

PUSCH TRANSMISSION

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to a user equipment (UE), a base station, processors for wireless communication and methods for physical uplink shared channel (PUSCH) transmissions.

BACKGROUND

[0002] A wireless communications system may include one or multiple network communication devices, such as base stations, which may be otherwise known as an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. Each network communication devices, such as a base station may support wireless communications for one or multiple user communication devices, which may be otherwise known as user equipment (UE), or other suitable terminology. The wireless communications system may support wireless communications with one or multiple user communication devices by utilizing resources of the wireless communication system (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers). Additionally, the wireless communications system may support wireless communications across various radio access technologies including third generation (3G) radio access technology, fourth generation (4G) radio access technology, fifth generation (5G) radio access technology, among other suitable radio access technologies beyond 5G (e.g., sixth generation (6G)).

[0003] In the wireless communications system, PUSCH transmission(s) can be dynamically scheduled by an uplink (UL) grant in downlink control information (DCI), or PUSCH transmission(s) can be semi-statically configured and correspond to a configured grant (CG) Type 1 or Type 2. to meet the various improvements and requirements that accompany the development of wireless communication technology, further study on PUSCH transmissions is still needed.

SUMMARY

[0004] The present disclosure relates to methods, apparatuses, and systems that support PUSCH transmissions. By separately configuring respective sounding reference signal (SRS) resource set(s) for different formats of time units and applying a

corresponding SRS resource set to a PUSCH transmission at least based on the format of a time unit in which the PUSCH transmission is transmitted, the base station and the user equipment may have a common understanding about how the PUSCH transmission is to be transmitted, and the reliability of the PUSCH transmissions may thus be guaranteed.

[0005] In a first aspect of the solution, a UE receives, from a base station, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format. The UE transmits, to the base station, at least one PUSCH transmission across at least one time unit. At least one of the following is satisfied: in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit. In this way, respective SRS resource set(s) may be configured for different formats of time units and the base station and the user equipment have a common understanding about the SRS resource set to be applied to a PUSCH transmission at least based on the format of a time unit in which the PUSCH transmission is transmitted. The reliability of the PUSCH transmissions may thus be guaranteed.

[0006] In some implementations of the methods and apparatuses described herein, the first one or more SRS resource sets include a first SRS resource set and a second SRS resource set. The second one or more SRS resource sets include one SRS resource set associated with a SBFD time unit format, and wherein the one SRS resource set associated with the SBFD time unit format is one of the first and second SRS resource sets.

[0007] In some implementations of the methods and apparatuses described herein, the one SRS resource set associated with the SBFD time unit format is predefined as the first or second SRS resource set.

[0008] Some implementations of the methods and apparatuses described herein may further include: receiving, from the base station, an indication that the one of the first and

second SRS resource sets is the one SRS resource set associated with the SBFD time unit format.

[0009] In some implementations of the methods and apparatuses described herein, receiving the configuration of the plurality of SRS resource sets includes: receiving, from the base station, a configuration of two SRS resource sets, wherein one of the two SRS resource sets is associated with the non-SBFD time unit format, and the other one of the two SRS resource sets is associated with the SBFD time unit format.

[0010] In some implementations of the methods and apparatuses described herein, the at least one PUSCH transmission across the at least one time unit includes one of the following: a PUSCH transmission with a plurality of repetitions in a plurality of slots; or a transport block (TB) processing over multi-slot PUSCH (TBoMS) transmission.

[0011] Some implementations of the methods and apparatuses described herein may further include: receiving, from the base station, an indicator; determining a respective SRS resource set index associated with each of the at least one time unit based on the indicator; and for a PUSCH transmission of the at least one PUSCH transmission in a time unit of the at least one time unit, determining a respective SRS resource set applied to the PUSCH transmission from the first one or more SRS resource sets or from the second one or more SRS resource sets based on the determined SRS resource set index associated with the time unit and a format of the time unit.

[0012] In some implementations of the methods and apparatuses described herein, determining a respective SRS resource set applied to the PUSCH transmission based on the determined SRS resource set index associated with the time unit and a format of the time unit includes: in the case that the format of the time unit is a non-SBFD time unit format, determining the SRS resource set applied to the PUSCH transmission to be a SRS resource set among the first one or more SRS resource sets with the SRS resource set index associated with the time unit; in the case that the format of the time unit is a SBFD time unit format, determining the SRS resource set applied to the PUSCH transmission to be a SRS resource set among the second one or more SRS resource sets with the SRS resource set index associated with the time unit.

[0013] In some implementations of the methods and apparatuses described herein, determining a respective SRS resource set index associated with each of the at least one time unit includes: in the case that the indicator has a first value, associating a first SRS

resource set index with each of the at least one time unit; in the case that the indicator has a second value, associating a second SRS resource set index with each of the at least one time unit; in the case that the indicator has a third value, performing one of the following: if the at least one time unit includes two time units, associating a first SRS resource set index and a second SRS resource set index with a first time unit and a second time unit among the two time units, respectively; if the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a first SRS resource set mapping pattern to the at least three time units, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or if the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a second SRS resource set mapping pattern to the at least three time units, wherein the second SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes; and in the case that the indicator has a fourth value, performing one of the following: if the at least one time unit includes two time units, associating a second SRS resource set index and a first SRS resource set index with a first time unit and a second time unit among the two time units, respectively; if the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a third SRS resource set mapping pattern to the at least three time units, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index; or if the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a fourth SRS resource set mapping pattern to the at least three time units, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0014] In some implementations of the methods and apparatuses described herein, in the case that the first one or more SRS resource sets or the second one or more SRS set includes one SRS resource set, both a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index correspond to the one SRS resource set.

[0015] Some implementations of the methods and apparatuses described herein may further include: for one or more PUSCH transmissions in one or more time units with a first time unit format, in the case that one SRS resource set is associated with the first

time unit format, applying the SRS resource set associated with the first time unit format to the one or more PUSCH transmissions in the one or more time units; and in the case that more than one SRS resource set is associated with the first time unit format, determining a respective SRS resource set applied to each of the one or more PUSCH transmissions based on an indicator for the first time unit format.

[0016] In some implementations of the methods and apparatuses described herein, determining a respective SRS resource set applied to each of the one or more PUSCH transmissions based on an indicator for the first time unit format includes: in the case that the indicator for the first time unit format has a first value, applying a SRS resource set with a first SRS resource set index to each of the one or more PUSCH transmission; in the case that the indicator for the first time unit format has a second value, applying a SRS resource set with a second SRS resource set index to each of the one or more PUSCH transmission; in the case that the indicator for the first time unit format has a third value, performing one of the following: if the one or more time units include one time unit, applying a SRS resource set with a first SRS resource set index or second SRS resource set index to the one or more PUSCH transmissions; if the one or more time units include two time units, applying a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively; if the one or more time units include at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a first SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or if the one or more time units include at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a second SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes; or in the case that the indicator for the first time unit format has a fourth value, performing one of the following: if the one or more time units include one time unit, applying a SRS resource set with a second SRS resource set index to the one or more PUSCH transmissions; if the one or more time units include two time units, applying a SRS resource set with a second SRS resource set index and a SRS resource set with a first SRS resource set index to a first PUSCH transmission and a second PUSCH transmission

among the one or more PUSCH transmissions, respectively; if the one or more time units include at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a third SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index; or if the one or more time units include at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a fourth SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0017] Some implementations of the methods and apparatuses described herein may further include: receiving, from the base station, one indicator for the non-SBFD time unit format and the SBFD time unit format.

[0018] Some implementations of the methods and apparatuses described herein may further include: receiving, from the base station, at least one of the following: a first indicator for the non-SBFD time unit format in the case that the first one or more SRS resource sets include more than one SRS resource set associated with the non-SBFD time unit format; or a second indicator for the SBFD time unit format in the case that the second one or more SRS resource sets include more than one SRS resource set associated with the SBFD time unit format.

[0019] Some implementations of the methods and apparatuses described herein may further include: determining one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets; and determining a respective SRS resource set applied to each of the at least one PUSCH transmission based on a format of a time unit for the PUSCH transmission.

[0020] In some implementations of the methods and apparatuses described herein, one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets are determined based on one of the following: a third indicator received from the base station, or a predefinition. The third indicator indicates which one SRS resource set from the first one or more SRS resource sets and which one SRS resource set from the second one or more SRS resource sets are used.

[0021] In some implementations of the methods and apparatuses described herein, the first one or more SRS resource sets include two SRS resource sets associated with the non-SBFD time unit format, and the second one or more SRS resource sets include two SRS resource sets associated with the SBFD time unit format, and the third indicator includes two bits.

[0022] In some implementations of the methods and apparatuses described herein, the at least one time unit includes first one or more time units with the non-SBFD time unit format and second one or more time units with the SBFD time unit format.

[0023] In some implementations of the methods and apparatuses described herein, the first time unit format is a non-SBFD time unit format or a SBFD time unit format.

[0024] Some implementations of the methods and apparatuses described herein may further include: determining the first time unit format from the non-SBFD time unit format and the SBFD time unit format to be used for PUSCH transmission.

[0025] In some implementations of the methods and apparatuses described herein, the first time unit format is determined based on one of the following: a format of a first time unit for a first PUSCH transmission in time domain among the at least one PUSCH transmission; a pre-definition as a SBFD time unit format or a non-SBFD time unit format; or a configuration signaling from the base station.

[0026] Some implementations of the methods and apparatuses described herein may further include: receiving, from the base station, an indication of one or more SRS resource sets among the plurality of SRS resource sets; and determining a respective SRS resource set applied to each of the at least one PUSCH transmission from the one or more SRS resource sets based on an indicator from the base station.

[0027] Some implementations of the methods and apparatuses described herein may further include: determining a respective SRS resource set applied to each of the at least one PUSCH transmission based on a format of a time unit for the PUSCH transmission.

[0028] In some implementations of the methods and apparatuses described herein, determining a respective SRS resource set applied to each of the at least one PUSCH transmission based on a format of a time unit for the PUSCH transmission includes: in the case that the time unit for the PUSCH transmission is a SBFD time unit, applying the SRS resource set associated with the SBFD time unit format to the PUSCH transmission;

and in the case that the time unit for the PUSCH transmission is a non-SBFD time unit, applying the SRS resource set associated with the non-SBFD time unit format to the PUSCH transmission.

[0029] Some implementations of the methods and apparatuses described herein may further include: receiving, from the base station, an indicator; and determining a respective SRS resource set applied to each of the at least one PUSCH transmission based on the indicator.

[0030] In some implementations of the methods and apparatuses described herein, determining a respective SRS resource set applied to each of the at least one PUSCH transmission based on the indicator includes: in the case that the indicator has a first value, applying a SRS resource set with a first SRS resource set index to each of the at least one PUSCH transmission; in the case that the indicator has a second value, applying a SRS resource set with a second SRS resource set index to each of the at least one PUSCH transmission; in the case that the indicator has a third value, performing one of the following: if the at least one time unit includes two time units, applying a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the at least one PUSCH transmission, respectively; if the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a first SRS resource set mapping pattern to the at least one PUSCH transmission, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or if the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a second SRS resource set mapping pattern to the at least one PUSCH transmission, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes; or in the case that the indicator has a fourth value, performing one of the following: if the at least one time unit includes two time units, applying a SRS resource set with a second SRS resource set index and a SRS resource set with a first SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the at least one PUSCH transmission, respectively; if the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a third SRS resource set mapping pattern to the at least one PUSCH transmission, wherein the third SRS resource set mapping pattern

includes one second SRS resource set index followed by one first SRS resource set index; or if the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a fourth SRS resource set mapping pattern to the at least one PUSCH transmission, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0031] In some implementations of the methods and apparatuses described herein, transmitting the at least one PUSCH transmission across the at least one time unit includes: omitting a PUSCH transmission among the at least one PUSCH transmission in a time unit among the at least one time unit, wherein the determined SRS resource set applied to the PUSCH transmission is not associated with a format of the time unit.

[0032] Some implementations of the methods and apparatuses described herein may further include: determining a respective SRS resource set index associated with each of the at least one time unit; and for a PUSCH transmission of the at least one PUSCH transmission in a time unit of the at least one time unit, determining a respective SRS resource set applied to the PUSCH transmission from the first one or more SRS resource sets or from the second one or more SRS resource sets based on the determined SRS resource set index associated with the PUSCH transmission and a format of the time unit. Determining a respective SRS resource set index associated with each of the at least one time unit includes one of the following: in the case that the at least one time unit includes two time units, associating a first SRS resource set index and a second SRS resource set index with a first time unit and a second time unit among the two time units, respectively; in the case that the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a first SRS resource set mapping pattern to the at least three time units, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or in the case that the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a second SRS resource set mapping pattern to the at least three time units, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes.

[0033] Some implementations of the methods and apparatuses described herein may further include: for one or more PUSCH transmissions in one or more time units with a first time unit format, in the case that one SRS resource set is associated with the first time unit format, applying the SRS resource set associated with the first time unit format to the one or more PUSCH transmissions in the one or more time units; and in the case that more than one SRS resource set is associated with the first time unit format, determining a respective SRS resource set applied to each of the one or more PUSCH transmissions in the one or more time units. Determining a respective SRS resource set applied to each of the one or more PUSCH transmission in the one or more time units include one of the following: in the case that the one or more time units include one time unit, applying a SRS resource set with a first SRS resource set index to the one or more PUSCH transmissions; in the case that the one or more time units include two time units, applying a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively; in the case that the one or more time units include at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a first SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or in the case that the one or more time units include at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a second SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes.

[0034] In a second aspect of the solution, a base station transmits, to a UE, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format. The base station receives, from the UE, at least one PUSCH transmission across at least one time unit. At least one of the following is satisfied: in the case that a PUSCH transmission among the at least one PUSCH transmission is received in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource

sets is applied to the PUSCH transmission in the non-SBFD time unit; or in the case that a PUSCH transmission among the at least one PUSCH transmission is received in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit. In this way, the respective sounding reference signal (SRS) resource set(s) may be configured for different formats of time units and the base station and the user equipment have a common understanding about the SRS resource set to be applied to a PUSCH transmission at least based on the format of a time unit in which the PUSCH transmission is transmitted. The reliability of the PUSCH transmissions may thus be guaranteed.

[0035] In some implementations of the methods and apparatuses described herein, the first one or more SRS resource sets include a first SRS resource set and a second SRS resource set. The second one or more SRS resource sets include one SRS resource set associated with a SBFD time unit format, and wherein the one SRS resource set associated with the SBFD time unit format is one of the first and second SRS resource sets.

[0036] In some implementations of the methods and apparatuses described herein, the one SRS resource set associated with the SBFD time unit format is predefined as the first or second SRS resource set.

[0037] Some implementations of the methods and apparatuses described herein may further include: transmitting, to the UE, an indication that the one of the first and second SRS resource sets is the one SRS resource set associated with the SBFD time unit format.

[0038] In some implementations of the methods and apparatuses described herein, transmitting the configuration of the plurality of SRS resource sets includes: transmitting, to the UE, a configuration of two SRS resource sets, wherein one of the two SRS resource sets is associated with the non-SBFD time unit format, and the other one of the two SRS resource sets is associated with the SBFD time unit format.

[0039] In some implementations of the methods and apparatuses described herein, the at least one PUSCH transmission across the at least one time unit includes one of the following: a PUSCH transmission with a plurality of repetitions in a plurality of slots; or a transport block (TB) processing over multi-slot PUSCH (TBoMS) transmission.

[0040] Some implementations of the methods and apparatuses described herein may further include: transmitting, to the UE, an indicator. A respective SRS resource set index

associated with each of the at least one time unit is based on the indicator. For a PUSCH transmission of the at least one PUSCH transmission in a time unit of the at least one time unit, a respective SRS resource set applied to the PUSCH transmission is determined from the first one or more SRS resource sets or from the second one or more SRS resource sets based on the SRS resource set index associated with the time unit and a format of the time unit.

[0041] In some implementations of the methods and apparatuses described herein, in the case that the format of the time unit is a non-SBFD time unit format, the SRS resource set applied to the PUSCH transmission is a SRS resource set among the first one or more SRS resource sets with the SRS resource set index associated with the time unit; in the case that the format of the time unit is a SBFD time unit format, the SRS resource set applied to the PUSCH transmission is a SRS resource set among the second one or more SRS resource sets with the SRS resource set index associated with the time unit.

[0042] In some implementations of the methods and apparatuses described herein, in the case that the indicator has a first value, a first SRS resource set index is associated with each of the at least one time unit. In the case that the indicator has a second value, a second SRS resource set index is associated with each of the at least one time unit. In the case that the indicator has a third value, one of the following: if the at least one time unit includes two time units, a first SRS resource set index and a second SRS resource set index are associated with a first time unit and a second time unit among the two time units, respectively; if the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, a first SRS resource set mapping pattern is repeatedly applied to the at least three time units, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or if the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, a second SRS resource set mapping pattern is repeatedly applied to the at least three time units, wherein the second SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes. In the case that the indicator has a fourth value, one of the following: if the at least one time unit includes two time units, a second SRS resource set index and a first SRS resource set index is associated with a first time unit and a second time unit among the two time units, respectively; if the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, a third SRS resource set mapping

pattern is repeatedly applied to the at least three time units, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index; or if the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, a fourth SRS resource set mapping pattern is repeatedly applied to the at least three time units, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0043] In some implementations of the methods and apparatuses described herein, in the case that the first one or more SRS resource sets or the second one or more SRS set includes one SRS resource set, both a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index correspond to the one SRS resource set.

[0044] In some implementations of the methods and apparatuses described herein, for one or more PUSCH transmissions in one or more time units with a first time unit format, in the case that one SRS resource set is associated with the first time unit format, the SRS resource set associated with the first time unit format is applied to the one or more PUSCH transmissions in the one or more time units; and in the case that more than one SRS resource set is associated with the first time unit format, a respective SRS resource set applied to each of the one or more PUSCH transmissions is determined based on an indicator for the first time unit format.

[0045] In some implementations of the methods and apparatuses described herein, in the case that the indicator for the first time unit format has a first value, a SRS resource set with a first SRS resource set index is applied to each of the one or more PUSCH transmission. In the case that the indicator for the first time unit format has a second value, a SRS resource set with a second SRS resource set index is applied to each of the one or more PUSCH transmission. In the case that the indicator for the first time unit format has a third value, one of the following: if the one or more time units include one time unit, a SRS resource set with a first SRS resource set index or second SRS resource set index is applied to the one or more PUSCH transmissions; if the one or more time units include two time units, a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index are applied to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions,

respectively; if the one or more time units include at least three time units, and a cyclic mapping for PUSCH is enabled, a first SRS resource set mapping pattern is repeatedly applied to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or if the one or more time units include at least three time units, and a sequential mapping for PUSCH is enabled, a second SRS resource set mapping pattern is repeatedly applied to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes. In the case that the indicator for the first time unit format has a fourth value, one of the following: if the one or more time units include one time unit, a SRS resource set with a second SRS resource set index is applied to the one or more PUSCH transmissions; if the one or more time units include two time units, a SRS resource set with a second SRS resource set index and a SRS resource set with a first SRS resource set index are applied to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively; if the one or more time units include at least three time units, and a cyclic mapping for PUSCH is enabled, a third SRS resource set mapping pattern is repeatedly applied to the one or more PUSCH transmissions, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index; or if the one or more time units include at least three time units, and a sequential mapping for PUSCH is enabled, a fourth SRS resource set mapping pattern is repeatedly applied to the one or more PUSCH transmissions, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0046] Some implementations of the methods and apparatuses described herein may further include: transmitting, to the UE, one indicator for the non-SBFD time unit format and the SBFD time unit format.

[0047] Some implementations of the methods and apparatuses described herein may further include: transmitting, to the UE, at least one of the following: a first indicator for the non-SBFD time unit format in the case that the first one or more SRS resource sets include more than one SRS resource set associated with the non-SBFD time unit format; or a second indicator for the SBFD time unit format in the case that the second one or

more SRS resource sets include more than one SRS resource set associated with the SBFD time unit format.

[0048] In some implementations of the methods and apparatuses described herein, one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets are determined; and a respective SRS resource set applied to each of the at least one PUSCH transmission is based on a format of a time unit for the PUSCH transmission.

[0049] In some implementations of the methods and apparatuses described herein, one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets are determined based on one of the following: a third indicator transmitted to the UE, or a predefinition. The third indicator indicates which one SRS resource set from the first one or more SRS resource sets and which one SRS resource set from the second one or more SRS resource sets are used.

[0050] In some implementations of the methods and apparatuses described herein, the first one or more SRS resource sets include two SRS resource sets associated with the non-SBFD time unit format, and the second one or more SRS resource sets include two SRS resource sets associated with the SBFD time unit format, and the third indicator includes two bits.

[0051] In some implementations of the methods and apparatuses described herein, the at least one time unit includes first one or more time units with the non-SBFD time unit format and second one or more time units with the SBFD time unit format.

[0052] In some implementations of the methods and apparatuses described herein, the first time unit format is a non-SBFD time unit format or a SBFD time unit format.

[0053] In some implementations of the methods and apparatuses described herein, the first time unit format is determined from the non-SBFD time unit format and the SBFD time unit format for PUSCH transmission.

[0054] In some implementations of the methods and apparatuses described herein, the first time unit format is determined based on one of the following: a format of a first time unit for a first PUSCH transmission in time domain among the at least one PUSCH transmission; a pre-definition as a SBFD time unit format or a non-SBFD time unit format; or a configuration signaling to the UE.

[0055] Some implementations of the methods and apparatuses described herein may further include: transmitting, to the UE, an indication of one or more SRS resource sets among the plurality of SRS resource sets. A respective SRS resource set applied to each of the at least one PUSCH transmission is determined from the one or more SRS resource sets based on an indicator to the UE.

[0056] In some implementations of the methods and apparatuses described herein, a respective SRS resource set applied to each of the at least one PUSCH transmission is based on a format of a time unit for the PUSCH transmission.

[0057] In some implementations of the methods and apparatuses described herein, in the case that the time unit for the PUSCH transmission is a SBFD time unit, the SRS resource set associated with the SBFD time unit format is applied to the PUSCH transmission; and in the case that the time unit for the PUSCH transmission is a non-SBFD time unit, the SRS resource set associated with the non-SBFD time unit format is applied to the PUSCH transmission.

[0058] Some implementations of the methods and apparatuses described herein may further include: transmitting, to the UE, an indicator. A respective SRS resource set applied to each of the at least one PUSCH transmission is based on the indicator.

[0059] In some implementations of the methods and apparatuses described herein, in the case that the indicator has a first value, a SRS resource set with a first SRS resource set index is applied to each of the at least one PUSCH transmission. In the case that the indicator has a second value, a SRS resource set with a second SRS resource set index is applied to each of the at least one PUSCH transmission. In the case that the indicator has a third value, one of the following: if the at least one time unit includes two time units, a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index are applied to a first PUSCH transmission and a second PUSCH transmission among the at least one PUSCH transmission, respectively; if the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, a first SRS resource set mapping pattern is repeatedly applied to the at least one PUSCH transmission, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or if the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, a second SRS resource set mapping pattern is repeatedly applied to the at least

one PUSCH transmission, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes. In the case that the indicator has a fourth value, one of the following: if the at least one time unit includes two time units, a SRS resource set with a second SRS resource set index and a SRS resource set with a first SRS resource set index are applied to a first PUSCH transmission and a second PUSCH transmission among the at least one PUSCH transmission, respectively; if the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, a third SRS resource set mapping pattern is repeatedly applied to the at least one PUSCH transmission, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index; or if the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, a fourth SRS resource set mapping pattern is repeatedly applied to the at least one PUSCH transmission, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0060] In some implementations of the methods and apparatuses described herein, for a PUSCH transmission of the at least one PUSCH transmission in a time unit of the at least one time unit, a respective SRS resource set applied to the PUSCH transmission is determined from the first one or more SRS resource sets or from the second one or more SRS resource sets based on a respective SRS resource set index associated with the PUSCH transmission and a format of the time unit. One of the following is satisfied: in the case that the at least one time unit includes two time units, a first SRS resource set index and a second SRS resource set index are associated with a first time unit and a second time unit among the two time units, respectively; in the case that the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, a first SRS resource set mapping pattern is repeatedly applied to the at least three time units, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or in the case that the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, a second SRS resource set mapping pattern is repeatedly applied to the at least three time units, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes.

[0061] In some implementations of the methods and apparatuses described herein, for one or more PUSCH transmissions in one or more time units with a first time unit format, in the case that one SRS resource set is associated with the first time unit format, the SRS resource set associated with the first time unit format is applied to the one or more PUSCH transmissions in the one or more time units; and in the case that more than one SRS resource set is associated with the first time unit format, one of the following is satisfied: if the one or more time units include one time unit, a SRS resource set with a first SRS resource set index is applied to the one or more PUSCH transmissions; if the one or more time units include two time units, a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index are applied to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively; if the one or more time units include at least three time units, and a cyclic mapping for PUSCH is enabled, a first SRS resource set mapping pattern is repeatedly applied to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index; or if the one or more time units include at least three time units, and a sequential mapping for PUSCH is enabled, a second SRS resource set mapping pattern is repeatedly applied to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0062] FIG. 1A illustrates an example of a wireless communications system that supports PUSCH transmissions in accordance with aspects of the present disclosure.

[0063] FIG. 1B illustrates an example diagram of time domain resource allocation for PUSCH transmissions with PUSCH repetition type A.

[0064] FIG. 1C illustrates an example diagram of time domain resource allocation for PUSCH transmissions with PUSCH repetition type B.

[0065] FIG. 1D illustrates an example diagram of time domain resource allocation for PUSCH transmissions with enhanced PUSCH repetition type A.

[0066] FIG. 1E illustrates an example diagram of time domain resource allocation for a TBOMS-based PUSCH transmission.

[0067] FIG. 1F illustrates an example diagram of applying SRS resource sets to dynamically scheduled PUSCH transmissions in downlink symbols/slots.

[0068] FIG. 1G illustrates an example diagram of a sub-band full duplex scheme.

[0069] FIG. 1H illustrates an example diagram of PUSCH transmissions across different slots each comprising all SBFD symbols or all non-SBFD symbols.

[0070] FIG. 1I illustrates an example diagram of panel group allocation in SBFD symbols/slots and in non-SBFD symbols/slots.

[0071] FIG. 1J illustrates another example diagram of panel group allocation in SBFD symbols/slots and in non-SBFD symbols/slots.

[0072] FIG. 2 illustrates an example signaling chart of an example process that supports PUSCH transmissions in accordance with aspects of the present disclosure.

[0073] FIGS. 3A through 3C illustrate examples of SRS resource set configurations for SBFD symbols/slots and non-SBFD symbols/slots that support PUSCH transmissions in accordance with aspects of the present disclosure.

[0074] FIGS. 4A through 4F illustrate an example of a first implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure.

[0075] FIGS. 5A through 5E illustrate an example of a second implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure.

[0076] FIGS. 6A through 6D illustrate an example of a third implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure.

[0077] FIGS. 7A through 7D illustrate an example of a fourth implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure.

[0078] FIGS. 8A through 8E illustrate an example of a fifth implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure.

[0079] FIG. 9 illustrates an example of a device that supports PUSCH transmissions in accordance with aspects of the present disclosure.

[0080] FIG. 10 illustrates an example of a processor that supports PUSCH transmissions in accordance with aspects of the present disclosure.

[0081] FIGS. 11 through 12 illustrate flowcharts of methods that support PUSCH transmissions in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

[0082] Principles of the present disclosure will now be described with reference to some embodiments. It is to be understood that these embodiments are described only for the purpose of illustration and help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure. The disclosure described herein may be implemented in various manners other than the ones described below.

[0083] In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skills in the art to which this disclosure belongs.

[0084] References in the present disclosure to “one embodiment,” “an example embodiment,” “an embodiment,” “some embodiments,” and the like indicate that the embodiment(s) described may include a particular feature, structure, or characteristic, but it is not necessary that every embodiment includes the particular feature, structure, or characteristic. Moreover, such phrases do not necessarily refer to the same embodiment(s). Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0085] It shall be understood that although the terms “first” and “second” or the like may be used herein to describe various elements, these elements should not be limited by

these terms. These terms are only used to distinguish one element from another element. For example, a first element could also be termed as a second element, and similarly, a second element could also be termed as a first element, without departing from the scope of embodiments. As used herein, the term “and/or” includes any and all combinations of one or more of the listed terms.

[0086] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of example embodiments. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises”, “comprising”, “has”, “having”, “includes” and/or “including”, when used herein, specify the presence of stated features, elements, and/or components etc., but do not preclude the presence or addition of one or more other features, elements, components and/ or combinations thereof. For example, the term “includes” and its variants are to be read as open terms that mean “includes, but is not limited to.” The term “based on” is to be read as “based at least in part on.” The term “one embodiment” and “an embodiment” are to be read as “at least one embodiment.” The term “another embodiment” is to be read as “at least one other embodiment.” The use of an expression such as “A and/or B” can mean either “only A” or “only B” or “both A and B.” Other definitions, explicit and implicit, may be included below.

[0087] As used herein, the term “communication network” refers to a network following any suitable communication standards, such as, 5G NR, long term evolution (LTE), LTE-advanced (LTE-A), wideband code division multiple access (WCDMA), high-speed packet access (HSPA), narrow band internet of things (NB-IoT), and so on. Further, the communications between a terminal device and a network device in the communication network may be performed according to any suitable generation communication protocols, including but not limited to, the first generation (1G), the second generation (2G), 2.5G, 2.75G, the third generation (3G), the fourth generation (4G), 4.5G, the fifth generation (5G) communication protocols, and/or any other protocols either currently known or to be developed in the future. Embodiments of the present disclosure may be applied in various communication systems. Given the rapid development in communications, there will also be future type communication technologies and systems in which the present disclosure may be embodied. It should not be seen as limiting the scope of the present disclosure to only the aforementioned systems.

[0088] As used herein, the term “network device” generally refers to a node in a communication network via which a terminal device can access the communication network and receive services therefrom. The network device may refer to a base station (BS) or an access point (AP), for example, a node B (NodeB or NB), a radio access network (RAN) node, an evolved NodeB (eNodeB or eNB), an NR NB (also referred to as a gNB), a remote radio unit (RRU), a radio header (RH), an infrastructure device for a V2X (vehicle-to-everything) communication, a transmission and reception point (TRP), a reception point (RP), a remote radio head (RRH), a relay, an integrated access and backhaul (IAB) node, a low power node such as a femto BS, a pico BS, and so forth, depending on the applied terminology and technology.

[0089] As used herein, the term “terminal device” generally refers to any end device that may be capable of wireless communications. By way of example rather than a limitation, a terminal device may also be referred to as a communication device, a user equipment (UE), an end user device, a subscriber station (SS), an unmanned aerial vehicle (UAV), a portable subscriber station, a mobile station (MS), or an access terminal (AT). The terminal device may include, but is not limited to, a mobile phone, a cellular phone, a smart phone, a voice over IP (VoIP) phone, a wireless local loop phone, a tablet, a wearable terminal device, a personal digital assistant (PDA), a portable computer, a desktop computer, an image capture terminal device such as a digital camera, a gaming terminal device, a music storage and playback appliance, a vehicle-mounted wireless terminal device, a wireless endpoint, a mobile station, laptop-embedded equipment (LEE), laptop-mounted equipment (LME), a USB dongle, a smart device, wireless customer-premises equipment (CPE), an internet of things (IoT) device, a watch or other wearable, a head-mounted display (HMD), a vehicle, a drone, a medical device (for example, a remote surgery device), an industrial device (for example, a robot and/or other wireless devices operating in an industrial and/or an automated processing chain contexts), a consumer electronics device, a device operating on commercial and/or industrial wireless networks, and the like. In the following description, the terms: “terminal device,” “communication device,” “terminal,” “user equipment” and “UE,” may be used interchangeably.

[0090] Aspects of the present disclosure are described in the context of a wireless communications system.

[0091] FIG. 1A illustrates an example of a wireless communications system 100 that supports PUSCH transmissions in accordance with aspects of the present disclosure. The wireless communications system 100 may include one or more network entities 102 (also referred to as network equipment (NE)), one or more UEs 104, a core network 106, and a packet data network 108. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as an LTE network or an LTE-Advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a 5G network, such as an NR network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0092] The one or more network entities 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the network entities 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a radio access network (RAN), a base transceiver station, an access point, a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. A network entity 102 and a UE 104 may communicate via a communication link 110, which may be a wireless or wired connection. For example, a network entity 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0093] A network entity 102 may provide a geographic coverage area 112 for which the network entity 102 may support services (e.g., voice, video, packet data, messaging, broadcast, etc.) for one or more UEs 104 within the geographic coverage area 112. For example, a network entity 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, a network entity 102 may be moveable, for example, a satellite associated with a non-terrestrial network. In some implementations, different geographic coverage areas 112

associated with the same or different radio access technologies may overlap, but the different geographic coverage areas 112 may be associated with different network entities 102. Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0094] The one or more UEs 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a mobile device, a wireless device, a remote device, a remote unit, a handheld device, or a subscriber device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an Internet-of-Things (IoT) device, an Internet-of-Everything (IoE) device, or machine-type communication (MTC) device, among other examples. In some implementations, a UE 104 may be stationary in the wireless communications system 100. In some other implementations, a UE 104 may be mobile in the wireless communications system 100.

[0095] The one or more UEs 104 may be devices in different forms or having different capabilities. Some examples of UEs 104 are illustrated in FIG. 1. A UE 104 may be capable of communicating with various types of devices, such as the network entities 102, other UEs 104, or network equipment (e.g., the core network 106, the packet data network 108, a relay device, an integrated access and backhaul (IAB) node, or another network equipment), as shown in FIG. 1. Additionally, or alternatively, a UE 104 may support communication with other network entities 102 or UEs 104, which may act as relays in the wireless communications system 100.

[0096] A UE 104 may also be able to support wireless communication directly with other UEs 104 over a communication link 114. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink. For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0097] A network entity 102 may support communications with the core network 106, or with another network entity 102, or both. For example, a network entity 102 may interface with the core network 106 through one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The network entities 102 may communicate with each other over the backhaul links 116 (e.g., via an X2, Xn, or another network interface). In some implementations, the network entities 102 may communicate with each other directly (e.g., between the network entities 102). In some other implementations, the network entities 102 may communicate with each other or indirectly (e.g., via the core network 106). In some implementations, one or more network entities 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0098] In some implementations, a network entity 102 may be configured in a disaggregated architecture, which may be configured to utilize a protocol stack physically or logically distributed among two or more network entities 102, such as an integrated access backhaul (IAB) network, an open RAN (O-RAN) (e.g., a network configuration sponsored by the O-RAN Alliance), or a virtualized RAN (vRAN) (e.g., a cloud RAN (C-RAN)). For example, a network entity 102 may include one or more of a central unit (CU), a distributed unit (DU), a radio unit (RU), a RAN Intelligent Controller (RIC) (e.g., a Near-Real Time RIC (Near-RT RIC), a Non-Real Time RIC (Non-RT RIC)), a Service Management and Orchestration (SMO) system, or any combination thereof.

[0099] An RU may also be referred to as a radio head, a smart radio head, a remote radio head (RRH), a remote radio unit (RRU), or a transmission reception point (TRP). One or more components of the network entities 102 in a disaggregated RAN architecture may be co-located, or one or more components of the network entities 102 may be located in distributed locations (e.g., separate physical locations). In some implementations, one or more network entities 102 of a disaggregated RAN architecture may be implemented as virtual units (e.g., a virtual CU (VCU), a virtual DU (VDU), a virtual RU (VRU)).

[0100] Split of functionality between a CU, a DU, and an RU may be flexible and may support different functionalities depending upon which functions (e.g., network layer

functions, protocol layer functions, baseband functions, radio frequency functions, and any combinations thereof) are performed at a CU, a DU, or an RU. For example, a functional split of a protocol stack may be employed between a CU and a DU such that the CU may support one or more layers of the protocol stack and the DU may support one or more different layers of the protocol stack. In some implementations, the CU may host upper protocol layer (e.g., a layer 3 (L3), a layer 2 (L2)) functionality and signaling (e.g., Radio Resource Control (RRC), service data adaptation protocol (SDAP), Packet Data Convergence Protocol (PDCP)). The CU may be connected to one or more DUs or RUs, and the one or more DUs or RUs may host lower protocol layers, such as a layer 1 (L1) (e.g., physical (PHY) layer) or an L2 (e.g., radio link control (RLC) layer, medium access control (MAC) layer) functionality and signaling, and may each be at least partially controlled by the CU 160.

[0101] Additionally, or alternatively, a functional split of the protocol stack may be employed between a DU and an RU such that the DU may support one or more layers of the protocol stack and the RU may support one or more different layers of the protocol stack. The DU may support one or multiple different cells (e.g., via one or more RUs). In some implementations, a functional split between a CU and a DU, or between a DU and an RU may be within a protocol layer (e.g., some functions for a protocol layer may be performed by one of a CU, a DU, or an RU, while other functions of the protocol layer are performed by a different one of the CU, the DU, or the RU).

[0102] A CU may be functionally split further into CU control plane (CU-CP) and CU user plane (CU-UP) functions. A CU may be connected to one or more DUs via a midhaul communication link (e.g., F1, F1-c, F1-u), and a DU may be connected to one or more RUs via a fronthaul communication link (e.g., open fronthaul (FH) interface). In some implementations, a midhaul communication link or a fronthaul communication link may be implemented in accordance with an interface (e.g., a channel) between layers of a protocol stack supported by respective network entities 102 that are in communication via such communication links.

[0103] The core network 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The core network 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity

(MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more network entities 102 associated with the core network 106.

[0104] The core network 106 may communicate with the packet data network 108 over one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The packet data network 108 may include an application server 118. In some implementations, one or more UEs 104 may communicate with the application server 118. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the core network 106 via a network entity 102. The core network 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server 118 using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the core network 106 (e.g., one or more network functions of the core network 106).

[0105] In the wireless communications system 100, the network entities 102 and the UEs 104 may use resources of the wireless communications system 100 (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the network entities 102 and the UEs 104 may support different resource structures. For example, the network entities 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the network entities 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the network entities 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures). The network entities 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0106] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., $\mu=0$) may be associated with a first subcarrier spacing (e.g., 15

kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., $\mu=0$) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., $\mu=1$) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., $\mu=2$) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g., $\mu=3$) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., $\mu=4$) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

[0107] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0108] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., $\mu=0$, $\mu=1$, $\mu=2$, $\mu=3$, $\mu=4$) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., $\mu=0$) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0109] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the network entities 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the network entities 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the network entities 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0110] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., $\mu=0$), which includes 15 kHz subcarrier spacing; a second numerology (e.g., $\mu=1$), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., $\mu=2$), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., $\mu=2$), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., $\mu=3$), which includes 120 kHz subcarrier spacing.

[0111] For the purpose of illustration without suggesting any limitations, some embodiments of the present disclosure will be described with reference to the scenario that a UE 104 performs PUSCH transmissions to a network entity 102. It is to be understood that the disclosure described herein may be implemented in various manners other than the ones described below.

[0112] As mentioned above, PUSCH transmission(s) can be dynamically scheduled by an UL grant in a DCI, or the transmission can correspond to a configured grant (CG) Type 1 or Type 2. The CG Type 1 PUSCH transmission is semi-statically configured to operate upon the reception of a higher layer parameter of *configuredGrantConfig* including *rrc-ConfiguredUplinkGrant* without the detection of an UL grant in a DCI. The CG Type 2 PUSCH transmission is semi-persistently scheduled by an UL grant in a valid

activation DCI after the reception of a higher layer parameter *configuredGrantConfig* not including *rrc-ConfiguredUplinkGrant*. Before a NR UE transmits PUSCH, including dynamic scheduled PUSCH and CG PUSCH, the UE receives frequency domain resource allocation assignment and time domain resource assignment from the NR gNB to determine the frequency and time domain resource of the PUSCH.

[0113] As for the resource allocation in frequency domain, for dynamically scheduled PUSCH and CG Type 2 PUSCH, the UE shall determine the resource assignment using the resource allocation field in the detected PDCCH DCI. But for CG Type 1 PUSCH, the resource assignment applied for the transmission are provided by a higher layer parameter *frequencyDomainAllocation* in *configuredGrantConfig*. The frequency domain resource assignment indicates to a scheduled UE a set of resource blocks (RB) within the active bandwidth part. The RB indexing for resource allocation is determined within the UE's active bandwidth part.

[0114] As for the resource allocation in time domain, for dynamically scheduled PUSCH, the 'Time domain resource assignment' field value m of the DCI provides a row index $m+1$ to an allocated table, and the used resource allocation table could be predefined by 3GPP specification or could be configured by a higher layer parameter. The indexed row defines the slot offset K_2 , the start and length indicator *SLIV* (or directly the start symbol S and the allocation length L) and the number of repetitions (if *numberOfRepetitions* is present in the resource allocation table) to be applied in the PUSCH transmission. The slot offset K_2 is used to indicate the number of slots between the DCI received slot and PUSCH transmitted slot.

[0115] There are mainly four schemes for resource allocation in time domain of dynamically scheduled PUSCH, which includes PUSCH repetition Type A, PUSCH repetition Type B, enhanced PUSCH repetition type A, TB processing over multi-slot PUSCH (TBOMS). For a certain PUSCH transmission, which scheme among these four schemes is used could be configured by a higher layer parameter. FIGS. 1B through 1E illustrate examples of time domain resource allocation for these four schemes. The four schemes for time domain resource allocation apply to embodiments of the present disclosure. It is to be understood that other schemes for time domain resource allocation are also possible.

[0116] For PUSCH repetition Type A, the starting symbol S relative to the start of the slot, and the number of consecutive symbols L counting from the symbol S allocated for the PUSCH are determined from the start and length indicator SLIV of the indexed row: if $(L-1) \leq 7$, then $SLIV = 14 \cdot (L-1) + S$; else, $SLIV = 14 \cdot (14-L+1) + (14-1-S)$; where $0 < L \leq 14-S$.

[0117] When transmitting PUSCH scheduled by DCI format 0_1 or 0_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with $NDI=1$, the number of repetitions K is determined as follows: if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions K is equal to *numberOfRepetitions*; else if the UE is configured with *pusch-AggregationFactor*, the number of repetitions K is equal to *pusch-AggregationFactor*; otherwise $K=1$.

[0118] For PUSCH repetition Type A, in case $K>1$, the same symbol allocation is applied across the K consecutive slots. The UE shall repeat the TB across the K consecutive slots applying the same symbol allocation in each slot. For example, assuming $K_2=1$, $S=2$, $L=8$, $K=4$, an example diagram of time domain resource allocation for PUSCH transmissions with PUSCH repetition type A is illustrated in FIG. 1B.

[0119] For PUSCH repetition Type B, the number of nominal repetitions is given by *numberOfRepetitions*. For the n -th nominal repetition, $n = 0, \dots, \text{numberOfRepetitions} - 1$, the slot where the nominal repetition starts is given by $K_s + \left\lfloor \frac{S+n \cdot L}{N_{\text{slot}}^{\text{slot}}} \right\rfloor$, and the starting symbol relative to the start of the slot is given by $\text{mod}(S+n \cdot L, N_{\text{slot}}^{\text{slot}})$; and the slot where the nominal repetition ends is given by $K_s + \left\lfloor \frac{S+(n+1) \cdot L-1}{N_{\text{slot}}^{\text{slot}}} \right\rfloor$, and the ending symbol relative to the start of the slot is given by $\text{mod}(S+(n+1) \cdot L-1, N_{\text{slot}}^{\text{slot}})$. Here, K_s is the slot where the PUSCH transmission starts, and $N_{\text{slot}}^{\text{slot}}$ is the number of symbols per slot. The starting symbol S relative to the start of the slot, and the number of consecutive symbols L counting from the symbol S allocated for the PUSCH are provided by *startSymbol* and *length* of the indexed row of the resource allocation table, respectively.

[0120] For PUSCH repetition Type B, a symbol that is indicated as downlink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, is considered as an invalid symbol for PUSCH repetition Type B transmission. After determining the

invalid symbol(s) for PUSCH repetition type B transmission for each of the K nominal repetitions, the remaining symbols are considered as potentially valid symbols for PUSCH repetition Type B transmission. If the number of potentially valid symbols for PUSCH repetition type B transmission is greater than zero for a nominal repetition, the nominal repetition consists of one or more actual repetitions, where each actual repetition consists of a consecutive set of all potentially valid symbols that can be used for PUSCH repetition Type B transmission within a slot. An actual repetition with a single symbol is omitted except for the case of $L=1$.

[0121] An actual repetition is omitted if any symbol of the PUSCH is overlapped with the set of symbols of the slot that are indicated to a UE as downlink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*. For example, assuming $K_2=0$, $S=2$, $L=8$, $K=4$, an example diagram of time domain resource allocation for PUSCH transmissions with PUSCH repetition type B is illustrated in FIG. 1C.

[0122] For enhanced PUSCH repetition Type A, the resource allocation in time domain is almost same as PUSCH repetition type A, excluding that the number of repetitions is counted on the basis of available slots. A slot is determined as unavailable if at least one of the symbols indicated by TDRA for a PUSCH in the slot overlaps with the symbol not intended for UL transmissions, and semi-static flexible symbol configured by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, is considered as available. For example, assuming $K_2=1$, $S=2$, $L=8$, $K=4$, an example diagram of time domain resource allocation for PUSCH transmissions with enhanced PUSCH repetition type A is illustrated in FIG. 1D.

[0123] For TBOMS, time domain resource determination can be performed via PUSCH repetition Type A like TDRA. The number of slots K allocated for TBOMS is determined by using a row index of a TDRA list, configured via RRC and is counted based on the available slots for UL transmission. The transmission in each slot could be names as one transmission part of the TB in this invention. The determination of available slots is as defined in enhanced PUSCH repetition Type A. For example, assuming $K_2=1$, $S=2$, $L=8$, $K=4$, an example diagram of time domain resource allocation for a TBOMS-based PUSCH transmission is illustrated in FIG. 1E.

[0124] For CG Type 1 PUSCH transmissions, the higher layer parameter *timeDomainAllocation* value m provides a row index $m+1$ pointing to the determined

time domain resource allocation table, where the start symbol and the length are determined following the procedure defined in above for dynamically scheduled PUSCH. For CG Type 2 PUSCH transmissions, the resource allocation follows UL grant received on the DCI.

[0125] There are also mainly four schemes for resource allocation in time domain of CG PUSCH including CG Type 1 or CG Type 2. The schemes of time domain resource determination for CG PUSCH differ from the schemes for dynamically scheduled PUSCH in some aspects, such as for PUSCH repetition Type A, PUSCH repetition Type B, enhanced PUSCH repetition Type A and TBOMS, the number of (nominal) repetitions K to be applied to the transmitted transport block is provided by the indexed row in the time domain resource allocation table if *numberOfRepetitions* is present in the table; otherwise K is provided by the higher layer configured parameters *repK*. Besides, other procedures defined in clause of dynamically scheduled could be reused. For PUSCH repetition Type B, for PUSCH transmissions with CG Type 1 or CG Type 2, the nominal repetitions and the actual repetitions are determined according to the procedures for PUSCH repetition Type B defined in clause of dynamically scheduled PUSCH.

[0126] In addition to resource allocation in frequency domain and time domain, the spatial domain parameters or the beam to be used also needs to be defined for PUSCH transmissions.

[0127] For dynamically scheduling PUSCH, the used beam is indicated by SRS resource indicator (SRI) in a DCI to indicate one SRS resource from a configured SRS resource set. The spatial domain parameters or the beam is configured per SRS resource. If a SRS resource is indicated, then the PUSCH would use the same spatial domain parameters or the same beam as the indicated SRS resource.

[0128] If two SRS resource sets are configured (codebook or non-codebook), the SRS resource set indicator comprises 2 bits, and for PUSCH repetition type A, the association of the first and second SRS resource set in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* to each slot may be determined.

[0129] If a DCI format 0_1 or DCI format 0_2 indicates codepoint "00" for the SRS resource set indicator, the first SRS resource set is associated with all K consecutive slots. If a DCI format 0_1 or DCI format 0_2 indicates codepoint "01" for the SRS resource set indicator, the second SRS resource set is associated with all K consecutive slots.

[0130] If a DCI format 0_1 or DCI format 0_2 indicates codepoint "10" for the SRS resource set indicator, the association of the first and second SRS resource sets to K consecutive slots is determined based on K . When $K = 2$, the first and second SRS resource sets are applied to the first and second slot of 2 consecutive slots, respectively. When $K > 2$ and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets are applied to the first and second slot of K consecutive slots, respectively, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots. When $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, first SRS resource set is applied to the first and second slots of K consecutive slots, and the second SRS resource set is applied to the third and fourth slot of K consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots.

[0131] If a DCI format 0_1 or DCI format 0_2 indicates codepoint "11" for the SRS resource set indicator, and the association of the first and second SRS resource sets to K consecutive slots is determined based on K . When $K = 2$, the second and first SRS resource set are applied to the first and second slot of 2 consecutive slots, respectively. When $K > 2$ and *cyclicMapping* in *PUSCH-Config* is enabled, the second and first SRS resource sets are applied to the first and second slot of K consecutive slots, respectively, and the same SRS resource set mapping pattern continues to the remaining slots of the K consecutive slots. When $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the second SRS resource set is applied to the first and second slot of K consecutive slots, and the first SRS resource set is applied to the third and fourth slot of K consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of the K consecutive.

[0132] FIG. 1F illustrates an example diagram of applying SRS resource sets to dynamically scheduled PUSCH transmissions in downlink symbols/slots. As shown in FIG. 1F, two SRS resource sets are configured, namely SRS resource set #1 and SRS resource set #2. The indexes of these two SRS resource sets may be associated to the slots based on the SRS resource set indicator, and accordingly, the corresponding SRS resource sets be applied to the PUSCH transmissions in the slots.

[0133] For CG PUSCH, the SRI is configured by RRC signalling. If two SRS resource sets are configured, then the association of the first and second SRS resource

sets to K consecutive slots is determined based on K . When $K = 2$, the first and second SRS resource sets are applied to the first and second (nominal) repetitions, respectively. When $K > 2$ and *cyclicMapping* in *configuredGrantConfig* is enabled, the first and second SRS resource sets are applied to the first and second (nominal) repetitions, respectively, and the same SRS resource set mapping pattern continues to the remaining (nominal) repetitions. When $K > 2$ and *sequentialMapping* in *configuredGrantConfig* is enabled, first SRS resource set is applied to the first and second (nominal) repetitions, and the second SRS resource set is applied to the third and fourth (nominal) repetitions, and the same SRS resource set mapping pattern continues to the remaining (nominal) repetitions.

[0134] In order to realize the superior data rate and latency, 5G spectrum on higher frequency band is inevitable. Enhancements are still needed to overcome the coverage reduction on such carriers. A duplexing scheme that enables simultaneous use of downlink and uplink within a TDD carrier using non-overlapped frequency resource might be introduced, which could be named as sub-band full duplex (SBFD). The intention of this scheme is to extend the duration over which uplink transmission could occur for improved the uplink coverage and capacity. The simultaneous use of DL and UL is only at the gNB side and not at the UE side. An example of a duplexing scheme could be seen in FIG. 1G. In the example of FIG. 1G, two downlink (DL) sub-bands are duplex with an uplink (UL) sub-band in slot #0 and slot #1.

[0135] There may be four symbol formats in a system adopting the subband full duplex scheme. The four symbol formats include DL, flexible, SBFD, and UL. For example, a DL or UL symbol may mean that the transmission direction on this symbol is DL or UL. For example, a flexible symbol may mean that a UE cannot make any assumptions on the transmission direction of this symbol. For example, a SBFD symbol may mean that this symbol can support simultaneous DL and UL transmissions in gNB side. For example, a symbol being SBFD may mean the symbol being indicated as DL with a UL frequency region or a UL subband; the symbol being indicated as flexible with a UL frequency region or a UL subband; or the symbol being indicated as flexible and a DL reception and a UL reception being configured to be performed in the symbol simultaneously (e.g., configured by a BS for a UE). For example, an SBFD symbol may include a UL frequency domain resource or UL subband and be initially indicated or configured by a high layer configuration or a slot format indication (SFI) from a BS as downlink or flexible (for example, there could be at least two subbands or frequency

domain regions with different transmission directions in this symbol). For example, a BS may simultaneously perform a DL transmission and a UL reception in an SBFD symbol while a UE can only perform a DL reception or a UL transmission. For example, an SBFD symbol may be configured with a UL subband, a DL subband, a flexible subband or any combination thereof. For example, an SBFD symbol may include a UL subband configuration. A slot format being SBFD may mean a slot includes only SBFD symbol or some SBFD symbols.

[0136] According to the NR resource allocation, it would be supported that the PUSCHs are transmitted in different slots, where each transmission within a slot has either all SBFD or all non-SBFD symbols. Resource allocation in frequency domain for transmission or reception in SBFD symbols and non-SBFD symbols should be supported, with different available frequency resources in different slots. FIG. 1H illustrates an example diagram of PUSCH transmissions across different slots each comprising all SBFD symbols or all non-SBFD symbols. The four PUSCH transmissions in slots #0 to #3 could be a PUSCH with four repetitions, or a TB over four slots, and could be dynamic scheduling PUSCH or CG PUSCH.

[0137] Considering that in SBFD symbols/slots, from UE side, some antennas would be used for DL reception(as shown in FIG. 1I and FIG. 1J), so the number of antennas in SBFD symbol would be different with the number of antennas in non-SBFD symbol (for example, UL symbol). Thus, it is possible that the beam or spatial domain parameter is different for SBFD slots/symbols and non-SBFD slots/symbols. Thus, the SRS resource set(s) that can be applied to PUSCH transmissions could be different in SBFD slots/symbols and non-SBFD slots/symbols.

[0138] Assuming two SRS resource sets are configured for non-SBFD symbols/slots, and one or two SRS resource sets are configured for SBFD slots/symbols. Since only at most two SRS resource sets could be configured in legacy, it needs to be specified about how to determine and use the SRS resource set indicator field, and/or how to determine the associated SRS resource set for each PUSCH transmission of multiple PUSCHs in multiple slots (e.g., PUSCH with multiple repetitions, or TBOMS).

[0139] For example, assuming there are still 2 bits in DCI for SRS resource set indication, if a DCI format 0_1 or DCI format 0_2 indicates codepoint "10", the association of the first and second SRS resource sets to K consecutive slots would be

determined as follows: when $K = 4$ and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets are applied to the first and second slot of K consecutive slots, respectively, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots.

[0140] When the K consecutive slots comprise both SBFD slots and non-SBFD slots, e.g., for the case in FIG. 1H where the first slot and the second slot comprise SBFD symbols, the third slot and the fourth slot comprise non-SBFD symbols, how to determine the SRS resource set to be applied to the PUSCH transmissions should be determined.

[0141] Assuming two SRS resource sets are configured for SBFD slots/symbols and non-SBFD slots/symbols in total. In one scenario, in a SBFD symbol, only one panel group could be used for PUSCH transmission, the other panel group should be used for DL reception, but in non-SBFD symbol, both panel groups could be used for PUSCH transmission. FIG. 1I illustrates an example diagram of panel group allocation in SBFD symbols/slots and in non-SBFD symbols/slots. As shown in FIG. 1I, in UL slots/symbols, both the panel group #1 and the panel group #2 are used for UL transmission; in SBFD slots/symbols, the panel group #1 is used for DL transmission and the panel group #2 is used for UL transmission.

[0142] In another scenario, different panel groups may be used for PUSCH transmission for SBFD symbols/slots and for non-SBFD symbols/slots. FIG. 1J illustrates another example diagram of panel group allocation in SBFD symbols/slots and in non-SBFD symbols/slots. As shown in FIG. 1J, in UL slots/symbols, only the panel group #1 is used for UL transmission; in SBFD slots/symbols, only the panel group #2 is used for UL transmission while the panel group #1 is used for DL transmission.

[0143] From the perspective view of UE, the UE should determine which panel group should be used for UL transmission in SBFD symbols/slots. In addition, further enhancements are needed on the bit number of SRS resource set indication and how to determine the SRS resource set to be applied to each PUSCH when there is a SRS resource set indication in the DCI.

[0144] In view of the above and other aspects, embodiments of the present disclosure provide solutions for PUSCH transmissions. In one solution, a UE receives, from a base station, a configuration of a plurality of SRS resource sets. First one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-SBFD

time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format. The UE transmits, to the base station, at least one PUSCH transmission across at least one time unit. In some embodiments, in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit. Alternatively or additionally, in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit. In this way, respective SRS resource set(s) may be configured for different formats of time units and the base station and the user equipment have a common understanding about the SRS resource set to be applied to a PUSCH transmission at least based on the format of a time unit in which the PUSCH transmission is transmitted. The reliability of the PUSCH transmissions may thus be guaranteed.

[0145] FIG. 2 illustrates an example signaling chart of an example process 200 that supports PUSCH transmissions in accordance with aspects of the present disclosure. For the purpose of discussion, the process 200 will be described with reference to FIG. 1, and the process 200 may involve a UE 104 and a network entity 102 as shown in FIG. 1. The network entity 102 may be also referred to as the base station 102. It is to be understood that the steps and the order of the steps in FIG. 2 are merely for illustration, and not for limitation. It is to be understood that process 200 may further include additional blocks not shown and/or omit some shown blocks, and the scope of the present disclosure is not limited in this regard.

[0146] As shown in FIG. 2, a base station 102 transmits 202, to a UE 104, a configuration 204 of a plurality of SRS resource sets. First one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-SBFD time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format.

[0147] The UE 104 receives 206 the configuration 204 and transmits 208, to the base station 102, at least one PUSCH transmission 210 across at least one time unit. The base station 102 receives 212 the at least one PUSCH transmission 210. The at least one PUSCH transmission may be semi-statically configured or dynamically scheduled. For

example, the at least one PUSCH transmission may be associated with a CG configuration, e.g., a type 1 CG configuration or a type 2 CG configuration. Alternatively, the at least one PUSCH transmission may be scheduled by one DCI.

[0148] In some embodiments, in the case that a PUSCH transmission among the at least one PUSCH transmission 210 is transmitted in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit. Alternatively or additionally, in the case that a PUSCH transmission among the at least one PUSCH transmission 210 is transmitted in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit.

[0149] It should be understood that SRS resource set(s) in the first one or more SRS resource sets and SRS resource set(s) in the second one or more SRS resource sets may be completely different or partially the same. In some embodiments, the UE 104 may determine one or two SRS resource sets configured for non-SBFD symbols/slots, and one or two SRS resource sets configured for SBFD symbols/slots based on the configuration 204.

[0150] In some embodiments, the term “time unit” may refer to a slot, a sub-slot or one or multiple symbols. One sub-slot may include fewer symbols than one slot. The slot used herein may refer to a normal slot which comprises a predetermined number of symbols and also refer to a sub-slot which comprises fewer symbols than the predetermined number of symbols. Some embodiments of the present disclosure may be illustrated with reference to a slot, but it should be understood that embodiments of the present disclosure may also apply to other time units, such as but not limited to symbols or sub-slots.

[0151] In some implementations, the first one or more SRS resource sets include a first SRS resource set and a second SRS resource set. The second one or more SRS resource sets include a third and a fourth SRS resource set. In other words, two SRS resource sets may be configured for non-SBFD symbols/slots and two SRS resource sets may be configured for SBFD symbols/slots.

[0152] FIG. 3A illustrates an example of a SRS resource set configuration for SBFD symbols/slots and non-SBFD symbols/slots that support PUSCH transmissions in accordance with aspects of the present disclosure. As shown in FIG. 3A, a SRS resource

set #1 301 and a SRS resource set #2 302 are configured for non-SBFD symbols/slots and a SRS resource set #1' 311 and a SRS resource set #2' 312 are configured for SBFD symbols/slots.

[0153] In some implementations, the first one or more SRS resource sets include a first SRS resource set and a second SRS resource set. The second one or more SRS resource sets include one SRS resource set associated with a SBFD time unit format. The one SRS resource set associated with the SBFD time unit format is one of the first and second SRS resource sets. In other words, the one SRS resource set configured for SBFD symbols/slots could be one of the two SRS resource sets configured for non-SBFD symbols/slots. In some embodiments, the one SRS resource set associated with the SBFD time unit format is predefined as the first or second SRS resource set. In other words, which one of the two SRS resource sets configured for non-SBFD symbols/slots may be predefined. For example, the SRS resource set configured for SBFD symbols/slots may be predefined as the first SRS resource set, i.e., the SRS resource set with smaller index, among the two SRS resource sets configured for non-SBFD symbols/slots. Alternatively, the UE 104 may receive, from the base station 102, an indication that the one of the first and second SRS resource sets is the one SRS resource set associated with the SBFD time unit format. For example, which one of the two SRS resource sets configured for non-SBFD symbols/slots may be indicated by a RRC signalling or a DCI scheduling the PUSCH transmission.

[0154] FIG. 3B illustrates another example of a SRS resource set configuration for SBFD symbols/slots and non-SBFD symbols/slots that support PUSCH transmissions in accordance with aspects of the present disclosure. As shown in FIG. 3B, a SRS resource set #1 301 and a SRS resource set #2 302 are configured for non-SBFD symbols/slots and the SRS resource set #1 301 is configured for SBFD symbols/slots.

[0155] In some implementations, when receiving the configuration 204 of the plurality of SRS resource sets, the UE 104 may receive a configuration of two SRS resource sets from the base station 102. One of the two SRS resource sets is associated with the non-SBFD time unit format, and the other one of the two SRS resource sets is associated with the SBFD time unit format.

[0156] FIG. 3C illustrates a further example of a SRS resource set configuration for SBFD symbols/slots and non-SBFD symbols/slots that support PUSCH transmissions in

accordance with aspects of the present disclosure. As shown in FIG. 3C, a SRS resource set #2 302 are configured for non-SBFD symbols/slots and a SRS resource set #1 301 is configured for SBFD symbols/slots.

[0157] In some implementations, the at least one PUSCH transmission 210 across the at least one time unit includes a PUSCH transmission with a plurality of repetitions in a plurality of slots. Alternatively, the at least one PUSCH transmission 210 across the at least one time unit includes a TBoMS transmission. The time domain resource determination for the at least one PUSCH transmission may follow one of the following schemes, but not limited to, PUSCH repetition Type A, PUSCH repetition Type B, enhanced PUSCH repetition Type A or TBOMS.

[0158] In some embodiments, the UE 104 determines the SRS resource set to be applied to each PUSCH transmission of the PUSCH transmissions across different slots including non-SBFD symbols/slots and SBFD symbols/slots.

[0159] For dynamically scheduling PUSCH transmission, if two SRS resource sets are configured for SBFD symbols or non-SBFD symbols, there could be an indicator in the DCI for scheduling the PUSCH transmission to indicate which SRS resource set to apply to the PUSCH in the SBFD or non-SBFD symbols/slots. In some implementations, if there is only one SRS resource set for a slot format, both the first resource set and the second resource set for the slot format refer to the same SRS resource set, i.e., the only one SRS resource set. In some embodiments, the indicator may reuse the SRS resource set indicator field in the DCI for scheduling PUSCH. Alternatively, the indicator may use other bits in the DCI for scheduling PUSCH. Hereinafter, some specific example solutions for applying the SRS resource set to dynamically scheduled PUSCH transmission will be described in detail.

[0160] In a first example solution, the UE 104 may receive an indicator from the base station 102 and determine a respective SRS resource set index associated with each of the at least one time unit based on the indicator. For a PUSCH transmission of the at least one PUSCH transmission 210 in a time unit of the at least one time unit, the UE 104 may determine a respective SRS resource set applied to the PUSCH transmission from the first one or more SRS resource sets or from the second one or more SRS resource sets based on the determined SRS resource set index associated with the time unit and a format of the time unit. For example, if one indicator indicates the SRS resource set index for all

slots and for different slot formats, the UE 104 may determine the SRS resource set for a slot according to the slot format.

[0161] In some implementations, if the format of the time unit is a non-SBFD time unit format, the UE 104 determines the SRS resource set applied to the PUSCH transmission in the time unit to be a SRS resource set among the first one or more SRS resource sets with the SRS resource set index associated with the time unit. If the format of the time unit is a SBFD time unit format, the UE 104 determines the SRS resource set applied to the PUSCH transmission in the time unit to be a SRS resource set among the second one or more SRS resource sets with the SRS resource set index associated with the time unit.

[0162] In some implementations, when determining a respective SRS resource set index associated with each of the at least one time unit, if the indicator has a first value, the UE 104 may associate a first SRS resource set index with each of the at least one time unit. For example, if the indicator has a value of “00”, then the first SRS resource set is indicated. The first SRS resource set of the corresponding slot format is applied to the PUSCH transmission in the slot.

[0163] If the indicator has a second value, the UE 104 may associate a second SRS resource set index with each of the at least one time unit. For example, if the indicator has a value of “01”, the second SRS resource set is indicated. The second SRS resource set of different slot format is applied to the PUSCH repetition in the slot.

[0164] If the indicator has a third value or a fourth value, the UE may determine a respective SRS resource set index associated with each of the at least one time unit based on the number of time units for PUSCH transmissions.

[0165] In some examples, if the indicator has a third value and the at least one time unit includes two time units, then the UE 104 may associate a first SRS resource set index and a second SRS resource set index with a first time unit and a second time unit among the two time units, respectively. For example, if the indicator has a value of “10”, when $K = 2$, the first and second SRS resource sets are applied to the first and second slot of two consecutive slots, respectively. K is the number of PUSCH transmissions for both slot formats.

[0166] If the indicator has a third value, the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a first SRS resource set mapping pattern to the at least three time units. The first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index. For example, if the indicator has a value of “10”, when $K > 2$ and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets are applied to the first and second slot of K consecutive slots, respectively, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots.

[0167] If the indicator has a third value, the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a second SRS resource set mapping pattern to the at least three time units, wherein the second SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes. For example, if the indicator has a value of “10”, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, first SRS resource set is applied to the first and second slots of K consecutive slots, and the second SRS resource set is applied to the third and fourth slot of K consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots.

[0168] If the indicator has a fourth value and the at least one time unit includes two time units, the UE 104 may associate a second SRS resource set index and a first SRS resource set index with a first time unit and a second time unit among the two time units, respectively. For example, if the indicator has a value of “11”, when $K = 2$, the second and first SRS resource set are applied to the first and second slot of two consecutive slots, respectively.

[0169] If the indicator has a fourth value, the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a third SRS resource set mapping pattern to the at least three time units, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index. For example, if the indicator has a value of “11”, when $K > 2$ and *cyclicMapping* in *PUSCH-Config* is enabled, the second and first SRS resource sets are applied to the first and second slot of K consecutive slots,

respectively, and the same SRS resource set mapping pattern continues to the remaining slots of the K consecutive slots.

[0170] If the indicator has a fourth value, the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a fourth SRS resource set mapping pattern to the at least three time units, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes. For example, if the indicator has a value of “11”, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the second SRS resource set is applied to the first and second slot of K consecutive slots, and the first SRS resource set is applied to the third and fourth slot of K consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of the K consecutive slots.

[0171] In some implementations, if the first one or more SRS resource sets or the second one or more SRS set includes one SRS resource set, both a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index correspond to the one SRS resource set. In other words, if there is only one SRS resource set for a slot format, both the first resource set and the second resource set for the slot format indicated by the indicator refer to the same SRS resource set, i.e., the only one SRS resource set.

[0172] FIGS. 4A through 4F illustrate an example of a first implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure. For the purpose of discussion, the example in FIGS. 4A through 4F are shown with reference to the SRS resource set configuration in FIG. 3A. When applied with the SRS resource set configuration in FIG. 3A, the first and second SRS resource set configured for non-SBFD symbols/slots are the SRS resource set #1 301 and the SRS resource set #2 302, respectively; and the first and second SRS resource set configured for SBFD symbols/slots are the SRS resource set #1' 311 and the SRS resource set #2' 312, respectively.

[0173] It should be understood that other SRS resource set configurations are also possible. For example, when applied with the SRS resource set configuration in FIG. 3B, the first and second SRS resource set configured for non-SBFD symbols/slots are the SRS

resource set #1 301 and the SRS resource set #2 302, respectively; and both the first and second SRS resource set configured for SBFD symbols/slots are the SRS resource set #1 301. When applied with the SRS resource set configuration in FIG. 3C, both the first and second SRS resource set configured for non-SBFD symbols/slots are the SRS resource set #2 302; and both the first and second SRS resource set configured for SBFD symbols/slots are the SRS resource set #1 301.

[0174] As shown in FIG. 4A, when the indicator has a value of “00”, the indexes for the four slots are all “1”. The first SRS resource set for SBFD slots is applied to PUSCH transmissions in SBFD slots #1 and #2 and the first SRS resource set for non-SBFD slots is applied to PUSCH transmissions in non-SBFD slots #1 and #2.

[0175] As shown in FIG. 4B, when the indicator has a value of “01”, the indexes for the four slots are all “2”. The second SRS resource set for SBFD slots is applied to PUSCH transmissions in SBFD slots #1 and #2 and the second SRS resource set for non-SBFD slots is applied to PUSCH transmissions in non-SBFD slots #1 and #2.

[0176] As shown in FIG. 4C, when the indicator has a value of “10”, $K > 2$, and *cyclicMapping* in *PUSCH-Config* is enabled, the index pattern is “1212”. The first and second SRS resource sets for SBFD slots are applied to the first and second slots, i.e., SBFD slots #1 and #2, respectively, and the first and second SRS resource sets for non-SBFD slots are applied to the third and fourth slots, i.e., non-SBFD slots #1 and #2, respectively.

[0177] As shown in FIG. 4D, when the indicator has a value of “10”, $K > 2$, and *sequentialMapping* in *PUSCH-Config* is enabled, the index pattern is “1122”. The first SRS resource set for SBFD slots is applied to the first and second slots, i.e., SBFD slots #1 and #2, respectively, and the second SRS resource set for non-SBFD slots are applied to the third and fourth slots, i.e., non-SBFD slots #1 and #2, respectively.

[0178] As shown in FIG. 4E, when the indicator has a value of “11”, $K > 2$, and *cyclicMapping* in *PUSCH-Config* is enabled, the index pattern is “2121”. The second and first SRS resource sets for SBFD slots are applied to the first and second slots, i.e., SBFD slots #1 and #2, respectively, and the second and first SRS resource sets for non-SBFD slots are applied to the third and fourth slots, i.e., non-SBFD slots #1 and #2, respectively.

[0179] As shown in FIG. 4F, when the indicator has a value of “11”, $K > 2$, and *sequentialMapping* in *PUSCH-Config* is enabled, the index pattern is “2211”. The second SRS resource set for SBFD slots is applied to the first and second slots, i.e., SBFD slots #1 and #2, respectively, and the first SRS resource set for non-SBFD slots is applied to the third and fourth slots, i.e., non-SBFD slots #1 and #2, respectively.

[0180] In a second example solution, for one or more PUSCH transmissions in one or more time units with a first time unit format, in the case that one SRS resource set is associated with the first time unit format, the UE 104 may apply the SRS resource set associated with the first time unit format to the one or more PUSCH transmissions in the one or more time units. In the case that more than one SRS resource set is associated with the first time unit format, the UE 104 may determine a respective SRS resource set applied to each of the one or more PUSCH transmissions based on an indicator for the first time unit format. The first time unit format may be a non-SBFD time unit format or a SBFD time unit format.

[0181] In some implementations, the at least one time unit includes first one or more time units with the non-SBFD time unit format and second one or more time units with the SBFD time unit format. In some scenarios, if the PUSCH transmissions are transmitted in only one SBFD time unit format, the UE may determine the SRS resource set to be applied to the PUSCH transmissions as in FIG. 1F.

[0182] For example, the UE may determine a SRS resource set pattern per slot format based on an indicator for that slot format. In some implementations, the UE 104 may receive, from the base station 102, one indicator for the non-SBFD time unit format and the SBFD time unit format. For example, the indicator may have 2 bits and may be used for SRS resource set indication for both slot formats. Alternatively, the UE 104 may receive, from the base station 102, at least one of a first indicator for the non-SBFD time unit format or a second indicator for the SBFD time unit format. For example, the UE 104 may receive, from the base station 102, the first indicator for the non-SBFD time unit format if the first one or more SRS resource sets include more than one SRS resource set associated with the non-SBFD time unit format. The UE 104 may receive, from the base station 102, the second indicator for the SBFD time unit format if the second one or more SRS resource sets include more than one SRS resource set associated with the SBFD time unit format. In other words, the indicator may have 4 bits, wherein 2 bits are for SBFD

slots and 2 bits are for non-SBFD slots. If there is only one SRS resource set for a slot format, if there is only one SRS resource set for a slot format, both the first resource set and the second resource set for the slot format refer to the same SRS resource set, i.e., the only one SRS resource set. And no indication bit is needed for that slot format.

[0183] In some implementations, when determining a respective SRS resource set applied to each of the one or more PUSCH transmissions based on an indicator for the first time unit format, if the indicator for the first time unit format has a first value, the UE 104 may apply a SRS resource set with a first SRS resource set index to each of the one or more PUSCH transmission. For example, if the indicator for SBFD slot format has a value of “00”, then the first SRS resource set of SBFD symbol is applied to the PUSCH repetition in a SBFD slot; if the indicator for non-SBFD slot format has a value of “00”, then the first SRS resource set of non-SBFD symbol is applied to the PUSCH repetition in a non- SBFD slot.

[0184] If the indicator for the first time unit format has a second value, the UE 104 may apply a SRS resource set with a second SRS resource set index to each of the one or more PUSCH transmission. For example, if the indicator for SBFD slot format has a value of “01”, then the second SRS resource set of SBFD symbol is applied to the PUSCH repetition in a SBFD slot; if the indicator for non-SBFD slot format has a value of “01”, then the second SRS resource set of non-SBFD symbol is applied to the PUSCH repetition in a non- SBFD slot.

[0185] If the indicator for the first time unit format has a third value or a fourth value, the UE may apply a respective SRS resource set to a PUSCH transmission in a time unit with the first time unit format based on the number of time units with the first time unit format.

[0186] In some examples, if the indicator for the first time unit format has a third value and the one or more time units with the first time unit format include one time unit, the UE 104 may apply a SRS resource set with a first SRS resource set index or second SRS resource set index to the one or more PUSCH transmissions. For example, if the indicator for the first slot format has a value of “10”, when the number K of repetitions for the first slot format equals to 1, the first SRS resource set for the first slot format may be applied to the slot. Alternatively, if the indicator for the first slot format has a value

of “10”, when the number K of repetitions for the first slot format equals to 1, the second SRS resource set for the first slot format may be applied to the slot.

[0187] In some examples, if the indicator for the first time unit format has a third value and the one or more time units with the first time unit format include two time units, the UE 104 may apply a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively. For example, if the indicator for the first slot format has a value of “10”, when $K = 2$, the first and second SRS resource sets for the first slot format are applied to the first and second slot of 2 consecutive slots, respectively.

[0188] In some examples, if the indicator for the first time unit format has a third value, the one or more time units with the first time unit format include at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a first SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index. For example, if the indicator for the first slot format has a value of “10”, when $K > 2$ and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets for the first slot format are applied to the first and second slot of K consecutive slots (with the same slot format), respectively, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots (with the same slot format).

[0189] In some examples, if the indicator for the first time unit format has a third value, the one or more time units with the first time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a second SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes. For example, if the indicator for the first slot format has a value of “10”, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the first SRS resource set for the first slot format is applied to the first and second slots of K consecutive slots, and the second SRS resource set for the first slot format is applied to the third and fourth slot of K

consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots (with the same slot format).

[0190] In some examples, if the indicator for the first time unit format has a third value, the one or more time units with the first time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may apply a SRS resource set with a first SRS resource set index to a first half of the one or more PUSCH transmissions and apply a SRS resource set with a second SRS resource set index to a second half of the one or more PUSCH transmissions. For example, if the indicator for the first slot format has a value of “10”, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the first SRS resource set may be applied to the first $K/2 + \text{mod}(K/2)$ consecutive slots, and the second SRS resource set for the first slot format is applied to the last $K/2$ slots. Alternatively, the invalid slots may be counted in K , where K is the total repetition number of PUSCH. Then method may be the same as in legacy.

[0191] In some examples, if the indicator for the first time unit format has a fourth value and the one or more time units with the first time unit format include one time unit, the UE 104 may apply a SRS resource set with a second SRS resource set index to the one or more PUSCH transmissions.

[0192] In some examples, if the indicator for the first time unit format has a fourth value and the one or more time units with the first time unit format include two time units, the UE 104 may apply a SRS resource set with a second SRS resource set index and a SRS resource set with a first SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively.

[0193] In some examples, if the indicator for the first time unit format has a fourth value, the one or more time units with the first time unit format include at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a third SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index.

[0194] In some examples, if the indicator for the first time unit format has a fourth value, the one or more time units with the first time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a fourth SRS resource set mapping pattern to the one or more PUSCH transmissions,

wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0195] In some examples, if the indicator for the first time unit format has a fourth value, the one or more time units with the first time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may apply a SRS resource set with a second SRS resource set index to a first half of the one or more PUSCH transmissions and apply a SRS resource set with a first SRS resource set index to a second half of the one or more PUSCH transmissions. For example, if the indicator for the first slot format has a value of “11”, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the second SRS resource set may be applied to the first $K/2 + \text{mod}(K/2)$ consecutive slots, and the first SRS resource set for the first slot format is applied to the last $K/2$ slots. Alternatively, the invalid slots may be counted in K , where K is the total repetition number of PUSCH. Then method may be the same as in legacy.

[0196] FIGS. 5A through 5E illustrate an example of a second implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure. For the purpose of discussion, the example in FIGS. 5A through 5E are shown with reference to the SRS resource set configuration in FIG. 3A. When applied with the SRS resource set configuration in FIG. 3A, the first and second SRS resource set configured for non-SBFD symbols/slots are the SRS resource set #1 301 and the SRS resource set #2 302, respectively; and the first and second SRS resource set configured for SBFD symbols/slots are the SRS resource set #1' 311 and the SRS resource set #2' 312, respectively. The resource set indications for SBFD slot format and non-SBFD slot format may be the same or different.

[0197] It should be understood that other SRS resource set configurations are also possible. For example, when applied with the SRS resource set configuration in FIG. 3B, the first and second SRS resource set configured for non-SBFD symbols/slots are the SRS resource set #1 301 and the SRS resource set #2 302, respectively; and both the first and second SRS resource set configured for SBFD symbols/slots are the SRS resource set #1 301. No indication bit is needed for SBFD slot format in the SRS resource set configuration in FIG. 3B.

[0198] As shown in FIG. 5A, when the indicator for SBFD slot format has a value of “00”, the first SRS resource set of SBFD symbol is applied to PUSCH transmission in SBFD slots #1 and #2. When the indicator for non-SBFD slot format has a value of “00”, the first SRS resource set of non-SBFD symbol is applied to PUSCH transmission in non-SBFD slots #1 and #2.

[0199] As shown in FIG. 5B, when the indicator for SBFD slot format has a value of “01”, the second SRS resource set of SBFD symbol is applied to PUSCH transmission in SBFD slots #1 and #2. When the indicator for non-SBFD slot format has a value of “01”, the second SRS resource set of non-SBFD symbol is applied to PUSCH transmission in non-SBFD slots #1 and #2.

[0200] As shown in FIG. 5C, when the indicator for SBFD slot format has a value of “10” and the number K of repetitions for SBFD slot format equals to 2, the first and second SRS resource sets for SBFD symbol are applied to PUSCH transmission in SBFD slots #1 and #2, respectively. When the indicator for non-SBFD slot format has a value of “10” and the number K of repetitions for non-SBFD slot format equals to 2, the first and second SRS resource sets for non-SBFD symbol are applied to PUSCH transmission in non-SBFD slots #1 and #2, respectively.

[0201] As shown in FIG. 5D, when the indicator for SBFD slot format has a value of “10” and $K > 2$ for SBFD slot format and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets for the first slot format are applied to the SBFD slots #1 and #2, respectively, and the same SRS resource set mapping pattern continues to the remaining slots (e.g., SBFD slot #3 in FIG. 5C) of K consecutive slots. When the indicator for SBFD slot format has a value of “10” and $K = 1$ for non-SBFD slot format, the first second SRS resource set for non-SBFD symbol is applied to PUSCH transmission in non-SBFD slot #1.

[0202] As shown in FIG. 5E, when the indicator for SBFD slot format has a value of “10” and $K > 2$ for SBFD slot format and *sequentialMapping* in *PUSCH-Config* is enabled, the first SRS resource set for the first slot format is applied to the SBFD slots #1 and #2, and the second SRS resource set for the first slot format is applied to PUSCH transmission in SBFD slot #3.

[0203] In a third example solution, the UE 104 may determine one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second

one or more SRS resource sets; and determine a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on a format of a time unit for the PUSCH transmission. For example, the UE does not expect the number of total SRS resource sets for all slot formats indicated by the base station exceeds 2. The UE 104 may determine one SRS resource set per slot format for PUSCH transmission, then determine the SRS resource set associated with a PUSCH transmission in a slot according to the slot format.

[0204] In some implementations, when determining a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on a format of a time unit for the PUSCH transmission, if the time unit for the PUSCH transmission is a SBFD time unit, the UE 104 may apply the SRS resource set associated with the SBFD time unit format to the PUSCH transmission. If the time unit for the PUSCH transmission is a non-SBFD time unit, the UE 104 may apply the SRS resource set associated with the non-SBFD time unit format to the PUSCH transmission.

[0205] In some implementations, the at least one time unit includes first one or more time units with the non-SBFD time unit format and second one or more time units with the SBFD time unit format. In some scenarios, if the PUSCH transmissions are transmitted in only one SBFD time unit format, the UE may determine the SRS resource set to be applied to the PUSCH transmissions as in FIG. 1F.

[0206] In some implementations, one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets are determined a predefinition. In other words, which one SRS resource set to used for the transmission for each slot format may be defined.

[0207] Alternatively, one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets are determined based on an indicator received from the base station 102. The indicator indicates which one SRS resource set from the first one or more SRS resource sets and which one SRS resource set from the second one or more SRS resource sets are used.

[0208] For example, there could be an indicator in the DCI for scheduling PUSCH to indicate which one SRS resource set for each slot format is used for the transmission. In some implementations, if only one SRS resource set is configured for SBFD symbols or

non SBFD symbols, the indicator could be 1 bit to indicate which SRS resource set is used for the other slot format.

[0209] In some implementations, the first one or more SRS resource sets include two SRS resource sets associated with the non-SBFD time unit format, and the second one or more SRS resource sets include two SRS resource sets associated with the SBFD time unit format, and the third indicator includes two bits.

[0210] For example, if two SRS resource sets are configured for SBFD symbols and two SRS resource sets are configured for non SBFD symbols, the indicator could be two bits. The indicator may indicate the corresponding SRS resource set using one bit for each slot format. Alternatively, the indicator may jointly indicate the SRS resource sets for the two slot formats. The indicator could reuse the SRS resource set indicator field in the DCI for scheduling PUSCH.

[0211] FIGS. 6A through 6D illustrate an example of a third implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure. For the purpose of discussion, the example in FIGS. 6A through 6D are shown with reference to the SRS resource set configuration in FIG. 3A. When applied with the SRS resource set configuration in FIG. 3A, the first and second SRS resource set configured for non-SBFD symbols/slots are the SRS resource set #1 301 and the SRS resource set #2 302, respectively; and the first and second SRS resource set configured for SBFD symbols/slots are the SRS resource set #1' 311 and the SRS resource set #2' 312, respectively. Two bits are used to indicate which among the SRS resource set #1 301 and the SRS resource set #2 302 is to be used for PUSCH transmission in the non-SBFD slots and which among the SRS resource set #1' 311 and the SRS resource set #2' 312 is to be used for PUSCH transmission in the SBFD slots

[0212] It should be understood that other SRS resource set configurations are also possible. For example, when applied with the SRS resource set configuration in FIG. 3B, the first and second SRS resource set configured for non-SBFD symbols/slots are the SRS resource set #1 301 and the SRS resource set #2 302, respectively; and both the first and second SRS resource set configured for SBFD symbols/slots are the SRS resource set #1 301. Only one bit is needed to indicate which among the SRS resource set #1 301 and the SRS resource set #2 302 is to be used for PUSCH transmission in the non-SBFD slots.

[0213] As shown in FIG. 6A, the indicator may have a value of “00” to choose set #1 for both slot formats. In FIG. 6B, the indicator may have a value of “01” to choose set #2 for both slot formats. In FIG. 6C, the indicator may have a value of “10” to choose set #1 for SBFD slots and choose set #2 for non-SBFD slots. In FIG. 6D, the indicator may have a value of “11” to choose set #2 for SBFD slots and choose set #1 for non-SBFD slots.

[0214] In a fourth example solution, the UE 104 may determine a time unit format from the non-SBFD time unit format and the SBFD time unit format to be used for PUSCH transmission.

[0215] For one or more PUSCH transmissions in one or more time units with a determined time unit format, in the case that one SRS resource set is associated with the determined time unit format, the UE 104 may apply the SRS resource set associated with the determined time unit format to the one or more PUSCH transmissions in the one or more time units. In the case that more than one SRS resource set is associated with the determined time unit format, the UE 104 may determine a respective SRS resource set applied to each of the one or more PUSCH transmissions based on an indicator for the determined time unit format. In other words, only one time unit format could be used for PUSCH transmission, then only the SRS resource set for that time unit format could be used for transmission.

[0216] In some implementations, the at least one time unit includes first one or more time units with the non-SBFD time unit format and second one or more time units with the SBFD time unit format. In some scenarios, if the PUSCH transmissions are transmitted in only one SBFD time unit format, the UE may determine the SRS resource set to be applied to the PUSCH transmissions as in FIG. 1F.

[0217] In some implementations, the time unit format for PUSCH transmission may be determined based on a format of a first time unit for a first PUSCH transmission in time domain among the at least one PUSCH transmission 210. For example, the UE may determine the slot format for PUSCH transmission based on the format of the first slot for the first transmission. Alternatively, the time unit format for PUSCH transmission may be determined based on a pre-definition as a SBFD time unit format or a non-SBFD time unit format.

[0218] Alternatively, the time unit format for PUSCH transmission may be determined based on a configuration from the base station 102. For example, the time unit format for PUSCH transmission may be configured by a RRC signaling. In another example, the DCI for scheduling PUSCH may comprise an indication to indicate which slot format could be used for transmission. For example, if the indication has a bit value of 0, the non-SBFD slot format may be used for PUSCH transmission; if indication has a bit value of 1, the SBFD slot format may be used for PUSCH transmission.

[0219] In some embodiments, a respective SRS resource set applied to each of the one or more PUSCH transmissions may be determined based on an indicator for the determined time unit format. For example, the UE 104 may receive, from the base station 102, an indicator for the determined time unit format if there are more than one SRS resource set associated with the determined time unit format. If there is only one SRS resource set for the first slot format, both the first resource set and the second resource set for the determined time unit format refer to the same SRS resource set, i.e., the only one SRS resource set. And no indication bit is needed for the determined time unit format.

[0220] In some implementations, when determining a respective SRS resource set applied to each of the one or more PUSCH transmissions based on an indicator for the determined time unit format, if the indicator for the determined time unit format has a first value, the UE 104 may apply a SRS resource set with a first SRS resource set index to each of the one or more PUSCH transmission. For example, if the indicator for the determined time unit format has a value of “00” and the determined time unit format is SBFD slot format, then the first SRS resource set of SBFD symbol is applied to the PUSCH repetition in a SBFD slot; if the indicator for non-SBFD slot format has a value of “00” and the determined time unit format is non-SBFD slot format, then the first SRS resource set of non-SBFD symbol is applied to the PUSCH repetition in a non- SBFD slot.

[0221] If the indicator for the determined time unit format has a second value, the UE 104 may apply a SRS resource set with a second SRS resource set index to each of the one or more PUSCH transmission. For example, if the indicator for the determined time unit format has a value of “01” and the determined time unit format is SBFD slot format, then the second SRS resource set of SBFD symbol is applied to the PUSCH repetition in a SBFD slot; if the indicator for the determined time unit format has a value of “01” and

the determined time unit format is non-SBFD slot format, then the second SRS resource set of non-SBFD symbol is applied to the PUSCH repetition in a non- SBFD slot.

[0222] If the indicator for the determined time unit format has a third value or a fourth value, the UE may apply a respective SRS resource set to a PUSCH transmission in a time unit with the determined time unit format based on the number of time units with the determined time unit format.

[0223] In some examples, if the indicator for the determined time unit format has a third value and the one or more time units with the determined time unit format include one time unit, the UE 104 may apply a SRS resource set with a first SRS resource set index or second SRS resource set index to the one or more PUSCH transmissions. For example, if the indicator for the first slot format has a value of “10”, when the number K of repetitions for the first slot format equals to 1, the first SRS resource set for the first slot format may be applied to the slot. Alternatively, if the indicator for the first slot format has a value of “10”, when the number K of repetitions for the first slot format equals to 1, the second SRS resource set for the first slot format may be applied to the slot.

[0224] In some examples, if the indicator for the determined time unit format has a third value and the one or more time units with the determined time unit format include two time units, the UE 104 may apply a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively. For example, if the indicator for the first slot format has a value of “10”, when $K = 2$, the first and second SRS resource sets for the first slot format are applied to the first and second slot of 2 consecutive slots, respectively.

[0225] In some examples, if the indicator for the determined time unit format has a third value, the one or more time units with the determined time unit format include at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a first SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index. For example, if the indicator for the first slot format has a value of “10”, when $K > 2$ and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets for the first slot format

are applied to the first and second slot of K consecutive slots (with the same slot format), respectively, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots (with the same slot format).

[0226] In some examples, if the indicator for the determined time unit format has a third value, the one or more time units with the determined time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a second SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes. For example, if the indicator for the first slot format has a value of “10”, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the first SRS resource set for the first slot format is applied to the first and second slots of K consecutive slots, and the second SRS resource set for the first slot format is applied to the third and fourth slot of K consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots (with the same slot format).

[0227] In some examples, if the indicator for the determined time unit format has a third value, the one or more time units with the determined time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may apply a SRS resource set with a first SRS resource set index to a first half of the one or more PUSCH transmissions and apply a SRS resource set with a second SRS resource set index to a second half of the one or more PUSCH transmissions. For example, if the indicator for the first slot format has a value of “10”, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the first SRS resource set may be applied to the first $K/2 + \text{mod}(K/2)$ consecutive slots, and the second SRS resource set for the first slot format is applied to the last $K/2$ slots. Alternatively, the invalid slots may be counted in K , where K is the total repetition number of PUSCH. Then method may be the same as in legacy.

[0228] In some examples, if the indicator for the determined time unit format has a fourth value and the one or more time units with the determined time unit format include one time unit, the UE 104 may apply a SRS resource set with a second SRS resource set index to the one or more PUSCH transmissions.

[0229] In some examples, if the indicator for the determined time unit format has a fourth value and the one or more time units with the determined time unit format include

two time units, the UE 104 may apply a SRS resource set with a second SRS resource set index and a SRS resource set with a first SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively.

[0230] In some examples, if the indicator for the determined time unit format has a fourth value, the one or more time units with the determined time unit format include at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a third SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index.

[0231] In some examples, if the indicator for the determined time unit format has a fourth value, the one or more time units with the determined time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a fourth SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0232] In some examples, if the indicator for the determined time unit format has a fourth value, the one or more time units with the determined time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may apply a SRS resource set with a second SRS resource set index to a first half of the one or more PUSCH transmissions and apply a SRS resource set with a first SRS resource set index to a second half of the one or more PUSCH transmissions.

[0233] FIGS. 7A through 7D illustrate an example of a fourth implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure. For the purpose of discussion, the example in FIGS. 7A through 7D are shown with reference to the SRS resource set configuration in FIG. 3A. When applied with the SRS resource set configuration in FIG. 3A, the first and second SRS resource set configured for non-SBFD symbols/slots are the SRS resource set #1 301 and the SRS resource set #2 302, respectively; and the first and second SRS resource set configured for SBFD symbols/slots are the SRS resource set #1' 311 and the SRS resource set #2' 312, respectively.

[0234] It should be understood that other SRS resource set configurations are also possible. For example, when applied with the SRS resource set configuration in FIG. 3B, the first and second SRS resource set configured for non-SBFD symbols/slots are the SRS resource set #1 301 and the SRS resource set #2 302, respectively; and both the first and second SRS resource set configured for SBFD symbols/slots are the SRS resource set #1 301. No indication bit is needed for SBFD slot format in the SRS resource set configuration in FIG. 3B.

[0235] For the purpose of discussion, in the example of FIGS. 7A through 7D, the SBFD slot format is determined as the slot format for PUSCH transmission. The SRS resource set to be applied to each PUSCH transmission in SBFD slots may be determined based on an indicator. The indicator may reuse the SRS resource set indicator field in the DCI for scheduling PUSCH. As shown in FIG. 7A, when the indicator has a value of “00”, the first SRS resource set of SBFD symbol is applied to PUSCH transmission in SBFD slots #1 and #2. No PUSCH transmission is transmitted in non-SBFD slots #1 and #2.

[0236] As shown in FIG. 7B, when the indicator has a value of “01”, the second SRS resource set of SBFD symbol is applied to PUSCH transmission in SBFD slots #1 and #2. No PUSCH transmission is transmitted in non-SBFD slots #1 and #2.

[0237] As shown in FIG. 7C, when the indicator has a value of “10” and the number K of repetitions equals to 2, the first and second SRS resource sets for SBFD symbol are applied to PUSCH transmission in SBFD slots #1 and #2, respectively. No PUSCH transmission is transmitted in non-SBFD slots #1 and #2.

[0238] As shown in FIG. 7D, when the indicator has a value of “11” and the number K of repetitions equals to 2, the second and first SRS resource sets for SBFD symbol are applied to PUSCH transmission in SBFD slots #1 and #2, respectively. No PUSCH transmission is transmitted in non-SBFD slots #1 and #2.

[0239] In a fifth example solution, the UE 104 may receive, from the base station 102, an indication of one or more SRS resource sets among the plurality of SRS resource sets; and determine a respective SRS resource set applied to each of the at least one PUSCH transmission 210 from the one or more SRS resource sets based on an indicator from the base station 102. In other words, the UE may receive an indication indicating which SRS resource set combination could be used for transmission. For each combination, there

could be only at most two SRS resource sets. If the indicated SRS resource set combination only includes SRS resource set for one slot format, the PUSCH could not be transmitted in the other slot format.

[0240] In some implementations, the UE 104 may receive an indicator from the base station 102; and determine a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on the indicator.

[0241] In some implementations, when determining a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on the indicator, if the indicator has a first value, the UE 104 may apply a SRS resource set with a first SRS resource set index to each of the at least one PUSCH transmission 210. For example, if the indicator has a value of “00”, then the first SRS resource set among the two selected SRS resource sets may be applied to PUSCH transmission.

[0242] If the indicator has a second value, the UE 104 may apply a SRS resource set with a second SRS resource set index to each of the at least one PUSCH transmission 210. For example, if the indicator has a value of “00”, then the second SRS resource set among the two selected SRS resource sets may be applied to PUSCH transmission.

[0243] If the indicator has a third value and the at least one time unit includes two time units, the UE 104 may apply a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the at least one PUSCH transmission 210, respectively.

[0244] If the indicator has a third value, the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a first SRS resource set mapping pattern to the at least one PUSCH transmission 210, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index.

[0245] If the indicator has a third value, the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a second SRS resource set mapping pattern to the at least one PUSCH transmission 210, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes.

[0246] If the indicator has a fourth value and the at least one time unit includes two time units, the UE 104 may apply a SRS resource set with a second SRS resource set index and a SRS resource set with a first SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the at least one PUSCH transmission 210, respectively.

[0247] If the indicator has a fourth value, the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a third SRS resource set mapping pattern to the at least one PUSCH transmission 210, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index.

[0248] If the indicator has a fourth value, the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a fourth SRS resource set mapping pattern to the at least one PUSCH transmission 210, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0249] In some implementations, if the determined SRS resource set applied to the PUSCH transmission is not associated with a format of the time unit, the UE 104 may omit a PUSCH transmission among the at least one PUSCH transmission 210 in a time unit among the at least one time unit.

[0250] FIGS. 8A through 8E illustrate an example of a fifth implementation of applying SRS resource sets to dynamically scheduled PUSCH transmissions across SBFD symbols/slots and non-SBFD symbols/slots in accordance with aspects of the present disclosure. For the purpose of discussion, the example in FIGS. 8A through 8E are shown with reference to the SRS resource set configuration in FIG. 3A. It should be understood that other SRS resource set configurations are also possible.

[0251] As shown in FIG. 8A, the SRS resource set #1 301 and the SRS resource set #2' 312 are selected for PUSCH transmission. The SRS resource set #1 301 may be associated with a resource set index "1" and the SRS resource set #2' 312 may be associated with a resource set index "2".

[0252] As shown in FIG. 8B, when the indicator has a value of "00", the indexes for the four slots are all "1". The PUSCH transmissions in SBFD slots #1 and #2 are omitted

and the SRS resource set #1 301 is applied to PUSCH transmissions in non-SBFD slots #1 and #2.

[0253] As shown in FIG. 8C, when the indicator has a value of “01”, the indexes for the four slots are all “2”. The SRS resource set #2’ 312 is applied to PUSCH transmissions in SBFD slots #1 and #2 and the PUSCH transmissions in non-SBFD slots #1 and #2 are omitted.

[0254] As shown in FIG. 8D, when the indicator has a value of “11”, $K > 2$, and *sequentialMapping* in *PUSCH-Config* is enabled, the index pattern is “2211”. The SRS resource set #2’ 312 is applied to the first and second slots, i.e., SBFD slots #1 and #2, respectively, and the SRS resource set #1 301 is applied to the third and fourth slots, i.e., non-SBFD slots #1 and #2, respectively.

[0255] As shown in FIG. 8E, when the indicator has a value of “11”, $K > 2$, and *cyclicMapping* in *PUSCH-Config* is enabled, the index pattern is “2121”. The SRS resource set #2’ 312 and the SRS resource set #1 301 are applied to SBFD slots #1 and #4, respectively, and the PUSCH transmissions in non-SBFD slots #2 and #3 are omitted.

[0256] In a sixth example solution, when receiving the configuration 204, the UE 104 may receive, from the base station 102, a configuration of two SRS resource sets, wherein one of the two SRS resource sets is associated with the non-SBFD time unit format, and the other one of the two SRS resource sets is associated with the SBFD time unit format. The UE 104 may determine a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on a format of a time unit for the PUSCH transmission. For example, if one SRS resource set is configured for SBFD symbol and the other one SRS resource set is configured for non-SBFD symbol, there is no need for SRS resource set indication in the DCI for scheduling PUSCH (e.g., the SRS resource set indicator in the DCI could be 0 bits), the SRS resource set applied to a PUSCH transmission could be determined based on the slot format for the PUSCH transmission.

[0257] In some implementations, when determining a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on a format of a time unit for the PUSCH transmission, if the time unit for the PUSCH transmission is a SBFD time unit, the UE 104 may apply the SRS resource set associated with the SBFD time unit format to the PUSCH transmission. If the time unit for the PUSCH transmission is a non-

SBFD time unit, the UE 104 may apply the SRS resource set associated with the non-SBFD time unit format to the PUSCH transmission.

[0258] In a seventh example solution, when receiving the configuration 204, the UE 104 may receive, from the base station 102, a configuration of two SRS resource sets, wherein one of the two SRS resource sets is associated with the non-SBFD time unit format, and the other one of the two SRS resource sets is associated with the SBFD time unit format. The UE 104 may receive an indicator from the base station 102; and determine a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on the indicator. For example, if one SRS resource set is configured for SBFD symbol and the other one SRS resource set is configured for non-SBFD symbol, the UE 104 may determine the SRS resource set applied to PUSCH transmission from the SRS resource set for SBFD symbol and the SRS resource set for non-SBFD symbol based on the indicator and the slot format.

[0259] In some implementations, when determining a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on the indicator, if the indicator has a first value, the UE 104 may apply a SRS resource set with a first SRS resource set index to each of the at least one PUSCH transmission 210. For example, if the indicator has a value of "00", then the first SRS resource set among the two selected SRS resource sets may be applied to PUSCH transmissions.

[0260] If the indicator has a second value, the UE 104 may apply a SRS resource set with a second SRS resource set index to each of the at least one PUSCH transmission 210. For example, if the indicator has a value of "01", then the second SRS resource set among the two selected SRS resource sets may be applied to PUSCH transmission.

[0261] If the indicator has a third value and the at least one time unit includes two time units, the UE 104 may apply a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the at least one PUSCH transmission 210, respectively.

[0262] If the indicator has a third value, the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a first SRS resource set mapping pattern to the at least one PUSCH

transmission 210, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index.

[0263] If the indicator has a third value, the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a second SRS resource set mapping pattern to the at least one PUSCH transmission 210, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes.

[0264] If the indicator has a fourth value and the at least one time unit includes two time units, the UE 104 may apply a SRS resource set with a second SRS resource set index and a SRS resource set with a first SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the at least one PUSCH transmission 210, respectively.

[0265] If the indicator has a fourth value, the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a third SRS resource set mapping pattern to the at least one PUSCH transmission 210, wherein the third SRS resource set mapping pattern includes one second SRS resource set index followed by one first SRS resource set index.

[0266] If the indicator has a fourth value, the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a fourth SRS resource set mapping pattern to the at least one PUSCH transmission 210, wherein the fourth SRS resource set mapping pattern includes two second SRS resource set indexes followed by two first SRS resource set indexes.

[0267] In some implementations, if the determined SRS resource set applied to the PUSCH transmission is not associated with a format of the time unit, the UE 104 may omit a PUSCH transmission among the at least one PUSCH transmission 210 in a time unit among the at least one time unit.

[0268] Hereinafter, some specific example solutions for applying the SRS resource set to CG PUSCH transmission will be described in detail.

[0269] In a first example solution, the UE 104 may determine a time unit format from the non-SBFD time unit format and the SBFD time unit format to be used for PUSCH transmission.

[0270] For one or more PUSCH transmissions in one or more time units with a determined time unit format, in the case that one SRS resource set is associated with the determined time unit format, the UE 104 may apply the SRS resource set associated with the determined time unit format to the one or more PUSCH transmissions in the one or more time units. In the case that more than one SRS resource set is associated with the determined time unit format, the UE 104 may determine a respective SRS resource set applied to each of the one or more PUSCH transmissions. In other words, only one time unit format could be used for PUSCH transmission, then only the SRS resource set for that time unit format could be used for transmission and the PUSCH transmission in the other slot format is omitted. If there is only one SRS resource set for the first slot format, both the first resource set and the second resource set for the determined time unit format refer to the same SRS resource set, i.e., the only one SRS resource set.

[0271] In some implementations, when determining a respective SRS resource set applied to each of the one or more PUSCH transmissions, the UE may apply a respective SRS resource set to a PUSCH transmission in a time unit with the determined time unit format based on the number of time units with the determined time unit format.

[0272] In some examples, if the one or more time units with the determined time unit format include one time unit, the UE 104 may apply a SRS resource set with a first SRS resource set index or second SRS resource set index to the one or more PUSCH transmissions. For example, when the number K of repetitions for the first slot format equals to 1, the first SRS resource set for the first slot format may be applied to the slot. Alternatively, when the number K of repetitions for the first slot format equals to 1, the second SRS resource set for the first slot format may be applied to the slot.

[0273] In some examples, if the one or more time units with the determined time unit format include two time units, the UE 104 may apply a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively. For example, when $K = 2$, the first and second SRS resource sets for the first slot format are applied to the first and second slot of 2 consecutive slots, respectively.

[0274] In some examples, if the one or more time units with the determined time unit format include at least three time units, and a cyclic mapping for PUSCH is enabled, then

the UE 104 may repeatedly apply a first SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index. For example, when $K > 2$ and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets for the first slot format are applied to the first and second slot of K consecutive slots (with the same slot format), respectively, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots (with the same slot format).

[0275] In some examples, if the one or more time units with the determined time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a second SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes. For example, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the first SRS resource set for the first slot format is applied to the first and second slots of K consecutive slots, and the second SRS resource set for the first slot format is applied to the third and fourth slot of K consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots (with the same slot format).

[0276] In some examples, if the one or more time units with the determined time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may apply a SRS resource set with a first SRS resource set index to a first half of the one or more PUSCH transmissions and apply a SRS resource set with a second SRS resource set index to a second half of the one or more PUSCH transmissions. For example, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the first SRS resource set may be applied to the first $K/2 + \text{mod}(K/2)$ consecutive slots, and the second SRS resource set for the first slot format is applied to the last $K/2$ slots. Alternatively, the invalid slots may be counted in K , where K is the total repetition number of PUSCH. Then method may be the same as in legacy.

[0277] In some implementations, the time unit format for PUSCH transmission may be determined based on a format of a first time unit for a first PUSCH transmission in time domain among the at least one PUSCH transmission 210. For example, the UE may determine the slot format for PUSCH transmission based on the format of the first slot

for the first transmission. Alternatively, the time unit format for PUSCH transmission may be determined based on a pre-definition as a SBFD time unit format or a non-SBFD time unit format. Alternatively, the time unit format for PUSCH transmission may be determined based on a configuration from the base station 102. For example, the time unit format for PUSCH transmission may be configured by a RRC signaling.

[0278] In a second example solution, for one or more PUSCH transmissions in one or more time units with a first time unit format, in the case that one SRS resource set is associated with the first time unit format, the UE 104 may apply the SRS resource set associated with the first time unit format to the one or more PUSCH transmissions in the one or more time units. In the case that more than one SRS resource set is associated with the first time unit format, the UE 104 may determine a respective SRS resource set applied to each of the one or more PUSCH transmissions. The first time unit format may be a non-SBFD time unit format or a SBFD time unit format. In other words, the UE may determine a SRS resource set pattern per slot format.

[0279] In some implementations, the at least one time unit includes first one or more time units with the non-SBFD time unit format and second one or more time units with the SBFD time unit format. In some scenarios, if the PUSCH transmissions are transmitted in only one SBFD time unit format, both the two SRS resource sets may be used.

[0280] In some examples, if the one or more time units with the first time unit format include one time unit, the UE 104 may apply a SRS resource set with a first SRS resource set index or second SRS resource set index to the one or more PUSCH transmissions. For example, when the number K of repetitions for the first slot format equals to 1, the first SRS resource set for the first slot format may be applied to the slot. Alternatively, when the number K of repetitions for the first slot format equals to 1, the second SRS resource set for the first slot format may be applied to the slot.

[0281] In some examples, if the one or more time units with the first time unit format include two time units, the UE 104 may apply a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively. For example, when $K = 2$, the first and second SRS resource

sets for the first slot format are applied to the first and second slot of 2 consecutive slots, respectively.

[0282] In some examples, if the one or more time units with the first time unit format include at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a first SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index. For example, when $K > 2$ and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets for the first slot format are applied to the first and second slot of K consecutive slots (with the same slot format), respectively, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots (with the same slot format).

[0283] In some examples, if the one or more time units with the first time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a second SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes. For example, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the first SRS resource set for the first slot format is applied to the first and second slots of K consecutive slots, and the second SRS resource set for the first slot format is applied to the third and fourth slot of K consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots (with the same slot format).

[0284] In some examples, if the one or more time units with the first time unit format include at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may apply a SRS resource set with a first SRS resource set index to a first half of the one or more PUSCH transmissions and apply a SRS resource set with a second SRS resource set index to a second half of the one or more PUSCH transmissions. For example, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, the first SRS resource set may be applied to the first $K/2 + \text{mod}(K/2)$ consecutive slots, and the second SRS resource set for the first slot format is applied to the last $K/2$ slots. Alternatively, the invalid slots may be counted in K , where K is the total repetition number of PUSCH. Then method may be the same as in legacy.

[0285] In a third example solution, the UE 104 may determine a respective SRS resource set index associated with each of the at least one time unit. For a PUSCH transmission of the at least one PUSCH transmission 210 in a time unit of the at least one time unit, the UE 104 may determine a respective SRS resource set applied to the PUSCH transmission from the first one or more SRS resource sets or from the second one or more SRS resource sets based on the determined SRS resource set index associated with the time unit and a format of the time unit.

[0286] In some implementations, if the format of the time unit is a non-SBFD time unit format, the UE 104 determines the SRS resource set applied to the PUSCH transmission in the time unit to be a SRS resource set among the first one or more SRS resource sets with the SRS resource set index associated with the time unit. If the format of the time unit is a SBFD time unit format, the UE 104 determines the SRS resource set applied to the PUSCH transmission in the time unit to be a SRS resource set among the second one or more SRS resource sets with the SRS resource set index associated with the time unit.

[0287] In some implementations, the UE may determine a respective SRS resource set index associated with each of the at least one time unit based on the number of time units for PUSCH transmissions.

[0288] In some examples, if the at least one time unit includes two time units, then the UE 104 may associate a first SRS resource set index and a second SRS resource set index with a first time unit and a second time unit among the two time units, respectively. For example, when $K = 2$, the first and second SRS resource sets are applied to the first and second slot of two consecutive slots, respectively. K is the number of PUSCH transmissions for both slot formats.

[0289] If the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, then then the UE 104 may repeatedly apply a first SRS resource set mapping pattern to the at least three time units. The first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index. For example, when $K > 2$ and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets are applied to the first and second slot of K consecutive slots, respectively, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots.

[0290] If the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a second SRS resource set mapping pattern to the at least three time units, wherein the second SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes. For example, when $K > 2$ and *sequentialMapping* in *PUSCH-Config* is enabled, first SRS resource set is applied to the first and second slots of K consecutive slots, and the second SRS resource set is applied to the third and fourth slot of K consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots.

[0291] In a fourth example solution, the UE 104 may determine one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets; and determine a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on a format of a time unit for the PUSCH transmission. For example, the UE does not expect the number of total SRS resource sets for all slot formats configured by the base station exceeds 2. The UE 104 may determine one SRS resource set per slot format for PUSCH transmission, then determine the SRS resource set associated with a PUSCH transmission in a slot according to the slot format.

[0292] In some implementations, when determining a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on a format of a time unit for the PUSCH transmission, if the time unit for the PUSCH transmission is a SBFD time unit, the UE 104 may apply the SRS resource set associated with the SBFD time unit format to the PUSCH transmission. If the time unit for the PUSCH transmission is a non-SBFD time unit, the UE 104 may apply the SRS resource set associated with the non-SBFD time unit format to the PUSCH transmission.

[0293] In some implementations, the at least one time unit includes first one or more time units with the non-SBFD time unit format and second one or more time units with the SBFD time unit format. In some scenarios, if the PUSCH transmissions are transmitted in only one SBFD time unit format, both the two SRS resource sets may be used.

[0294] In some implementations, one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource

sets are determined a predefinition. In other words, which one SRS resource set to be used for the transmission for each slot format may be defined.

[0295] Alternatively, one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets are determined based on a RRC configuration received from the base station 102.

[0296] In a fifth example solution, when receiving the configuration 204, the UE 104 may receive, from the base station 102, a configuration of two SRS resource sets, wherein one of the two SRS resource sets is associated with the non-SBFD time unit format, and the other one of the two SRS resource sets is associated with the SBFD time unit format. The UE 104 may determine a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on a format of a time unit for the PUSCH transmission.

[0297] In some implementations, when determining a respective SRS resource set applied to each of the at least one PUSCH transmission 210 based on a format of a time unit for the PUSCH transmission, if the time unit for the PUSCH transmission is a SBFD time unit, the UE 104 may apply the SRS resource set associated with the SBFD time unit format to the PUSCH transmission. If the time unit for the PUSCH transmission is a non-SBFD time unit, the UE 104 may apply the SRS resource set associated with the non-SBFD time unit format to the PUSCH transmission.

[0298] In a sixth example solution, when receiving the configuration 204, the UE 104 may receive, from the base station 102, a configuration of two SRS resource sets, wherein one of the two SRS resource sets is associated with the non-SBFD time unit format, and the other one of the two SRS resource sets is associated with the SBFD time unit format. The UE 104 may determine a respective SRS resource set applied to each of the at least one PUSCH transmission 210.

[0299] If the at least one time unit includes two time units, the UE 104 may apply a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the at least one PUSCH transmission, respectively.

[0300] If the at least one time unit includes at least three time units, and a cyclic mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a first SRS

resource set mapping pattern to the at least one PUSCH transmission, wherein the first SRS resource set mapping pattern includes one first SRS resource set index followed by one second SRS resource set index.

[0301] If the at least one time unit includes at least three time units, and a sequential mapping for PUSCH is enabled, then the UE 104 may repeatedly apply a second SRS resource set mapping pattern to the at least one PUSCH transmission, wherein the first SRS resource set mapping pattern includes two first SRS resource set indexes followed by two second SRS resource set indexes.

[0302] In some implementations, if the determined SRS resource set applied to the PUSCH transmission is not associated with a format of the time unit, the UE 104 may omit a PUSCH transmission among the at least one PUSCH transmission 210 in a time unit among the at least one time unit.

[0303] FIG. 9 illustrates an example of a device 900 that supports PUSCH transmissions in accordance with aspects of the present disclosure. The device 900 may be an example of a UE 104 or a base station 102 as described herein. The device 900 may support wireless communication with one or more network entities 102, UEs 104, or any combination thereof. The device 900 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 902, a memory 904, a transceiver 906, and, optionally, an I/O controller 908. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0304] The processor 902, the memory 904, the transceiver 906, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 902, the memory 904, the transceiver 906, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[0305] In some implementations, the processor 902, the memory 904, the transceiver 906, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-

programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 902 and the memory 904 coupled with the processor 902 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 902, instructions stored in the memory 904).

[0306] For example, the processor 902 may support wireless communication at the device 900 in accordance with examples as disclosed herein. The processor 902 may be configured to operable to support a means for receiving, from a base station, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format; and a means for transmitting, to the base station, at least one PUSCH transmission across at least one time unit, wherein at least one of the following: in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit.

[0307] In another example, the processor 902 may support wireless communication at the device 900 in accordance with examples as disclosed herein. The processor 902 may be configured to operable to support a means for transmitting, to a user equipment, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format; and a means for receiving, from the user equipment, at least one PUSCH transmission across at least one time unit, wherein at least one of the following: in the case that a PUSCH transmission among the at least one PUSCH transmission is received in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or in the

case that a PUSCH transmission among the at least one PUSCH transmission is received in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit.

[0308] The processor 902 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 902 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 902. The processor 902 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 904) to cause the device 900 to perform various functions of the present disclosure such that the device 900 may perform any process of the disclosure as discussed with reference to FIGS. 2 to 5.

[0309] The memory 904 may include random access memory (RAM) and read-only memory (ROM). The memory 904 may store computer-readable, computer-executable code including instructions that, when executed by the processor 902 cause the device 900 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 902 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 904 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0310] The I/O controller 908 may manage input and output signals for the device 900. The I/O controller 908 may also manage peripherals not integrated into the device 900. In some implementations, the I/O controller 908 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 908 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 908 may be implemented as part of a processor, such as the processor 906. In some implementations, a user may interact with the device 900

via the I/O controller 908 or via hardware components controlled by the I/O controller 908.

[0311] In some implementations, the device 900 may include a single antenna 910. However, in some other implementations, the device 900 may have more than one antenna 910 (i.e., multiple antennas), including multiple antenna panels or antenna arrays, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 906 may communicate bi-directionally, via the one or more antennas 910, wired, or wireless links as described herein. For example, the transceiver 906 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 906 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 910 for transmission, and to demodulate packets received from the one or more antennas 910. The transceiver 906 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[0312] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 910 for transmitting the amplified signal into the air or wireless medium.

[0313] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 910 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain

may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0314] FIG. 10 illustrates an example of a processor 1000 that supports PUSCH transmissions in accordance with aspects of the present disclosure. The processor 1000 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 1000 may be implemented in a device or its components as described herein. For example, the device may be an example of a UE 104 or a base station 102 as described herein. The processor 1000 may include a controller 1002 configured to perform various operations in accordance with examples as described herein. The processor 1000 may optionally include at least one memory 1004, such as L1/L2/L3 cache. Additionally, or alternatively, the processor 1000 may optionally include one or more arithmetic-logic units (ALUs) 1000. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0315] The processor 1000 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 1000) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0316] The controller 1002 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 1000 to cause the processor 1000 to support various operations in accordance with examples as described herein. For example, the controller 1002 may operate as a control unit of the processor 1000, generating control signals that manage the operation of various components of the processor 1000. These control signals include enabling or

disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0317] The controller 1002 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 1004 and determine subsequent instruction(s) to be executed to cause the processor 1000 to support various operations in accordance with examples as described herein. The controller 1002 may be configured to track memory address of instructions associated with the memory 1004. The controller 1002 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 1002 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 1000 to cause the processor 1000 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 1002 may be configured to manage flow of data within the processor 1000. The controller 1002 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 1000.

[0318] The memory 1004 may include one or more caches (e.g., memory local to or included in the processor 1000 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementation, the memory 1004 may reside within or on a processor chipset (e.g., local to the processor 1000). In some other implementations, the memory 1004 may reside external to the processor chipset (e.g., remote to the processor 1000).

[0319] The memory 1004 may store computer-readable, computer-executable code including instructions that, when executed by the processor 1000, cause the processor 1000 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 1002 and/or the processor 1000 may be configured to execute computer-readable instructions stored in the memory 1004 to cause the processor 1000 to perform various functions. For example, the processor 1000 and/or the controller 1002 may be coupled with or to the memory 1004, and the processor 1000, the controller 1002, and the memory 1004 may be configured to perform various functions described herein. In some examples, the processor 1000 may include multiple processors and the memory 1004 may include multiple memories. One or more of the multiple processors may be coupled with

one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0320] The one or more ALUs 1000 may be configured to support various operations in accordance with examples as described herein. In some implementation, the one or more ALUs 1000 may reside within or on a processor chipset (e.g., the processor 1000). In some other implementations, the one or more ALUs 1000 may reside external to the processor chipset (e.g., the processor 1000). One or more ALUs 1000 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 1000 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 1000 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 1000 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 1000 to handle conditional operations, comparisons, and bitwise operations.

[0321] For example, the processor 1000 may support wireless communication in accordance with examples as disclosed herein. The processor 1000 may be configured to or operable to support a means for receiving, from a base station, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format; and a means for transmitting, to the base station, at least one PUSCH transmission across at least one time unit, wherein at least one of the following: in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit.

[0322] In another example, the processor 1000 may support wireless communication in accordance with examples as disclosed herein. The processor 1000 may be configured to or operable to support a means for transmitting, to a user equipment, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format; and a means for receiving, from the user equipment, at least one PUSCH transmission across at least one time unit, wherein at least one of the following: in the case that a PUSCH transmission among the at least one PUSCH transmission is received in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or in the case that a PUSCH transmission among the at least one PUSCH transmission is received in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit.

[0001] FIG. 11 illustrates a flowchart of a method 1100 that supports PUSCH transmissions in accordance with aspects of the present disclosure. The operations of the method 1100 may be implemented by a device or its components as described herein. For example, the operations of the method 1100 may be performed by a UE 104 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0002] At 1105, the method may include receiving, from a base station, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format. The operations of 1105 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1105 may be performed by a device as described with reference to FIG. 1A.

[0003] At 1110, the method may include transmitting, to the base station, at least one PUSCH transmission across at least one time unit, wherein at least one of the following:

in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit. The operations of 1110 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1110 may be performed by a device as described with reference to FIG. 1A.

[0004] FIG. 12 illustrates a flowchart of a method 1200 that supports PUSCH transmissions in accordance with aspects of the present disclosure. The operations of the method 1200 may be implemented by a device or its components as described herein. For example, the operations of the method 1200 may be performed by a base station 102 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0005] At 1205, the method may include transmitting, to a user equipment, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format. The operations of 1205 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1205 may be performed by a device as described with reference to FIG. 1A.

[0006] At 1210, the method may include receiving, from the user equipment, at least one PUSCH transmission across at least one time unit, wherein at least one of the following: in the case that a PUSCH transmission among the at least one PUSCH transmission is received in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or in the case that a PUSCH transmission among the at least one PUSCH transmission is received in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit. The operations of 1210

may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1210 may be performed by a device as described with reference to FIG. 1A.

[0323] It should be noted that the methods described herein describes possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

[0324] The various illustrative blocks and components described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a DSP, an ASIC, a CPU, an FPGA or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration).

[0325] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein may be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[0326] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer. By way of example, non-transitory computer-readable media may include

RAM, ROM, electrically erasable programmable ROM (EEPROM), flash memory, compact disk (CD) ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other non-transitory medium that may be used to carry or store desired program code means in the form of instructions or data structures and that may be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor.

[0327] As used herein, including in the claims, an article “a” before an element is unrestricted and understood to refer to “at least one” of those elements or “one or more” of those elements. The terms “a,” “at least one,” “one or more,” and “at least one of one or more” may be interchangeable. As used herein, including in the claims, “or” as used in a list of items (e.g., a list of items prefaced by a phrase such as “at least one of” or “one or more of” or “one or both of”) indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase “based on” shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as “based on condition A” may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase “based on” shall be construed in the same manner as the phrase “based at least in part on. Further, as used herein, including in the claims, a “set” may include one or more elements.

[0328] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. A user equipment, comprising:
a processor; and
a transceiver coupled to the processor,
wherein the processor is configured to:
receive, from a base station via the transceiver, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format; and
transmit, to the base station via the transceiver, at least one physical uplink shared channel (PUSCH) transmission across at least one time unit,
wherein at least one of the following:
in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or
in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit.
2. The user equipment of claim 1, wherein the first one or more SRS resource sets comprise a first SRS resource set and a second SRS resource set,
wherein the second one or more SRS resource sets comprise one SRS resource set associated with a SBFD time unit format, and wherein the one SRS resource set associated with the SBFD time unit format is one of the first and second SRS resource sets.
3. The user equipment of claim 2, wherein one of the following:

the one SRS resource set associated with the SBFD time unit format is predefined as the first or second SRS resource set; or

the processor is further configured to:

receive, from the base station via the transceiver, an indication that the one of the first and second SRS resource sets is the one SRS resource set associated with the SBFD time unit format.

4. The user equipment of claim 1, wherein receiving the configuration of the plurality of SRS resource sets comprises:

receiving, from the base station via the transceiver, a configuration of two SRS resource sets, wherein one of the two SRS resource sets is associated with the non-SBFD time unit format, and the other one of the two SRS resource sets is associated with the SBFD time unit format.

5. The user equipment of claim 1, wherein the processor is further configured to:

receive, from the base station via the transceiver, an indicator;

determine a respective SRS resource set index associated with each of the at least one time unit based on the indicator; and

for a PUSCH transmission of the at least one PUSCH transmission in a time unit of the at least one time unit, determine a respective SRS resource set applied to the PUSCH transmission from the first one or more SRS resource sets or from the second one or more SRS resource sets based on the determined SRS resource set index associated with the time unit and a format of the time unit.

6. The user equipment of claim 5, wherein determining a respective SRS resource set applied to the PUSCH transmission based on the determined SRS resource set index associated with the time unit and a format of the time unit comprises:

in the case that the format of the time unit is a non-SBFD time unit format, determining the SRS resource set applied to the PUSCH transmission to be a SRS resource set among the first one or more SRS resource sets with the SRS resource set index associated with the time unit;

in the case that the format of the time unit is a SBFD time unit format, determining the SRS resource set applied to the PUSCH transmission to be a SRS

resource set among the second one or more SRS resource sets with the SRS resource set index associated with the time unit.

7. The user equipment of claim 5, wherein determining a respective SRS resource set index associated with each of the at least one time unit comprises:

in the case that the indicator has a first value, associating a first SRS resource set index with each of the at least one time unit;

in the case that the indicator has a second value, associating a second SRS resource set index with each of the at least one time unit;

in the case that the indicator has a third value, performing one of the following:

in the case that the at least one time unit comprises two time units, associating a first SRS resource set index and a second SRS resource set index with a first time unit and a second time unit among the two time units, respectively;

in the case that the at least one time unit comprises at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a first SRS resource set mapping pattern to the at least three time units, wherein the first SRS resource set mapping pattern comprises one first SRS resource set index followed by one second SRS resource set index; or

in the case that the at least one time unit comprises at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a second SRS resource set mapping pattern to the at least three time units, wherein the second SRS resource set mapping pattern comprises two first SRS resource set indexes followed by two second SRS resource set indexes; and

in the case that the indicator has a fourth value, performing one of the following:

in the case that the at least one time unit comprises two time units, associating a second SRS resource set index and a first SRS resource set index with a first time unit and a second time unit among the two time units, respectively;

in the case that the at least one time unit comprises at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a third SRS resource set mapping pattern to the at least three time units, wherein the third SRS resource set mapping pattern comprises one second SRS resource set index followed by one first SRS resource set index; or

in the case that the at least one time unit comprises at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a fourth

SRS resource set mapping pattern to the at least three time units, wherein the fourth SRS resource set mapping pattern comprises two second SRS resource set indexes followed by two first SRS resource set indexes.

8. The user equipment of claim 7, wherein:

in the case that the first one or more SRS resource sets or the second one or more SRS set comprises one SRS resource set, both a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index correspond to the one SRS resource set.

9. The user equipment of claim 1, wherein the processor is further configured to:

for one or more PUSCH transmissions in one or more time units with a first time unit format,

in the case that one SRS resource set is associated with the first time unit format, apply the SRS resource set associated with the first time unit format to the one or more PUSCH transmissions in the one or more time units; and

in the case that more than one SRS resource set is associated with the first time unit format, determine a respective SRS resource set applied to each of the one or more PUSCH transmissions based on an indicator for the first time unit format.

10. The user equipment of claim 9, wherein determining a respective SRS resource set applied to each of the one or more PUSCH transmissions based on an indicator for the first time unit format comprises:

in the case that the indicator for the first time unit format has a first value, applying a SRS resource set with a first SRS resource set index to each of the one or more PUSCH transmission;

in the case that the indicator for the first time unit format has a second value, applying a SRS resource set with a second SRS resource set index to each of the one or more PUSCH transmission;

in the case that the indicator for the first time unit format has a third value, performing one of the following:

in the case that the one or more time units comprise one time unit, applying a SRS resource set with a first SRS resource set index or second SRS resource set index to the one or more PUSCH transmissions;

in the case that the one or more time units comprise two time units, applying a SRS resource set with a first SRS resource set index and a SRS resource set with a second SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively;

in the case that the one or more time units comprise at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a first SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern comprises one first SRS resource set index followed by one second SRS resource set index; or

in the case that the one or more time units comprise at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a second SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the first SRS resource set mapping pattern comprises two first SRS resource set indexes followed by two second SRS resource set indexes; or

in the case that the indicator for the first time unit format has a fourth value, performing one of the following:

in the case that the one or more time units comprise one time unit, applying a SRS resource set with a second SRS resource set index to the one or more PUSCH transmissions;

in the case that the one or more time units comprise two time units, applying a SRS resource set with a second SRS resource set index and a SRS resource set with a first SRS resource set index to a first PUSCH transmission and a second PUSCH transmission among the one or more PUSCH transmissions, respectively;

in the case that the one or more time units comprise at least three time units, and a cyclic mapping for PUSCH is enabled, repeatedly applying a third SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein the third SRS resource set mapping pattern comprises one second SRS resource set index followed by one first SRS resource set index; or

in the case that the one or more time units comprise at least three time units, and a sequential mapping for PUSCH is enabled, repeatedly applying a fourth SRS resource set mapping pattern to the one or more PUSCH transmissions, wherein

the fourth SRS resource set mapping pattern comprises two second SRS resource set indexes followed by two first SRS resource set indexes.

11. The user equipment of claim 9, wherein the processor is further configured to perform one of the following:

receiving, from the base station via the transceiver, one indicator for the non-SBFD time unit format and the SBFD time unit format; or

receiving, from the base station via the transceiver, at least one of the following:

a first indicator for the non-SBFD time unit format in the case that the first one or more SRS resource sets comprise more than one SRS resource set associated with the non-SBFD time unit format, or

a second indicator for the SBFD time unit format in the case that the second one or more SRS resource sets comprise more than one SRS resource set associated with the SBFD time unit format.

12. The user equipment of claim 1, wherein the processor is further configured to:

determine one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets; and

determine a respective SRS resource set applied to each of the at least one PUSCH transmission based on a format of a time unit for the PUSCH transmission.

13. The user equipment of claim 12, wherein one SRS resource set from the first one or more SRS resource sets and one SRS resource set from the second one or more SRS resource sets are determined based on one of the following: a third indicator received from the base station, or a predefinition,

wherein the third indicator indicates which one SRS resource set from the first one or more SRS resource sets and which one SRS resource set from the second one or more SRS resource sets are used.

14. The user equipment of claim 9 or 12, wherein the at least one time unit comprises first one or more time units with the non-SBFD time unit format and second one or more time units with the SBFD time unit format.

15. The user equipment of claim 9, wherein the processor is further configured to:

- determine the first time unit format from the non-SBFD time unit format and the SBFD time unit format to be used for PUSCH transmission,
- wherein the first time unit format is determined based on one of the following:
 - a format of a first time unit for a first PUSCH transmission in time domain among the at least one PUSCH transmission;
 - a pre-definition as a SBFD time unit format or a non-SBFD time unit format; or
 - a configuration signaling from the base station.

16. The user equipment of claim 4, wherein the processor is further configured to:

- determine a respective SRS resource set applied to each of the at least one PUSCH transmission based on a format of a time unit for the PUSCH transmission.

17. The user equipment of claim 12 and 16, wherein determining a respective SRS resource set applied to each of the at least one PUSCH transmission based on a format of a time unit for the PUSCH transmission comprises:

- in the case that the time unit for the PUSCH transmission is a SBFD time unit, applying the SRS resource set associated with the SBFD time unit format to the PUSCH transmission; and
- in the case that the time unit for the PUSCH transmission is a non-SBFD time unit, applying the SRS resource set associated with the non-SBFD time unit format to the PUSCH transmission.

18. A base station, comprising:

- a processor; and
- a transceiver coupled to the processor,

wherein the processor is configured to:

- transmit, to a user equipment via the transceiver, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS

resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format; and

receive, from the user equipment via the transceiver, at least one physical uplink shared channel (PUSCH) transmission across at least one time unit,

wherein at least one of the following:

in the case that a PUSCH transmission among the at least one PUSCH transmission is received in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or

in the case that a PUSCH transmission among the at least one PUSCH transmission is received in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit.

19. A method performed by a user equipment, comprising:

receiving, from a base station, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format; and

transmitting, to the base station, at least one physical uplink shared channel (PUSCH) transmission across at least one time unit,

wherein at least one of the following:

in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or

in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit.

20. A processor for wireless communication, comprising:

at least one memory; and

a controller coupled with the at least one memory and configured to cause the controller to:

receive, from a base station, a configuration of a plurality of sounding reference signal (SRS) resource sets, wherein first one or more SRS resource sets among the plurality of SRS resource sets are associated with a non-sub-band full duplex (non-SBFD) time unit format, and second one or more SRS resource sets among the plurality of SRS resource sets are associated with a SBFD time unit format; and

transmit, to the base station, at least one physical uplink shared channel (PUSCH) transmission across at least one time unit,

wherein at least one of the following:

in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a non-SBFD time unit, one SRS resource set among the first one or more SRS resource sets is applied to the PUSCH transmission in the non-SBFD time unit; or

in the case that a PUSCH transmission among the at least one PUSCH transmission is transmitted in a SBFD time unit, one SRS resource set among the second one or more SRS resource sets is applied to the PUSCH transmission in the SBFD time unit.