In a first aspect, the present disclosure provides a method comprising supporting, by a wireless communication device, transmitting single-port uplink signals on a first carrier in response to determining that the wireless communication device is in a first transmission method; supporting, by the wireless communication device, transmitting the single-port uplink signals or dual-port uplink signals on a second carrier in response to determining that the wireless communication device is in a second transmission method; and determining, by the wireless communication device based on scheduling information received from a base station, a transmission method used to transmit uplink signals, the transmission method comprising the first transmission method or the second transmission method.

In a second aspect, the present disclosure provides a wireless communication device comprising: at least one processor configured to: support transmitting single-port uplink signals on a first carrier in response to determining that the wireless communication device is in a first transmission method; support transmitting the single-port uplink signals or dual-port uplink signals on a second carrier in response to determining that the wireless communication device is in a second transmission method; and determine, based on scheduling information received from a base station, a transmission method used to transmit uplink signals, the transmission method comprising the first transmission method or the second transmission method.

In a third aspect, the present disclosure provides a method for managing uplink transmission, comprising: receiving, by a base station from a wireless communication device, single-port uplink signals on a first carrier as the wireless communication device is transmitting using a first transmission method; receiving, by the base station from the wireless communication device, the single-port uplink signals or dual-port uplink signals on a second carrier as the wireless communication device is transmitting using a second transmission method; and transmitting, by

the base station to the wireless communication device, scheduling information indicating a transmission method used by the wireless communication device to transmit uplink transmissions, the transmission method comprises the first transmission method or the second transmission method.

In a fourth aspect, the present disclosure provides a base station, comprising: at least one processor configured to: receive, via a transceiver from a wireless communication device, single-port uplink signals on a first carrier as the wireless communication device is transmitting using a first transmission method; receive, via the transceiver from the wireless communication device, the single-port uplink signals or dual-port uplink signals on a second carrier as the wireless communication device is transmitting using a second transmission method; and transmit, via the transceiver to the wireless communication device, scheduling information indicating a transmission method used by the wireless communication device to transmit uplink transmissions, the transmission method comprises the first transmission method or the second transmission method.

One ~~aspect~~ embodiment disclosed herein is directed to a method for an uplink signal transmission. In some embodiments, the method includes supporting, by a wireless communication device (e.g., UE 104 in FIG. 1), transmitting single-port uplink signals on a first carrier in response to determining that the wireless communication device is in a first transmission method. In some embodiments, the method includes supporting, by the wireless communication device, transmitting the single-port uplink signals or dual-port uplink signals on a second carrier in response to determining that the wireless communication device is in a second transmission method. In some embodiments, the method includes determining, by the wireless communication device based on scheduling information received from a base station, a transmission method used

to transmit uplink signals, the transmission method comprises the first transmission method or the second transmission method.

In some embodiments, the method includes determining, by the wireless communication device, a transmission mode for the wireless communication device using a Radio Resource Control (RRC) parameter received from the base station, wherein in response to determining that the RRC parameter indicates that the transmission mode is a first transmission mode, the wireless communication device supports transmitting the single-port uplink signals on the first carrier using the first transmission method.

In some embodiments, in response to determining that: a previous uplink transmission is transmitted using the first carrier; and based on the scheduling information, the wireless communication device determines to transmit a next uplink signal on a next transmission occasion on the second carrier, the wireless communication device: switches to the second transmission method; and does not request transmitting any uplink signals using the first carrier or the second carrier within a time interval T before transmitting the next uplink signal; and in

In some embodiments, the wireless communication device is to transmit a first uplink signal using one of the first transmission method and the second transmission method, and to transmit a second uplink signal using a different one of the first transmission method and the second transmission method; in response to determining that a time interval between a last symbol of the first uplink signal and a first symbol of the second uplink signal is less than a radio frequency switching time T, the wireless communication device does not transmit the second uplink signal.

In some embodiments, the wireless communication device is to transmit a first uplink signal using one of the first transmission method and the second transmission method, and to transmit a second uplink signal using a different one of the first transmission method and the second transmission method; in response to determining that: a time interval between a last symbol of the first signal and a first symbol of the second signal is less than a radio frequency switching time T, and the second uplink signal is a terminal-self-transmitted uplink signal, the wireless communication device transmits the second uplink signal.

Another ~~aspect~~ embodiment disclosed herein is directed to a method for managing uplink transmissions. In some embodiments, the method includes receiving, by a base station from a wireless communication device, single-port uplink signals on a first carrier as the wireless communication device is transmitting using a first transmission method. In some embodiments, the method includes receiving, by the base station from the wireless communication device, the single-port uplink signals or dual-port uplink signals on a second carrier as the wireless communication device is transmitting using a second transmission method. In some embodiments, the method includes transmitting, by the base station to the wireless communication device, scheduling information indicating a transmission method used by the

CLAIMS

1. An uplink signal transmission method, comprising:

supporting, by a wireless communication device, transmitting single-port uplink signals on a first carrier in response to determining that the wireless communication device is in a first transmission method;

supporting, by the wireless communication device, transmitting the single-port uplink signals or dual-port uplink signals on a second carrier in response to determining that the wireless communication device is in a second transmission method; and

determining, by the wireless communication device based on scheduling information received from a base station, a transmission method used to transmit uplink signals, the transmission method comprisinges the first transmission method or the second transmission method.

2. The method of claim 1, further comprising determining, by the wireless communication device, a transmission mode for the wireless communication device using a Radio Resource Control (RRC) parameter received from the base station, wherein in response to determining that the RRC parameter indicates that the transmission mode is a first transmission mode, the wireless communication device supports transmitting the single-port uplink signals on the first carrier using the first transmission method.

3. The method of claim 1, wherein

in response to determining that:

a previous uplink transmission is transmitted using the first carrier; and

based on the scheduling information, the wireless communication device determines to transmit a next uplink signal on a next transmission occasion on the second carrier,

the wireless communication device:

switches to the second transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within a time interval T before transmitting the next uplink signal; and

in response to determining that:

the previous uplink transmission is transmitted using the second carrier; and

based on the scheduling information, the wireless communication device determines to transmit the next uplink signal on the next transmission occasion on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T before transmitting the next uplink signal.

4. The method of claim 1, wherein

in response to determining that:

the wireless communication device is currently using the first transmission method; and

based on the scheduling information, the wireless communication device determines to transmit a next uplink signal on a next transmission occasion on the second carrier,

the wireless communication device:

switches to the second transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within a time interval T before transmitting the next uplink signal; and

in response to determining that:

the wireless communication device is currently using the second transmission method; and

based on the scheduling information, the wireless communication device determines to transmit the next uplink signal on the next transmission occasion on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T before transmitting the next uplink signal.

5. The method of claim 1, wherein

in response to determining that:

the wireless communication device is currently using the first transmission method;

and

based on the scheduling information, the wireless communication device determines to transmit a dual-port uplink signal on a next transmission occasion on the second carrier,

the wireless communication device:

switches to the second transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within a time interval T before transmitting the dual-port uplink signal; and

in response to determining that:

the wireless communication device is currently using the second transmission method; and

based on the scheduling information, the wireless communication device determines to transmit a next uplink signal on the next transmission occasion on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T before transmitting the next uplink signal.

6. The method of claim 1, wherein

in response to determining that:

a time interval T corresponds to the first carrier;

the wireless communication device is using the first transmission method before an uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit a next uplink signal in the uplink phase on the second carrier,

the wireless communication device:

switches to the second transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T before the uplink phase starts;

in response to determining that:

the time interval T corresponds to the first carrier;

the wireless communication device is using the second transmission method before the uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit the next uplink signal in the uplink phase on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T before the uplink phase starts.

in response to determining that:

the time interval T corresponds to the first carrier;

the wireless communication device is using the second transmission method in the uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit the next uplink signal after the uplink phase on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T after the uplink phase ends.

7. The method of claim 1, wherein

in response to determining that:

a time interval T corresponds to the second carrier;

the wireless communication device is using the first transmission method before an uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit a next uplink signal in the uplink phase on the second carrier,

the wireless communication device:

switches to the second transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T after the uplink phase begins;

in response to determining that:

the time interval T corresponds to the second carrier;

the wireless communication device is using the second transmission method before the uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit the next uplink signal in the uplink phase on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T after the uplink phase begins; and

in response to determining that:

the time interval T corresponds to the second carrier;

the wireless communication device is using the second transmission method in the uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit the next uplink signal after the uplink phase on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T before the uplink phase ends.

8. The method of claim 1, wherein

in response to determining that:

a time interval T corresponds to the first carrier;

the wireless communication device is using the first transmission method before an uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit a dual-port uplink signal in the uplink phase on the second carrier,

the wireless communication device:

switches to the second transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T before the uplink phase begins;

in response to determining that:

the time interval T corresponds to the first carrier;

the wireless communication device is using the second transmission method before the uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit a next uplink signal in the uplink phase on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier before the time interval T before the uplink phase begins; and

in response to determining that:

the time interval T corresponds to the first carrier;

the wireless communication device is using the second transmission method in the uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit the next uplink signal after the uplink phase on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T after the uplink phase ends.

9. The method of claim 1, wherein

in response to determining that:

a time interval T corresponds to the second carrier;

the wireless communication device is using the first transmission method before an uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit a dual-port uplink signal in the uplink phase on the second carrier,

the wireless communication device:

switches to the second transmission method; and

does not request transmitting any uplink signals using the first carrier or the second

carrier within the time interval T after the uplink phase begins;

in response to determining that:

the time interval T corresponds to the second carrier;

the wireless communication device is using the second transmission method before the uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit a next uplink signal in the uplink phase on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier before the time interval T after the uplink phase begins; and

in response to determining that:

the time interval T corresponds to the second carrier;

the wireless communication device is using the second transmission method in the uplink phase; and

based on the scheduling information, the wireless communication device determines to transmit the next uplink signal after the uplink phase on the first carrier,

the wireless communication device:

switches to the first transmission method; and

does not request transmitting any uplink signals using the first carrier or the second carrier within the time interval T before the uplink phase ends.

10. The method of claim 1, wherein

the wireless communication device does not request transmitting uplink signals using the first carrier or the second carrier based on an uplink phase;

the uplink phase has a length of a time slot length;

the time slot length corresponds to a larger one of a first Numerology of an activated Bandwidth Part (BWP) of the first carrier and a second Numerology of an activated BWP of the second carrier.

11. The method of claim 1, wherein in response to the wireless communication device switching~~es~~

the transmission method, a radio frequency switching time T is configured to be located in a boundary of a time slot or in flexible symbols of a flexible time slot.

12. The method of claim 1, wherein

the wireless communication device is to transmit a first uplink signal using one of the first transmission method and the second transmission method, and to transmit a second uplink signal using a different one of the first transmission method and the second transmission method;

in response to determining that a time interval between a last symbol of the first uplink signal and a first symbol of the second uplink signal is less than a radio frequency switching time T, the wireless communication device does not transmit the second uplink signal.

13. The method of claim 12, wherein

the wireless communication device is to transmit a first uplink signal using one of the first transmission method and the second transmission method, and to transmit a second uplink signal using a different one of the first transmission method and the second transmission method;

in response to determining that:

a time interval between a last symbol of the first signal and a first symbol of the second signal is less than a radio frequency switching time T, and

the second uplink signal is a terminal-self-transmitted uplink signal,

the wireless communication device transmits the second uplink signal.

14. A wireless communication ~~apparatus~~ device comprising:

at least one processor configured to:~~and a memory, wherein the at least one processor is configured to read code from the memory and implement a method recited in claim 1~~

support transmitting single-port uplink signals on a first carrier in response to determining that the wireless communication device is in a first transmission method;

support transmitting the single-port uplink signals or dual-port uplink signals on a second carrier in response to determining that the wireless communication device is in a second transmission method; and

determine, based on scheduling information received from a base station, a transmission method used to transmit uplink signals, the transmission method comprising

the first transmission method or the second transmission method.

~~15. A computer program product comprising a computer readable program medium code stored thereupon, the code, when executed by at least one processor, causing the at least one processor to implement a method recited in claim 1.~~

15. The wireless communication device of claim 14, wherein the at least one processor is further configured to:

determine a transmission mode for the wireless communication device using a Radio Resource Control (RRC) parameter received from the base station, wherein in response to determining that the RRC parameter indicates that the transmission mode is a first transmission mode, the wireless communication device supports transmitting the single-port uplink signals on the first carrier using the first transmission method.

16. The wireless communication device of claim 14, wherein

the wireless communication device does not request transmitting uplink signals using the first carrier or the second carrier based on an uplink phase;

the uplink phase has a length of a time slot length;

the time slot length corresponds to a larger one of a first Numerology of an activated Bandwidth Part (BWP) of the first carrier and a second Numerology of an activated BWP of the second carrier.

~~16~~17. A~~n~~ method for managing uplink transmissions, comprising:

receiving, by a base station from a wireless communication device, single-port uplink signals on a first carrier as the wireless communication device is transmitting using a first transmission method;

receiving, by the base station from the wireless communication device, the single-port uplink signals or dual-port uplink signals on a second carrier as the wireless communication device is transmitting using a second transmission method; and

transmitting, by the base station to the wireless communication device, scheduling information indicating a transmission method used by the wireless communication device to transmit uplink transmissions, the transmission method comprises the first transmission method or the second transmission method.

~~17~~18. The method of claim ~~16~~17, further comprising transmitting, by the base station to the wireless communication device, a Radio Resource Control (RRC) parameter, the RRC parameter indicatinges ~~that~~ a transmission mode of the wireless communication device, wherein the transmission mode is a first transmission mode, and the wireless communication device supports transmitting the single-port uplink signals on the first carrier using the first transmission method.

~~18. A wireless communication apparatus comprising at least one processor and a memory, wherein the at least one processor is configured to read code from the memory and implement a method recited in claim 16.~~

~~19. A computer program product comprising a computer-readable program medium code stored thereupon, the code, when executed by at least one processor, causing the at least one processor to implement a method recited in claim 16.~~

19. A base station, comprising:

at least one processor configured to:

receive, via a transceiver from a wireless communication device, single-port uplink signals on a first carrier as the wireless communication device is transmitting using a first transmission method;

receive, via the transceiver from the wireless communication device, the single-port uplink signals or dual-port uplink signals on a second carrier as the wireless communication device is transmitting using a second transmission method; and

transmit, via the transceiver to the wireless communication device, scheduling information indicating a transmission method used by the wireless communication device to transmit uplink transmissions, the transmission method comprises the first transmission method or the second transmission method.

20. The base station of claim 19, further comprising transmitting, by the base station to the wireless communication device, a Radio Resource Control (RRC) parameter, the RRC parameter indicating a transmission mode of the wireless communication device, wherein the transmission mode is a

first transmission mode, and the wireless communication device supports transmitting the single-port uplink signals on the first carrier using the first transmission method.