval (regardless of whether the first time interval is used as a sending interval). Certainly, it may be understood that the first terminal device may alternatively determine, based on other status information (for example, data transmission status information) of the first terminal device and the second terminal device, an occasion in which the second terminal device should send the first channel quality reporting information. This is not specifically limited in this application. In addition, when finding that the first time interval and/or the second time interval are/is updated, the first terminal device may also indicate the second terminal device to update the first time interval and/or the second time interval stored in the first terminal device. Then, after one or more of a plurality of events such as that the first terminal device determines the target format, determines the occasion in which the second terminal device sends the first channel quality reporting information, or determines whether to update the first time interval and/or the second time interval, the first terminal device may determine the value of the reporting mode indication information from the value indication set based on these events. Then, the first terminal device may store the value of the reporting mode indication information in the AFH_reporting_mode_ex field in the LMP_channel_classification_req packet, and respectively store the first time interval and the second time interval in the AFH_min_interval field and the AFH_max_interval field in the LMP_channel_classification_req packet, to obtain the channel quality assessment request in the implementation 1.

[00119] Optionally, if the first terminal device generates the channel quality request described in the foregoing implementation 2 or implementation 3, the first terminal device may determine the target moment, and determine, based on a service status between the first terminal device and the second terminal, an occasion in which the second terminal device should send the first channel quality reporting information. For example, if the first terminal device determines that the service status between the first terminal device and the second terminal is busy, the first terminal device may determine that the second terminal device should send the first channel quality ~~indicator~~ reporting information before the target moment. If the first terminal device determines that the service status between the first terminal device and the second terminal is idle, the first terminal device determines that the second terminal device sends the first channel quality ~~indicator~~ reporting information at the target moment. In addition, if the target channel indication information

determined by the first terminal device is equivalent to the first frequency hopping map, the first terminal device may also indicate the second terminal device to update the second frequency hopping map based on the at least one target channel indicated by the target channel indication information. Then, after one or more of a plurality of events such as that the first terminal device determines the target format, determines the occasion in which the second terminal device sends the first channel quality reporting information, or determines whether the second terminal device needs to update the second frequency hopping map based on the at least one target channel indicated by the target channel indication information, the first terminal device may determine the value of the reporting mode indication information from the value indication set based on these events.

[00120] Then, the first terminal device may determine the target channel indication information based on a channel quality measurement value of each of the N1 channels that is obtained by the first terminal device by performing channel quality assessment on each channel. Herein, to distinguish between results obtained by the first terminal device and the second terminal device by performing channel quality assessment on the N1 channels, a channel quality measurement value of each channel determined by the second terminal device is replaced with a channel quality measurement value below for description, and a channel quality measurement value of each channel determined by the first terminal device is replaced with a second channel quality measurement value below for description. Specifically, after determining the second channel quality measurement value of each channel, the first terminal device may sort the N1 channels based on the second channel quality measurement value of each channel, and determine that a plurality of channels that rank top or a plurality of channels that rank bottom are target channels whose channel quality parameters need to be reported by the second terminal device. Then, the second terminal device may adjust report indication identifiers corresponding to the plurality of target channels in the target channel indication information to 1, and adjust a report indication identifier of a remaining channel to 0, to generate the target channel indication information.

[00121] Optionally, in a special scenario in which the first terminal device requires the second terminal device to report channel quality and also requires the second terminal device to ~~perform~~ update the second frequency hopping map based on the first frequency hopping map of the first terminal device, the first terminal device may alternatively determine the current first frequency hopping map of the first terminal device as the target channel indication information (in other words, the target channel indication information and the first frequency hopping map may be

reused, and the two are equivalent). In this way, the at least one target channel indicated by the target channel indication information is the at least one available channel indicated by the current first frequency hopping map. In this scenario, on one hand, the first terminal device may indicate, by using the target channel indication information, the second terminal device to report a channel quality parameter of the at least one target channel. On the other hand, the first terminal device may alternatively indicate the second terminal device to update the second frequency hopping map. Specifically, the second terminal device may be indicated to adjust an availability indication identifier that is of the at least one target channel and that is included in the second frequency hopping map to 1, in other words, determine all the at least one target channel in the second frequency hopping map as an available channel. Herein, the first terminal device can not only indicate, by using the target channel indication information, the second terminal device to report the channel quality parameter of the at least one target channel, but also notify the second terminal device that the at least one target channel is also the available channel determined by the second terminal device, so that the second terminal device can update the second frequency hopping map based on the at least one target channel. In this way, the first terminal device does not need to separately send a first frequency hopping map to trigger the second terminal device to update the second frequency hopping map. This reduces communication resources between the first terminal device and the second terminal device.

[00122] Then, the first terminal device may store the value of the reporting mode indication information in the AFH_mode_ex field in the LMP_set_AFH packet, store the target moment in the AFH_instant field, and store the target channel indication information in the AFH_channel_map field, to obtain the channel quality assessment request in the foregoing implementation 2. Alternatively, the first terminal device may store the value of the reporting mode indication information in the CQI_mode field and the CQI_format field in the CQI_req packet, store the target moment in the CQI_instant field, and store the target channel indication information in the CQI_quality_map field, to obtain the channel quality assessment request in the foregoing implementation 3.

[00123] In some feasible implementations, after generating the channel quality assessment request, the first terminal device may randomly select one first target available channel from the at least one available channel indicated by the first frequency hopping map. For example, the first terminal device may obtain a time identifier that can represent a current moment and that is output

the second time interval from the channel quality assessment request, and determine, based on the value of the reporting mode indication information and the value indication set, a format (namely, the target format) of first channel quality reporting information to be generated by the second terminal device and an occasion in which the second terminal device sends the first channel quality assessment request. Then, the second terminal device may generate the first channel quality reporting information in the target format. Herein, the target format is any one of the foregoing format 1, format 2, format 3, or format 4. For a process in which the second terminal device generates the first channel quality reporting information in the target format, refer to the process in which the second terminal device generates the first channel quality reporting information in the format 1, the format 2, the format 3, or the format 4 described in the scenario 1. Details are not described herein again.

[00127] In a scenario of the implementation 2 or the implementation 3, the second terminal device may first extract the reporting mode indication information, the target moment, and the target channel indication information from the channel quality assessment request. Then, the second terminal device may determine, based on the value of the reporting mode indication information and the value indication set, a format (namely, the target format) of first channel quality reporting information to be generated by the second terminal device and the at least one target channel indicated by the first channel reporting indication information. Then, the second terminal device may perform channel quality assessment on the at least one target channel, to obtain the channel quality measurement value of each target channel. Herein, for a process in which the second terminal device obtains the channel quality measurement value of each target channel, refer to the process in which the second terminal device obtains the channel quality measurement value of each channel described in the scenario 1. Details are not described herein again. Then, the second terminal device may generate the first channel quality reporting information in the target format. Herein, the target format is any one of the foregoing format 1, format 2, format 3, or format 4. The first channel quality ~~indicator~~ reporting information includes the channel quality parameter of each target channel. Herein, for a process in which the second terminal device generates the first channel quality reporting information in the target format, refer to the process in which the second terminal device generates the first channel quality reporting information in the format 1, the format 2, the format 3, or the format 4 described in the scenario 1. Details are not described herein again.

immediately sends the first channel quality reporting information to the first terminal device after generating the first channel quality reporting information. If a moment at which the second terminal device generates the first channel quality reporting information is before the target moment, the second terminal device may send the first channel quality reporting information in the target format 1 to the first terminal device at one or more random time nodes before the target moment.

[00132] In some feasible implementations, the first terminal device may receive, by using the second target available channel, the first channel quality reporting information in the target format sent by the second terminal device, and parse the first channel quality reporting information, to obtain the channel quality parameter of the at least one target channel. Herein, for a process in which the first terminal device selects the second target available channel from the at least one available channel indicated by the first frequency hopping map, refer to the process in which the first terminal device determines the first target available channel described in step S1012. Details are not described herein again.

[00133] Optionally, after obtaining the channel quality parameter of the at least one target channel, the first terminal device may further update, based on the channel quality parameter of the at least one target channel and the channel quality parameter that is of each of the N1 channels and that is determined by the first terminal device, the first frequency hopping map used by the first terminal device. The first terminal device updates the first frequency hopping map based on the channel quality parameter that is reported by the second terminal device and that has appropriate precision, so that precision of the first frequency hopping map can be ensured, and an anti-interference capability of the frequency hopping technology can be improved. In the following description, to distinguish between the channel quality measurement value and the channel quality measurement parameter~~value~~ that are obtained by the first terminal device or the second terminal device, the channel quality measurement value and the channel quality measurement parameter~~value~~ that are obtained by the second terminal device are replaced with a first channel quality measurement value and a first channel quality parameter for description. The channel quality measurement value and the channel quality measurement parameter~~value~~ that are obtained by the first terminal device are replaced with a second channel quality measurement value and a second channel quality parameter for description.

[00134] During specific implementation, the first terminal device may perform channel quality

assessment on each of the at least one target channel indicated by the first channel quality reporting information, to obtain a second channel quality measurement value of each target channel. For a specific process, refer to the foregoing process in which the second terminal device determines the channel quality measurement value of each channel. Details are not described herein again. Then, the first terminal device may perform quantization processing on the second channel quality measurement value of each target channel by using a quantization rule (the first quantization rule, the second quantization rule, the third quantization rule, or the fourth quantization rule described above) corresponding to the target format, to obtain a second channel quality parameter of each target channel. For a specific quantization process, refer to the foregoing process in which the second terminal device quantizes the channel quality measurement value. Details are not described herein again. After obtaining a first channel quality parameter and the second channel quality parameter of each target channel, the first terminal device may determine availability of each target channel based on the first channel quality parameter and the second channel quality parameter of each target channel, to determine whether each target channel is an available channel. The following briefly describes, based on different target formats, a process in which the second terminal device determines availability of each target channel based on the first channel quality parameter and the second channel quality parameter of each target channel.

[00135] It is assumed that the target format is the format 1, the format 2, or the format 3, in an optional implementation. If the second terminal device determines that both a first channel quality parameter and a second channel quality parameter of a target channel indicate that channel quality of the target channel is good (in other words, values of both the first channel quality parameter and the second channel quality parameter are 1), the second terminal device may determine that the target channel is an available channel. If the second terminal device determines that a first channel quality parameter and/or a second channel quality parameter of a target channel indicate/indicates that channel quality of the target channel is unknown, poor, or applicable (in other words, a value of the first channel quality parameter and/or a value of the second channel quality parameter are/is not 1), the second terminal device may determine that the target channel is an unavailable channel. In another optional implementation, if the second terminal device determines that both a first channel quality parameter and a second channel quality parameter of a target channel indicate that channel quality of the target channel is poor (in other words, values of both the first channel quality parameter and the second channel quality parameter are 1 or 3), the second terminal device may

target channel. Herein, for each target channel, the first channel quality parameter and the second channel quality parameter of the target channel each correspond to one weight value. For example, it is assumed that weights of a first channel quality parameter and a second channel quality parameter of a target channel 3 are 0.7 and 0.3 respectively. If the first channel quality parameter is 5 and the second channel quality parameter is 7, a weighted average value of the first channel quality parameter and the second channel quality parameter is 5*0.7+7*0.3=5.6. Then, the first terminal device may determine, as an available channel, a target channel whose weighted average value of a first channel quality parameter and a second channel quality parameter is greater than or equal to a second preset average value~~, and determine, as an available channel, a target channel whose average value of a first channel quality parameter and a second channel quality parameter is less than the first preset average value~~.

[00138] Optionally, when determining that a quantity of available channels in the at least one target channel is less than a preset minimum quantity of available channels, the first terminal device also needs to perform supplementary selection of available channels. Specifically, the first terminal device sorts the target channels based on average values or weighted average values of first channel quality parameters and second channel quality parameters of the target channels, and then selects a target channel that ranks top but that is determined as an unavailable channel to supplement available channels. In this way, a quantity of supplemented available channels can be greater than or equal to the minimum quantity of available channels.

[00139] After the first terminal device determines availability of each target channel, the first terminal device may update the currently used first frequency hopping map based on an availability determining result of each target channel, to obtain an updated first frequency hopping map. Specifically, the first terminal device may adjust, based on the availability determining result of each target channel, an availability indication identifier that is of the at least one target channel and that is included in the first frequency hopping map. For example, the first terminal device may adjust an availability indication identifier that is of a target channel determined as an available channel and that is in the first frequency hopping map to 1, and adjust an availability indication identifier of a target channel determined as an unavailable channel to 0.

[00140] Further, after determining the updated first frequency hopping map, the first terminal device may send the updated first frequency hopping map to the second terminal device. After receiving the updated first frequency hopping map, the second terminal device may use the updated

hopping map module 7002, and the frequency hopping core 7004 may be configured to generate the foregoing second target available channel. The radio frequency module 7005 may send the first channel quality reporting information to the first terminal device by using the second target available channel. The channel quality assessment module 7001 may further update the second frequency hopping map based on an updated first frequency hopping map sent by the first terminal device, and send an updated second frequency hopping map to the frequency hopping map module 7002 for storage.

[00179] In another example, the clock module 7003, the frequency hopping map module 7002, and the frequency hopping core 7004 may be configured to generate the foregoing first target available channel. The radio frequency module 7005 may receive a channel quality report request by using the first target available channel. The channel quality assessment module 7001 may further generate the first channel quality reporting information based on the channel quality report request. The clock module 7003, the frequency hopping map module 7002, and the frequency hopping core 7004 may be further configured to generate one second target available channel. The radio frequency module 7005 may further send the first channel quality reporting information to the first terminal device by using the second target available channel.

[00180] An embodiment of this application further provides a chip system. The chip system includes a processor, configured to support a first terminal device or a second terminal device to implement a function in the foregoing embodiments, for example, generating or processing data and/or information in the foregoing method. In a possible design, the chip system may further include a memory. The memory is configured to store program instructions and data that are necessary for a transmit end or a receive end. When the processor runs the program instructions, a device mounted in the chip system is enabled to perform the method in any one of the foregoing embodiments. The chip system may include a chip, or may include a chip and another discrete component.

[00181] An embodiment of this application further provides a processor, configured to be coupled to a memory. The memory stores instructions. When the processor runs the instructions, the processor is enabled to perform the method and the function related to the first terminal device or the second terminal device in the foregoing embodiments.

[00182] An embodiment of this application further provides a computer program product including instructions. When the computer program product runs on a computer, the computer performs the method and the function related to the first terminal device or the second terminal

CLAIMS

What is claimed is:

1. A communication apparatus in a wireless communication system, applied to a first terminal device, wherein the communication apparatus comprises:

a transceiver unit, configured to receive first channel quality reporting information sent by a second terminal device, wherein a format of the first channel quality reporting information is one of at least two preset formats, the first channel quality reporting information comprises a channel quality parameter of at least one target channel determined by the second terminal device, and the target channel is a radio channel between the second terminal device and the first terminal device; and

a processing unit, configured to parse the first channel quality reporting information, to obtain the channel quality parameter of the at least one target channel.

2. The communication apparatus according to claim 1, wherein the processing unit is further configured to update a first frequency hopping map based on the channel quality parameter of the at least one target channel, wherein the first frequency hopping map is used by the first terminal device to determine at least one available channel between the first terminal device and the second terminal device.

3. The communication apparatus according to claim 1 or 2, wherein precision of channel quality parameters comprised in first channel quality reporting information in different formats is different.

4. The communication apparatus according to any one of claims 1 to 3, wherein the transceiver unit is further configured to:

send a channel quality assessment request to the second terminal device, wherein the channel quality assessment request comprises reporting mode indication information, and the reporting mode indication information indicates a format of the first channel quality reporting information.

5. The communication apparatus according to claim 4, wherein the channel quality assessment request further comprises a first time interval and a second time interval, and the second time interval is greater than the first time interval; and

the reporting mode indication information further indicates that the second terminal device sends the first channel quality reporting information within the first time interval;

the reporting mode indication information further indicates that the second terminal device sends the first channel quality reporting information within the second time interval; or

the reporting mode indication information further indicates that the second terminal device sends the first channel quality reporting information within the second time interval by using the first time interval as a sending interval.

6. The communication apparatus according to claim 4, wherein the channel quality assessment request further comprises a target moment; and

the reporting mode indication information further indicates that the second terminal device sends the first channel quality reporting information before the target moment.

7. The communication apparatus according to claim 6, wherein the channel quality assessment request further comprises target channel indication information, and the target channel indication information indicates the at least one target channel.

8. The communication apparatus according to claim 7, wherein the at least one available channel indicated by the first frequency hopping map is the same as the at least one target channel indicated by the target channel indication information, the reporting mode indication information further indicates that the second terminal device updates a second frequency hopping map based on the at least one target channel, and the second frequency hopping map is used by the second terminal device to determine the at least one available channel between the first terminal device and the second terminal device.

9. The communication apparatus according to any one of claims 4 to 8, wherein the transceiver unit is further configured to receive second channel quality indicator information from the second terminal device;

the processing unit is further configured to determine at least one first channel indicated by the second channel indication information, wherein a channel quality parameter of the first channel is less than or equal to a first preset parameter, or a channel quality parameter of the first channel is greater than a channel quality parameter of a channel other than the first channel in all channels indicated by the second channel quality indicator information;

the processing unit is further configured to determine the at least one available channel indicated by the first frequency hopping map;

the processing unit is further configured to determine a first quantity of channels that do not coexist in the at least one available channel and the at least one first channel; and

the processing unit is further configured to determine, based on the first quantity, to trigger the transceiver unit to perform an operation of sending the channel quality assessment request to the second terminal device.

10. The communication apparatus according to any one of claims 2 to 9, wherein the transceiver unit is further configured to send an updated first frequency hopping map to the second terminal device, wherein the updated first frequency hopping map is used by the second terminal device to update the second frequency hopping map, and the second frequency hopping map is used by the second terminal device to determine the at least one available channel between the first terminal device and the second terminal device.

11. A communication apparatus in a wireless communication system, applied to a second terminal device, wherein the communication apparatus comprises:

a processing unit, configured to determine first channel quality reporting information, wherein a format of the first channel quality reporting information is one of at least two preset formats, the first channel quality reporting information comprises a channel quality parameter of at least one target channel determined by the second terminal device, and the target channel is a radio channel between the second terminal device and a first terminal device; and

a transceiver unit, configured to send the first channel quality reporting information to the first terminal device.

12. The communication apparatus according to claim 11, wherein precision of channel quality parameters comprised in first channel quality reporting information in different formats is different.

13. The communication apparatus according to claim 11 or 12, wherein the transceiver unit is further configured to receive a channel quality assessment request from the first terminal device, wherein the channel quality assessment request comprises reporting mode indication information, and the reporting mode indication information indicates a format of the first channel quality reporting information.

14. The communication apparatus according to claim 13, wherein the channel quality assessment request further comprises a first time interval and a second time interval, and the second time interval is greater than the first time interval; and

the processing unit is further configured to determine the first time interval or the second time interval based on the reporting mode indication information; and

the transceiver unit is further configured to send the first channel quality reporting

information to the first terminal device within the first time interval or the second time interval.

15. The communication apparatus according to claim 13, wherein the channel quality assessment request comprises a first time interval and a second time interval, and the second time interval is greater than the first time interval; and

the processing unit is further configured to determine the first time interval and the second time interval based on the reporting mode indication information; and

the transceiver unit is further configured to send the first channel quality reporting information to the first terminal device within the second time interval by using the first time interval as a sending interval.

16. The communication apparatus according to claim 13, wherein the channel quality reporting requests a target moment; and

the processing unit is further configured to determine the target moment based on the reporting mode indication information; and

the transceiver unit is further configured to send the first channel quality reporting information to the first terminal device before the target moment.

17. The communication apparatus according to claim 16, wherein the channel quality assessment request further comprises target channel indication information, and the target channel indication information indicates the at least one target channel.

18. The communication apparatus according to claim 17, wherein the first channel quality reporting information is used by the first terminal device to update a first frequency hopping map, and the first frequency hopping map is used by the first terminal device to determine at least one available channel between the first terminal device and the second terminal device.

19. The communication apparatus according to claim 18, wherein the at least one available channel indicated by the first frequency hopping map is the same as the at least one target channel indicated by the target channel indication information; and

the processing unit is further configured to determine, based on the reporting mode indication information, to update a second frequency hopping map by using the at least one target channel, wherein the second frequency hopping map is used by the second terminal device to determine the at least one available channel between the first terminal device and the second terminal device.

20. The communication apparatus according to any one of claims 17 to 19, wherein the processing unit is further configured to determine the at least one target channel based on the target

~~channel indication information;~~

~~the processing unit is further configured to perform channel quality assessment on the at least one target channel to obtain a channel quality parameter of each target channel in the at least one target channel; and~~

~~the processing unit is further configured to generate, based on the channel quality parameter of the target channel, first channel quality reporting information in a format indicated by the reporting mode indication information.~~

~~21. The communication apparatus according to claim 11, wherein the processing unit is further configured to determine at least one available channel based on a second frequency hopping map;~~

~~the processing unit is further configured to perform channel quality assessment on all channels between the second terminal device and the first terminal device, to obtain channel quality parameters of all the channels;~~

~~the processing unit is further configured to determine at least one second channel from all the channels based on the channel quality parameters of the channels, wherein a channel quality parameter of the second channel is less than or equal to a second preset parameter, or the channel quality parameter of the second channel is greater than a channel quality parameter of a channel other than the second channel in all the channels;~~

~~the processing unit is further configured to determine a second quantity of channels that do not coexist in at least one available channel indicated by the second frequency hopping map and the at least one second channel, wherein the second frequency hopping map is used by the second terminal device to determine the at least one available channel between the first terminal device and the second terminal device; and~~

~~the processing unit is further configured to determine, based on the second quantity, to perform an operation of determining the first channel quality reporting information.~~

~~22. The communication apparatus according to any one of claims 18 to 21, wherein the transceiver unit is further configured to receive an updated first frequency hopping map sent by the first terminal device; and~~

~~the processing unit is further configured to update the second frequency hopping map based on the updated first frequency hopping map.~~

~~23~~1. A communication method in a wireless communication system, wherein the method

comprises:

receiving, by a first terminal device, first channel quality reporting information sent by a second terminal device, wherein a format of the first channel quality reporting information is one of at least two preset formats, the first channel quality reporting information comprises a channel quality parameter of at least one target channel determined by the second terminal device, and the target channel is a radio channel between the second terminal device and the first terminal device; and

parsing, by the first terminal device, the first channel quality reporting information, to obtain the channel quality parameter of the at least one target channel.

~~24~~2. The method according to claim ~~23~~1, wherein the method further comprises:

updating, by the first terminal device, a first frequency hopping map based on the channel quality parameter of the at least one target channel, wherein the first frequency hopping map is used by the first terminal device to determine at least one available channel between the first terminal device and the second terminal device.

~~25~~3. The method according to claim ~~23 or 24~~1 or 2, wherein precision of channel quality parameters comprised in first channel quality reporting information in different formats is different.

~~26~~4. The method according to any one of claims ~~23 to 25~~1 to 3, wherein the method further comprises:

sending, by the first terminal device, a channel quality assessment request to the second terminal device, wherein the channel quality assessment request comprises reporting mode indication information, and the reporting mode indication information indicates a format of the first channel quality reporting information.

~~27~~5. The method according to claim ~~26~~4, wherein the channel quality assessment request further comprises a first time interval and a second time interval, and the second time interval is greater than the first time interval; and

the reporting mode indication information further indicates that the second terminal device sends the first channel quality reporting information within the first time interval;

the reporting mode indication information further indicates that the second terminal device sends the first channel quality reporting information within the second time interval; or

the reporting mode indication information further indicates that the second terminal device sends the first channel quality reporting information within the second time interval by using the

first time interval as a sending interval.

~~28~~6. The method according to claim ~~26~~4, wherein the channel quality assessment request further comprises a target moment; and

the reporting mode indication information further indicates that the second terminal device sends the first channel quality reporting information before the target moment.

~~29~~7. The method according to claim ~~28~~6, wherein the channel quality assessment request further comprises target channel indication information, and the target channel indication information indicates the at least one target channel.

~~30~~8. The method according to claim ~~29~~7, wherein the at least one available channel indicated by the first frequency hopping map is the same as the at least one target channel indicated by the target channel indication information, the reporting mode indication information further indicates that the second terminal device updates a second frequency hopping map based on the at least one target channel, and the second frequency hopping map is used by the second terminal device to determine the at least one available channel between the first terminal device and the second terminal device.

~~31~~9. The method according to any one of claims ~~26 -~~4 to ~~30~~8, wherein the method further comprises:

receiving, by the first terminal device, second ~~channel quality indicator information~~channel quality reporting information from the second terminal device;

determining, by the first terminal device, at least one first channel indicated by the second channel quality indication information, wherein a channel quality parameter of the first channel is less than or equal to a first preset parameter, or a channel quality parameter of the first channel is greater than a channel quality parameter of a channel other than the first channel in all channels indicated by the second ~~channel quality indicator information~~channel quality reporting information;

determining, by the first terminal device, the at least one available channel indicated by the first frequency hopping map;

determining, by the first terminal device, a first quantity of channels that do not coexist in the at least one available channel and the at least one first channel; and

determining, by the first terminal device based on the first quantity, to trigger performing an operation of sending the channel quality assessment request to the second terminal device.

~~32~~10. The method according to any one of claims ~~24 -~~2 to ~~31~~9, wherein the method further

comprises:

sending an updated first frequency hopping map to the second terminal device, wherein the updated first frequency hopping map is used by the second terminal device to update the second frequency hopping map, and the second frequency hopping map is used by the second terminal device to determine the at least one available channel between the first terminal device and the second terminal device.

~~33~~11. A communication method in a wireless communication system, wherein the method comprises:

determining, by a second terminal device, first channel quality reporting information, wherein a format of the first channel quality reporting information is one of at least two preset formats, the first channel quality reporting information comprises a channel quality parameter of at least one target channel determined by the second terminal device, and the target channel is a radio channel between the second terminal device and a first terminal device; and

sending, by the second terminal device, the first channel quality reporting information to the first terminal device.

~~34~~12. The method according to claim ~~33~~11, wherein precision of channel quality parameters comprised in first channel quality reporting information in different formats is different.

~~35~~13. The method according to claim ~~33 or 34~~11 or 12, wherein the method further comprises:

receiving, by the second terminal device, a channel quality assessment request from the first terminal device, wherein the channel quality assessment request comprises reporting mode indication information, and the reporting mode indication information indicates a format of the first channel quality reporting information.

~~36~~14. The method according to claim ~~35~~13, wherein the channel quality assessment request further comprises a first time interval and a second time interval, and the second time interval is greater than the first time interval; and

the sending, by the second terminal device, the first channel quality reporting information to the first terminal device comprises:

determining, by the second terminal device, the first time interval or the second time interval based on the reporting mode indication information; and

sending, by the second terminal device, the first channel quality reporting information to the first terminal device within the first time interval or the second time interval.

~~37~~15. The method according to claim ~~36~~14, wherein the channel quality assessment request comprises the first time interval and the second time interval, and the second time interval is greater than the first time interval; and

the sending, by the second terminal device, the first channel quality reporting information to the first terminal device comprises:

determining, by the second terminal device, the first time interval and the second time interval based on the reporting mode indication information; and

sending, by the second terminal device, the first channel quality reporting information to the first terminal device within the second time interval by using the first time interval as a sending interval.

~~38~~16. The method according to claim ~~36~~14, wherein the channel quality reporting requests a target moment; and

the sending, by the second terminal device, the first channel quality reporting information to the first terminal device comprises:

determining, by the first terminal device, the target moment based on the reporting mode indication information; and

sending, by the first terminal device, the first channel quality reporting information to the first terminal device before the target moment.

~~39~~17. The method according to claim 16~~38~~, wherein the channel quality assessment request further comprises target channel indication information, and the target channel indication information indicates the at least one target channel.

~~40~~18. The communication apparatus according to claim ~~39~~17, wherein the first channel quality reporting information is used by the first terminal device to update a first frequency hopping map, and the first frequency hopping map is used by the first terminal device to determine at least one available channel between the first terminal device and the second terminal device.

~~41~~19. The method according to claim ~~40~~18, wherein the at least one available channel indicated by the first frequency hopping map is the same as the at least one target channel indicated by the target channel indication information; and

the method further comprises:

determining, by the second terminal device, based on the reporting mode indication information, to update a second frequency hopping map by using the at least one target channel,

wherein the second frequency hopping map is used by the second terminal device to determine the at least one available channel between the first terminal device and the second terminal device.

~~42~~20. The method according to any one of claims ~~39 to 41~~17 to 19, wherein the determining first channel quality reporting information comprises:

determining, by the second terminal device, the at least one target channel based on the target channel indication information;

performing, by the second terminal device, channel quality assessment on the at least one target channel to obtain a channel quality parameter of each target channel in the at least one target channel; and

generating, by the second terminal device based on the channel quality parameter of the target channel, first channel quality reporting information in a format indicated by the reporting mode indication information.

~~43~~21. The method according to claim ~~42~~20, wherein the method further comprises:

determining, by the second terminal device, the at least one available channel based on the second frequency hopping map;

performing, by the second terminal device, channel quality assessment on all channels between the second terminal device and the first terminal device, to obtain channel quality parameters of all the channels;

determining, by the second terminal device, at least one second channel from all the channels based on the channel quality parameters of the channels, wherein a channel quality parameter of the second channel is less than or equal to a second preset parameter, or the channel quality parameter of the second channel is greater than a channel quality parameter of a channel other than the second channel in all the channels;

determining, by the second terminal device, a second quantity of channels that do not coexist in at least one available channel indicated by the second frequency hopping map and the at least one second channel, wherein the second frequency hopping map is used by the second terminal device to determine the at least one available channel between the first terminal device and the second terminal device; and

determining, by the second terminal device based on the second quantity, to perform an operation of determining the first channel quality reporting information.

~~44~~22. The method according to any one of claims ~~40 to 43~~18 to 21, wherein the method

further comprises:

receiving, by the second terminal device, an updated first frequency hopping map sent by the first terminal device; and

updating, by the second terminal device, the second frequency hopping map based on the updated first frequency hopping map.

~~45~~23. A communication apparatus in a wireless communication system, comprising a processor and a memory, wherein the memory is configured to store instructions, and when the processor runs the instructions, the communication apparatus is enabled to perform the method according to any one of claims ~~23 to 32~~1 to 10 or claims ~~33 to 44~~11 to 22.

~~46~~24. A computer-readable storage medium, wherein the computer-readable storage medium stores program instructions, and when the program instructions are run, the method according to any one of claims ~~23 to 32~~1 to 10 or claims ~~33 to 44~~11 to 22 is performed.

~~47. A wireless communication system, comprising a first terminal device and a second terminal device, wherein~~

~~the first terminal device is the communication apparatus according to any one of claims 1 to 10; and~~

~~the second terminal device is the communication apparatus according to any one of claims 11 to 22.~~

~~48. A chip, comprising an input/output interface and a processing circuit, wherein the processing circuit is configured to implement the method according to any one of claims 23 to 32 or claims 33 to 44.~~

~~49. A computer program product, comprising computer program code, wherein when the computer program code is run on a computer, the computer is enabled to implement the method according to any one of claims 23 to 32 or claims 33 to 44.~~