

WHAT IS CLAIMED IS:

1. A method for transmitting a reference signal, comprising:

determining transmission configuration information of a vehicle synchronization signal block (VSSB) in a new radio (NR) vehicle-to-everything (V2X) system, the transmission configuration information comprising: a transmitting cycle of the VSSB and a time domain position of a VSSB transmitting time window in the transmitting cycle; and

transmitting N VSSBs in the VSSB transmitting time window that occurs periodically, according to the transmission configuration information, where N is an integer greater than or equal to 1;

wherein each of the VSSBs comprises: a primary sidelink synchronization signal (PSSS), a secondary sidelink synchronization signal (SSSS), a physical sidelink broadcast channel (PSBCH) signal, and a demodulation reference signal (DMRS);

wherein transmitting the N VSSBs in the VSSB transmitting time window that occurs periodically comprises:

determining information of a target carrier frequency for transmitting the VSSBs;

determining a maximum number of time domain resources transmittable for the VSSBs in the VSSB transmitting time window, according to the information of the target carrier frequency;

determining information of valid time domain resources in the VSSB transmitting time window, according to the maximum number of the time domain resources transmittable for the VSSBs and configuration information of uplink and downlink time domain resources sent by a base station; and

transmitting the VSSBs in the VSSB transmitting time window according to the information of the valid time domain resources.

2. The method according to claim 1, wherein determining the information of the target carrier frequency for transmitting the VSSBs comprises:

receiving resource configuration information sent by the base station, the resource configuration information being configured to inform the vehicle UE to transmit the VSSBs with configured resources; and

determining the information of the target carrier frequency according to the resource configuration information, or determining the information of the target carrier frequency according to preset resource configuration information.

3. The method of claim 1, wherein determining the maximum number of the time domain resources transmittable for the VSSBs in the VSSB transmitting time window, according to the information of the target carrier frequency comprises:

querying a preset list according to the information of the target carrier frequency, and

determining the maximum number of the time domain resources transmittable for the VSSBs corresponding to the target carrier frequency,

wherein the preset list comprises: a correspondence relationship between information of carrier frequency bands and maximum numbers of the time domain resources transmittable for the VSSBs in the VSSB transmitting time window.

4. The method of claim 1, wherein the information of the valid time domain resources comprises: a number of valid unit time domain resources and a location of each of the valid unit time domain resources;

wherein determining the information of the valid time domain resources in the VSSB transmitting time window, according to the maximum number of the time domain resources transmittable for the VSSBs and the configuration information of the uplink and downlink time domain resources sent by the base station comprises:

determining a target subcarrier spacing according to the information of the target carrier frequency;

determining location and index information of each of unit time domain resources in the VSSB transmitting time window, according to the maximum number of the time

domain resources transmittable for the VSSBs and the target subcarrier spacing, wherein each of the unit time domain resources is a time domain resource for carrying one VSSB;

determining the valid time domain resources in a current VSSB transmitting time window, according to the configuration information of the uplink and downlink time domain resources, wherein the valid time domain resources comprise uplink time domain resources and/or blank resources configured by the base station; and

determining, the number of the valid unit time domain resources and location and index information of each of the valid unit time domain resources, according to the valid time domain resources and the location and index information of each of the unit time domain resources in the VSSB transmitting time window.

5. The method of claim 4, wherein transmitting the VSSBs in the VSSB transmitting time window according to the information of the valid time domain resources comprises:

determining a number of target beams according to preset reference information, the preset reference information being configured to determine a number of beams for transmitting the VSSBs in a current context, wherein each of the beams is configured to transmit at least one of the VSSBs in a respective preset direction, and the number of the target beams is less than or equal to the maximum number of the time domain resources transmittable for the VSSBs;

determining transmission information of the VSSBs to be transmitted, based on the information of the valid time domain resources and the number of the target beams, wherein the transmission information of the VSSBs to be transmitted comprises: an actual number of the VSSBs to be transmitted, a location and index information of each of valid unit time domain resources occupied by each of the VSSBs to be transmitted; and

transmitting the VSSBs in the VSSB transmitting time window according to the transmission information of the VSSBs to be transmitted.

6. The method of claim 5, wherein determining the transmission information of the VSSBs to be transmitted, based on the information of the valid time domain resources and the number of the target beams comprises:

determining the actual number of the VSSBs to be transmitted, based on the information of the valid time domain resources and the number of the target beams; and

determining, the location and index information of each of the valid unit time domain resources occupied by each of the VSSBs to be transmitted, according to the actual number of the VSSBs to be transmitted and the location and index information of each of the valid unit time domain resources.

7. The method of claim 6, wherein the actual number of the VSSBs to be transmitted is determined based on the information of the valid time domain resources and the number of the target beams in one of the following manners:

determining the number of the valid unit time domain resources to be the actual number of the VSSBs to be transmitted, in response to that the number of the target beams is greater than or equal to the number of the valid unit time domain resources; or

determining the number of the target beams to be the actual number of the VSSBs to be transmitted, in response to that the number of the target beams is less than the number of the valid unit time domain resources.

8. The method of claim 6, wherein transmitting the VSSBs in the VSSB transmitting time window according to the transmission information of the VSSBs to be transmitted comprises:

loading index information of the VSSBs to be transmitted into a set signal of the VSSBs to be transmitted, to generate target VSSBs that carry the index information; and

transmitting the target VSSBs through multiple beams respectively in the VSSB transmitting time window.

9. The method of claim 8, wherein the index information of the VSSBs to be transmitted

is loaded into the set signal of the VSSBs to be transmitted in one of the following manners:

indicating the index information of the VSSBs to be transmitted through corresponding DMRS target sequences;

loading the index information of the VSSBs to be transmitted into a first bit of a preset PSBCH signal; or

indicating a partial bit value of the index information of the VSSBs to be transmitted through the corresponding DMRS target sequences, and loading a remaining bit value of the index information of the VSSBs to be transmitted into a second bit of the preset PSBCH signal.

10. The method of claim 1, wherein transmitting the N VSSBs in the VSSB transmitting time window comprises:

transmitting the PSBCH signal and the DMRS in each of the VSSBs in at least one of the following manners: frequency division multiplexing (FDM) or time division multiplexing (TDM).

11. A method for receiving a reference signal, comprising:

detecting a vehicle synchronization signal block (VSSB) in a new radio (NR) vehicle-to-everything (V2X) system transmitted by a vehicle UE;

acquiring VSSB index information from the detected target VSSB;

determining a time domain location corresponding to the target VSSB according to the VSSB index information; and

performing time domain synchronization with the vehicle UE according to the time domain location;

wherein detecting the VSSB transmitted by the vehicle UE comprises:

receiving resource configuration information sent by a base station, the resource configuration information being configured to inform the receiving terminal to receive the VSSB with a configured resource;

determining information of a target carrier frequency for receiving the VSSB according to the resource configuration information;

determining a detection subcarrier spacing according to the information of the target carrier frequency; and

detecting the VSSB on a target resource by using the detection subcarrier spacing.

12. The method of claim 11, wherein acquiring the VSSB index information from the detected target VSSB comprises:

parsing the target VSSB to acquire a plurality of signals, wherein the plurality of signals comprise: a primary sidelink synchronization signal (PSSS), a secondary sidelink synchronization signal (SSSS), a physical sidelink broadcast channel (PSBCH) signal, and a demodulation reference signal (DMRS); and

acquiring the VSSB index information from a preset signal, wherein the preset signal comprises at least one of the PSBCH signal or the DMRS.

13. The method of claim 12, wherein acquiring the VSSB index information from the preset signal comprises:

acquiring the VSSB index information according to information carried in a preset DMRS sequence; and

parsing the VSSB index information from a first bit of a preset PSBCH signal.

14. The method of claim 12, wherein acquiring the VSSB index information from the preset signal comprises:

acquiring a partial bit value corresponding to the VSSB index information according to the information carried in a preset DMRS sequence;

acquiring a remaining bit value corresponding to the VSSB index information from a second bit of a preset PSBCH signal; and

determining the VSSB index information according to a complete bit value composed of the partial bit value and the remaining bit value.

15. The method of claim 11, wherein determining the time domain location corresponding to the target VSSB according to the VSSB index information comprises:

determining the time domain location corresponding to the target VSSB, according to the VSSB index information, the information of the target carrier frequency and a target subcarrier spacing; wherein the target subcarrier spacing is a detection subcarrier spacing used when the target VSSB is detected.

16. An apparatus for transmitting a reference signal, comprising:

a configuration information determination module, configured to determine transmission configuration information of a vehicle synchronization signal block (VSSB) in a new radio (NR) vehicle-to-everything (V2X) system, the transmission configuration information comprising: a transmitting cycle of the VSSB and a time domain position of a VSSB transmitting time window in the transmitting cycle; and

a transmitting module, configured to transmit N VSSBs in the VSSB transmitting time window, according to the transmission configuration information, where N is an integer greater than or equal to 1, and the VSSB transmitting time window occurs periodically;

wherein each of the VSSBs comprises: a primary sidelink synchronization signal (PSSS), a secondary sidelink synchronization signal (SSSS), a physical sidelink broadcast channel (PSBCH) signal, and a demodulation reference signal (DMRS);

wherein the transmitting module comprises:

a carrier frequency determination submodule, configured to determine information of a target carrier frequency for transmitting the VSSBs;

a resource quantity determination submodule, configured to determine a maximum number of time domain resources transmittable for the VSSBs in the VSSB transmitting time window, according to the information of the target carrier frequency;

a valid resource determination submodule, configured to determine information of valid time domain resources in the VSSB transmitting time window, according to the

maximum number of the time domain resources transmittable for the VSSBs and configuration information of uplink and downlink time domain resources sent by a base station; and

a transmission submodule, configured to transmit the VSSBs in the VSSB transmitting time window according to the information of the valid time domain resources.

17. The apparatus of claim 16, wherein the carrier frequency determination submodule, comprises:

a configuration information receiving unit, configured to receive resource configuration information sent by the base station, the resource configuration information being configured to inform the vehicle-mounted device to transmit the VSSBs with configured resources, and

one of a first carrier frequency determination unit or a second carrier frequency determination unit,

wherein the first carrier frequency determination unit is configured to determine the information of the target carrier frequency according to the resource configuration information; or,

the second carrier frequency determination unit is configured to determine the information of the target carrier frequency according to preset resource configuration information.

18. The apparatus of claim 16, wherein the resource quantity determination submodule is further configured to:

query a preset list according to the information of the target carrier frequency, and determine the maximum number of the time domain resources transmittable for the VSSBs corresponding to the target carrier frequency,

wherein the preset list comprises: a correspondence relationship between information of carrier frequency bands and maximum numbers of the time domain

resources transmittable for the VSSBs in the VSSB transmitting time window.

19. The apparatus of claim 16, wherein the information of the valid time domain resources comprises: a number of valid unit time domain resources and a location of each of the valid unit time domain resources;

wherein the valid resource determination submodule comprises:

a subcarrier spacing determination unit, configured to determine a target subcarrier spacing according to the information of the target carrier frequency;

a unit time domain resource determination unit, configured to determine location and index information of each of unit time domain resources in the VSSB transmitting time window, according to the maximum number of the time domain resources transmittable for the VSSBs and the target subcarrier spacing, wherein each of the unit time domain resources is a time domain resource for carrying one VSSB;

an valid unit time domain resource determination unit, configured to determine the valid time domain resources in a current VSSB transmitting time window, according to the configuration information of the uplink and downlink time domain resources, wherein the valid time domain resources comprise: uplink time domain resources and/or blank resources configured by the base station; and

an index information determination unit, configured to determine the number of the valid unit time domain resources, and location and index information of each of the valid unit time domain resources, according to the valid time domain resources, and the location and index information of each of the unit time domain resources in the VSSB transmitting time window.

20. The apparatus of claim 19, wherein the transmission submodule comprises:

a target beam determination unit, configured to determine a number of target beams according to preset reference information, the preset reference information being configured to determine a number of beams for transmitting the VSSBs in a current context, wherein each of the beams is configured to transmit at least one of the VSSBs

in a respective preset direction, and the number of the target beams is less than or equal to the maximum number of the time domain resources transmittable for the VSSBs;

a transmission information determination unit, configured to determine transmission information of the VSSBs to be transmitted, based on the information of the valid time domain resources and the number of the target beams, wherein the transmission information of the VSSBs to be transmitted comprises: an actual number of the VSSBs to be transmitted, a location and index information of each of valid unit time domain resources occupied by each of the VSSBs to be transmitted; and

a transmitting unit, configured to transmit the VSSBs in the VSSB transmitting time window according to the transmission information of the VSSBs to be transmitted.

21. The apparatus of claim 20, wherein the transmission information determination unit, comprises:

a quantity determination unit, configured to determine the actual number of the VSSBs to be transmitted, based on the information of the valid time domain resources and the number of the target beams; and

an valid location determination unit, configured to determine the location and index information of each of the valid unit time domain resources occupied by each of the VSSBs to be transmitted, according to the actual number of the VSSBs to be transmitted and the location and index information of each of the valid unit time domain resources.

22. The apparatus of claim 21, wherein the quantity determination unit is further configured to perform at least one of the following operations:

determining the number of the valid unit time domain resources to be the actual number of the VSSBs to be transmitted, in response to that the number of the target beams is greater than or equal to the number of the valid unit time domain resources; or

determining the number of the target beams to be the actual number of the VSSBs to be transmitted, in response to that the number of the target beams is less than the number of the valid unit time domain resources.

23. The apparatus of claim 21, wherein the transmitting unit comprises:

a target VSSB generation subunit, configured to load index information of the VSSBs to be transmitted into a set signal of the VSSBs to be transmitted, to generate target VSSBs that carry the index information; and

a target VSSB transmission subunit, configured to transmit the target VSSBs through multiple beams respectively in the VSSB transmitting time window.

24. The apparatus of claim 21, wherein the target VSSB generation subunit is further configured to perform at least one of the following operations:

indicating the index information of the VSSBs to be transmitted through corresponding DMRS target sequences;

loading the index information of the VSSBs to be transmitted into a first bit of a preset PSBCH signal; or

indicating a partial bit value of the index information of the VSSBs to be transmitted through the corresponding DMRS target sequences, and loading a remaining bit value of the index information of the VSSBs to be transmitted into a second bit of the preset PSBCH signal.

25. The apparatus of claim 23, wherein the target VSSB transmission subunit is further configured to transmit the PSBCH signal and the DMRS in each of the VSSBs in at least one of the following manners: frequency division multiplexing (FDM) or time division multiplexing (TDM).

26. An apparatus for receiving a reference signal, comprising:

a detection module, configured to detect a vehicle synchronization signal block (VSSB) in a new radio (NR) vehicle-to-everything (V2X) system transmitted by a vehicle-mounted device;

an index information acquisition module, configured to acquire VSSB index

information from the detected target VSSB;

a location determination module, configured to determine a time domain location corresponding to the target VSSB according to the VSSB index information; and

a synchronization module, configured to perform time domain synchronization with the vehicle-mounted device according to the time domain location;

wherein the detection module comprises:

a configuration information receiving submodule, configured to receive resource configuration information sent by a base station, the resource configuration information being configured to inform the receiving terminal to receive the VSSB with a configured resource;

a carrier frequency determination submodule, configured to determine information of a target carrier frequency for receiving the VSSBs according to the resource configuration information;

a subcarrier spacing determination submodule, configured to determine a detection subcarrier spacing according to the information of the target carrier frequency; and

a detection submodule, configured to detect the VSSB in a target resource by using the detection subcarrier spacing.

27. The apparatus of claim 26, wherein the index information acquisition module, comprises:

a parsing submodule, configured to parse the target VSSB to acquire a plurality of signals, wherein the plurality of signals comprise: a primary sidelink synchronization signal (PSSS), a secondary sidelink synchronization signal (SSSS), a physical sidelink broadcast channel (PSBCH) signal, and a demodulation reference signal (DMRS); and

an index information acquisition submodule, configured to acquire the VSSB index information from a preset signal, wherein the preset signal comprises at least one of the PSBCH signal or the DMRS.

28. The apparatus of claim 27, wherein the index information acquisition submodule,

comprises:

a first acquisition unit, configured to acquire the VSSB index information according to information carried in a preset DMRS sequence; and

a second acquisition unit, configured to parse the VSSB index information from a first bit of a preset PSBCH signal.

29. The apparatus of claim 27, wherein the index information acquisition submodule, comprises:

a first bit value determination unit, configured to acquire a partial bit value corresponding to the VSSB index information according to the information carried in a preset DMRS sequence;

a second bit value determination unit, configured to acquire a remaining bit value corresponding to the VSSB index information from a second bit of a preset PSBCH signal; and

a third bit value determination unit, configured to determine the VSSB index information, according to a complete bit value composed of the partial bit value and the remaining bit value.

30. The apparatus of claim 26, wherein the location determination module is further configured to:

determine the time domain location corresponding to the target VSSB, according to the VSSB index information, the information of the target carrier frequency and a target subcarrier spacing; wherein the target subcarrier spacing is a detection subcarrier spacing used when the target VSSB is detected.

31. A non-transitory computer storage medium having stored thereon computer executable instructions that, when executed by a processor, implement the steps of the method of any one of claims 1 to 10.

32. A non-transitory computer storage medium having stored thereon computer executable instructions that, when executed by a processor, implement the steps of the method of any one of claims 11 to 15.