transmissions from multiple antennas, cyclic shift multiplexing and different transmission combs may be used. The cyclic shift for an antenna may be determined from a cyclic shift reference value, where the cyclic shift determined for each antenna provides a maximum distance or even distribution between cyclic shifts for the antennas transmitting SRS in a same WTRU-specific subframe. SRS transmissions from multiple antennas in the WTRU-specific subframe may be done in parallel and the number of antennas may be less than the number of antennas available on the WTRU. Methods for handling collisions between SRS, physical uplink shared channel, and physical uplink control channel are also presented.

[0004a] According to a first aspect of the invention, there is provided a method for performing uplink sounding reference signals (SRS) transmissions in a multiple antenna wireless transmit/receive unit (WTRU), comprising:

receiving a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions;

receiving a trigger from a base station to transmit SRS for a predetermined number of antennas; and

transmitting the SRS for the predetermined number of antennas in a first WTRU-specific subframe from the configured WTRU-specific SRS subframes which is at least a triggering subframe plus four subframes after the triggering subframe.

[0004b] According to a second aspect of the invention, there is provided a multiple antenna wireless transmit/receive unit (WTRU), comprising:

a receiver configured to receive a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions;

the receiver further configured to receive a trigger from a base station to transmit SRS for a predetermined number of antennas; and

a transmitter configured to transmit the SRS for the predetermined number of antennas in a first WTRU-specific subframe from the configured WTRU-specific SRS subframes which is at least a triggering subframe plus four subframes after the triggering subframe.

[0004c] According to a third aspect of the invention, there is provided a method for performing uplink sounding reference signals (SRS) transmissions in a wireless transmit/receive unit (WTRU), comprising:

receiving a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions; and

receiving a trigger from a base station to transmit SRS; and

transmitting the SRS in a first WTRU-specific subframe which is at least a triggering subframe plus four subframes after the triggering subframe.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] A more detailed understanding may be had from the following description, given by way of example in conjunction with the accompanying drawings wherein:

[0006] FIG. 1A is a system diagram of an example communications system in which one or more disclosed embodiments may be implemented;

[0007] FIG. 1B is a system diagram of an example wireless transmit/receive unit (WTRU) that may be used within the communications system illustrated in FIG. 1A;

[0008] FIG. 1C is a system diagram of an example radio access network and an example core network that may be used within the communications system illustrated in FIG. 1A;

[0009] FIG. 2 is a flowchart of an example sounding reference signals (SRS) configuration and transmission;

[0010] FIG. 3 is a flowchart of an example procedure for determining maximal cyclic shift separation;

[0011] FIG. 4 is a diagram of sounding reference signals (SRS) transmission subframes, cyclic shift (CS) and transmission comb (TC) for N_{Ant}^{SRS} = 2 and $N_{subframes}^{SRS} = 1$;

What is claimed:

1. A method for performing uplink sounding reference signals (SRS) transmissions in a multiple antenna wireless transmit/receive unit (WTRU), comprising:

receiving a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions;

receiving a trigger from a base station to transmit SRS for a predetermined number of antennas; and

transmitting the SRS for the predetermined number of antennas in a first WTRU-specific subframe from the configured WTRU-specific SRS subframes which is at least a triggering subframe plus four subframes after the triggering subframe.

2. The method of claim 1, wherein the trigger may be a multi-bit indicator that provides predetermined SRS transmission parameters to the WTRU.

3. The method of claim 1, further comprising:

receiving a cyclic shift reference value; and

determining a cyclic shift for an antenna based on at least the cyclic shift reference value.

4. The method of claim 3, wherein the cyclic shift determined for each antenna provides a maximum distance between cyclic shifts for the antennas transmitting SRS in a same WTRU-specific subframe.

5. The method of claim 3, wherein the cyclic shift determined for each antenna provides even distribution between cyclic shifts for the antennas transmitting SRS in a same WTRU-specific subframe.

6. The method of claim 1, wherein at least one of cyclic shift multiplexing or different transmission comb assignments is used for transmission from multiple antennas in the predetermined WTRU-specific subframe.

7. The method of claim 6, further comprising:

receiving a cyclic shift reference value; and

determining a cyclic shift for an antenna based on at least the cyclic shift reference value, wherein the cyclic shift determined for each antenna provides a maximum distance between cyclic shifts for the antennas transmitting SRS in a same WTRU-specific subframe.

8. The method of claim 1, wherein SRS transmissions from multiple antennas in the predetermined WTRU-specific subframe are done in parallel.

9. The method of claim 1, wherein the predetermined number of antennas is less than a number of antennas available on the WTRU.

10. The method of claim 1, wherein the WTRU-specific SRS subframes is different for periodic SRS transmission and aperiodic SRS transmission.

11. The method of claim 1, further comprising:

determining resource allocation overlap between physical uplink shared channel (PUSCH) and the WTRU-specific configuration for SRS; and

foregoing PUSCH transmission in a last symbol of a subframe on a condition of a partial overlap.

12. A multiple antenna wireless transmit/receive unit (WTRU), comprising:

a receiver configured to receive a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions;

the receiver further configured to receive a trigger from a base station to transmit SRS for a predetermined number of antennas; and

a transmitter configured to transmit the SRS for the predetermined number of antennas in a first WTRU-specific subframe from the configured WTRU-specific SRS subframes which is at least a triggering subframe plus four subframes after the triggering subframe.

13. A method for performing uplink sounding reference signals (SRS) transmissions in a wireless transmit/receive unit (WTRU), comprising:

receiving a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions; and

transmitting the SRS in predetermined WTRU-specific subframes in response to a trigger, wherein a transmission power of each SRS is scaled equally across all component carriers on a condition that a sum of SRS transmission powers across all the component carriers exceeds a maximum configured transmit power.

14. A method for performing uplink sounding reference signals (SRS) transmissions in a wireless transmit/receive unit (WTRU), comprising:

receiving a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions; and

foregoing transmitting the SRS in a predetermined WTRU-specific subframe in response to a trigger on a condition that maximum power in a last symbol in the predetermined WTRU-specific subframe is exceeded and other channels are to be transmitted in the last symbol.

15. A method for performing uplink sounding reference signals (SRS) transmissions in a wireless transmit/receive unit (WTRU), comprising:

receiving a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions; and

receiving a trigger from a base station to transmit SRS; and

transmitting the SRS in a first WTRU-specific subframe which is at least a triggering subframe plus four subframes after the triggering subframe.

CLAIMS

1. A method for performing uplink sounding reference signals (SRS) transmissions in a multiple antenna wireless transmit/receive unit (WTRU), comprising:
receiving a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions;
receiving a trigger from a base station to transmit SRS for a predetermined number of antennas; and
transmitting the SRS for the predetermined number of antennas in a first WTRU-specific subframe from the configured WTRU-specific SRS subframes which is at least a triggering subframe plus four subframes after the triggering subframe.

2. The method of claim 1, wherein the trigger may be a multi-bit indicator that provides predetermined SRS transmission parameters to the WTRU.

3. The method of claim 1, further comprising:
receiving a cyclic shift reference value; and
determining a cyclic shift for an antenna based on at least the cyclic shift reference value.

4. The method of claim 3, wherein the cyclic shift determined for each antenna provides a maximum distance between cyclic shifts for the antennas transmitting SRS in a same WTRU-specific subframe.

5. The method of claim 3, wherein the cyclic shift determined for each antenna provides even distribution between cyclic shifts for the antennas transmitting SRS in a same WTRU-specific subframe.

6. The method of claim 1, wherein at least one of cyclic shift multiplexing or different transmission comb assignments is used for transmission from multiple antennas in the predetermined WTRU-specific subframe.

7. The method of claim 6, further comprising:
receiving a cyclic shift reference value; and
determining a cyclic shift for an antenna based on at least the cyclic shift reference value, wherein the cyclic shift determined for each antenna provides a maximum distance between cyclic shifts for the antennas transmitting SRS in a same WTRU-specific subframe.

8. The method of claim 1, wherein SRS transmissions from multiple antennas in the predetermined WTRU-specific subframe are done in parallel.

9. The method of claim 1, wherein the predetermined number of antennas is less than a number of antennas available on the WTRU.

10. The method of claim 1, wherein the WTRU-specific SRS subframes is different for periodic SRS transmission and aperiodic SRS transmission.

11. The method of claim 1, further comprising:
determining resource allocation overlap between physical uplink shared channel (PUSCH) and the WTRU-specific configuration for SRS; and
foregoing PUSCH transmission in a last symbol of a subframe on a condition of a partial overlap.

12. A multiple antenna wireless transmit/receive unit (WTRU), comprising:
a receiver configured to receive a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions;
the receiver further configured to receive a trigger from a base station to transmit SRS for a predetermined number of antennas; and
a transmitter configured to transmit the SRS for the predetermined number of antennas in a first WTRU-specific subframe from the configured WTRU-specific SRS subframes which is at least a triggering subframe plus four subframes after the triggering subframe.

13. A method for performing uplink sounding reference signals (SRS) transmissions in a wireless transmit/receive unit (WTRU), comprising:
receiving a WTRU-specific configuration of WTRU-specific SRS subframes for performing SRS transmissions; and
receiving a trigger from a base station to transmit SRS; and
transmitting the SRS in a first WTRU-specific subframe which is at least a triggering subframe plus four subframes after the triggering subframe.