

SYNCHRONIZATION SIGNAL TRANSMISSION METHOD, TRANSMITTING END DEVICE AND RECEIVING END DEVICE

5 Technical field

The embodiments of this application relate to the field of communication, and in particular, to a method of synchronous signal transmission, a transmitting device and a receiving end device.

Related Art

10 In 5-Generation New Radio (5G NR) system, in order to meet the flexibility of network deployment, it is necessary to ensure that cell synchronization signals can be deployed in any available frequency band to assist cell establishment. Driven by the above requirements, the synchronization raster (SS raster) in 5G NR system are relatively dense in order to provide enough frequency position for base stations to establish cells and UE to access the cells.

15 When communicating on the unlicensed frequency band, the initial access bandwidth of the cell in the unlicensed frequency band is not more than 20MHz, and the candidate positions of each 20MHz bandwidth on the unlicensed frequency band are also constrained. Therefore, the deployment of the initial access sub-band position of the cell in the unlicensed frequency band must be limited. It is obviously inefficient to continue to use the dense SS raster defined
20 by 5G NR as the position of synchronization signals for terminal devices to retrieve. Therefore, how to design SS raster with unlicensed frequency band is an urgent problem to be solved.

SUMMARY

The embodiments of this application provide a synchronous signal transmission method,
25 a transmitting device and a receiving end device, and designs frequency domain candidate positions of a synchronous signal on an unlicensed frequency band (also called SS raster), which can reduce the complexity of cell initially searching and reduce the influence of the position, where a cell in the unlicensed frequency band initially access the SS/PBCH block (SSB) in the subband, on the other channels in the subband.

30 In the first aspect, a method of synchronous signal transmission is provided, which includes:

The transmitting device transmits a synchronization signal block on a first frequency domain position, the first frequency domain position is located on the frequency domain candidate position of the synchronization signal, and each 20 MHz subband includes at least

one frequency domain candidate position of the synchronization signal.

Optionally, the first frequency domain position may be a resource on an unlicensed spectrum.

It should be noted that the transmitting device may be a network device.

5 In the second aspect, a method of synchronous signal transmission is provided, which includes:

the receiving device monitors for the synchronization signal block on a first frequency domain position, a first frequency domain position is located on the frequency domain candidate position of the synchronization signal, and each 20 MHz subband includes at least
10 one frequency domain candidate position of the synchronization signal.

It should be noted that the receiving device may be a terminal device.

In the third aspect, a transmitting device is provided for performing the methods in the first aspect or the embodiments thereof.

Specifically, the transmitting device includes a functional module for performing the
15 methods in the first aspect described above or the embodiments thereof.

In the fourth aspect, a receiving device is provided for performing the method in the second aspect described above or the embodiments thereof.

Specifically, the receiving device includes a functional module for performing the methods in the second aspect or the embodiments thereof.

20 In the fifth aspect, a transmitting device is provided, including a processor and a memory. The memory is used to a store computer program, and the processor is used to call and run the computer program stored in the memory to execute the methods in the first aspect or the embodiments thereof.

In the sixth aspect, a receiving device is provided, including a processor and a memory.
25 The memory is used to store a computer program, and the processor is used to call and run the computer program stored in the memory to execute the methods in the second aspect or the embodiments thereof.

In the seventh aspect, a chip is provided to execute the methods in any aspect of the first and the second aspects or the embodiments thereof.

30 Specifically, the chip includes a processor for calling and running a computer program from a memory so that the device installed with the chip performs the methods in any aspect of the first and the second aspects or the embodiments thereof.

In the eighth aspect, a computer-readable storage medium is provided for storing a computer program that causes the computer to perform the methods in any aspect of the first

and the second aspects or the embodiments thereof.

In the ninth aspect, a computer program product is provided, including a computer program instruction that causes the computer to perform the methods in any aspect of the first and the second aspects or the embodiments thereof.

5 In the tenth aspect, a computer program is provided, when which is running on a computer, causes the computer to perform the methods in any aspect of the first and the second aspects or the embodiments thereof.

The above embodiments design the frequency domain candidate position of synchronization signal on the unlicensed frequency band (also called SS raster), which can
10 reduce the complexity of cell initially searching and reduce the influence of the position, where a cell in the unlicensed frequency band initially access the SS/PBCH block (SSB) in the subband, on the other channels in the subband.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a schematic diagram of a communication system architecture according to the
15 embodiment of this application.

Fig.2 is a schematic flow chart of a synchronous signal transmission method according to the embodiment of this application.

Fig.3 is another schematic diagram of a synchronous signal transmission according to an embodiment of this application.

20 Fig.4 is another schematic diagram of another synchronous signal transmission according to an embodiment of this application.

Fig.5 is another schematic diagram of another synchronous signal transmission according to an embodiment of this application.

25 Fig.6 is another schematic diagram of another synchronous signal transmission according to an embodiment of this application.

Fig.7 is another schematic diagram of another synchronous signal transmission according to the embodiment of this application.

Fig.8 is another schematic diagram of another synchronous signal transmission according to an embodiment of this application.

30 Fig.9 is another schematic diagram of another synchronous signal transmission according to an embodiment of this application.

Fig.10 is a schematic flow chart of another synchronous signal transmission method according to the embodiment of this application.

Fig.11 is a schematic block diagram of a transmitting device according to an embodiment

of this application.

Fig.12 is a schematic block diagram of a receiving device according to an embodiment of this application.

Fig.13 is a schematic block diagram of a communication device according to an
5 embodiment of this application.

Fig.14 is a schematic block diagram of a chip according to an embodiment of this application.

Fig.15 is a schematic block diagram of a communication system according to an embodiment of this application.

10 **DETAILED DESCRIPTION**

The following describes the technical solutions in the embodiments of this application with reference to the the drawings in the embodiments of this application. Obviously, the described embodiments are some of the embodiments of this application rather than all the embodiments. Based on the embodiments of this application, all other embodiments obtained
15 by a person of ordinary skill in the art without creative efforts shall fall within the protection scope of this application.

The embodiment of this application can be applied to various communication systems, such as global system of mobile communication (GSM), a code division multiple access (CDMA) system, a wideband code division multiple access (WCDMA) system and a general
20 packet radio service (GPRS), a long term evolution (LTE) system, an advanced long term evolution (LTE-A) system, a new radio (NR) system, a NR system evolution system, LTE system on unlicensed spectrum(LTE-U), a NR based access to unlicensed spectrum) system on unlicensed spectrum (NR-U) system, a universal mobile communication system (UMTS), a wireless local area networks (WLAN), a wireless fidelity (WiFi), a next generation
25 communication system or other communication systems.

Generally speaking, the traditional communication system supports a limited number of connections and is easy to implement. However, with the development of communication technology, mobile communication system will not only support traditional communications, but also support, for example, device to device (D2D) communication, machine to machine
30 (M2M) communication, machine type communication (MTC), and vehicle to vehicle (V2V) communication and so on. The embodiments of this application can also be applied to these communication systems.

Optionally, the communication systems in the embodiments of this application can be applied to the carrier aggregation (CA) scenario, the dual connectivity (DC) scenario, and the
35 stand-alone (SA) networking scenario.

The embodiments of this application can be applied to unlicensed spectrum.

For example, the communication system 100 applied by the embodiment of this application is shown in Fig.1. The communication system 100 may include a network device 110, which may be a device communicating with a terminal device 120 (or called a communication terminal or a terminal). The network device 110 may provide communication coverage for a specific geographical region and may communicate with the terminal devices located in the coverage region.

Fig.1 illustrates an exemplary network device and two terminal devices. Optionally, the communication system 100 may include a plurality of network devices, and other number of terminal devices may be included within the coverage range of each network device, which is not limited in the embodiments of this application.

Optionally, the communication system 100 may further include a network controller, a mobility management entity and other network entities, which is not limited in the embodiments of this application.

It should be understood that the device with communication function in the network system in the embodiments of this application can be called communication device. Taking the communication system 100 shown in Fig.1 as an example, the communication device can include the network device 110 and the terminal device 120 with the communication function. The network device 110 and the terminal device 120 may be the specific device described above, which will not be repeated here. The communication device may also include other devices in the communication system 100, such as a network controller, a mobile management entity and other network entities, which are not limited in the embodiments of this application.

The embodiments of this application describe various embodiments in combination with network device and terminal device, wherein the terminal device can also be called a user device(UE), an access terminal, a user unit, a user station, a mobile station, a remote station, a remote terminal, a mobile device, a user terminal, a terminal, a wireless communication device, a user agent or a user device, etc. The terminal device can be a station (ST) in WLAN, a cellular phone, a cordless telephone, a session initiation protocol (SIP) telephone, a wireless local loop (WLL) station, a personal digital assistant (PDA) device, a handheld device with wireless communication function, a computing device or an other processing device connected to a wireless modem, a vehicle device, a wearable device and the next generation communication system, for example, a terminal device in NR network or a terminal device in future evolution public land mobile network (PLMN), etc.

As an example, rather than a limitation, in the embodiments of this application, the terminal device may also be a wearable device. The wearable device may also be called a wearable intelligent device, which is the general term for the wearable devices developed by

applying wearable technology to conduct intelligent design for daily wearables, such as glasses, gloves, watches, clothing and shoes, etc. The wearable devices are portable devices which are worn directly on the body or integrated into the user's clothing or accessories. Wearable devices are not only hardware devices, but also a device that implements powerful functions through software support, data interaction and cloud interaction. Generalized wearable intelligent devices include a kind of devices which are full-featured, large-size, and may achieve complete or partial functions without smart phones, such as smart watches or smart glasses, and a kind of devices which are only focus on one kind of application function, and need to cooperate with other devices such as smart phones, such as various types of smart bracelets and smart jewelry for physical signs monitoring.

Network device may be used to communicate with mobile devices. Network device may be an access point (AP) in WLAN, a base transceiver station (BTS) in GSM or CDMA, a NodeB (NB) in WCDMA, an evolutional node B (eNB or eNodeB) in LTE, a relay station or an access point, vehicle devices, wearable devices, network devices in NR network (gNB), or network devices in the future evolution PLMN.

In the embodiments of this application, the network devices provide services for the cell, and the terminal devices communicate with the network devices through the transmission resources (such as frequency domain resources or spectrum resources) used by the cell. The cell may be a cell corresponding to a network device (such as a base station), and the cell may belong to a macro base station or a base station corresponding to a small cell. The small cells here may include: a Metro cell, a Micro cell, a Pico cell, a Femto cell, etc. These small areas have the characteristics of small coverage and low transmission power, which are suitable for providing high-speed data transmission services.

It should be understood that, in 5G NR, the terminal device may search for synchronization signals on SS raster, then find cells and attempt to initiate access. The design details of SS raster for 5G NR are described in detail in 3GPP protocol 38.101. For example, the frequency domain positions of synchronization signals below 6GHz are shown in Table 1.

Table 1

Frequency Range	Frequency domain positions of synchronous signal blocks
0 – 3000 MHz	$N * 1200\text{kHz} + M * 50\text{ kHz}$, $N=1:2499, M \in \{1, 3, 5\}$
3000-6000 MHz	$3000\text{ MHz} + N * 1.44\text{ MHz}$ $N = 0:14756$

It should also be understood that in the study of unlicensed frequency bands, channel

candidate positions for 20MHz bandwidth are limited, as shown in Formula 1.

$$f_c = 5160 + (g * 20) \text{ MHz} \quad (\text{Formula 1})$$

wherein $0 \leq g \leq 9$ or $16 \leq g \leq 27$, g is an integer.

In addition, in the study of unlicensed frequency bands, the initial access bandwidth of the cells in unlicensed frequency bands is further restricted to less than 20MHz. Therefore, the initial access sub-band positions of the cells in unlicensed frequency bands will not be deployed at will like 5G NR.

After considering the above characteristics of the unlicensed frequency bands, it is obviously inefficient to continue to use the relatively dense SS raster defined by 5G NR as the positions of the synchronization signals for the terminal device to retrieve. How to redesign the SS raster of the unlicensed frequency bands will be a new problem. It will also be a new problem to consider which related factors should be considered when redesigning SS raster of unlicensed frequency bands. Based on considering the above problems, this application proposes a design method of synchronous signal transmitting and receiving positions in unlicensed frequency band.

Fig.2 is a schematic flow chart of a synchronous signal transmission method 200 according to the embodiment of this application. As shown in Fig.2, the method 200 may include the following contents:

S210, the transmitting device transmits a synchronization signal block on a first frequency domain position, the first frequency domain position is located on the candidate position in frequency domain of synchronous signal, and each 20 MHz subband includes at least one of the synchronization signal frequency domain candidate positions.

Optionally, the transmitting device may be a network device, for example, a network device as shown in Fig.1

It should be noted that the frequency domain candidate positions of the synchronization signals may be the SS raster on the unlicensed frequency bands.

It should be noted that, in the design of the candidate positions in frequency domain of synchronous signals, considering that the PDCCH and the synchronous signal block multiplex the frequency domain in the unlicensed frequency band, and the frequency domain granularity of the basic constituent unit of PDCCH needs six consecutive RBs, when designing the synchronous signal block positions within 20M bandwidth, it needs to be ensured that after removing the frequency bandwidth occupied by synchronous signal blocks within 20M bandwidth so that the remaining part shall be continuous 6 RBs or integer multiples of 6 RBs.

Optionally, in the embodiment of this application, the first frequency domain position can satisfy the following three situations:

In case 1, the first frequency domain position is the center frequency point position of the synchronization signal block;

In case 2, the first frequency domain position is the position of the resource element (RE) with the smallest number in the resource block (RB) with the smallest number of the synchronous signal block;

In case 3, the first frequency domain position is the position of the RE with the largest number in the RB with the largest number of the synchronous signal block.

Optionally, as an example 1, the first frequency domain position satisfies the case 1, that is, the first frequency domain position is the center frequency point position of the synchronization signal block.

Optionally, in example 1, the transmitting device determines the frequency domain candidate position of the synchronization signal according to formula 2,

$$f_c = f_1 + (g * 20) + f_2 \quad \text{Formula 2}$$

wherein,

f_c is the candidate position in frequency domain of synchronous signal,

f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

$f_1 + (g * 20)$ is the center frequency point position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and G is an integer,

f_2 is the offset of the candidate position of the center frequency point of the synchronous signal within a 20MHz subband.

Optionally, in example 1, the value of the f_2 is at least one of 180hz, -180kHz; or

the value of the f_2 is at least one of 0Hz, 360hz and -360kHz.

Optionally, in example 1, the transmitting device determines that the f_2 is at least one value satisfying any one of the formulas in formulas 3, 4, 5 and 6.

$$f_2 = \pm (25.5 - (6N + 10)) * 12 * 30\text{kHz} \quad \text{Formula 3}$$

wherein $0 \leq n \leq 5$.

$$f_2 = \pm (53 - (6N + 10)) * 12 * 15\text{KHz} \quad \text{Formula 4}$$

wherein $0 \leq n \leq 14$.

$$f_2 = \pm (26 - (6N + 10)) * 12 * 30\text{kHz} \quad \text{Formula 5}$$

wherein $0 \leq n \leq 5$.

$$f_2 = \pm (25 - (6N + 10)) * 12 * 30\text{kHz} \quad \text{Formula 6}$$

wherein $0 \leq n \leq 5$.

It should be noted that the Formula 3 is applicable to the scenario that the 20MHz unlicensed bandwidth includes 51 30kHz RBs, the subcarrier spacing is 30kHz, and the center points of 51 30kHz RBs are 25.5 30kHz RBs.

5 The Formula 4 is applicable to the scenario that 20MHz unlicensed bandwidth includes 106 15kHz RBs, the subcarrier spacing is 15kHz, and the center points of 106 15kHz RBs are 53 15kHz RBs.

The Formula 5 is applicable to the scenario that 20MHz unlicensed bandwidth includes 51 30kHz RBs, the subcarrier spacing is 30kHz, and the center points of 51 30kHz RBs are rounded up to 26 30kHz RBs.

The Formula 5 is applicable to the scenario that 20MHz unlicensed bandwidth includes 51 30kHz RBs, the subcarrier spacing is 30kHz, and the center points of 51 30kHz RBs are rounded down to 25 30kHz RBs.

15 Optionally, in example 1, the transmitting device determines that the f_2 satisfies at least one value according to formula 7 or formula 8.

$$f_2 = \pm (N_{bw}/2 - (6N + N_{ssb}/2)) * N_{sc} * \Delta F \text{ kHz} \quad \text{Formula 7}$$

Wherein, N_{bw} is the number of RBs within the 20MHz bandwidth when the subcarrier spacing is ΔF , N_{ssb} is the number of RBs occupied by synchronous signal block in frequency domain, N_{sc} is the number of subcarriers in one RB, and N is an integer.

20
$$f_2 = \pm ((N_{bw} \pm 1)/2 - (6N + N_{ssb}/2)) * N_{sc} * \Delta f \text{ kHz} \quad \text{Formula 8}$$

Wherein, N_{bw} is the number of RBs within 20MHz bandwidth when the subcarrier spacing is ΔF , N_{ssb} is the number of RBs occupied by synchronous signal block in frequency domain, N_{sc} is the number of subcarriers in one RB, and N is an integer.

25 Optionally, in example 1, the value of the f_2 is at least one of 5580kHz, 3420kHz, 1260kHz, -900kHz, -3060kHz and -5220kHz; or the value of the f_2 is at least one of 5220kHz, 3060kHz, 900kHz, -1260kHz, -3420kHz and -5580kHz; or the value of the f_2 is at least one of 5760kHz, 3600kHz, 1440kHz, -720kHz, -2880kHz and -5040kHz; or the value of the f_2 is at least one of 5040kHz, 2880kHz, 720kHz, -1440kHz, -3600kHz and -5760kHz; or the value of THE F_2 is at least one of 5400kHz, 3240kHz, 1080kHz, -1080kHz, -3240kHz and -5400kHz.

Optionally, as example 2, the first frequency domain position satisfies the case 2. That is, the first frequency domain position is the position of the RE with the smallest number in the RB with the smallest number of the synchronous signal block.

35 Optionally, in example 2, the transmitting device determines the frequency domain candidate position of the synchronization signal according to formula 9,

$$f_c = f_1 + (g \cdot 20) + f_2 + f_3$$

Formula 9

Wherein,

f_c is the candidate position in frequency domain of synchronous signal,

f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

$f_1 + (g \cdot 20)$ is the center frequency point position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and g is an integer,

f_2 is the offset of the candidate position of the center frequency point of the synchronous signal within a 20MHz subband,

f_3 is the offset of the position of the RE with the smallest number in the RB with the smallest number of the synchronous signal block from the position of the center frequency point of the synchronous signal block.

Optionally, in example 2,

the value of the f_2 is at least one of 180hz, -180kHz; or

the value of the f_2 is at least one of 0Hz, 360hz and -360kHz.

Optionally, in example 2, the transmitting device determines that the f_2 is at least one value satisfying any one of the formulas 3, 4, 5 and 6.

Optionally, in example 2, the transmitting device determines that the f_2 satisfies at least one value according to the formula 7 or formula 8.

Optionally, in example 2, the value of the f_2 is at least one of 5580kHz, 3420kHz, 1260kHz, -900kHz, -3060kHz and -5220kHz; or the value of the f_2 is at least one of 5220kHz, 3060kHz, 900kHz, -1260kHz, -3420kHz and -5580kHz; or the value of the f_2 is at least one of 5760kHz, 3600kHz, 1440kHz, -720kHz, -2880kHz and -5040kHz; or the value of the f_2 is at least one of 5040kHz, 2880kHz, 720kHz, -1440kHz, -3600kHz and -5760kHz; or the value of the f_2 is at least one of 5400kHz, 3240kHz, 1080kHz, -1080kHz, -3240kHz and -5400kHz.

Optionally, in example 2,

If the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 30kHz, the transmitting device determines that the $f_3 = -3600$ kHz; or

If the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 15 kHz, the transmitter determines that the $f_3 = -1800$ kHz.

Optionally, as example 3, the first frequency domain position satisfies case 3. That is, the

first frequency domain position is the position of the RE with the largest number in the RB with the largest number of the synchronous signal block.

Optionally, in example 3, the transmitting device determines the frequency domain candidate position of the synchronization signal according to formula 10,

5
$$f_c = f_1 + (g \cdot 20) + f_2 + f_4$$
 Formula 10

Wherein,

f_c is the candidate position in frequency domain of synchronous signal,

f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

10 $f_1 + (g \cdot 20)$ is the center frequency point position of the (g+1)th 20MHz subband of the unlicensed frequency band, and g is an integer,

f_2 is the offset of the candidate position of the center frequency point of the synchronous signal within a 20MHz subband,

15 f_4 is the offset of the position of the RE with the largest number in the RB with the largest number of the synchronous signal block from the center frequency point of the synchronous signal block.

Optionally, in example 3,

the value of the f_2 is at least one of 180hz, -180kHz; or

the value of the f_2 is at least one of 0Hz, 360hz and -360kHz.

20 Optionally, in example 3, the transmitting device determines that the f_2 is at least one value satisfying any one of the formulas 3, 4, 5 and 6.

Optionally, in example 3, the transmitting device determines that the f_2 satisfies at least one value according to the formula 7 or formula 8.

25 Optionally, in example 3, the value of the f_2 is at least one of 5580kHz, 3420kHz, 1260kHz, -900kHz, -3060kHz and -5220kHz; or the value of the f_2 is at least one of 5220kHz, 3060kHz, 900kHz, -1260kHz, -3420kHz and -5580kHz; or the value of the f_2 is at least one of 5760kHz, 3600kHz, 1440kHz, -720kHz, -2880kHz and -5040kHz; or the value of the f_2 is at least one of 5040kHz, 2880kHz, 720kHz, -1440kHz, -3600kHz and -5760kHz; or the value of the f_2 is at least one of 5400kHz, 3240kHz, 1080kHz, -1080kHz, -3240kHz and -5400kHz.

30 Optionally, in example 3,

If the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal block is 30 kHz, the transmitting device determines that the $f_4 = 3600\text{kHz}$; or

If the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal block is 15 kHz, the transmitting device determines that the $f_4 = 1800$ kHz.

Optionally, as an embodiment 1, the first frequency domain position is the center frequency point position of the synchronization signal block. That is, the transmitting device determines the frequency domain candidate position of the synchronization signal according to the Formula 2.

Specifically, as shown in Fig.3, in the embodiment 1, the values of parameters in Formula 2 are as follows:

$f_1 = 5160\text{MHz}$, which is the center frequency point of the first 20MHz subband of the unlicensed frequency band;

$f_1 + (g \times 20)$ is the center frequency position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and g is an integer;

$$f_2 = -(25.5 - (6 \times 3 + 10)) \times 12 \times 30\text{kHz} = 900\text{kHz}.$$

To sum up, it is concluded that the frequency domain candidate positions of the synchronous signal are: $f_c = 5160.9 + (g \times 20)$ MHz, and g is an integer.

It should be noted that, as shown in Fig.3, in addition to the 20 30kHz RBs occupied by the synchronous signal block, there are 18 30kHz continuous RBs. The 18 30kHz RBs can ensure the PDCCH transmission. That is, the multiplexing in frequency domain of PDCCH and synchronous signal block is realized.

Specifically, in the embodiment 1, when the network device transmits the synchronization signal on the unlicensed frequency band, the synchronization signal block occupies 20 30kHz RB in the frequency domain (referring to the area represented by the shaded part in Fig.3), and the network device selects one or more frequency points from the frequency points corresponding to f_c to send the synchronous signal block. The central frequency point of the synchronization signal block is located in the frequency point selected by the network device. When the terminal device conducts cell search on the unlicensed frequency band, it tries to search the synchronization signal on the frequency points corresponding to f_c .

Optionally, as an embodiment 2, the first frequency domain position is the center frequency point position of the synchronization signal block. That is, the transmitting device determines the frequency domain candidate position of the synchronization signal according to the Formula 2.

Specifically, as shown in Fig.4, in the embodiment 2, the values of parameters in Formula 2 are as follows:

$f_1 = 5160$ MHz, which is the center frequency point of the first 20MHz subband of the unlicensed frequency band;

$f_1 + (g*20)$ is the center frequency position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and g is an integer;

5 $f_2 = (25.5 - (6*2 + 10)) * 12 * 30 \text{ kHz} = 1260 \text{ kHz}.$

To sum up, it is concluded that the frequency domain candidate positions of the synchronous signal are: $f_c = 5161.26 + (g*20)$ MHz, g is an integer.

10 It should be noted that, as shown in Fig.4, in addition to the 20 30kHz RBs occupied by the synchronous signal block, there are 12 30kHz continuous RBs. The 12 30kHz RBs can ensure the PDCCH transmission. That is, the multiplexing in frequency domain of PDCCH and synchronous signal block is realized.

Specifically, in embodiment 2, when the network device transmits the synchronization signal on the unlicensed frequency band, the synchronization signal block occupies 20 30 kHz RBs in the frequency domain (referring to the area represented by the shaded part in Fig.4), and the network device selects one or more frequency points from the frequency points corresponding to f_c to send the synchronous signal block. The central frequency point of the synchronization signal block is located on the frequency point selected by the network device. When the terminal device conducts cell search on the unlicensed frequency band, it tries to search the synchronization signal on the corresponding frequency points corresponding to f_c .

20 Optionally, as an embodiment 3, the first frequency domain position is the center frequency point position of the synchronization signal block. That is, the transmitting device determines the frequency domain candidate position of the synchronization signal according to the Formula 2.

Specifically, as shown in Fig.5, in the third embodiment, the values of parameters in Formula 2 are as follows:

$f_1 = 5160$ MHz, which is the center frequency point of the first 20MHz subband of the unlicensed frequency band;

$f_1 + (g*20)$ is the center frequency position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and g is an integer;

30 $f_2 = -180 \text{ kHz}.$

To sum up, it is concluded that the frequency domain candidate positions of the synchronous signal are: $f_c = 5159.82 + (g * 20)$ MHz, and g is an integer.

Specifically, in the embodiment 3, when the network device transmits the synchronization signal on the unlicensed frequency band, the synchronization signal block occupies 20 30 kHz RBs in the frequency domain (referring to the area represented by the

shaded part in Fig.5), and the network device selects one or more frequency points from the frequency points corresponding to f_c to send the synchronous signal block. The central frequency point of the synchronization signal block is located on the frequency point selected by the network device. When the terminal device conducts cell search on the unlicensed frequency band, it tries to search the synchronization signal on the corresponding frequency points corresponding to f_c .

Optionally, as an embodiment 4, the first frequency domain position is the center frequency point position of the synchronization signal block. That is, the transmitting device determines the frequency domain candidate positions of the synchronization signal according to the Formula 2.

Specifically, as shown in Fig.6, in the embodiment 4, the values of parameters in Formula 2 are as follows:

$f_1 = 5160\text{MHz}$, which is the center frequency point of the first 20MHz subband of the unlicensed frequency band;

$f_1 + (g \times 20)$ is the center frequency position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and g is an integer;

$$f_2 = (26 - (6 \times 2 + 10)) \times 12 \times 30 \text{ kHz} = 1440 \text{ kHz}.$$

To sum up, it is concluded that the frequency domain candidate positions of the synchronous signal are $f_c = 5161.44 + (g \times 20) \text{ MHz}$, and g is an integer.

It should be noted that, as shown in Fig.6, there are 12 30kHz continuous RBS outside the 20 30kHz RBS occupied by the synchronous signal block. These 12 30kHz RBS can ensure the transmission of PDCCH, that is, the multiplexing in frequency domain of PDCCH and synchronous signal block is realized.

Specifically, in the embodiment 4, when the network device transmits the synchronization signal on the unlicensed frequency band, the synchronization signal block occupies 20 30 kHz RBs in the frequency domain (referring to the area represented by the shaded part in Fig.6), and the network device selects one or more frequency points from the frequency points corresponding to f_c to send the synchronous signal block. The central frequency point of the synchronization signal block is located on the frequency point selected by the network device. When the terminal device conducts cell search on the unlicensed frequency band, it tries to search the synchronization signal on the corresponding frequency points corresponding to f_c .

Optionally, as an embodiment 5, the first frequency domain position is the center frequency point position of the synchronization signal block. That is, the transmitting device determines the frequency domain candidate positions of the synchronization signal according to the Formula 2.

Specifically, as shown in Fig.7, in the embodiment 5, the values of parameters in formula 2 are as follows:

$f_1 = 5160\text{mhz}$, which is the center frequency point of the first 20MHz subband of the unlicensed frequency band;

5 $f_1+(g*20)$ is the center frequency position of the (g+1)th 20MHz subband of the unlicensed frequency band, and G is an integer;

$$f_2=-(26-(6*3+10))*12*30\text{ kHz}=720\text{kHz}.$$

To sum up, it is concluded that the frequency domain candidate positions of the synchronous signal are: $f_c = 5160.72 + (g * 20)$ MHz, and G is an integer.

10 It should be noted that, as shown in Fig.7, in addition to the 20 30kHz RBs occupied by the synchronous signal block, there are 18 30kHz continuous RBs. The 18 30kHz RBS can ensure the PDCCH transmission. That is, the multiplexing in frequency domain of PDCCH and synchronous signal block is realized.

Specifically, in the embodiment 5, when the network device transmits the
15 synchronization signal on the unlicensed frequency band, the synchronization signal block occupies 20 30 kHz RBs in the frequency domain (referring to the area represented by the shaded part in Fig.7), and the network device selects one or more frequency points from the frequency points corresponding to f_c to send the synchronous signal block. The central frequency point of the synchronization signal block is located on the frequency point selected
20 by the network device. When the terminal device conducts cell search on the unlicensed frequency band, it tries to search the synchronization signal on the corresponding frequency points corresponding to f_c .

Optionally, as an embodiment 6, the first frequency domain position is the center frequency point position of the synchronization signal block. That is, the transmitting device
25 determines the frequency domain candidate position of the synchronization signal according to the Formula 2.

Specifically, as shown in Fig.8, in the embodiment 6, the values of parameters in Formula 2 are as follows:

30 $f_1 = 5160\text{mhz}$, which is the center frequency point of the first 20MHz subband of the unlicensed frequency band;

$f_1+(g*20)$ is the center frequency position of the (g+1)th 20MHz subband of the unlicensed frequency band, and G is an integer;

$$f_2=(25-(6*2+10))*12*30\text{ kHz}=1080\text{kHz}.$$

To sum up, it is concluded that the frequency domain candidate positions of the
35 synchronous signal are: $f_c = 5161.08 + (g * 20)$ MHz, and g is an integer.

It should be noted that, as shown in Fig.8, in addition to the 20 30kHz RBS occupied by the synchronous signal block, there are 12 30kHz continuous RBS. The 12 30kHz RBS can ensure the PDCCH transmission. That is, the multiplexing in frequency domain of PDCCH and synchronous signal block is realized.

5 Specifically, in the embodiment 6, when the network device transmits the synchronization signal on the unlicensed frequency band, the synchronization signal block occupies 20 30 kHz RBs in the frequency domain (referring to the area represented by the shaded part in Fig.8), and the network device selects one or more frequency points from the frequency points corresponding to f_c to send the synchronous signal block. The central
10 frequency point of the synchronization signal block is located on the frequency point selected by the network device. When the terminal device conducts cell search on the unlicensed frequency band, it tries to search the synchronization signal on the corresponding frequency points corresponding to f_c .

Optionally, as an embodiment 7, the first frequency domain position is the center
15 frequency point position of the synchronization signal block, that is, the transmitting device determines the frequency domain candidate position of the synchronization signal according to the Formula 2.

Specifically, as shown in Fig.9, in the embodiment 7, the values of parameters in formula 2 are as follows:

20 $f_1 = 5160\text{MHz}$, which is the center frequency point of the first 20MHz subband of the unlicensed frequency band;

$f_1 + (g \cdot 20)$ is the center frequency position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and g is an integer;

$f_2 = 0\text{kHz}$.

25 To sum up, it is concluded that the frequency domain candidate positions of the synchronous signal are: $f_c = 5160 + (g \cdot 20)$ MHz, and g is an integer.

Specifically, in the embodiment 7, when the network device transmits the synchronization signal on the unlicensed frequency band, the synchronization signal block occupies 20 30kHz RBs in the frequency domain (referring to the area represented by the shaded part in Fig.9), and the network device selects one or more frequency points from the frequency points corresponding to f_c to send the synchronous signal block. The central
30 frequency point of the synchronization signal block is located on the frequency point selected by the network device. When the terminal device conducts cell search on the unlicensed frequency band, it tries to search the synchronization signal on the corresponding frequency points corresponding to f_c .
35

It should be understood that, in the embodiments 1 to 7 stated above, it is an example that

the first frequency domain position is the center frequency point position of the synchronization signal block. The first frequency domain position is the position of the RE with the smallest number in the R) with the smallest number of the synchronous signal block (corresponding to Formula 9). And t the first frequency domain position is the position of the RE with the largest number in the RB with the largest number of the synchronous signal block (corresponding to formula 10). For brevity, details are not described herein again.

It should also be understood that, in the embodiments 1 to 7 stated above, it is an example for illustration that a 20MHz unlicensed bandwidth includes 51 30kHz RBs, and the subcarrier spacing is 30kHz. The scenario of a 20MHz unlicensed bandwidth including 106 15kHz RBs and the subcarrier spacing being 15kHz is also applicable. For brevity, details are not described herein again.

Therefore, in the embodiments of this application, the frequency domain candidate position of the synchronization signal on the unlicensed frequency band (also called SS raster) is designed, which can reduce the complexity of the cell initially searching and reduce the influence of the position, where a cell in the unlicensed frequency band initially access the synchronization signal block in the subband, on the other channels in the subband.

Fig.10 is a schematic flow chart of a synchronous signal transmission method 300 according to an embodiment of this application. As shown in FIG.10, the method 300 may include the following contents:

S310, the receiving device monitors a synchronization signal block on a first frequency domain position, the first frequency domain position is located on the candidate positions in frequency domain of the synchronous signals, and each 20 MHz subband includes at least one of the synchronization signal frequency domain candidate positions.

Optionally, the receiving device is a terminal device, for example, the ermental device shown in Fig.1.

Optionally, in the embodiment of this application, the first frequency domain position can satisfy the following three situations:

In case 1, the first frequency domain position is the center frequency point position of the synchronization signal block;

In case 2, the first frequency domain position is the position of the RE with the smallest number in the RB with the smallest number of the synchronous signal block;

In case 3, the first frequency domain position is the position of the RE with the largest number in the RB with the largest number of the synchronous signal block.

Optionally, the first frequency domain position is the center frequency point position of the synchronization signal block.

Optionally, as an example 1, the first frequency domain position satisfies case 1, that is, the first frequency domain position is the center frequency point position of the synchronization signal block.

Optionally, in example 1, the receiving device determines the frequency domain
5 candidate position of the synchronization signal according to the formula $f_c = f_1 + (g \cdot 20) + f_2$,
wherein,

f_c is the candidate position in frequency domain of synchronous signal,

f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

10 $f_1 + (g \cdot 20)$ is the center frequency point position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and g is an integer,

f_2 is the offset of the candidate position of the center frequency point of the synchronous signal within a 20MHz subband.

Optionally, in example 1, the value of f_2 is at least one of 180hz, -180kHz; or

15 the value of the f_2 is at least one of 0Hz, 360Hz and -360kHz.

Optionally, in example 1,

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(N_{bw}/2 - (6n + N_{ssb}/2)) \cdot N_{sc} \cdot \Delta F$ kHz,

20 wherein, N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF ,
 N_{ssb} is the RB number occupied by the synchronous signal block in frequency domain, N_{sc} is the subcarrier number in one RB, and N is an integer.

Optionally, in example 1,

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm((N_{bw} \pm 1)/2 - (6n + N_{ssb}/2)) \cdot N_{sc} \cdot \Delta F$ kHz,

25 wherein, N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF ,
 N_{ssb} is the RB number occupied by the synchronous signal block in frequency domain, N_{sc} is the subcarrier number in one RB, and N is an integer.

Optionally, in example 1,

30 the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(25.5 - (6n + 10)) \cdot 12 \cdot 30\text{kHz}$, $0 \leq n \leq 5$; or

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(53 - (6n + 10)) \cdot 12 \cdot 15\text{KHz}$, $0 \leq n \leq 14$; or

the receiving device determines that the f_2 is at least one of the values satisfying the

formula $f2 = \pm(26 - (6n + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$; or

the receiving device determines that the $f2$ is at least one of the values satisfying the formula $f2 = \pm(25 - (6n + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$.

Optionally, in example 1, the value of the $f2$ is at least one of 5580kHz, 3420kHz, 1260kHz, -900kHz, -3060kHz and -5220kHz; or the value of the $f2$ is at least one of 5220kHz, 3060kHz, 900kHz, -1260kHz, -3420kHz and -5580kHz; or the value of the $f2$ is at least one of 5760kHz, 3600kHz, 1440kHz, -720kHz, -2880kHz and -5040kHz; or the value of the $f2$ is at least one of 5040kHz, 2880kHz, 720kHz, -1440kHz, -3600kHz and -5760kHz; or the value of the $f2$ is at least one of 5400kHz, 3240kHz, 1080kHz, -1080kHz, -3240kHz and -5400kHz.

Optionally, as example 2, the first frequency domain position satisfies the case 2. That is, the first frequency domain position is the position of the RE with the smallest number in the RB with the smallest number of the synchronous signal block.

Optionally, in example 2, the receiving device determines the frequency domain candidate position of the synchronization signal according to the formula $f_c = f1 + (g * 20) + f2 + f3$,

Wherein,

f_c is the candidate position in frequency domain of synchronous signal,

$f1$ is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

$f1 + (g * 20)$ is the center frequency point position of the $(g + 1)$ th 20MHz subband of the unlicensed frequency band, and g is an integer,

$f2$ is the offset position of the candidate position of the center frequency point of the synchronous signal in a 20MHz subband,

$f3$ is the offset of the position of the RE with the smallest number in the RB with the smallest number of the synchronous signal block from the position of the center frequency point of the synchronous signal block.

Optionally, in example 2, the value of the $f2$ is at least one of 180Hz, -180kHz; or

the value of the $f2$ is at least one of 0Hz, 360Hz and -360kHz.

Optionally, in example 2,

the receiving device determines that the $f2$ is at least one of the values satisfying the formula $f2 = \pm(N_{bw}/2 - (6n + N_{ssb}/2)) * N_{sc} * \Delta F$ kHz,

wherein, N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF , N_{ssb} is the RB number occupied by the synchronous signal block in frequency domain, N_{sc} is the subcarrier number in one RB, and N is an integer.

Optionally, in example 2,

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm((N_{bw} \pm 1)/2 - (6n + N_{ssb}/2)) * N_{sc} * \Delta F$ kHz,

wherein, N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF ,
5 N_{ssb} is the RB number occupied by the synchronous signal block in frequency domain, N_{sc} is the subcarrier number in one RB, and N is an integer.

Optionally, in example 2,

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(25.5 - (6n + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$; or

10 the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(53 - (6n + 10)) * 12 * 15\text{kHz}$, $0 \leq n \leq 14$; or

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(26 - (6n + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$; or

the receiving device determines that the f_2 is at least one of the values satisfying the
15 formula $f_2 = \pm(25 - (6n + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$.

Optionally, in example 2, the value of the f_2 is at least one of 5580kHz, 3420kHz, 1260kHz, -900kHz, -3060kHz and -5220kHz; or the value of the f_2 is at least one of 5220kHz, 3060kHz, 900kHz, -1260kHz, -3420kHz and -5580kHz; or the value of the f_2 is at least one of 5760kHz, 3600kHz, 1440kHz, -720kHz, -2880kHz and -5040kHz; or the value of the f_2 is
20 at least one of 5040kHz, 2880kHz, 720kHz, -1440kHz, -3600kHz and -5760kHz; or the value of the f_2 is at least one of 5400kHz, 3240kHz, 1080kHz, -1080kHz, -3240kHz and -5400kHz.

Optionally, in example 2,

if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 30kHz, the transmitting device
25 determines that the $f_3 = -3600\text{kHz}$; or

if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 15 kHz, the transmitter determines that the $f_3 = -1800\text{kHz}$.

Optionally, as example 3, the first frequency domain position satisfies the case 3. That is,
30 the first frequency domain position is the position of the RE with the largest number in the RB with the largest number of the synchronous signal block.

Optionally, in example 3, the receiving device determines the frequency domain candidate position of the synchronization signal according to the formula $f_c = f_1 + (g * 20) + f_2 + f_4$,

Wherein,

f_c is the candidate position in frequency domain of synchronous signal,

f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

5 $f_1+(g*20)$ is the center frequency point position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and G is an integer,

f_2 is the offset of the candidate position of the center frequency point of the synchronous signal in a 20MHz subband,

10 f_4 is the offset of the position of the RE with the largest number in the RB with the largest number of the synchronous signal block from the center frequency point of the synchronous signal block.

Optionally, in example 3,

the value of the f_2 is at least one of 180hz, -180kHz; or

the value of the f_2 is at least one of 0Hz, 360hz and -360kHz.

15 Optionally, in example 3,

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm (N_{bw}/2 - (6n + N_{ssb}/2)) * N_{sc} * \Delta f$ kHz,

20 wherein, N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF , N_{ssb} is the RB number occupied by synchronous signal block in frequency domain, N_{sc} is the number of subcarriers in one RB, and N is an integer.

Optionally, in example 3,

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm ((N_{bw} \pm 1)/2 - (6n + N_{ssb}/2)) * N_{sc} * \Delta f$ kHz,

25 wherein N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF , N_{ssb} is the RB number occupied by synchronous signal block in frequency domain, N_{sc} is the number of subcarriers in one RB, and N is an integer.

Optionally, in example 3,

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm (25.5 - (6n + 10)) * 12 * 30 \text{kHz}$, $0 \leq n \leq 5$; or

30 the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm (53 - (6n + 10)) * 12 * 15 \text{kHz}$, $0 \leq n \leq 14$; or

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm (26 - (6n + 10)) * 12 * 30 \text{kHz}$, $0 \leq n \leq 5$; or

the receiving device determines that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(25 - (6n + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$.

Optionally, in example 3, the value of the f_2 is at least one of 5580kHz, 3420kHz, 1260kHz, -900kHz, -3060kHz and -5220kHz; or the value of f_2 is at least one of 5220kHz, 3060kHz, 900kHz, -1260kHz, -3420kHz and -5580kHz; or the value of the f_2 is at least one of 5760kHz, 3600kHz, 1440kHz, -720kHz, -2880kHz and -5040kHz; or the value of the f_2 is at least one of 5040kHz, 2880kHz, 720kHz, -1440kHz, -3600kHz and -5760kHz; or the value of the f_2 is at least one of 5400kHz, 3240kHz, 1080kHz, -1080kHz, -3240kHz and -5400kHz.

Optionally, in example 3,

if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 30kHz, the transmitting device determines that the $f_4 = 3600\text{kHz}$; or

if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 15 kHz, the transmitter determines that the $f_4 = 1800\text{ kHz}$.

It should be understood that the steps in the method 300 of synchronous signal transmission can refer to the corresponding steps in the method 200 of synchronous signal transmission. For brevity, details are not described herein again.

Therefore, in the embodiments of this application, the frequency domain candidate position of the synchronization signal on the unlicensed frequency band (also called SS raster) is designed, which can reduce the complexity of the cell initially searching and reduce the influence of the position, where a cell in the unlicensed frequency band initially access the synchronization signal block in the subband, on the other channels in the subband.

Fig.11 shows a schematic block diagram of a transmitting device 400 according to an embodiment of this application. As shown in FIG.11, the transmitting device 400 includes:

a communication unit 410, configured to transmit a synchronization signal block at a first frequency domain position located on a frequency domain candidate position of a synchronous signal, and each 20 MHz subband includes at least one frequency domain candidate position of the synchronization signal.

Optionally, the first frequency domain position is the center frequency point position of the synchronization signal block.

Optionally, the transmitting device 400 further includes:

a processing unit 420, configured to determine the frequency domain candidate position of the synchronization signal according to the formula $f_c = f_1 + (g * 20) + f_2$,

wherein,

f_c is the candidate position in frequency domain of synchronous signal,
 f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,
 $f_1+(g*20)$ is the center frequency point position of the (g+1)th 20MHz subband of the unlicensed frequency band, and g is an integer,
 f_2 is the offset of the candidate position of the center frequency point of the synchronous signal within a 20MHz subband.
 Optionally, the transmitting device 400 further includes:
 a processing unit 420, configured to determine the frequency domain candidate position of the synchronous signal according to the formula $f_c = f_1+(g*20) + f_2 + f_3$,
 wherein,
 f_c is the candidate position in frequency domain of synchronous signal,
 f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,
 $f_1+(g*20)$ is the center frequency point position of the (g+1)th 20MHz subband of the unlicensed frequency band, and g is an integer,
 f_2 is the offset of the candidate position of the center frequency point of the synchronous signal in a 20MHz subband,
 f_3 is the offset of the position of the RE with the smallest number in the RB with the smallest number of the synchronous signal block from the position of the center frequency point of the synchronous signal block.
 Optionally, the processing unit 420 is further configured to:
 determine the $f_3 = -3600\text{kHz}$ if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 30kHz; or
 determine the $f_3 = -1800\text{kHz}$ if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 15 kHz.
 Optionally, the first frequency domain position is the position of the RE with the largest number in the RB with the largest number of the synchronous signal block.
 Optionally, the transmitting device 400 further includes:
 a processing unit 420 is used to determine the frequency domain candidate position of the synchronous signal according to the formula $f_c = f_1+(g*20) + f_2 + f_4$,
 wherein,

fc is the candidate position in frequency domain of synchronous signal,

f1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

f1+(g*20) is the center frequency point position of the (g+1)th 20MHz subband of the unlicensed frequency band, and g is an integer,

f2 is the offset position of the candidate position of the center frequency point of the synchronous signal in a 20MHz subband,

f4 is the offset of the position of the RE with the largest number in the RB with the largest number of the synchronous signal block from the center frequency point of the synchronous signal block.

Optionally, the processing unit 420 is further configured to:

determine the f4=3600 kHz if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 30kHz; or

determine the f4=1800 kHz if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 15 kHz.

Optionally, the value of f2 is at least one of 180hz, -180kHz; or

the value of the f2 is at least one of 0Hz, 360hz and -360kHz.

Optionally, the processing unit 420 is further configured to:

determine that the f2 is at least one of the values satisfying the formula $f2 = \pm (N_{bw}/2 - (6n + N_{ssb}/2)) * N_{sc} * \Delta f$ kHz,

wherein, N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF , N_{ssb} is the number of Rb occupied by synchronous signal block in frequency domain, n_{sc} is the number of subcarriers in one Rb, and N is an integer.

Optionally, the processing unit 420 is further configured to:

determine that the f2 is at least one of the values satisfying the formula $f2 = \pm ((N_{bw} \pm 1)/2 - (6n + N_{ssb}/2)) * N_{sc} * \Delta f$ kHz,

wherein, N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF , N_{ssb} is the RB number occupied by synchronous signal block in frequency domain, N_{sc} is the number of subcarriers in one RB, and N is an integer.

Optionally, the processing unit 420 is further configured to:

determine that the f2 is at least one of the value satisfying the formula $f2 = \pm (25.5 - (6N + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$; or

determine that the f_2 is at least one of the values satisfying the formula $f_2 = \pm (53 - (6N + 10)) * 12 * 15 \text{kHz}$, $0 \leq n \leq 14$; or

determine that the f_2 is at least one of the values satisfying the formula $f_2 = \pm (26 - (6N + 10)) * 12 * 30 \text{kHz}$, $0 \leq n \leq 5$; or

5 determine that the f_2 is at least one of the values satisfying the formula $f_2 = \pm (25 - (6N + 10)) * 12 * 30 \text{kHz}$, $0 \leq n \leq 5$.

Optionally, the value of the f_2 is at least one of 5580kHz, 3420kHz, 1260kHz, -900kHz, -3060kHz and -5220kHz; or

10 The value of the f_2 is at least one of 5220kHz, 3060kHz, 900kHz, -1260kHz, -3420kHz and -5580kHz; or

The value of the f_2 is at least one of 5760kHz, 3600kHz, 1440kHz, -720kHz, -2880kHz and -5040kHz; or

The value of the f_2 is at least one of 5040kHz, 2880kHz, 720kHz, -1440kHz, -3600kHz and -5760kHz; or

15 The value of the f_2 is at least one of 5400kHz, 3240kHz, 1080kHz, -1080kHz, -3240kHz and -5400kHz.

Optionally, the transmitting device 400 is a network device.

20 It should be understood that the transmitting device 400 according to the embodiment of this application can correspond to the transmitting device in the embodiments of the method of this application, and the above and other operations and/or functions of each unit in the transmitting device 400 respectively realize the corresponding processes of the transmitting device in the method 200 shown in Fig.2, and will not be described here for brevity.

Fig.12 shows a schematic block diagram of a receiving device 500 according to an embodiment of this application. As shown in FIG.12, the receiving device 500 includes:

25 a communication unit 510, configured to monitor for a synchronization signal block at a first frequency domain position, which is located on the frequency domain candidate position of the synchronization signal, wherein each 20 MHz subband includes at least one frequency domain candidate position of the synchronization signal.

30 Optionally, the first frequency domain position is the center frequency point position of the synchronization signal block.

The receiving device 500 further includes:

a processing unit 520, configured to determine the frequency domain candidate position of the synchronous signal according to the formula $f_c = f_1 + (g * 20) + f_2$,

wherein,

f_c is the candidate position in frequency domain of synchronous signal,

f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

5 $f_1+(g*20)$ is the center frequency point position of the (g+1)th 20MHz subband of the unlicensed frequency band, and g is an integer,

f_2 is the offset position of the candidate position of the center frequency point of the synchronous signal in a 20MHz subband.

Optionally, the first frequency domain position is the position of the RE with the smallest number of the RB with the smallest number in the synchronization signal block.

10 The receiving device 500 further includes:

a processing unit 520, configured to determine the frequency domain candidate position of the synchronous signal according to the formula $f_c = f_1+(g*20) + f_2 + f_3$,

wherein,

15 f_c is the candidate position in frequency domain of synchronous signal,

f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

$f_1+(g*20)$ is the center frequency point position of the (g+1)th 20MHz subband of the unlicensed frequency band, and g is an integer,

20 f_2 is the offset position of the candidate position of the center frequency point of the synchronous signal in a 20MHz subband,

f_3 is the offset of the position of the RE with the smallest number in the RB with the smallest number in the synchronous signal block from the position of the center frequency point of the synchronous signal block.

25 Optionally, the processing unit 520 is further configured to:

determine the $f_3=-3600$ kHz if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 30kHz; or

determine the $f_3=-1800$ kHz if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 15 kHz.

30 Optionally, the first frequency domain position is the position of the RE with the largest number in the RB with the largest number in the synchronization signal block.

The receiving device 500 further includes:

a processing unit 520, configured to determine the frequency domain candidate position of the synchronous signal according to the formula $f_c = f_1 + (g \cdot 20) + f_2 + f_4$,

wherein,

f_c is the candidate position in frequency domain of synchronous signal,

5 f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

$f_1 + (g \cdot 20)$ is the center frequency point position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and g is an integer,

10 f_2 is the offset of the candidate position of the center frequency point of the synchronous signal within a 20MHz subband,

f_4 is the offset of the position of the RE with the largest number in the RB with the largest number of the synchronous signal block from the center frequency point of the synchronous signal block.

Optionally, the processing unit 520 is further configured to:

15 determine the $f_4 = 3600$ kHz if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 30kHz; or

determine the $f_4 = 1800$ kHz if the synchronous signal block occupies 20 RBs in the frequency domain, and the subcarrier spacing of the synchronous signal blocks is 15 kHz.

Optionally, the value of the f_2 is at least one of 180Hz, -180kHz; or

20 the value of the f_2 is at least one of 0Hz, 360Hz and -360kHz.

Optionally, the processing unit 520 is further configured to:

determine that the f_2 is at least one of the values satisfying the formula $f_2 = \pm (N_{bw}/2 - (6N + n_{ssb}/2)) \cdot N_{sc} \cdot \Delta f$ kHz,

25 wherein, N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF , N_{ssb} is the RB number occupied by synchronous signal block in frequency domain, N_{sc} is the number of subcarriers in one RB, and N is an integer.

Optionally, the processing unit 520 is further configured to:

determine that the f_2 is at least one of the values satisfying the formula $f_2 = \pm ((N_{bw} \pm 1)/2 - (6N + N_{ssb}/2)) \cdot N_{sc} \cdot \Delta f$ kHz,

30 wherein N_{bw} is the RB number in 20MHz bandwidth when the subcarrier spacing is ΔF , N_{ssb} is the RB number occupied by synchronous signal block in frequency domain, N_{sc} is the number of subcarriers in one RB, and N is an integer.

Optionally, the processing unit 520 is further configured to:

determine that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(25.5 - (6n + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$; or

determine that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(53 - (6n + 10)) * 12 * 15\text{kHz}$, $0 \leq n \leq 14$; or

5 determine that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(26 - (6n + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$; or

determine that the f_2 is at least one of the values satisfying the formula $f_2 = \pm(25 - (6n + 10)) * 12 * 30\text{kHz}$, $0 \leq n \leq 5$.

10 Optionally, the value of the f_2 is at least one of 5580kHz, 3420kHz, 1260kHz, -900kHz, -3060kHz and -5220kHz; or

the value of the f_2 is at least one of 5220kHz, 3060kHz, 900kHz, -1260kHz, -3420kHz and -5580kHz; or

the value of the f_2 is at least one of 5760kHz, 3600kHz, 1440kHz, -720kHz, -2880kHz and -5040kHz; or

15 the value of the f_2 is at least one of 5040kHz, 2880kHz, 720kHz, -1440kHz, -3600kHz and -5760kHz; or

the value of the f_2 is at least one of 5400kHz, 3240kHz, 1080kHz, -1080kHz, -3240kHz and -5400kHz.

Optionally, the communication unit 510 is specifically configured to:

20 when cell search is performed on the unlicensed frequency band, monitor the synchronization signal block at the first frequency domain position.

Optionally, the receiving device 500 is a terminal device.

25 It should be understood that the receiving device 500 according to the embodiment of this application may correspond to the receiving device in the embodiments of the method of this application, and the above and other operations and/or functions of each unit in the receiving device 500 respectively realize the corresponding processes of the receiving device in the method 300 shown in FIG.10, and will not be repeated here for brevity.

30 Fig.13 is a schematic structural diagram of a communication device 600 provided by the embodiment of this application. The communication device 600 shown in FIG.13 includes a processor 610, which can call and run computer programs from the memory to realize the methods in the embodiments of this application.

Optionally, as shown in FIG.13, the communication device 600 may also include a memory 620, wherein the processor 610 may call and run a computer program from the memory 620 to implement the method in the embodiment of this application.

The memory 620 may be a separate device independent of the processor 610, or may be integrated in the processor 610.

Optionally, as shown in FIG.13, the communication device 600 may further include a transceiver 630, which can be controlled by the processor 610 to communicate with other devices and, in particular, may send information or data to other devices, or receive information or data sent by other devices.

Wherein, the transceiver 630 may include a transmitter and a receiver. The transceiver 630 further includes antennas and the number of the antennas may be one or more.

Optionally, the communication device 600 may be the transmitting device of the embodiments of this application, and the communication device 600 may realize the corresponding processes realized by the transmitting device in each method of the embodiments of this application. For brevity, details are not described herein again.

Optionally, the communication device 600 may be the receiving device of the embodiment of this application, and the communication device 600 may realize the corresponding processes realized by the receiving device in each method of the embodiment of this application. For brevity, details are not described herein again.

Fig.14 is a schematic structure diagram of the chip in the embodiment of this application. The chip 700 shown in FIG.14 includes a processor 710, which may call and run computer programs from the memory to realize the method in the embodiment of this application.

Optionally, as shown in FIG.14, the chip 700 may also include a memory 720. Wherein the processor 710 may call and run a computer program from the memory 720 to realize the methods in the embodiment of this application.

The memory 720 may be a separate device independent of processor 710 or integrated in the processor 710.

Optionally, the chip 700 may also include an input interface 730. Wherein the processor 710 may control the input interface 730 to communicate with other devices or other chips, in specifically, may obtain information or data sent by the other devices or the other chips.

Optionally, the chip 700 may also include an output interface 740. Wherein the processor 710 may control the output interface 740 to communicate with other devices or other chips, in specifically, may output information or data to the other devices or the other chips.

Optionally, the chip may be applied to the transmitting device in the embodiments of this application, and the chip may realize the corresponding processes implemented by the transmitting device in each method of the embodiments of this application. For brevity, details are not described herein again.

Optionally, the chip may be applied to the receiving device in the embodiments of this

application, and the chip may realize the corresponding processes realized by the receiving device in each method of the embodiments of this application. For brevity, details are not described herein again.

It should be understood that the chip mentioned in the embodiments of this application may also be referred to as system level chip, system chip, chip system or system on chip chip, etc.

FIG.15 is a schematic block diagram of a communication system 800 provided by the embodiment of this application. As shown in FIG.15, the communication system 800 includes a transmitting device 810 and a receiving device 820.

Wherein, the transmitting device 810 may be used to realize the corresponding functions realized by the transmitting device in the above methods, and the receiving device 820 may be used to realize the corresponding functions realized by the receiving device in the above methods. For brevity, details are not described herein again.

It should be understood that the processor of the embodiment of this application may be an integrated circuit chip with signal processing capability. In the implementation process, each step of the embodiments of the above methods may be completed through the integrated logic circuit of the hardware in the processor or the instruction in the form of software. The processor may be a general-purpose processor or a digital signal processor(DSP), an application specific integrated circuit (ASIC), a field programmable gate array(FPGA) or other programmable logic devices, discrete gates or transistor logic devices, and discrete hardware components. The methods, steps and logic block diagrams disclosed in the embodiments of this application may be implemented or executed. The general processor may be a microprocessor or any conventional processor, etc. The steps of the method disclosed in the embodiments of this application may completely executed by the hardware decoder processor directly, or by a combination of hardware and software modules in the decoder processor. The software modules may be located in a RAM, a flash memory, a read-only memory, a programmable read-only memory, or an electrically erasable programmable memory, a register and other mature storage media in the field. The storage medium is located in the memory. The processor reads the information in the memory and completes the steps of the above methods in combination with the hardware.

It may be understood that the memory in the embodiments of this application may be a volatile memory or a non-volatile memory, or may include both volatile and nonvolatile memories. Wherein the nonvolatile memory may be a read-only memory (ROM), a programmable ROM (PROM), an erasable PROM (EPROM), an electrically EPROM(EEPROM) or a flash memory. The volatile memory may be a random access memory (RAM), which is used as an external cache. By example but not by limitation, many forms of RAM are available, such as a static RAM (SRAM), a dynamic RAM (DRAM), a

synchronous DRAM (SDRAM), a double data rate SDRAM (DDR SDRAM), an enhanced SDRAM, (ESDRAM), a synchlink DRAM (SLDRAM) and a direct rambus RAM(DR RAM). It should be noted that the memory of the systems and methods described herein is intended to include, but is not limited to, these and any other suitable types of memory. It should be understood that the above memories are examples for illustration but not limitation. For example, the memory in the embodiments of this application may also be a static random access memory (SRAM), a dynamic random access memory (DRAM), a synchronous DRAM (SDRAM), a double data rate SDRAM (DDR SDRAM), an enhanced SDRAM (ESDRAM), a synch link DRAM (SLDRAM), a direct rambus RAM (DR RAM) and so on. That is, the storage in the embodiments of this application is intended to include but not be limited to these and any other suitable types of storages.

The embodiments of this application also provide a computer-readable storage medium for storing computer programs.

Optionally, the computer-readable storage medium may be applied to the transmitting device in the embodiments of this application, and the computer program enables the computer to execute the corresponding processes realized by the transmitting device in the various methods of the embodiments of this application. For brevity, details are not described herein again.

Optionally, the computer-readable storage medium may be applied to the receiving device in the embodiments of this application, and the computer program enables the computer to execute the corresponding processes implemented by the receiving device in the various methods of the embodiments of this application. For brevity, details are not described herein again.

The embodiments of this application also provide a computer program product including computer program instructions.

Optionally, the computer program product may be applied to the transmitting device in the embodiments of this application, and the computer program instruction enables the computer to execute the corresponding processes realized by the transmitting device in each method of the embodiments of this application. For brevity, details are not described herein again.

Optionally, the computer program product may be applied to the receiving device in the embodiment of this application, and the computer program instruction enables the computer to execute the corresponding processes realized by the receiving device in each method of the embodiments of this application. For brevity, details are not described herein again.

The embodiment of this application also provides a computer program.

Optionally, the computer program may be applied to the transmitting device in the

embodiment of this application. When the computer program is running on the computer, the computer may execute the corresponding processes realized by the transmitting device in each method of the embodiments of this application. For brevity, details are not described herein again.

5 Optionally, the computer program may be applied to the receiving device in the embodiments of this application. When the computer program is running on the computer, the computer may execute the corresponding processes realized by the receiving device in each method of the embodiments of this application. For brevity, details are not described herein again.

10 A person skilled in the art may realize that the units and algorithm steps of each example described in the embodiments disclosed herein may be realized in an electronic hardware, in a computer software or in combination with the computer software and the electronic hardware. Whether these functions are performed in hardware or software mode depends on the specific application and design constraints of the technical solution. Professional technicians may use
15 different methods to realize the described functions for each specific application, but such realizations shall not be considered beyond the scope of this application.

 A person skilled in the art may clearly understand that for the convenience and conciseness of the description, the specific working process of the system, the device and the unit described above may refer to the corresponding process in the embodiments of the above
20 methods, and details are not described herein again.

 In the embodiments provided by this application, it should be understood that the disclosed systems, the devices and the methods may be implemented in other ways. For example, the device embodiment described above is only schematic. For example, the division of the unit is only a logic function division, and there may be another division mode
25 in the actual implementation. For example, multiple units or components may be combined or integrated into another system, or some features may be ignored or not implemented. Another point, the coupling or direct coupling or communication connection between each other shown or discussed may be indirect coupling or communication connection through some interfaces, devices or units, and may be in electrical, mechanical or other forms.

30 The unit described as a separation component may or may not be physically separated, and the component displayed as a unit may be or may not be a physical unit, that is, it may be located in one place or distributed on a plurality of network units. Some or all of the units may be selected according to actual needs to realize the purpose of the present embodiment.

 In addition, each functional unit in each embodiment of this application may be
35 integrated into a processing unit, each unit may exist independently, or two or more units may be integrated in one unit.

If the function is realized in the form of a software function unit and sold or used as an independent product, it may be stored in a computer-readable storage medium. Based on such understanding, the essence part of the technical solution of this application, the part that contributes to the existing technology or the part of the technical solution can be embodied in the form of software products. The computer software product is stored in a storage medium, including a number of instructions to enable a computer device (which may be a personal computer, a server, or a network device, etc.) to perform all or some of the steps of the methods described in each embodiment of this application,). The storage medium stated above includes: a U disk, a , removable hard disk, a read-only Memory (ROM), a random access memory (RAM), a diskette or a CD- ROM, etc., which may store program code.

The above mentioned is merely specific implementations of this application, but not limit the protection scope of this application. Any variation or replacement readily figured only by a person skilled in the art within the technical scope disclosed in this application shall fall within the protection scope of this application. Therefore, the protection scope of this application shall be subject to the protection scope of the claims.

CLAIMS

What is claimed is:

1. A method for synchronous signal transmission, characterized in that the method comprises:

transmitting, by a transmitting device, a synchronization signal block on a first frequency domain position, wherein the first frequency domain position is located on the frequency domain candidate position of a synchronization signal, and each 20 MHz subband comprises one frequency domain candidate position of the synchronization signal; wherein the first frequency domain position is the center frequency point position of the synchronization signal block; wherein the frequency domain candidate position of the synchronization signal satisfies the formula $f_c = f_1 + (g \times 20) + f_2$,

wherein,

f_c is the candidate position in frequency domain of synchronous signal,

f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

$f_1 + (g \times 20)$ is the center frequency point position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and G is an integer,

f_2 is the offset of the candidate position of the center frequency point of the synchronous signal within a 20MHz subband.

2. The method according to claim 1, wherein,

the value of the f_2 is at least one of 180hz, -180kHz, 0Hz, 360hz, -360kHz, 5220kHz and 5040kHz.

3. The method according to any one of claims 1 to 2, wherein, a remaining part shall be continuous 6 RBs or integer multiples of 6 RBs after removing the frequency bandwidth occupied by synchronous signal blocks within the 20M bandwidth.

4. A method for synchronous signal transmission, characterized in that the method comprises:

monitoring, by the receiving device, for a synchronization signal block on a first frequency domain position, wherein first frequency domain position is located on the frequency domain candidate position of the synchronization signal, and each 20 MHz subband includes one frequency domain candidate position of the synchronization signal; wherein the first frequency domain position is the center frequency point position of the synchronization signal block; wherein the frequency domain candidate position of the synchronization signal satisfies the formula $f_c = f_1 + (g \times 20) + f_2$,

wherein,

f_c is the candidate position in frequency domain of synchronous signal,

f_1 is the center frequency point position of the first 20MHz subband of the unlicensed frequency band,

$f_1 + (g \times 20)$ is the center frequency point position of the $(g+1)$ th 20MHz subband of the unlicensed frequency band, and G is an integer,

f_2 is the offset of the candidate position of the center frequency point of the synchronous signal within a 20MHz subband.

5. The method according to claim 4, wherein,

the value of the f_2 is at least one of 180hz, -180kHz, 0Hz, 360hz, -360kHz, 5220kHz and 5040kHz.

6. The method according to any one of claims 4 to 5, wherein, a remaining part shall be continuous 6 RBs or integer multiples of 6 RBs after removing the frequency bandwidth occupied by synchronous signal blocks within the 20M bandwidth.

7. A transmitting device, wherein it comprises a processor and a memory, the memory is configured to store computer programs, and the processor is configured to call and run the computer programs stored in the memory to perform the method described in any one of claims 1 to 3.

8. A receiving end device, wherein it comprises a processor and a memory, the memory is configured to store computer programs, and the processor is configured to call and run the computer programs stored in the memory to perform the method according to any one of claims 4 to 6.

9. A computer-readable storage medium, wherein the computer-readable storage medium is configured to store a computer program that causes the computer to perform the method described in any one of claims 1 to 6.