In a first aspect, the present disclosure provides a method comprising receiving, by a wireless communication device from a base station, a configuration indicating a first carrier and a second carrier to the wireless communication device; supporting, by a wireless communication device, transmitting single-port uplink signals on the first carrier; supporting both, by the wireless communication device, transmitting the single-port uplink signals or dual-port uplink signals on the second carrier; and switching, by the wireless communication device, to a carrier indicated by scheduling information in response to determining that a carrier of a previous uplink transmission is different from a carrier indicated by the scheduling information received from the base station, wherein no uplink signals are transmitted on the first carrier or the second carrier within a switching time before transmitting a next uplink signal.

In a second aspect, the present disclosure provides a wireless communication device comprising: at least one processor configured to: receive, from a base station, a configuration indicating a first carrier and a second carrier to the wireless communication device; support transmitting single-port uplink signals on the first carrier;

support both transmitting the single-port uplink signals or dual-port uplink signals on the second carrier; and switch to a carrier indicated by scheduling information in response to determining that a carrier of a previous uplink transmission is different from a carrier indicated by the scheduling information received from the base station, wherein no uplink signals are transmitted on the first carrier or the second carrier within a switching time before transmitting a next uplink signal.

In a third aspect, the present disclosure provides a method for managing uplink transmission, comprising: transmitting, by a base station to a wireless communication device, a configuration indicating a first carrier and a second carrier to the wireless communication device; receiving, by the base station from the wireless communication device, single-port uplink signals on the first carrier, wherein the base station is configured to receive both, the single-port uplink signals or dual-port uplink signals; 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, wherein in response to determining that a carrier of a previous uplink transmission is different from a carrier indicated by the scheduling information received from the base station, causing the wireless communication device to switch to the carrier indicated by scheduling information, and wherein no uplink signals are transmitted on the first carrier or the second carrier within a switching time before transmitting a next uplink signal.

In a fourth aspect, the present disclosure provides a base station, comprising: at least one processor configured to: transmit, via a transceiver to a wireless communication device, a configuration indicating a first carrier and a second carrier to the wireless communication device; receive, via the transceiver from the wireless communication device, single-port uplink signals on the first carrier; receive, via the transceiver from the wireless communication device, the single-port uplink signals or dual-port uplink signals on the second carrier, the processor via the transceiver is configured to receive both, receiving the single-port uplink signals or dual-port uplink signals; and transmit, via the transceiver to the wireless communication device, scheduling information, wherein in response to determining that a carrier of a previous uplink transmission is different from a carrier indicated by the scheduling information received from the base station, causing the wireless communication device to switch to the carrier indicated by scheduling information, and wherein no uplink signals are transmitted on the first carrier or the second carrier within a switching time before transmitting a next uplink signal.

One 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

Amendments to the Claims

1. A method, comprising:

receiving, by a wireless communication device from a base station, a configuration indicating a first carrier and a second carrier to the wireless communication device;

supporting, by a wireless communication device, transmitting single-port uplink signals on the first carrier;

supporting both, by the wireless communication device, transmitting the single-port uplink signals or dual-port uplink signals on the second carrier; and

switching, by the wireless communication device, to a carrier indicated by scheduling information in response to determining that a carrier of a previous uplink transmission is different from a carrier indicated by the scheduling information received from the base station, wherein no uplink signals are transmitted on the first carrier or the second carrier within a switching time before transmitting a next uplink signal.

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

3. The method of claim 1, wherein

in response to determining that:

the previous uplink transmission is transmitted on the first carrier; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits the next uplink signal on the second carrier,

the wireless communication device:

switches to the second carrier to transmit the next uplink signal; and

refrains from transmitting any uplink signals using the first carrier or the second carrier within the switching time before transmitting the next uplink signal; and

in response to determining that:

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

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits the next uplink signal on the first carrier,

the wireless communication device:

switches to the first carrier to transmit the next uplink signal; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the switching time before transmitting the next uplink signal.

4. The method of claim 1, wherein

in response to determining that:

the wireless communication device is currently transmitting on the first carrier; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits a next uplink signal on the second carrier,

the wireless communication device:

switches to the second carrier to transmit the next uplink signal; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the switching time before transmitting the next uplink signal; and

in response to determining that:

the wireless communication device is currently transmitting on the second carrier; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits the next uplink signal on the first carrier,

the wireless communication device:

switches to the carrier to transmit the next uplink signal; and

refrains from transmitting any uplink signals on the first carrier or the

second carrier within the switching time before transmitting the next uplink signal.

5. The method of claim 1, wherein

in response to determining that:

the previous uplink transmission is the single-port uplink signal transmitted on the first carrier; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits a dual-port uplink signal on the second carrier,

the wireless communication device:

switches to the second carrier to transmit the dual-port uplink signal; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the switching time before transmitting the dual-port uplink signal; and

in response to determining that:

the previous uplink transmission is the dual-port uplink signal transmitted on the second carrier; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits a next uplink signal on the first carrier,

the wireless communication device:

switches to the first carrier to transmit the next uplink signal; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the switching time before transmitting the next uplink signal.

6. The method of claim 1, wherein

in response to determining that:

a time interval corresponds to the first carrier;

the wireless communication device transmits on the first carrier before an uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits a next uplink signal in the

uplink phase on the second carrier, wherein the uplink phase is a continuous uplink symbol,

the wireless communication device:

switches to the second carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the time interval before the uplink phase starts;

in response to determining that:

the time interval corresponds to the first carrier;

the wireless communication device transmits on the second carrier before the uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits the next uplink signal in the uplink phase on the first carrier,

the wireless communication device:

switches to the first carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the time interval before the uplink phase starts;

in response to determining that:

the time interval corresponds to the first carrier;

the wireless communication device transmits on the second carrier in the uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits the next uplink signal after the uplink phase on the first carrier,

the wireless communication device:

switches to the first carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the time interval after the uplink phase ends.

7. The method of claim 1, wherein

in response to determining that:

a time interval corresponds to the second carrier;

the wireless communication device transmits on the first carrier before an uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits a next uplink signal in the uplink phase on the second carrier,

the wireless communication device:

switches to the second carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the time interval after the uplink phase begins;

in response to determining that:

the time interval corresponds to the second carrier;

the wireless communication device transmits on the second carrier before the uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits the next uplink signal in the uplink phase on the first carrier,

the wireless communication device:

switches to the first carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the time interval after the uplink phase begins; and

in response to determining that:

the time interval corresponds to the second carrier;

the wireless communication device transmits on the second carrier in the uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits the next uplink signal after the uplink phase on the first carrier,

the wireless communication device:

switches to the first carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the time interval before the uplink phase ends.

8. The method of claim 1, wherein

in response to determining that:

a time interval corresponds to the first carrier;

the wireless communication device transmits on the first carrier before an uplink phase, wherein the uplink phase is a continuous uplink symbol; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits a dual-port uplink signal in the uplink phase on the second carrier,

the wireless communication device:

switches to the second carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the switching time before the uplink phase begins;

in response to determining that:

the time interval corresponds to the first carrier;

the wireless communication device transmits on the second carrier before the uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits a next uplink signal in the uplink phase on the first carrier,

the wireless communication device:

switches to the first carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier before the time interval before the uplink phase begins; and

in response to determining that:

the time interval corresponds to the first carrier;

the wireless communication device transmits on the second carrier in the uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits the next uplink signal after the uplink phase on the first carrier,

the wireless communication device:

switches to the first carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the time interval after the uplink phase ends.

9. The method of claim 1, wherein

in response to determining that:

a time interval corresponds to the second carrier;

the wireless communication device transmits on the first carrier before an uplink phase, wherein the uplink phase is a continuous uplink symbol; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits a dual-port uplink signal in the uplink phase on the second carrier,

the wireless communication device:

switches to the second carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier within the time interval after the uplink phase begins;

in response to determining that:

the time interval corresponds to the second carrier;

the wireless communication device transmits on the second carrier before the uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits a next uplink signal in the uplink phase on the first carrier,

the wireless communication device:

switches to the first carrier; and

refrains from transmitting any uplink signals on the first carrier or the second carrier before the time interval after the uplink phase begins; and

in response to determining that:

the time interval corresponds to the second carrier;

the wireless communication device transmits on the second carrier in the uplink phase; and

based on the scheduling information, the scheduling information indicates that the wireless communication device transmits the next uplink signal after

the uplink phase on the first carrier,

the wireless communication device:

switches to the first carrier; and

refrains from transmitting any uplink signals using the first carrier or the second carrier within the time interval before the uplink phase ends.

10. The method of claim 1, wherein

the wireless communication device refrains from transmitting uplink signals on the first carrier or the second carrier based on an uplink phase, wherein the uplink phase is a continuous uplink symbol;

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 the carrier, the switching time 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 on one of the first carrier and the second carrier, and to transmit a second uplink signal on the other of the first carrier and the second carrier;

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 switching time, 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 on one of the first carrier and the second carrier, and to transmit a second uplink signal on the other of the first carrier and the second carrier;

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 switching time, and

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

the wireless communication device transmits the second uplink signal.

14. A wireless communication device comprising:

at least one processor configured to:

receive, from a base station, a configuration indicating a first carrier and a second carrier to the wireless communication device;

support transmitting single-port uplink signals on the first carrier;

support both transmitting the single-port uplink signals or dual-port uplink signals on the second carrier; and

switch to a carrier indicated by scheduling information in response to determining that a carrier of a previous uplink transmission is different from a carrier indicated by the scheduling information received from the base station, wherein no uplink signals are transmitted on the first carrier or the second carrier within a switching time before transmitting a next uplink signal.

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

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

16. The wireless communication device of claim 14, wherein

the wireless communication device refrains from transmitting uplink signals on the first carrier or the second carrier based on an uplink phase, wherein the uplink phase is a continuous uplink symbol;

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.

17. A method for managing uplink transmissions, comprising:

transmitting, by a base station to a wireless communication device, a configuration indicating a first carrier and a second carrier to the wireless communication device;

receiving, by the base station from the wireless communication device, single-port uplink signals on the first carrier;

receiving, by the base station from the wireless communication device, the single-port uplink signals or dual-port uplink signals on the second carrier, wherein the base station is configured to receive both, the single-port uplink signals or dual-port uplink signals; and

transmitting, by the base station to the wireless communication device, scheduling information, wherein in response to determining that a carrier of a previous uplink transmission is different from a carrier indicated by the scheduling information received from the base station, causing the wireless communication device to switch to the carrier indicated by scheduling information, and wherein no uplink signals are transmitted on the first carrier or the second carrier within a switching time before transmitting a next uplink signal.

18. The method of claim 17, further comprising transmitting, by the base station to the wireless communication device, a Radio Resource Control (RRC) parameter, the RRC parameter indicating the carrier for the wireless communication device to transmit, wherein the carrier is a first carrier, and the wireless communication device supports transmitting the single-port uplink signals on the first carrier.

19. A base station, comprising:

at least one processor configured to:

transmit, via a transceiver to a wireless communication device, a configuration indicating a first carrier and a second carrier to the wireless communication device;

receive, via the transceiver from the wireless communication device, single-port

uplink signals on the first carrier;

receive, via the transceiver from the wireless communication device, the single-port uplink signals or dual-port uplink signals on the second carrier, the processor via the transceiver is configured to receive both, receiving the single-port uplink signals or dual-port uplink signals; and

transmit, via the transceiver to the wireless communication device, scheduling information, wherein in response to determining that a carrier of a previous uplink transmission is different from a carrier indicated by the scheduling information received from the base station, causing the wireless communication device to switch to the carrier indicated by scheduling information, and wherein no uplink signals are transmitted on the first carrier or the second carrier within a switching time before transmitting a next uplink signal.

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 the carrier for the wireless communication device to transmit, wherein the carrier is a first carrier, and the wireless communication device supports transmitting the single-port uplink signals on the first carrier.