

fourth possible implementation manner, the processor is specifically configured to: separately perform processing, that is, scrambling, channel coding, and rate matching, on multiple uplink scheduling information; generate an uplink scheduling information group by multiplexing all processed uplink scheduling information; and carry the
5 uplink scheduling information group over a downlink control channel, and send the uplink scheduling information group to the transmit end by using the communications interface.

With reference to the second possible implementation manner of the second aspect or the third possible implementation manner of the second aspect, in a
10 fifth possible implementation manner, the processor is specifically configured to: generate an uplink scheduling information group by multiplexing multiple uplink scheduling information; perform processing, that is, scrambling, channel coding, and rate matching, on the uplink scheduling information group; and carry the processed uplink scheduling information group over a downlink control channel, and send the
15 uplink scheduling information group to the transmit end by using the communications interface.

According to a third aspect, an embodiment of the present invention provides a data transmission method, where mapping information between a data flow identifier and a physical layer transmission technology identifier is stored at a transmit
20 end, the mapping information includes a correspondence between the data flow identifier and the physical layer transmission technology identifier, and the method includes:

determining, by the transmit end, a to-be-scheduled data flow; determining, by the transmit end, from the mapping information and according to a data flow
25 identifier of the data flow, a physical layer transmission technology identifier corresponding to the data flow;

generating, by the transmit end, different transport blocks according to data flows corresponding to different physical layer transmission technology identifiers, so as to send the data flow to a receive end by using the transport block,
30 where each physical layer transmission technology identifier is corresponding to one type of transport block;

generating, by the transmit end, wireless communication data by performing processing, according to a physical layer transmission technology

merely some but not all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

5 The following uses FIG. 1 as an example to describe in detail a communications device according to Embodiment 1 of the present invention. As shown in FIG. 1, FIG. 1 is a schematic structural diagram of the communications device according to Embodiment 1 of the present invention. In this embodiment, the communications device is a transmit end device, and may be specifically: a base
10 station (may also be referred to as an access point) or user equipment. When the communications device is the base station, a receive end is the user equipment; and when the communications device is the user equipment, the receive end is the base station.

 The user equipment may be any terminal device such as a mobile device, a
15 smartphone, an integrated messaging device (Integrated Messaging Device, IMD for short), a personal computer (Personal Computer, PC for short), a notebook computer, a personal digital assistant (Personal Digital Assistant, PDA for short), or a tablet computer. The user equipment may also be disposed on various traffic vehicles, or be disposed on a wearable device.

20 The communications device includes: a memory 110, a processor 120, and a communications interface 130.

 The memory 110 is configured to store mapping information between a data flow identifier and a physical layer transmission technology identifier.

25 The mapping information includes a correspondence between the data flow identifier and the physical layer transmission technology identifier.

 The data flow identifier may be specifically a logical channel identifier (Logical channel identifier, LCID) corresponding to a data flow, that is, an LCID at a media access control (Media Access Control, MAC for short) sublayer, a function entity number used at a Packet Data Convergence Protocol (Packet Data Convergence
30 Protocol, PDCP for short) sublayer or a radio link control (Radio Link Control, RLC for short) sublayer when data flow is being implemented in the communications device, or a network transmission port number or a tunnel endpoint identifier that identifies a data flow when the data flow is being implemented in different communications devices.

Physical layer transmission technologies include all technologies used in a physical layer data processing process: a waveform technology such as UFMC, FBMC, GFDM, BFDM, or OFDM; a coding technology such as Turbo code, Polar code, or LDPC code; a higher order modulation technology such as 128-QAM, 256-QAM, or 512-QAM; and a MIMO space modulation technology. No limitation is imposed in the present invention thereto. The physical layer transmission technology identifier may be one or a combination of identifiers of the foregoing physical layer transmission technologies.

The mapping information may be in a form shown in Table 1 or Table 2, or may be in another form, and no limitation is imposed in this embodiment of the present invention thereon.

Table 1

Data flow identifier (LCID)	Physical layer transmission technology identifier	Physical layer transmission technology
00001-01010	00000	UFMC
01011- 01100	00001	FBMC
01101-10000	00010	GFDM
10001-11000	00011	BFDM
11001-11100	00100	OFDM
...	...	...

Table 2

Data flow identifier (port number)	Physical layer transmission technology identifier	Physical layer transmission technology
0xC000-0xCFFF	00101	Polar
0xD000-0xDFFF	00110	Turbo
0xE000-0xEFFF	00111	LDPC
...	...	...

The physical layer transmission technology may include various technologies of different sublayers; therefore, a mapping manner of a multi-level table shown in the Table 1 or Table 2 may be used for mapping between the physical layer transmission technology identifier and the data flow identifier. Each level of the table indicates a mapping relationship between a data flow and a technology of a corresponding sublayer. Layered identifying may be performed by combining various technologies and using a unified or combined physical layer transmission technology identifier. A method of the layered identifying is shown in FIG. 5, where m1 bits identifies a waveform technology, m2 bits identifies a coding technology, m3 bits identifies a modulation technology, and the like. An instance of a mapping table is shown in Table 3, where a physical layer transmission technology identifier is identified with five bits, higher-order two bits identify a waveform technology, and lower-order three bits identify a coding technology.

Table 3

Data flow identifier (LCID)	Physical layer transmission technology identifier	Physical layer transmission technology
00001-01010	00 000	UFMC+Polar
01011- 01100	00 001	UFMC+Turbo
01101-10000	01 010	GFDM+LDPC
10001-11000	10 001	OFMD+Turbo
...	...	...

A processor 120 is configured to: determine a to-be-scheduled data flow; determine, from the mapping information and according to a data flow identifier of the to-be-scheduled data flow, a physical layer transmission technology identifier corresponding to the data flow; generate different transport blocks according to data flows corresponding to different physical layer transmission technology identifiers, where each physical layer transmission technology identifier is corresponding to one type of transport block; generate wireless communication data by performing processing, according to a physical layer transmission technology corresponding to

the physical layer transmission technology identifier, on a transport block corresponding to the physical layer transmission technology identifier; and send the wireless communication data to a receive end by using a communications interface 130. A person skilled in the art may learn that the to-be-scheduled data flow may be determined at different transmission sublayers or for multiple sublayers, and in this specification, a MAC sublayer is used as an example for description in the following, which is not described in detail herein again.

In a specific example, the processor 120 controls the MAC sublayer to determine the to-be-scheduled data flow, determine, from the mapping information and according to a data flow identifier of the to-be-scheduled data flow, the physical layer transmission technology identifier corresponding to the data flow, generate, according to a data flow corresponding to a same physical layer transmission technology, a transport block of a same type, and generate different transport blocks according to the data flows corresponding to the different physical layer transmission technologies.

Specifically, for different data flows corresponding to a same physical layer transmission technology, communications resources, such as a transport block, of the physical layer transmission technology may be multiplexed. For example, as shown in FIG. 1A, the processor 120 includes a controller, a MAC sublayer scheduler, and multiple processing modules at a PHY layer (different physical layer transmission technologies are corresponding to different processing modules). Data flows 1, 3, and m are corresponding to a same physical layer transmission technology identifier PHY1 and may be multiplexed to a time-frequency resource; the controller in the processor 120 controls the MAC sublayer scheduler to generate a transport block 1 according to the data flows 1, 3, and m. A data flow 2 is corresponding to a physical layer transmission technology identifier PHY2; the controller in the processor 120 controls the MAC sublayer scheduler to generate a transport block 2 according to the data flow 2. Then, a PHY1 processing module at the PHY layer in the processor 120 generates corresponding wireless communication data 1 by performing processing on the transport block 1 by using a physical layer transmission technology corresponding to the PHY1, and a PHY2 processing module at the PHY layer in the processor 120 generates corresponding wireless communication data 2 by performing processing on the transport block 2 by using a physical layer transmission technology corresponding

uplink scheduling information group, carrying the uplink scheduling information group over a downlink control channel, and sending the uplink scheduling information group to the transmit end by using the communications interface 220; alternatively, multiplexing, by the processor 210, multiple uplink scheduling information to generate an uplink scheduling information group, performing processing, that is, scrambling, channel coding, and rate matching, on the uplink scheduling information group, carrying processed uplink scheduling information group over a downlink control channel, and sending the processed uplink scheduling information group to the transmit end by using the communications interface 220.

By using the communications device provided in Embodiment 2 of the present invention, if the communications device is a base station, the base station may use different physical layer transmission technologies for multiple data flows of same user equipment, and if the communications device is user equipment, the user equipment may use the different physical layer transmission technologies for the multiple data flows, so that a spectrum resource is fully used and transmission efficiency is improved.

The following uses FIG. 3 as an example to describe in detail a data transmission method provided in Embodiment 3 of the present invention. As shown in FIG. 3, FIG. 3 is a schematic flowchart of a data transmission method according to Embodiment 3 of the present invention. The data transmission method is executed by a transmit end, where the transmit end may be specifically the communications device provided in Embodiment 1 of the present invention.

The data transmission method includes the following steps:

S301: The transmit end determines a to-be-scheduled data flow.

S302: The transmit end determines, from mapping information between a data flow identifier and a physical layer transmission technology identifier and according to a data flow identifier of the data flow, a physical layer transmission technology identifier corresponding to the data flow.

The mapping information between the data flow identifier and the physical layer transmission technology identifier is stored at the transmit end. The mapping information includes a correspondence between the data flow identifier and the physical layer transmission technology identifier.

The data flow identifier may be specifically a logical channel identifier

LCID corresponding to the data flow. A physical layer transmission technology includes: UPMC, FBMC, GFDM, BFDM, OFDM, or the like.

The mapping information may be in a form shown in FIG. 1, or may be in another form, and no limitation is imposed in this embodiment of the present invention thereon.

S303: The transmit end generates different transport blocks according to data flows that are corresponding to different physical layer transmission technology identifiers, where each physical layer transmission technology identifier is corresponding to one type of transport block.

Specifically, a MAC sublayer of the transmit end determines the to-be-scheduled data flow, determines, from the mapping information and according to the data flow identifier of the to-be-scheduled data flow, the physical layer transmission technology identifier corresponding to the data flow, generates, according to a data flow corresponding to a same physical layer transmission technology, a transport block of a same type, and generates different transport blocks according to data flows corresponding to different physical layer transmission technologies.

S304: The transmit end generates wireless communication data by performing processing, according to a physical layer transmission technology corresponding to the physical layer transmission technology identifier, on a transport block corresponding to the physical layer transmission technology identifier.

Specifically, for different data flows corresponding to a same physical layer transmission technology, communications resources, such as a transport block, of the physical layer transmission technology may be multiplexed. For example, if data flows 1, 3, and m are corresponding to a same physical layer transmission technology identifier PHY1, the data flows 1, 3, and m may be multiplexed, and a transport block 1 is generated at the MAC sublayer of the transmit end according to the data flows 1, 3, and m; and if a data flow 2 is corresponding to a physical layer transmission technology identifier PHY2, a transport block 2 is generated at the MAC sublayer of the transmit end according to the data flow 2. Then, a PHY layer of the transmit end generates corresponding wireless communication data 1 by performing processing on the transport block 1 by using a physical layer transmission technology corresponding to a PHY1, and generates corresponding wireless communication data

a physical layer transmission technology for the data flow.

Specifically, all transmit ends store mapping information between the data flow identifier and the physical layer transmission technology identifier. The mapping information includes the correspondence between the data flow identifier and the physical layer transmission technology identifier. The data flow identifier may be specifically an LCID corresponding to the data flow. The physical layer transmission technology includes: UFMC, FBMC, GFDM, BFDM, OFDM, or the like. The mapping information may be in a form shown in FIG. 1, or may be in another form, and no limitation is imposed in this embodiment of the present invention thereon.

A process in which the receive end sends the uplink scheduling information to the transmit end may be specifically: separately performing, by the receive end, processing, that is, scrambling, channel coding, and rate matching, on multiple uplink scheduling information, multiplexing all processed uplink scheduling information to generate an uplink scheduling information group, carrying the uplink scheduling information group over a downlink control channel, and sending the uplink scheduling information group to the transmit end; alternatively, multiplexing, by the receive end, the multiple uplink scheduling information to generate an uplink scheduling information group, performing processing, that is, scrambling, channel coding, and rate matching, on the uplink scheduling information group, carrying processed uplink scheduling information group over a downlink control channel, and sending the processed uplink scheduling information group to the transmit end.

Step S403: The receive end obtains, by parsing the wireless communication data according to the determined physical layer transmission technology, a transport block corresponding to the wireless communication data.

A PHY layer of the receive end obtains, by parsing the wireless communication data according to the determined physical layer transmission technology, a transport block corresponding to the wireless communication data.

Step S404: The receive end acquires a data flow included in the transport block corresponding to the wireless communication data.

A MAC sublayer of the receive end acquires the data flow from the transport block obtained by parsing the wireless communication data.

By using the data transmission method provided in Embodiment 4 of the present invention, if the receive end is a base station, the base station may use

algorithm steps may be implemented by electronic hardware, computer software, or a combination thereof. To clearly describe the interchangeability between the hardware and the software, the foregoing has generally described compositions and steps of each example according to functions. Whether the functions are performed by
5 hardware or software depends on particular applications and design constraint conditions of the technical solutions. A person skilled in the art may use different methods to implement the described functions for each particular application, but it should not be considered that the implementation goes beyond the scope of the present invention.

10 Steps of methods or algorithms described in the embodiments disclosed in this specification may be implemented by hardware, a software module executed by a processor, or a combination thereof. The software module may be configured in a random access memory (RAM), a memory, a read-only memory (ROM), an electrically programmable ROM, an electrically erasable programmable ROM, a
15 register, a hard disk, a removable disk, a CD-ROM, or a storage medium in any other forms well-known in the art.

In the foregoing specific embodiments, the objective, technical solutions, and benefits of the present invention are further described in detail. It should be understood that the foregoing descriptions are merely specific implementation
20 manners of the present invention, but are not intended to limit the protection scope of the present invention. Any modification, equivalent replacement, or improvement made without departing from the principle of the present invention should fall within the protection scope of the present invention.

CLAIMS

1. A communications device, wherein the communications device comprises: a memory, a processor, a communications interface, wherein:

5 the memory is configured to store mapping information between a data flow identifier and a physical layer transmission technology identifier, wherein a physical layer transmission technology corresponding to the physical layer transmission technology identifier comprises at least one of a waveform technology and a coding technology; and

10 the processor is configured to: determine a to-be-scheduled data flow; determine, according to the mapping information and a data flow identifier of the data flow, a physical layer transmission technology identifier corresponding to the data flow; generate different transport blocks according to data flows corresponding to different physical layer transmission technology identifiers, wherein each physical layer
15 transmission technology identifier is corresponding to one type of transport block; generate wireless communication data by performing processing, according to a physical layer transmission technology corresponding to the physical layer transmission technology identifier, on a transport block corresponding to the physical layer transmission technology identifier; and send the wireless communication data to
20 a receive end by using the communications interface.

2. The communications device according to claim 1, wherein when the communications device is a base station and the receive end is user equipment, the processor is further configured to:

25 before the sending the wireless communication data to a receive end by using the communications interface, send, by using the communications interface, downlink scheduling information corresponding to the wireless communication data to the receive end, wherein the downlink scheduling information carries the physical layer transmission technology identifier corresponding to the wireless communication data.

3. The communications device according to claim 1, wherein when the
30 communications device is user equipment and the receive end is a base station, the processor is further configured to:

 before the determining a to-be-scheduled data flow, receive, by using the communications interface, uplink scheduling information sent by the receive end, wherein the uplink scheduling information carries time-frequency resource

information corresponding to the physical layer transmission technology identifier;
and

the processor is specifically configured to:

5 determine, according to the time-frequency resource information corresponding to the physical layer transmission technology identifier, a time-frequency resource corresponding to the physical layer transmission technology corresponding to the wireless communication data; and

send the wireless communication data to the receive end by using the time-frequency resource.

10 4. The communications device according to claim 3, wherein the uplink scheduling information further carries a correspondence between the data flow identifier and the physical layer transmission technology identifier; and

the processor is further configured to:

15 before the determining a to-be-scheduled data flow, update the mapping information according to the correspondence between the data flow identifier and the physical layer transmission technology identifier that is carried in the uplink scheduling information.

5. The communications device according to any one of claims 1 to 4, wherein

20 the data flow identifier is a logical channel identifier, LCID, at a media access control sublayer, a function entity number used at a Packet Data Convergence Protocol, PDCP, sublayer or a radio link control, RLC, sublayer, or a network transmission port number or a tunnel endpoint identifier that is used for identifying a data flow when the data flow is being implemented in the communications device; and

25 the physical layer transmission technology identifier comprises one or any combination of: an identifier of a waveform technology, an identifier of a coding technology, an identifier of a higher order modulation technology, and an identifier of a space modulation technology.

30 6. A communications device, wherein the communications device comprises a processor and a communications interface; wherein

the processor is configured to: receive, by using the communications interface, wireless communication data sent by a transmit end; determine a physical layer transmission technology corresponding to the wireless communication data, wherein the physical layer transmission technology comprises at least one of a waveform

technology and a coding technology; obtain, by parsing the wireless communication data according to the determined physical layer transmission technology, a transport block corresponding to the wireless communication data; and acquire a data flow comprised in the transport block corresponding to the wireless communication data.

5 7. The communications device according to claim 6, wherein when the communications device is user equipment and the transmit end is a base station, the processor is further configured to:

before the receiving, by using the communications interface, wireless communication data sent by a transmit end, receive downlink scheduling information
10 that is corresponding to the wireless communication data and sent by the transmit end, wherein the downlink scheduling information carries a physical layer transmission technology identifier corresponding to the wireless communication data; wherein

the processor is specifically configured to:

determine, according to the physical layer transmission technology identifier, a
15 physical layer transmission technology corresponding to the wireless communication data.

8. The communications device according to claim 6, wherein when the communications device is a base station and the transmit end is user equipment, the processor is further configured to:

20 before the receiving, by using the communications interface, wireless communication data sent by a transmit end, allocate different time-frequency resources for different physical layer transmission technologies; send uplink scheduling information to the transmit end by using the communications interface, wherein the uplink scheduling information carries time-frequency resource
25 information corresponding to the physical layer transmission technology identifier; wherein

the processor is specifically configured to:

determine, according to the time-frequency resource used for the wireless communication data, the physical layer transmission technology corresponding to the
30 wireless communication data.

9. The communications device according to claim 8, wherein the processor is further configured to:

before the sending uplink scheduling information to the transmit end by using the communications interface, allocate a physical layer transmission technology for the data flow, wherein

the uplink scheduling information further carries a correspondence between the data flow identifier and the physical layer transmission technology identifier.

10. The communications device according to any one of claims 6 to 9, wherein

the data flow identifier is a logical channel identifier, LCID, at a media access control sublayer, a function entity number used at a Packet Data Convergence Protocol, PDCP, sublayer or a radio link control, RLC, sublayer, or a network transmission port number or a tunnel endpoint identifier that is used for identifying a data flow when the data flow is being implemented in the communications device; and

the physical layer transmission technology identifier comprises one or any combination of: an identifier of a waveform technology, an identifier of a coding technology, an identifier of a higher order modulation technology, or an identifier of a space modulation technology.

11. A data transmission method, wherein mapping information between a data flow identifier and a physical layer transmission technology identifier is stored at a transmit end, the mapping information comprises: a correspondence between the data flow identifier and the physical layer transmission technology identifier, and the method comprises:

determining, by the transmit end, a to-be-scheduled data flow; determining, by the transmit end, from the mapping information and according to a data flow identifier of the data flow, a physical layer transmission technology identifier corresponding to the data flow, wherein a physical layer transmission technology corresponding to the physical layer transmission technology identifier comprises at least one of a waveform technology and a coding technology;

generating, by the transmit end, different transport blocks according to data flows corresponding to different physical layer transmission technology identifiers, so as to send the data flow to a receive end by using the transport block, wherein each physical layer transmission technology identifier is corresponding to one type of transport block;

generating, by the transmit end, wireless communication data by performing processing, according to a physical layer transmission technology corresponding to

the physical layer transmission technology identifier, on a transport block corresponding to the physical layer transmission technology identifier; and

sending, by the transmit end, the wireless communication data to the receive end.

12. The method according to claim 11, wherein when the transmit end is a base station and the receive end is user equipment, before the sending, by the transmit end, the wireless communication data to the receive end, the method further comprises:

sending, by the transmit end, downlink scheduling information corresponding to the wireless communication data to the receive end, wherein the downlink scheduling information carries the physical layer transmission technology identifier corresponding to the wireless communication data.

13. The method according to claim 11, wherein when the transmit end is user equipment and the receive end is a base station, before the determining, by the transmit end, a to-be-scheduled data flow, the method further comprises:

receiving, by the transmit end, uplink scheduling information sent by the receive end, wherein the uplink scheduling information carries time-frequency resource information corresponding to the physical layer transmission technology identifier; and

the sending, by the transmit end, the wireless communication data to the receive end is specifically:

determining, by the transmit end according to the time-frequency resource information corresponding to the physical layer transmission technology identifier, a time-frequency resource corresponding to the physical layer transmission technology corresponding to the wireless communication data; and

sending, by the transmit end, the wireless communication data to the receive end by using the time-frequency resource.

14. The method according to claim 13, wherein the uplink scheduling information further carries a correspondence between the data flow identifier and the physical layer transmission technology identifier; and

before the determining, by the transmit end, a to-be-scheduled data flow, the method further comprises:

updating, by the transmit end, the mapping information according to the correspondence between the data flow identifier and the physical layer transmission technology identifier that is carried in the uplink scheduling information.

15. The communications device according to any one of claims 11 to 14, wherein

the data flow identifier is a logical channel identifier, LCID, at a media access control sublayer, a function entity number used at a Packet Data Convergence Protocol, PDCP, sublayer or a radio link control, RLC, sublayer, or a network transmission port number or a tunnel endpoint identifier that is used for identifying a data flow when the data flow is being implemented in the communications device;
5 and

the physical layer transmission technology identifier comprises one or any combination of: an identifier of a waveform technology, an identifier of a coding technology, an identifier of a higher order modulation technology, or an identifier of a space modulation technology.
10

16. A data transmission method, wherein the method comprises:

receiving, by a receive end, wireless communication data sent by a transmit end;

determining, by the receive end, a physical layer transmission technology corresponding to the wireless communication data, wherein the physical layer transmission technology comprises at least one of a waveform technology and a coding technology;
15

obtaining, by the receive end by parsing the wireless communication data according to the determined physical layer transmission technology, a transport block corresponding to the wireless communication data; and

20 acquiring, by the receive end, a data flow comprised in the transport block corresponding to the wireless communication data.

17. The method according to claim 16, wherein when the receive end is user equipment and the transmit end is a base station, before the receiving, by a receive end, wireless communication data sent by a transmit end, the method further comprises:
25

receiving, by the receive end, downlink scheduling information that is corresponding to the wireless communication data and sent by the transmit end, wherein the downlink scheduling information carries a physical layer transmission technology identifier corresponding to the wireless communication data;

30 the determining, by the receive end, a physical layer transmission technology corresponding to the wireless communication data is specifically:

determining, by the receive end according to the physical layer transmission technology identifier, a physical layer transmission technology corresponding to the wireless communication data.

18. The method according to claim 16, wherein when the receive end is a base station and the transmit end is user equipment, before the receiving, by a receive end, wireless communication data sent by a transmit end, the method further comprises:

5 allocating, by the receive end, different time-frequency resources for different physical layer transmission technologies;

sending, by the receive end, uplink scheduling information to the transmit end, wherein the uplink scheduling information carries time-frequency resource information corresponding to the physical layer transmission technology identifier; wherein

10 the determining, by the receive end, a physical layer transmission technology corresponding to the wireless communication data is specifically:

determining, by the receive end according to the time-frequency resource used for the wireless communication data, the physical layer transmission technology corresponding to the wireless communication data.

15 19. The method according to claim 18, wherein before the sending, by the receive end, uplink scheduling information to the transmit end, the method further comprises:

allocating, by the receive end, a physical layer transmission technology for the data flow; wherein

20 the uplink scheduling information further carries a correspondence between the data flow identifier and the physical layer transmission technology identifier.

20. The communications method according to any one of claims 16 to 19, wherein the data flow identifier is a logical channel identifier, LCID, at a media access control sublayer, a function entity number used at a Packet Data Convergence Protocol, PDCP, sublayer or a radio link control, RLC, sublayer, or a network transmission port number or a tunnel endpoint identifier that is used for identifying a data flow when the data flow is being implemented in the communications device; and

25 the physical layer transmission technology identifier comprises one or any combination of: an identifier of a waveform technology, an identifier of a coding technology, an identifier of a higher order modulation technology, or an identifier of a space modulation technology.