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(54) **REFERENCE SIGNAL TRANSMISSION METHOD AND DEVICE**

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to the field of communication technologies, for example, to a method and apparatus for transmitting a reference signal.

BACKGROUND

[0002] In the existing art, in the long term evolution (LTE) system, a channel sounding reference signal (SRS), as an uplink reference signal occupies one time domain symbol (may occupy more than one time domain symbol merely in a special uplink subframe or in a special uplink pilot time slot (UpPTS)) in a slot. The Zadoff Chu (ZC) sequence with better correlation performance is used for the SRS, and an acquisition parameter of a sequence group number *u* of the ZC sequence includes the subframe serial number, so that the sequence group number *u* changes with the subframe to achieve interference randomization.

[0003] Unlike in LTE, in the new radio (NR) system, an SRS resource may occupy more than one time domain symbol in a slot, so that an improvement solution considering a change of the sequence group number of the ZC sequence is needed so as to obtain a better interference randomization effect.

[0004] There is no effective solution to the problem, in the existing art, that the manner of determining the reference signal is not applicable to the new wireless system in which the sequence group number and/or the sequence number changes.

[0005] LG Electronics: "On SRS design", 3GPP draft; R1-1719914, vol. RAN WG1, no. Reno, USA, 20171227 - 20171201, XP051369627 relates to SRS design.

[0006] LG Electronics: "Design of short PUCCH for UCI of up to 2 bits for NR" 3GPP draft; R1-1717956, vol. RAN WG1, no. Prague, CZ, 20171009-20171013, XP051341140 relates to design of short PUCCH for UCI of up to 2 bits for NR.

SUMMARY

[0007] The present disclosure provides a method and apparatus for transmitting a reference signal to at least solve the problem, in the existing art, that the manner of determining the reference signal is not applicable to the new wireless system in which the sequence group number and/or the sequence number changes. The requirements for the new wireless system in which the sequence group number and/or the sequence number changes can be met and thereby the interference between uplink measurement reference signals of cells is reduced.

[0008] The present disclosure provides a method for transmitting a reference signal, according to independent claim 1.

[0009] The present disclosure further provides an apparatus for transmitting a reference signal, according to independent claim 4.

[0010] The present disclosure further provides a storage medium. The storage medium includes stored programs which, when executed, perform any method described above.

[0011] The present disclosure further provides a processor. The processor is configured to execute programs which, when executed, perform any method described above.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a schematic flowchart of a method for transmitting a reference signal according to an embodiment;

FIG. 2 is a schematic diagram of a time domain symbol position occupied by an SRS resource 1 in a slot according to an embodiment;

FIG. 3 is a schematic diagram of a time domain symbol position occupied by an SRS resource 2 in a slot according to the embodiment;

FIG. 4 is a schematic diagram of a time domain symbol position occupied by an SRS resource 3 in a slot according to the embodiment;

FIG. 5 is a schematic diagram of a time domain symbol position occupied by an SRS resource 4 in a slot according to the embodiment;

FIG. 6 is a schematic diagram of a frame including 40 slots according to an embodiment; and

FIG. 7 is a schematic diagram of different BWPs corresponding to different slot serial numbers according to an embodiment.

DETAILED DESCRIPTION

[0013] Embodiments of the present disclosure provide a mobile communication network (which includes, but is not limited to the fifth-generation (5G) mobile communication network). The network architecture of the network may include a network side device (such as a base station) and a terminal. The embodiments provide an information transmission method executable on the network architecture described above. The operating environment of the above-described method for transmitting a reference signal provided in the embodiments is not limited to the above network architecture.

[0014] The method provided in the embodiments of the present disclosure may be performed by the terminal or the base station side. Both the terminal and the base station side may perform the method provided in the present disclosure.

[0015] A time unit described in the present disclosure is a slot, or a subframe, or a time domain symbol of a first subcarrier spacing. The time domain symbol of the first subcarrier spacing includes Q second subcarrier time domain symbols. Q is a positive integer greater than or equal to 1. Another time unit may also be provided as the time unit.

Embodiment one

[0016] An embodiment of the present disclosure provides a method for transmitting a reference signal. Referring to FIG. 1, the method provided by the embodiment includes steps 110, 120 and 130.

[0017] In the step 110, a sequence group number and/or a sequence number of the reference signal is obtained according to at least one of following pieces of information: the number N of time domain symbols included in a time unit in which the reference signal is located; a positive integer M; index information of time domain symbols in which the reference signal is located among N time domain symbols included in one time unit; index information of the time domain symbol in which the reference signal is located among M preset time domain symbols; a frame number of a frame in which the reference signal is located; the number B of time units included in the frame in which the reference signal is located; or a time unit index obtained according to a subcarrier spacing of a BWP in which the reference signal is located.

[0018] In the embodiment, M satisfies the following condition: M is less than or equal to N, and is greater than or equal to A. A is the maximum number of time domain symbols allowed to be occupied by the reference signal in one time unit, or A is the number of time domain symbols occupied by the reference signal in one time unit. In the embodiment, when the reference signal is a measurement reference signal, the reference signal refers to a measurement reference signal resource, such as an SRS resource.

[0019] In the step 120, the reference signal is determined according to the sequence group number and/or the sequence number.

[0020] In the step 130, the reference signal is transmitted.

[0021] In the embodiment, transmitting the reference signal may include sending or receiving the reference signal.

[0022] Through the above steps, the sequence group number and/or the sequence number of the reference signal is obtained according to at least one of the recorded information in the embodiment: the reference signal is determined according to the sequence group number and/or the sequence number; and the reference signal is transmitted. Thus, the problem, in the existing art, that the manner of determining the reference signal is not applicable to the new wireless system in which the sequence group number and/or the sequence number changes is solved, a manner of determining the reference signal and that is applicable to the new wireless system is provided, and requirements for the new wireless system in which the sequence group number and/or the sequence number changes can be met.

[0023] In an embodiment, M is determined according to one of following pieces of information: the number of time domain symbols included in a time domain symbol set allowed to be occupied by the reference signal in one time unit; the maximum value of the number of time domain symbols occupied by the reference signal in one time unit; or a distance between a time domain symbol having the largest index and a time domain symbol having the smallest index in the time domain symbol set allowed to be occupied by the reference signal in one time unit. The index is an index of a time domain symbol in the time domain symbol set included in the time unit.

[0024] In an embodiment, N and/or M are determined in one of the following manners: N and/or M are carried in received signaling information; or N and/or M are pre-agreed.

[0025] In an embodiment, the step of determining the reference signal according to the sequence group number and/or the sequence number includes determining the reference signal through the following manner:

$$r_{u,v}^{(\alpha,\delta)}(n) = e^{j\alpha\left(n+\delta\frac{\omega \bmod 2}{2}\right)}\bar{r}_{u,v}(n), \quad 0 \le n < M_{SC}^{RS} - 1$$

.

[0026] Where u is the sequence group number, $r_{u,v}^{(\alpha,\delta)}$ is the reference signal, M_{SC}^{RS} is a length of the reference signal, δ is the total number of comb levels of an interleaved frequency division multiple access (IFDMA) or δ is 0, and ω belongs to {0, 1}. In condition that M_{SC}^{RS} is greater than a predetermined threshold: $\bar{r}_{u,v}(n) = x_q(n \bmod N_{zc}^{RS}), n = 0,1,...,M_{SC}^{RS} - 1$; $x_q(m) = e^{-j\frac{\pi q m(m+1)}{N_{zc}^{RS}}}, m = 0,1,...,N_{zc}^{RS} - 1$; $q = \lfloor \bar{q} + 1/2 \rfloor + v \times (-1)^{\lfloor 2\bar{q} \rfloor}$; and $\bar{q} = N_{zc}^{RS}(u+1)/31$. v is the sequence number and belongs to {0,1}, $0 \le \alpha \le 2\pi$, and N_{zc}^{RS} is a largest prime number less than M_{SC}^{RS} . In condition that M_{SC}^{RS} is less than or equal to the predetermined threshold, $\bar{r}_{u,v}(n) = e^{j\varphi(n)\pi/4}, n = 0,1,....,M_{SC}^{RS} - 1$. Where $\varphi(n)$ is obtained by searching a preset table according to the sequence group number u, and v is 0.

[0027] In the embodiment, for the total number of comb levels of the IFDMA, for example, the reference signal occupies one RE per b resource elements (REs) in the orthogonal frequency division multiplexing (OFDM), then the total number of comb levels is b.

[0028] In an embodiment, index information of time domain symbols in which the reference signal is located in a time domain symbol set included in one time unit is sequentially increased from back to front in chronological order. The indexes may be numbered from the end position, similar to numbering in reverse order.

[0029] According to the invention, the sequence group number of the reference signal is obtained through the following manner: the sequence group number = $(f_{gh}(x) + f_{ss}) \bmod C$; or the sequence group number u is obtained according to $f_{gh}(x)$.

[0030] Where $f_{gh}(x)$ is a function with respect to x, x includes at least one of the information, C is the total number of sequence groups, and f_{ss} is obtained according to an agreed rule and/or a parameter included in received signaling information.

[0031] According to the invention, the at least one of the information included in x is relevant information used for determining the sequence number in the step one.

[0032] In an embodiment, $f_{gh}(x) = \left(\sum_{i=0}^{D-1} c(D * h(x) + i) * 2^i\right) \bmod C$.

[0033] Where $h(x)$ is a function with respect to x. x includes at least one of the information, and/or x includes a time unit index of the time unit in one frame. D is an integer greater than or equal to 8, c(z) is the z-th value in a sequence generated by a random sequence function c(), and z is a non-negative integer.

[0034] In the embodiment, the at least one of the information included in x is relevant information used for determining the sequence group number in the step one. x may further include a time unit index of the time unit in which the reference signal is located in one frame.

[0035] In an embodiment, at least one of the following characteristics is satisfied: D is carried in the received signaling information; $c()$ is a pseudo-random random sequence generation function; in condition that a value of C is greater than 30, D is greater than 8; $D \ge [\log_2(C)] + \left\lceil \log_2\left(\frac{C}{x_1}\right) \right\rceil - 1$; $D \ge [\log_2(C)$-1; when $x_1 > 0$, $D \ge [\log_2(C)] + \left\lceil \log_2\left(\frac{C}{x_1}\right) \right\rceil - 1$; or when $x_1 = 0$, $D \ge [\log_2(C)$- 1.

[0036] In an embodiment, $h(x)$ satisfies one of the following formulas: $h(I_1, M, n_s) = I_1 + n_s * M$; $h(I_1, M, n_s, n_f) = I_1 + n_s * M + B * n_f * M$; $h(I_2, N, n_s) = I_2 + n_s * N$; and $h(I_2, N, n_s, n_f) = I_2 + n_s * N + B * n_f * N$.

[0037] Where I_1 is index information of time domain symbols in which the reference signal is located in a set including M preset time domain symbols, $0 \le I_1 < M$, I_2 is index information of the time domain symbol in which the reference signal

is located among N time domain symbols included in one time unit, $0 \le l_2 < N$, and $n_f' = n_f$ or $n_f' = n_f \bmod(E)$. Where n_f is a frame number of a frame in which the reference signal is located, E is a predetermined value, and n_s is a time unit index obtained according to a subcarrier spacing of a BWP in which the reference signal is located or n_s is an index of a time unit in which the reference signal is located in one frame.

[0038] In an embodiment, the reference signal includes at least one of: a measurement reference signal, a demodulation reference signal, or a control channel frequency domain spreading sequence.

[0039] In an embodiment, the step of obtaining the sequence number according to the information includes: in a case of sequence hopping, the sequence number v satisfies $v = c(z_1)$. Where z_1 is obtained according to at least one of the information; $c(z)$ is the z-th value in a sequence generated by a random sequence function $c()$, and z is a non-negative integer.

[0040] In an embodiment, z_1 is obtained according to one of the following formulas: $z_1 = n_s * N + l_2$; $z_1 = n_s * M + l_1$; $z_1 = n_s * N + l_2 + B * N * n_f'$ or $z_1 = n_s * M + l_1 + B * M * n_f'$. l_1 is the index information of the time domain symbol in which the reference signal is located in the set including the M preset time domain symbols, $0 \le l_1 < M$, l_2 is the index information of the time domain symbol in which the reference signal is located among the N time domain symbols included in one time unit, $0 \le l_2 < N$, and $n_f' = n_f$ or $n_f' = n_f \bmod(E)$. n_f is the frame number of the frame in which the reference signal is located, E is the predetermined value, and n_s is the time unit index obtained according to the subcarrier spacing of the BWP in which the reference signal is located or n_s is the index of the time unit in which the reference signal is located in one frame.

[0041] Another embodiment of the present disclosure further provides a method for transmitting a reference signal. The method includes steps described below.

[0042] In a step 1, at least one of the following operations: selecting a parameter set from a plurality of parameter sets or selecting a formula from a plurality of formulas is performed according to signaling information or a pre-agreed rule.

[0043] In a step 2, a sequence group number and/or a sequence number are determined according to the selected parameter set and/or the selected formula.

[0044] In a step 3, the reference signal is determined according to the sequence group number and/or the sequence number.

[0045] In a step 4, the reference signal is transmitted. Transmission includes sending or reception.

[0046] In an embodiment, the execution order of the step 1, the step 2, the step 3, and the step 4 may be interchangeable, that is, the order of the step 1, the step 2, the step 3, and the step 4 is not limited in implementation of the solution.

[0047] With the above solution, the problem, in the existing art, that the manner of determining the reference signal is not applicable to the new radio system in which the sequence group number and/or the sequence number changes is solved, a manner of determining the reference signal and that is applicable to the new wireless system is provided, and requirements for the new wireless system the sequence group number and/or the sequence number changes can be met.

[0048] In an embodiment, the plurality of parameter sets at least includes a first parameter set and a second parameter set.

[0049] In an embodiment, the first parameter set at least includes one of the following parameters: the number L of time domain symbols occupied by the reference signal in one time unit, index information of time domain symbols occupied by the reference signal among the L time domain symbols, or a time unit index obtained according to a subcarrier spacing of a BWP in which the reference signal is located.

[0050] The second parameter set at least includes one of the following parameters: the number N of time domain symbols included in a time unit in which the reference signal is located; a positive integer M; index information of time domain symbols in which the reference signal is located in one time unit; index information of the time domain symbol in which the reference signal is located among M preset time domain symbols; a frame number of a frame in which the reference signal is located; a number B of time units included in the frame in which the reference signal is located; or a time unit index obtained according to a subcarrier spacing of a BWP in which the reference signal is located.

[0051] In the embodiment, the above parameter set at least includes one parameter.

[0052] In an embodiment, the plurality of parameter sets at least includes a third parameter set and a fourth parameter set. The third parameter set includes time domain symbol index information, and the fourth parameter set does not include the time domain symbol index information.

[0053] In an embodiment, N and/or M are determined according to one of the following manners: N and/or M are carried in received signaling information; or N and/or M are pre-agreed.

[0054] In an embodiment, the step of determining the reference signal according to the sequence group number and/or the sequence number includes determining the reference signal in the following manner: $r_{u,v}^{(\alpha,\delta)}(n) = e^{j\alpha\left(n+\delta\frac{\omega \bmod 2}{2}\right)}\bar{r}_{u,v}(n)$, $0 \le n < M_{SC}^{RS} - 1$.

[0055] Where u is the sequence group number, $r_{u,v}^{(\alpha.\beta)}$ is the reference signal, M_{SC}^{RS} $r_{u,v}^{(\alpha.\beta)}$ is a length of the reference signal, δ is the total number of comb levels of an IFDMA or *v* is 0, and ω belongs to {0, 1}. In condition that M_{SC}^{RS} is greater than a predetermined threshold: $\bar{r}_{u,v}(n) = x_q(n \bmod N_{zc}^{RS}), n = 0,1,..., M_{SC}^{RS} - 1$; $x_q(m) = e^{-j\frac{\pi q m(m+1)}{N_{zc}^{RS}}}, m = 0,1,...,N_{zc}^{RS} - 1$; $q = \lfloor \bar{q} + 1/2 \rfloor + v \times (-1)^{\lfloor 2\bar{q} \rfloor}$; and $\bar{q} = N_{zc}^{RS}(u+1)/31$. v is the sequence number and belongs to {0,1}, $0 \le \alpha \le 2\pi$, and N_{zc}^{RS} is a largest prime less than M_{SC}^{RS} N_{zc}^{RS}. In condition that M_{SC}^{RS} is less than or equal to the predetermined threshold, $\bar{r}_{u,v}(n) = e^{j\varphi(n)\pi/4}, n = 0,1,...., M_{SC}^{RS} - 1$. $\varphi(n)$ is obtained by searching a preset table according to the sequence group number u, and *v* is 0.

[0056] In an embodiment, the sequence group number of the reference signal is obtained in the following manner: the sequence group number $u = (f_{gh}(x) + f_{ss}) \bmod C$; or the sequence group number *u* is obtained according to $f_{gh}(x)$.

[0057] wherein $f_{gh}(x)$ is a function with respect to *x, x* comprises at least one of the information, *C* is a total number of sequence groups, and f_{ss} is obtained according to an agreed rule and/or a parameter included in received signaling information.

[0058] In an embodiment, $f_{gh}(x) = \left(\sum_{i=0}^{D-1} c(D * h(x) + i) * 2^i\right) \bmod C$.

[0059] Where *h*(*x*) is a function with respect to *x*. *x* includes at least one of the information, and/or *x* includes an index of the time unit in one frame. D is an integer greater than or equal to 8, c(z) is a z-th value in a sequence generated by a random sequence function *c*(), and z is a non-negative integer.

[0060] In an embodiment, at least one of the following characteristics is satisfied in the above-mentioned embodiment. D is carried in the received signaling information; *c*() is a pseudo-random random sequence generation function. In condition that a value of C is greater than 30, *D* is greater than 8; $D \ge \lceil \log_2(C) \rceil + \left\lceil \log_2\left(\frac{C}{x_1}\right) \right\rceil - 1$; $D \ge \lceil \log_2(C) \rceil$ - 1; when $x_1 > 0$, $D \ge \lceil \log_2(C) \rceil + \left\lceil \log_2\left(\frac{C}{x_1}\right) \right\rceil - 1$; when $x_1 = 0$, $D \ge [\log_2(C)] - 1$.

[0061] In an embodiment, *h*(*x*) satisfies one of the following formulas: $h(l_1, M, n_s) = l_1 + n_s * M$; $h(l_1,M,n_s,n_f) = l_1 + n_s * M + B * n_f * M$; $h(l_2,N,n_s) = l_2 + n_s * N$; and $h(l_2,N,n_s,n_f) = l_2 + n_s * N + B * n_f * N$.

[0062] Where l_1 is the index information of the time domain symbol in which the reference signal is located in the set including the M preset time domain symbols, l_2 is the index information of the time domain symbol in which the reference signal is located among the N time domain symbols included in one time unit, and $n_f' = n_f$ or $n_f' = n_f \bmod(E)$. n_f is the frame number of the frame in which the reference signal is located, E is the predetermined value, and n_s is the time unit index obtained according to the subcarrier spacing of the BWP in which the reference signal is located or n_s is the index of the time unit in which the reference signal is located in one frame.

[0063] In an embodiment, the formula is used for describing the hopping rules of the sequence group number and/or the sequence number.

[0064] In an embodiment, a hopping formula of the sequence group number includes at least one of: $h(l_0, L, n_s) = l_0 + n_s * L$; $h(l_1, M, n_s) = l_1 + n_s * M$; $h(l_1, M, n_s, n_f) = l_1 + n_s * M + B * n_f * M$; $h(l_2, N, n_s) = l_2 + n_s * N$; and $h(l_2, N, n_s, n_f) = l_2 + n_s * N + B * n_f * N$. A hopping formula of the sequence number v satisfies $v = c(z_1)$. z_1 is obtained according to one of following formulas: $z_1 = n_s * N + l_2$; $z_1 = n_s * M + l_1$; $z_1 = n_s * N + l_2 + B * N * n_f'$; or

$$z_1 = n_s * M + l_1 + B * M * n'_f$$

[0065] Where l_1 is index information of time domain symbols in which the reference signal is located in a set including M preset time domain symbols, l_2 is index information of the time domain symbol in which the reference signal is located among N time domain symbols included in one time unit, and $n'_f = n_f$ or $n'_f = n_f \bmod(E)$. n_f is a frame number of a frame in which the reference signal is located, E is a predetermined value, B is the number of time units included in the frame in which the reference signal is located, and n_s is a time unit index obtained according to a subcarrier spacing of a BWP in which the reference signal is located or n_s is an index of a time unit in which the reference signal is located in one frame.

[0066] The sequence group number u satisfies $u = (f_{gh}(x) + f_{ss}) \bmod C$, $f_{gh}(x) = \left(\sum_{l=0}^{D-1} c(D * h(x) + i) * 2^i\right) \bmod C$, $f_{gh}(x)$ is a function with respect to x, x includes at least one of the information, and c is the total number of sequence groups. D is an integer greater than or equal to 8. $c(z)$ is the z-th value in a random sequence generated by a random sequence function $c()$, and z is a non-negative integer. $h(x)$ is a function with respect to x, and x includes at least one of the information, and/or x includes an index of the time unit in the frame.

[0067] In an embodiment, the step of obtaining the sequence number according to the parameter includes: in a case of sequence hopping, the sequence number v satisfies $v = c(z_1)$. z_1 is obtained according to the parameter; $c(z)$ is the z-th value in a sequence generated by a random sequence function $c()$, and z is a non-negative integer.

[0068] In an embodiment, z_1 is obtained according to one of the following formulas: $z_1 = n_s * N + l_2$; $z_1 = n_s * M + l_1$; $z_1 = n_s * N + l_2 + B * N * n'_f$; or $z_1 = n_s * M + l_1 + B * M * n'_f$. l_1 is index information of time domain symbols in which the reference signal is located in a set including M preset time domain symbols, $0 \le l_1 < M$, l_2 is index information of the time domain symbol in which the reference signal is located among N time domain symbols included in one time unit, $0 \le l_2 < N$, and $n'_f = n_f$ or $n'_f = n_f \bmod(E)$. n_f is a frame number of a frame in which the reference signal is located, E is the predetermined value, and n_s is a time unit index obtained according to a subcarrier spacing of a BWP in which the reference signal is located or n_s is an index of a time unit in which the reference signal is located in one frame.

[0069] Another embodiment of the present disclosure further provides a method for sending signaling. The method may, and may not necessarily, be applied to a base station side. The method includes the steps described below.

[0070] In a step 1, signaling information is sent to a second communication node. The signaling information is used for instructing the second communication node to perform at least one of the following operations: selecting a first parameter set from at least one parameter set, or selecting a first formula from at least one formula; and determining a reference signal according to the first parameter and/or the first formula.

[0071] Another embodiment of the present disclosure further provides a method for transmitting a reference signal. The method includes steps described below.

[0072] In a step 1, a manner of obtaining a parameter for generating a sequence group number and/or a sequence number is determined according to signaling information or an agreed rule.

[0073] In a step 2, the parameter is determined according to the obtaining manner.

[0074] In a step 3, the sequence group number and/or the sequence number are generated according to the parameter.

[0075] In a step 4, the reference signal is determined according to the sequence group number and/or the sequence number.

[0076] In a step 5, the reference signal is transmitted. Transmission may include sending or receiving the reference signal.

[0077] In an embodiment, the execution order of the step 1, the step 2, the step 3, the step 4 or the step 5 is interchangeable, that is, the order of the step 1, the step 2, the step 3, the step 4 and the step 5 is not limited in implementation of the solution.

[0078] With the above solution, the problem, in the existing art, that the manner of determining the reference signal is not applicable to the change of the sequence group number and/or the sequence number in the new wireless system is solved, a manner of determining the reference signal and that is applicable to the new wireless system is provided, and requirements of the change of the sequence group number and/or the sequence number in the new wireless system can be met.

[0079] In an embodiment, the parameter for determining the sequence group number and/or the sequence number includes at least one of: a time domain symbol index or the number of time domain symbols.

[0080] In an embodiment, a manner of obtaining the time domain symbol index at least includes two of the following obtaining manners. The time domain symbol index is an index of a time domain symbol in which the reference signal is located among L time domain symbols. L is the number of time domain symbols occupied by the reference signal in one time unit.

[0081] The time domain symbol index is an index of a time domain symbol in which the reference signal is located among N time domain symbols. N is the number of time domain symbols included in a time unit in which the reference signal is located.

[0082] The time domain symbol index is an index of a time domain symbol in which the reference signal is located among M time domain symbols. M is the number of time domain symbols included in a time domain symbol set allowed to be occupied by the reference signal in one time unit.

[0083] In an embodiment, a manner of obtaining the number of time domain symbols at least includes two of the following obtaining manners.

[0084] The number of time domain symbols is the number of time domain symbols occupied by the reference signal in one time unit. In the embodiment, when the reference signal is a measurement reference signal, the reference signal refers to a reference signal resource.

[0085] The number of time domain symbols is the number of time domain symbols included in a time unit in which the reference signal is located.

[0086] The number of time domain symbols is the number of time domain symbols included in a time domain symbol set allowed to be occupied by the reference signal in one time unit.

[0087] Description will be made below in conjunction with the exemplary embodiments.

Exemplary embodiment one

[0088] In the embodiment, a Zadoff-Chu (ZC) sequence is used for the uplink sounding reference signal (SRS) when the length of the SRS is greater than a predetermined threshold, and a predetermined sequence is used when the sequence length of the SRS is less than or equal to the predetermined threshold.

[0089] In the embodiment, in LTE, the SRS reference signal $r_{u,v}^{(\alpha,\delta)}(n)$ is obtained by the following formula: $r_{u,v}^{(\alpha,\delta)}(n) = e^{j\alpha\left(n+\delta\frac{\varpi \bmod 2}{2}\right)}\bar{r}_{u,v}(n)$, $0 \le n < M_{\mathrm{sc}}^{\mathrm{RS}}$. $M_{\mathrm{sc}}^{\mathrm{RS}} = mN_{\mathrm{sc}}^{\mathrm{RB}}/2^{\delta}$ is the sequence length of the SRS, m is the number of physical resource blocks (PRBs) occupied by the SRS, δ is the total number of comb levels in the IFDMA manner, α is a cyclic shift parameter, and ω belongs to {0,1} or is fixed as 0.

[0090] When the sequence length M_{SC}^{RS} of the SRS is greater than $2N_{SC}^{NB}$ (N_{SC}^{NB} is the number of subcarriers included in a PRB, for example, in LTE and NR, N_{SC}^{NB} is 12), $\bar{r}_{u,v}(n) = x_q(n \bmod N_{zc}^{RS}), n = 0,1,...,M_{SC}^{RS}-1$, $x_q(m) = e^{-j\frac{\pi \bar{q} m(m+1)}{N_{zc}^{RS}}}$, $m = 0,1,...,N_{zc}^{RS}-1$; $q = \lfloor \bar{q} + 1/2 \rfloor + v \times (-1)^{\lfloor 2\bar{q} \rfloor}$; and $\bar{q} = N_{zc}^{RS}(u+1)/31$.

[0091] v is the sequence number and belongs to {0,1}, $0 \le \alpha \le 2\pi$, and N_{zc}^{RS} is the largest prime less than M_{SC}^{RS}. In an embodiment, when the number of PRBs occupied by the SRS is less than 6, v is 0. When the number of PRBs occupied by the SRS is greater than or equal to 6, v may be 0 or 1.

[0092] When the sequence length M_{SC}^{RS} of the SRS is less than or equal to $2N_{SC}^{NB}$, $\bar{r}_{u,v}(n) = e^{j\varphi(n)\pi/4}$, n=0,1,...., $M_{SC}^{RS}-1$.

[0093] $\varphi(n)$ is obtained by searching a preset table according to the sequence group number u. u is the sequence group number and is obtained by the following formula.

$$u = \left(f_{\mathrm{gh}}(n_{\mathrm{s}}) + f_{\mathrm{ss}}\right) \bmod 30 \qquad (1).$$

$$f_{gh}(n_s)=\begin{cases}0 & \text{If grouping number hopping is disabled}\\ \left(\sum_{l=0}^{7}C(8n_s+i)*2^i\right)\bmod 30 & \text{If grouping number hopping is disabled}\end{cases} \quad (2).$$

$c(z)$ is the z-th value in the Pseudo-random random sequence. Once an initialization value is given, a random sequence can be generated. The initialization value in the sequence generation is $c_{init}=\left\lfloor \frac{n_{ID}^{RS}}{30} \right\rfloor$, $f_{ss}=n_{\mathrm{ID}}^{\mathrm{RS}} \bmod 30$, and $n_{\mathrm{ID}}^{\mathrm{RS}}$ is a parameter configured by the higher-layer or a physical cell identification number.

[0094] A length-31 Pseudo-random random sequence is generated in the following manner.

$$c(n)=\left(x_1(n+N_C)+x_2(n+N_C)\right)\bmod 2$$

$$x_1(n+31)=\left(x_1(n+3)+x_1(n)\right)\bmod 2$$

$$x_2(n+31)=\left(x_2(n+3)+x_2(n+2)+x_2(n+1)+x_2(n)\right)\bmod 2$$

$n=0,1,\ldots,M_{\mathrm{PN}}-1$, $N_C=1600$, $x_1(0)=1, x_1(n)=0, n=1,2,\ldots,30$, $c_{\mathrm{init}}=\sum_{i=0}^{30}x_2(i)\cdot 2^i$.

[0095] It may be seen from formula (2) that when the sequence group number hopping is enabled, the acquisition information of the sequence group number includes the subframe serial number n_s. One SRS resource in the NR may include more than one time domain symbol in one slot. Thereby, the acquisition of the above sequence group number may be improved. The sequence group number and/or the sequence number are obtained according to at least one of following pieces of information. The information is the number N of time domain symbols included in a time unit; a positive integer M; index information of time domain symbols in which the reference signal is located among N time domain symbols included in one time unit; index information of the time domain symbol in which the reference signal is located among M preset time domain symbols; a frame number of a frame in which the reference signal is located; or the number B of time units included in one frame. M is a positive integer less than or equal to N and is greater than or equal to A. A is the maximum number of time domain symbols allowed to be occupied by the reference signal in one time unit, or A is the number of time domain symbols occupied by the reference signal in one time unit.

[0096] For example, the number of time domain symbols that an SRS resource may occupy in a slot is {1, 2, 4}. FIG. 3 is a schematic diagram of a time domain symbol position occupied by an SRS resource2 in a slot according to an embodiment. As shown in FIG. 3, the SRS resource 2 occupies two time domain symbols in one slot. A is 2, and then A is the number of time domain symbols occupied by the SRS resource2 in one slot. Or A is 4, and then A is the maximum number of time domain symbols allowed to be occupied by the SRS in one slot.

[0097] In an embodiment, the sequence number is obtained by using the following formula.

$$f_{gh}(n_s)=\begin{cases}0 & \text{If grouping number hopping is disabled}\\ \left(\sum_{l=0}^{7}c(8h()+i)*2^i\right)\bmod 30 & \text{If grouping number hopping is disabled}\end{cases} \quad (1\text{-}0)$$

[0098] Or when group hopping is enabled, $f_{gh}(x)=\left(\sum_{l=0}^{D-1}c(D*h()+i)*2^i\right)\bmod C$. C is the total number of sequence groups, and D satisfies at least one of the following four characteristics.

[0099] Characteristic 1: in condition that a value of C is greater than 30, D is greater than 8.

[0100] Characteristic 2: $D \geq \lceil \log_2(C) \rceil + \left\lceil \log_2\left(\frac{C}{x_1}\right) \right\rceil - 1$.

[0101] Characteristic 3: $D \geq \lceil \log_2(C) \rceil - 1$.

[0102] Characteristic 4: $D \geq \lceil \log_2(C) \rceil + \left\lceil \log_2\left(\frac{C}{x_1}\right) \right\rceil - 1$; and when $x_1 = 0$, $D \geq \lceil \log_2(C) \rceil - 1$. Where $x_1 = 2\lceil \log_2(C) \rceil - C$.

[0103] $h()$ is a function and may be one of the following formulas, or $h()$ in the manner of obtaining the sequence number is indicated through signaling to be a formula in a formula set formed by more than one of the following formulas. For example, the formula set is {(3-1),(3-2)}, and then $h()$ is indicated through signaling to be one of the formula (3-1) or the formula (3-2). Or the formula set is {(3-1),(3-2),(3-3),(3-4)}, and then $h()$ is indicated through signaling to be one of the formula (3-1), the formula (3-2), the formula (3-3), or the formula (3-4).

$$h(l_1, M, n_s) = l_1 + n_s * M, \tag{3-1}$$

$$h(l_1, M, n_s, n_f) = l_1 + n_s * M + B * n_f^{'} * M \ ; \tag{3-2}$$

$$h(l_2, N, n_s) = l_2 + n_s * N \ ; \tag{3-3}$$

$$h(l_2, N, n_s, n_f) = l_2 + n_s * N + B * n_f^{'} * N \tag{3-4}$$

[0104] Or when the sequence hopping is enabled, the sequence number $v = c(z_1)$. z_1 is obtained by using one of the following formulas.

$$z_1 = l_1 + n_s * M \tag{3-1B}$$

$$z_1 = l_1 + n_s * M + B * n_f^{'} * M \tag{3-2B}$$

$$z_1 = l_2 + n_s * N \tag{3-3B}$$

$$z_1 = l_2 + n_s * N + B * n_f^{'} * N \tag{3-4B}$$

[0105] In the formula {(3-2), (3-4), (3-2B), (3-4B)}, B is the number of slots included in one frame, $n_f^{'} = n_f$ or $n_f^{'} = n_f \bmod(E)$. n_f is the frame number of the frame in which the reference signal is located, or may also be referred to as the frame index. FIG. 6 is a schematic diagram of a frame including 40 slots according to an embodiment. As shown in FIG. 6, one frame corresponds to 10 ms, one frame includes 40 slots, and then B is equal to 40. E is a predetermined value. In an embodiment, E is an integer multiple of C.

[0106] In the formula set {(3-1), (3-2), (3-1B), (3-2B)}, M is the number of time domain symbols included in the time domain symbol set that the SRS may occupy in a slot. As shown in FIG. 2 to FIG. 5, the time domain symbols that may be occupied by the SRS is the last six time domain symbols of one slot, and the number of time domain symbols occupied by one SRS resource in one slot belongs to {1, 2, 4}. Then, M=6. l_1 is the relative index of the time domain symbols occupied by the SRS resource among the preset M time domain symbols. As shown in FIG. 2 to FIG. 5, l_1 is the relative

index of the time domain symbol occupied by the SRS resource among the last 6 time domain symbols in one slot. As shown in FIG. 2, FIG. 2 is a schematic diagram of a time domain symbol position occupied by an SRS resource1 in a slot according to an embodiment. The SRS resource1 occupies four time domain symbols {9,10,11,12} in a slot, and correspondingly l_1 = {1,2,3,4}. As shown in FIG. 3, the SRS resource2 occupies two time domain symbols {11,12} in a slot, and the corresponding l_1 = {3,4}. FIG. 4 is a schematic diagram of a time domain symbol position occupied by an SRS resource 3 in a slot according to an embodiment. As shown in FIG. 4, the SRS resource 3 occupies two time domain symbols {12,13} in a slot, and correspondingly l_1 = {4,5}. FIG. 5 is a schematic diagram of a time domain symbol position occupied by an SRS resource4 in a slot according to an embodiment. As shown in FIG. 5, the SRS resource4 occupies one time domain symbol {12} in a slot, and correspondingly l_1 = {4}.

[0107] The above-mentioned symbol indexes l_1 of the M time domain symbols are numbered sequentially in chronological order from front to back, that is, the index l_1 of the foremost time domain symbol among the M time domain symbols is 0. The embodiment does not exclude that the symbol indexes l_1 of the M time domain symbols are numbered sequentially in chronological order from back to front, that is, the index l_1 of the backmost time domain symbol among the M time domain symbols corresponds to 0. As shown in FIG. 2 to FIG. 5, l_1 is the relative index of the time domain symbol occupied by the SRS resource among the last six time domain symbols in a slot. As shown in FIG. 2, the SRS resource1 occupies four time domain symbols {9,10,11,12} in a slot, and correspondingly l_1 = {4,3,2,1}. As shown in FIG. 3, the SRS resource2 occupies two time domain symbols {11, 12} in a slot, and correspondingly l_1 = {2,1}. As shown in FIG. 4, the SRS resource 3 occupies two time domain symbols {12,13} in a slot, and correspondingly l_1 = {1,0}. As shown in FIG. 4, the SRS resource 3 occupies one time domain symbol {12} in a slot, and correspondingly l_1 = {1}.

[0108] In the formula set {(3-3), (3-4), (3-3B), (3-4B)}, the number of time domain symbols included in one slot is 14, and then N = 14. As shown in FIG. 2 to FIG. 5, the time domain symbols that the SRS may occupy are the last six time domain symbols in a slot, and the number of time domain symbols occupied by an SRS resource in a slot belongs to {1, 2, 4}. l_2 is the index information of the time domain symbol occupied by the SRS resource and included in the time domain symbol set in a slot. As shown in FIG. 2 to FIG. 5, l_2 is the index information of the time domain symbol occupied by the SRS resource in the set including 14 time domain symbols and included in one slot. As shown in FIG. 2, the SRS resource1 occupies four time domain symbols {9,10,11,12} in a slot, and correspondingly l_2 = {9,10,11,12}. As shown in FIG. 3, the SRS resource2 occupies two time domain symbols {11,12}, and correspondingly l_2 = {11, 12}. As shown in FIG. 4, the SRS resource 3 occupies two time domain symbols {12,13} in a slot, and correspondingly l_2 = {12,13}. As shown in FIG. 5, the SRS resource4 occupies one time symbol {12} in a slot, and correspondingly l_2 = {12}.

[0109] l_2 is the symbol index of the time domain symbol occupied by the SRS among N time domain symbols included in a slot and the symbol indexes are numbered sequentially in chronological order from front to back, that is, l_2 of the starting time domain symbol among the N time domain symbols in the slot is 0. The embodiment does not exclude that the symbol indexes of the N time symbols included in a slot are numbered sequentially in chronological order from front to back, that is, l_2 of the end time domain symbol among the N time domain symbols in the slot corresponds to 0. As shown in FIG. 2, the SRS resource1 occupies four time domain symbols {9,10,11,12} in a slot, and correspondingly l_2 = {4,3,2,1}. As shown in FIG. 3, the SRS resource2 occupies two time domain symbols {11,12} in a slot, and correspondingly l_2 = {2,1}. As shown in FIG. 4, the SRS resource 3 occupies two time domain symbols {12,13} in a slot, and correspondingly l_2 = {1,0}. As shown in FIG. 5, the SRS resource 3 occupies one time domain symbol {12} in a slot, and correspondingly l_2 = {1}.

[0110] In the embodiment, the terminal determines the SRS reference signal according to the sequence group number, and sends the reference signal via the SRS port.

[0111] The above is taking the reference signal sequence acquisition of the uplink measurement reference signal as an example. Similarly, this method may also be used for the reference signal sequence of the uplink demodulation reference signal, or may also be used for the sequence group number of the ZC sequence used for frequency domain spreading of the uplink control channel. Details are not described here again.

[0112] In the embodiment, although N and M are preset fixed values, N and M are also called acquisition parameters or input parameters of the function $h()$.

[0113] In another embodiment, the base station may also allocate information about N and/or M to the terminal.

Exemplary embodiment two

[0114] In the embodiment, a base station sends signaling information. The signaling information includes selection information for Q parameter sets. The terminal obtains a sequence group number and/or a sequence number of a reference signal according to a parameter set indicated by the signaling information, and obtains the reference signal according to the sequence group number and/or the sequence number. The Q is a positive integer greater than or equal to 1.

[0115] For example, Q parameter sets includes a first parameter set and a second parameter set. The first parameter set at least includes one of the following parameters: the number L of time domain symbols occupied by the reference

signal in one time unit, index information of time domain symbols occupied by the reference signal among the L time domain symbols, or a time unit index obtained according to a BWP in which the reference signal is located. When the reference signal is a measurement reference signal, the number L of time domain symbols occupied by the reference signal in one time unit is the number L of time domain symbols occupied by a measurement reference signal resource in one time unit.

[0116] The second parameter set at least includes one of the following parameters: the number N of time domain symbols included in one time unit; a positive integer M; index information of time domain symbols in which the reference signal is located in one time unit; index information of the time domain symbol in which the reference signal is located among M preset time domain symbols; a frame number; the number B of time units included in the frame; or a time unit index obtained according to the BWP in which the reference signal is located.

[0117] The parameter set at least includes one parameter.

[0118] As shown in FIG. 2 to FIG. 5, the number of time domain symbols occupied by an SRS resource in a slot belongs to {1, 2, 4}, and the time domain symbols that the SRS may occupy is the last six time domain symbols in a slot.

[0119] If the sequence group number is obtained with the first parameter set, the formula $h()$ of the sequence group number hopping (1-0) is as shown in the formula (4-1).

$$h(l, L, n_s) = l_0 + n_s * L \quad , \tag{4-1}$$

[0120] And/or when the sequence number hopping is enabled, the sequence number $v = c(z_1)$ and z_1 is obtained by using the following formula.

$$z_1 = l_0 + n_s * L \tag{4-1B}$$

[0121] L is the number of time domain symbols occupied by an SRS resource in a slot, and l_0 is the index information of the time domain symbols occupied by the SRS resource among the L time domain symbols occupied by the SRS resource in the slot. As shown in FIG. 2, the SRS resource1 occupies four time domain symbols {9,10,11,12} in a slot, and correspondingly l_0 = {0,1,2,3} and L=4. As shown in FIG. 3, the SRS resource2 occupies two time domain symbols {11,12} in a slot, and correspondingly l_0 = {0,1} and L=2. As shown in FIG. 4, the SRS resource 3 occupies two time domain symbols {12,13} in a slot, and correspondingly l_0 = {0,1} and L=2. As shown in FIG. 5, the SRS resource4 occupies one time domain symbol {12} in a slot, and correspondingly l_0 = {0} and L=1.

[0122] If the sequence group number is obtained with the second parameter set, the hopping formula $h()$ of the sequence group number is one of formulas (4-2) to (4-5).

$$h(l_1, M, n_s) = l_1 + n_s * M \quad ; \tag{4-2}$$

$$h(l_1, M, n_s, n_f) = l_1 + n_s * M + B * n_f^{'} * M \quad ; \tag{4-3}$$

$$h(l_2, N, n_s) = l_2 + n_s * N \quad ; \tag{4-4}$$

$$h(l_2, N, n_s, n_f) = l_2 + n_s * N + B * n_f^{'} * N \tag{4-5}$$

[0123] And/or when the sequence number hopping is enabled, the sequence number $v = c(z_1)$ and z_1 is obtained by using the following formula.

$$z_1 = l_1 + n_s * M \quad (4\text{-}2B)$$

$$z_1 = l_1 + n_s * M + B * n_f^{'} * M \quad (4\text{-}3B)$$

$$z_1 = l_2 + n_s * N \quad (4\text{-}4B)$$

$$z_1 = l_2 + n_s * N + B * n_f^{'} * N \quad (4\text{-}5B)$$

[0124] In the formula set {(4-3), (4-5), (4-3B), (4-5B)}, B is the number of slots included in one frame, $n_f^{'} = n_f$ or $n_f^{'} = n_f \bmod(E)$. n_f is the frame number of the frame in which the reference signal is located, or may also be referred to as the frame index. FIG. 6 is a schematic diagram of a frame including 40 slots according to an embodiment. As shown in FIG. 6, one frame corresponds to 10 ms, one frame includes 40 slots, and then B is equal to 40. E is a predetermined value, and in an embodiment, E is an integer multiple of C.

[0125] In the formula set {(4-2), (4-3), (4-2B), (4-3B)}, M is the number of time domain symbols included in the time domain symbol set that the SRS may occupy in a slot. As shown in FIG. 2 to FIG. 5, the SRS may occupy the last six time domain symbols of a slot in the slot, and the number of time domain symbols occupied by an SRS resource in the slot belongs to {1, 2, 4}. That is, an SRS resource may occupy {1, 2, 4} time domain symbols among the last six time domain symbols in a slot, and then M=6. l_1 is the relative index of the time domain symbol occupied by the SRS resource among the preset M time domain symbols. As shown in FIG. 2 to FIG. 5, l_1 is the relative index of the time domain symbol occupied by the SRS resource among the last 6 time domain symbols in one slot. As shown in FIG. 2, the SRS resource1 occupies four time domain symbols {9,10,11,12} in a slot, and correspondingly l_1 = {1,2,3,4}. As shown in FIG. 3, the SRS resource2 occupies two time domain symbols {11,12} in a slot, and correspondingly l_1 = {3,4}. As shown in FIG. 4, the SRS resource 3 occupies two time domain symbols {12,13} in a slot, and correspondingly l_1 = {4,5}. As shown in FIG. 5, the SRS resource4 occupies one time domain symbol {12} in a slot, and correspondingly l_1 = {4}.

[0126] The above-mentioned symbol indexes l_1 of the M time domain symbols are numbered sequentially in chronological order from front to back, that is, the index l_1 of the foremost time domain symbol among the M time domain symbols is 0. The embodiment does not exclude that the symbol indexes l_1 of the M time domain symbols are numbered sequentially in chronological order from back to front, that is, the index l_1 of the backmost time domain symbol among the M time domain symbols corresponds to 0. As shown in FIG. 2 to FIG. 5, l_1 is the relative index of the time domain symbol occupied by the SRS resource among the last six time domain symbols in a slot. As shown in FIG. 2, the SRS resource1 occupies four time domain symbols {9,10,11,12} in a slot, and correspondingly l_1 = {4,3,2,1}. As shown in FIG. 3, the SRS resource2 occupies two time domain symbols {11,12} in a slot, and correspondingly l_1 = {2,1}. As shown in FIG. 4, the SRS resource 3 occupies two time domain symbols {12,13} in a slot, and correspondingly l_1 = {1,0}. As shown in FIG. 5, the SRS resource 3 occupies one time domain symbol {12} in a slot, and correspondingly l_1 = {1}.

[0127] In the formula set {(4-4),(4-5),(4-4B),(4-5B)}, the number of time domain symbols included in one slot is 14 and then N = 14, or the time domain symbols in a slot in which the reference symbol is located is 14 and then N=14. As shown in FIG. 2 to FIG. 5, the time domain symbols that the SRS may occupy are the last six time domain symbols in a slot, and the number of time domain symbols occupied by an SRS resource in a slot belongs to {1, 2, 4}. l_2 is the index information of the time domain symbol occupied by the SRS resource and included in a set including N time domain symbols and included in one slot. As shown in FIG. 2 to FIG. 5, l_2 is the index information of the time domain symbol occupied by the SRS resource in a set including 14 time domain symbols and included in one slot. As shown in FIG. 2, the SRS resource1 occupies four time domain symbols {9,10,11,12} in a slot, and correspondingly l_2 = {9,10,11,12}. As shown in FIG. 3, the SRS resource2 occupies two time domain symbols {11,12} in a slot, and correspondingly l_2 = {11, 12}. As shown in FIG. 4, the SRS resource 3 occupies two time domain symbols {12,13} in a slot, and correspondingly l_2 = {12,13}. As shown in FIG. 5, the SRS resource4 occupies one time domain symbol {12} in a slot, and correspondingly l_2 = {12}.

[0128] l_2 is the symbol index of the time domain symbol occupied by the SRS among N time domain symbols included

in a slot and the symbol indexes are numbered sequentially in chronological order from front to back, that is, l_2 of the starting time domain symbol among the N time domain symbols in the slot is 0. The embodiment does not exclude that the symbol indexes l_2 of the N time symbols included in a slot are numbered sequentially in chronological order from front to back, that is, l_2 of the end time domain symbol among the N time domain symbols in the slot corresponds to 0. As shown in FIG. 2, the SRS resource1 occupies four time domain symbols {9,10,11,12} in a slot, and correspondingly l_2 = {4,3,2,1}. As shown in FIG. 3, the SRS resource2 occupies two time domain symbols {11,12} in a slot, and correspondingly l_2 = {2,1}. As shown in FIG. 4, the SRS resource 3 occupies two time domain symbols {12,13} in a slot, and correspondingly l_2 = {1,0}. As shown in FIG. 5, the SRS resource 3 occupies one time domain symbol {12} in a slot, and correspondingly l_2 = {1}.

[0129] In the embodiment, the base station may also send signaling information to indicate a formula used for obtaining $h()$ of the sequence group number obtaining formula (1-0) to the terminal. The formula includes at least formula (4-1) and one in the formula set {(4-2) to (4-5)}.

[0130] Similarly, the base station may also send signaling information to indicate a formula used for obtaining z_1 of the sequence number hopping formula $v = c(z_1)$ to the terminal. The formula includes at least formula (4-1B) and one in the formula set {(4-2B) to (4-5B)}.

[0131] In another embodiment, Q parameter sets at least includes a third parameter set and a fourth parameter set. The third parameter set includes time domain symbol information, and the fourth parameter set does not include the time domain symbol information.

[0132] If the sequence group number is obtained with the fourth parameter set, the $h()$ of the sequence group number obtaining formula is as shown in the formula (4-6).

$$h(n_s) = n_s, \qquad (4\text{-}6)$$

[0133] Similarly, if the sequence number is obtained with the fourth parameter set, z_1 of the sequence number $v = c(z_1)$ is as shown in the formula (4-6B).

$$z_1 = n_s, \qquad (4\text{-}6B)$$

[0134] The base station may also notify through signaling a formula, in the formula set, referred to for sequence number hopping, and the formula set may include any two or more of the formulas (4-1) to (4-6).

[0135] Similarly, the base station may also notify through signaling a formula, in the formula set, referred to for determining z_1 of the sequence number hopping $v = c(z_1)$, and the formula set may include any two or more of the formulas (4-1B) to (4-6B).

[0136] The parameter set in the embodiment may also be selected from a plurality of parameter sets by using a rule agreed between the base station and the terminal. Similarly, the formula in the embodiment may also be selected from a plurality of formulas by using a rule agreed between the base station and the terminal.

Exemplary embodiment three

[0137] In the embodiment, a sequence group number of an uplink demodulation reference signal may also be obtained by using the method described in the above-mentioned exemplary embodiment one and/or exemplary embodiment two.

Exemplary embodiment four

[0138] In the embodiment, a sequence group number of an uplink control channel frequency domain spreading may also be obtained by using the method described in the above-mentioned exemplary embodiment one and/or exemplary embodiment two.

[0139] For example, in the physical uplink control channel (PUCCH) formats 1 and 2 in NR, uplink control information is spread in the frequency domain by using $r_{u,v}^{(\alpha,\delta)}(n)$, and the sequence group number u may also be obtained by using the method described in the above-mentioned exemplary embodiment one and/or exemplary embodiment two.

Exemplary embodiment five

[0140] In the embodiment, n_s is the index information of the slot in which the reference signal is located among B slots included in one radio frame. Since the BWPs in which the reference signal (such as the SRS) is located are different and the subcarrier spacings corresponding to the BWPs are different, the numbers of slots included in one frame corresponding to different BWPs are different, that is, B is different, and then n_s is different. n_s is obtained based on the BWP in which the SRS is located.

[0141] FIG. 7 is a schematic diagram of different BWPs corresponding to different slot serial numbers according to an embodiment. As shown in FIG. 7, one slot in the BWP1 corresponds to two slots in the BWP2, so that n_s in the above-mentioned embodiment is the slot serial number obtained according to the subcarrier spacing of the BWP in which the reference signal is located. For example, a frame is 10 ms, one frame including 20 slots is obtained according to the subcarrier spacing corresponding to the BWP1, and one frame including 40 slots is obtained according to the subcarrier spacing corresponding to the BWP2. At time t, if the BWP in which the reference signal is currently located is the BWP1 as shown in FIG. 7, $n_s = x$, and if the BWP in which the reference signal is currently located is the BWP2 as shown in FIG. 7, $n_s = 2x$ or $n_s = 2x+1$.

Exemplary embodiment six

[0142] In the embodiment, the manner of obtaining the parameter of the sequence group number or the sequence number is determined by signaling information or an agreed rule.

[0143] In an embodiment, the sequence group number u is obtained according to formulas (6-1) and (6-2).

$$u = \left(f_{\text{gh}}(n_{\text{s}}) + f_{\text{ss}}\right) \bmod 30 \tag{6-1}$$

$$f_{gh}(n_s) = \begin{cases} 0 & \text{If grouping number hopping is disabled} \\ \left(\sum_{i=0}^{7} C(8h() + i) * 2^i\right) \bmod 30 & \text{If grouping number hopping is disabled} \end{cases} \tag{6-2},$$

where

$$h(l_5, N_5, n_s) = l_5 + n_s * N_5 .$$

[0144] Or when the sequence number hopping is enabled, the sequence number $v = c(z_1)$. $z_1 = l_5 + n_s * N_5$.

[0145] The manner of obtaining (l_5, N_5) is determined by the signaling information or the agreed rule, or the meaning of (l_5, N_5) is determined by the signaling information or the agreed rule. The obtaining manner includes at least two of the three manners.

[0146] Manner 1: $(l_5, N_5) = (l_0, L)$. L is the number of time domain symbols occupied by an SRS resource in a slot. As shown in FIG. 2, L=4, l_5 is an index of the time domain symbol in which the reference signal is located among the L time domain symbols, and $0 \le l_5 \le L-1$. For example, l_5 of the time domain symbol 9 in which the reference signal is located in FIG. 2 is 0.

[0147] Manner 2: $(l_5, N_5) = (l_1, M)$. M is the number of time domain symbols included in the time domain symbol set that the SRS may occupy in a slot. As shown in FIG. 2, the SRS of every user may occupy only {1, 2, 4} time domain symbols of the last six time domain symbols in one slot, and then M=6. l_5 is the index of the time domain symbol in which the reference signal is located among the M time domain symbols, and $0 \le l_5 \le M-1$.For example, l_5 of the time domain symbol 9 in which the SRS is located in FIG. 2 is 1.

[0148] Manner 3: $(l_5, N_5) = (l_2, N)$. N is the number of time domain symbols included in in a slot in which the SRS resource is located. As shown in FIG. 2, N=14, l_5 is an index of the time domain symbol in which the reference signal is located among the L time domain symbols, and $0 \le l_5 \le N-1$. For example, l_5 of the time domain symbol 9 in which the reference signal is located in FIG. 2 is 9.

Exemplary embodiment 7

[0149] In the embodiment, a sequence number is obtained according to at least one of following pieces of information: the number N of time domain symbols included in a time unit in which the reference signal is located; a positive integer

M; index information of time domain symbols in which the reference signal is located among N time domain symbols included in one time unit; index information of the time domain symbol in which the reference signal is located among M preset time domain symbols; a frame number of a frame in which the reference signal is located; the number B of time units included in the frame in which the reference signal is located; or a time unit index obtained according to a subcarrier spacing of a BWP in which the reference signal is located. The reference signal is obtained according to the sequence number, and transmitted via the reference signal port.

[0150] In an embodiment, the reference signal is $r_{u,v}^{(\alpha,\delta)}(n)$, v is the sequence number, and v is obtained by using the following formula: $v = \begin{cases} 0 & \text{Sequence hopping is disabled} \\ c(z_1) & \text{Sequence hopping is enabled} \end{cases}$. $c(z_1)$ is the z_1-th value of the Pseudo-random random sequence. The initialization value of the Pseudo-random random sequence is obtained by the agreed rule. The obtaining formula of z_1 may be one of the following formulas: $z_1=n_s*N+l_2$; $z_1=n_s*M+l_1$; $z_1 = n_s * N + l_2 + B * N * n_f^{'}$; $z_1 = n_s * M + l_1 + B * M * n_f^{'}$; or $z_1=n_s*L+l_0$.

[0151] l_1 is the index information of the time domain symbol in which the reference signal is located in a preset set including M time domain symbols, and $0 \le l_1 < M$. l_2 is index information of the time domain symbol in which the reference signal is located among N time domain symbols included in one time unit, $0 \le l_2 < N$, and $n_f^{'} = n_f$ or $n_f^{'} = n_f \bmod(E)$. n_f is the frame number of the frame in which the reference signal is located, and E is a predetermined value. B is the number of time units included in the frame in which the reference signal is located. B is the number of slots included in the frame in which the reference signal is located.

[0152] In the above-mentioned embodiment, the uplink reference signal is taken as an example, and the present disclosure does not exclude that the reference signal is a downlink reference signal.

[0153] From the description of the embodiments described above, it may be understood by those skilled in the art that the method of any embodiment described above may be implemented by means of software plus a general-purpose hardware platform, or may be implemented by hardware. Based on such understanding, the solution provided by the present disclosure may be embodied in the form of a software product. The computer software product is stored in a non-transient storage medium (such as a read-only memory (ROM), a random-access memory (RAM), a magnetic disk or an optical disk) and the storage medium includes multiple instructions for enabling a terminal device (which may be a mobile phone, a computer, a server, or a network device) to perform the method described in any embodiment of the present disclosure.

Embodiment two

[0154] The embodiment further provides an apparatus for transmitting a reference signal. The apparatus is configured to implement the above-mentioned embodiments. What has been described will not be repeated. As used below, the term "module" may be software, hardware or a combination thereof capable of implementing predetermined functions. The apparatus described below in the embodiment may be implemented by software, but implementation by hardware or by a combination of software and hardware is also possible and conceived.

[0155] Another embodiment of the present disclosure further provides an apparatus for transmitting a reference signal. The apparatus includes: a first obtaining module, a first determination module and a first transmission module. The first obtaining module is configured to obtain a sequence group number and/or a sequence number of a reference signal according to at least one of following pieces of information: the number N of time domain symbols included in a time unit in which the reference signal is located; a positive integer M; index information of time domain symbols in which the reference signal is located among N time domain symbols included in one time unit; index information of the time domain symbol in which the reference signal is located among M preset time domain symbols; a frame number of a frame in which the reference signal is located; the number B of time units included in the frame in which the reference signal is located; or a time unit index obtained according to a subcarrier spacing of a BWP in which the reference signal is located. The first determination module is configured to determine the reference signal according to the sequence group number and/or the sequence number. The first transmission module is configured to transmit the reference signal. M satisfies the following condition: M is less than or equal to N and is greater than or equal to A. A is the maximum number of time domain symbols allowed to be occupied by the reference signal in one time unit, or A is the number of time domain symbols occupied by the reference signal in one time unit.

[0156] Another embodiment of the present disclosure further provides an apparatus for transmitting a reference signal.

The apparatus includes: a performing module, which is configured to perform, according to signaling information or a pre-agreed rule, at least one of following operations: selecting a parameter set from a plurality of parameter sets, or selecting a formula from a plurality of formulas; a second determination module, which is configured to determine, according to the selected parameter set and/or the selected formula, a sequence group number and/or a sequence number; a third determination module, which is configured to determine the reference signal according to the sequence group number and/or the sequence number; and a second transmission module, which is configured to transmit the reference signal.

[0157] Another embodiment of the present disclosure further provides an apparatus for transmitting a reference signal. The apparatus includes: a fourth determination module, which is configured to determine, according to signaling information or an agreed rule, a manner of obtaining a parameter for generating a sequence group number and/or a sequence number; a fifth determination module, which is configured to determine the parameter according to the obtaining manner; a first generation module, which is configured to generate the sequence group number and/or the sequence number according to the parameter; a sixth determination module, which is configured to determine the reference signal according to the sequence group number and/or the sequence number; and a third transmission module, which is configured to transmit the reference signal.

[0158] In the embodiment, the modules of the apparatus in any embodiment described above may perform the corresponding method and steps in the embodiment one.

[0159] The plurality of modules described above may be implemented by software or hardware. Implementation by hardware may, but may not necessarily, be performed in the following manner: the plurality of modules described above are located in a same processor or located in their respective processors in any combination form.

Embodiment three

[0160] Another embodiment of the present disclosure further provides a processor. The processor is configured to execute programs which, when executed, perform the method of any one of the embodiments described above.

Embodiment four

[0161] Another embodiment of the present disclosure further provides a storage medium. The storage medium includes stored programs which, when executed, perform the method of any one of the embodiments described above.

[0162] Those skilled in the art should know that the above-mentioned at least one module or at least one step of the present disclosure may be implemented by a general-purpose computing apparatus, and the above-mentioned at least one module or at least one step may be concentrated on a single computing apparatus or distributed on a network composed of a plurality of computing apparatuses. In an embodiment, the above-mentioned at least one module or at least one step may be implemented by program codes executable by the computing apparatuses, so that they may be stored in a storage apparatus to be executed by the computing apparatuses. In some circumstances, the illustrated or described steps may be executed in sequences different from those described herein, or the above-mentioned at least one module or at least one step may be separately made into at least one integrated circuit module, or a plurality of modules or steps therein may be made into a single integrated circuit module for implementation. In this way, the present disclosure is not limited to any specific combination of hardware and software.

Claims

1. A method for transmitting a reference signal, comprising:
   obtaining (110) a sequence group number of the reference signal according to at least one of the following pieces of information:

   a number N of time domain symbols comprised in a time unit in which the reference signal is located; index information of time domain symbols in which the reference signal is located among the N time domain symbols comprised in the time unit; or a time unit index obtained according to a subcarrier spacing of a bandwidth part, BWP, in which the reference signal is located;
   determining (120) the reference signal according to the sequence group number; and
   transmitting (130) the reference signal,
   wherein obtaining (110) the sequence group number of the reference signal according to the at least one of the pieces of information comprises: obtaining the sequence group number of the reference signal through the following manner:

the sequence group number $u = (f_{gh}(x) + f_{ss}) \bmod C$;
wherein $f_{gh}(x)$ is a function with respect to x, x comprises at least one of the pieces of information, C is a total number of sequence groups, and f_{ss} is obtained according to a parameter comprised in received signaling information, wherein $f_{gh}(x) = (\sum_{i=0}^{D-1} c(D*h(x)+i)*2^i) \bmod C$ wherein $h(x)$ is a function with respect to x; and
wherein D is an integer greater than or equal to 8, c(z) is a z-th value in a sequence generated by a random sequence function c(·), and z is a non-negative integer, and
wherein the method satisfies:

$$D \geq \lceil \log_2(C) \rceil + \left\lceil \log_2\left(\frac{C}{x_1}\right) \right\rceil - 1$$

wherein $x_1 = 2^{\lceil \log_2(C) \rceil} - C$.

2. The method of claim 1, wherein $h(x)$ satisfies the following formula:

$$h(l_2, N, n_s) = l_2 + n_s * N,$$

wherein l_2 is the index information of the time domain symbols in which the reference signal is located among the N time domain symbols comprised in the time unit, $0 \leq l_2 < N$, and n_s is the time unit index obtained according to the subcarrier spacing of the BWP in which the reference signal is located.

3. The method of claim 1 or 2, wherein N is determined according to one of the following:

N is carried in a signaling information;
N is pre-agreed;
N is the number of time domain symbols comprised in a slot in which the reference signal is located; or
N is the number of time domain symbols comprised in a subframe in which the reference signal is located.

4. An apparatus for transmitting a reference signal, comprising:
an obtaining module, which is configured to obtain a sequence group number of a reference signal according to at least one of the following pieces of information:

a number N of time domain symbols comprised in a time unit in which the reference signal is located; index information of time domain symbols in which the reference signal is located among N time domain symbols comprised in one time unit; or a time unit index obtained according to a subcarrier spacing of a bandwidth part, BWP, in which the reference signal is located;
a determination module, which is configured to determine the reference signal according to the sequence group number; and
a transmission module, which is configured to transmit the reference signal,
wherein obtaining the sequence group number of the reference signal according to the at least one of the pieces of information comprises: obtaining the sequence group number of the reference signal through the following manner:

the sequence group number $u = (f_{gh}(x) + f_{ss}) \bmod C$;
wherein $f_{gh}(x)$ is a function with respect to x, x comprises at least one of the pieces of information, C is a total number of sequence groups, and f_{ss} is obtained according to a parameter comprised in received signaling information, wherein

$$f_{gh}(x) = (\sum_{i=0}^{D-1} c(D*h(x)+i)*2^i) \bmod C;$$

wherein *h(x)* is a function with respect to *x*; and
wherein D is an integer greater than or equal to 8, *c(z)* is a *z*-th value in a sequence generated by a random sequence function c(·), and z is a non-negative integer, and wherein the following characteristic is satisfied:

$$D \geq \lceil \log_2(C) \rceil + \left\lceil \log_2\left(\frac{C}{x_1}\right) \right\rceil - 1;$$

wherein $x_1 = 2^{\lceil \log_2(C) \rceil} - C$.

5. The apparatus of claim 4, wherein $h(x)$ satisfies the following formula:

$$h(l_2, N, n_s) = l_2 + n_s * N,$$

wherein l_2 is the index information of the time domain symbols in which the reference signal is located among the N time domain symbols comprised in the time unit, $0 \leq l_2 < N$, and n_s is the time unit index obtained according to the subcarrier spacing of the BWP in which the reference signal is located.

6. The apparatus of claim 4 or 5, wherein N is determined according to one of the following:

N is carried in a signaling information;
N is pre-agreed;
N is the number of time domain symbols comprised in a slot in which the reference signal is located; or
N is the number of time domain symbols comprised in a subframe in which the reference signal is located.

7. A computer readable storage medium, comprising stored programs which, when executed by a computer, cause the computer to perform the method of any one of claims 1 to 3.

Patentansprüche

1. Verfahren zum Übertragen eines Referenzsignals, das aufweist:
Erhalten (110) einer Sequenzgruppennummer des Referenzsignals gemäß mindestens einer der folgenden Informationen:

einer Anzahl N von Zeitbereichssymbolen, die in einer Zeiteinheit enthalten sind, in der sich das Referenzsignal befindet; Indexinformationen von Zeitbereichssymbolen, in der sich das Referenzsignal unter den N Zeitbereichssymbolen befindet, die in der Zeiteinheit enthalten sind; oder einen Zeiteinheitsindex, der gemäß einem Unterträgerabstand eines Bandbreitenteils, BWP, erhalten wird, in der sich das Referenzsignal befindet;
Bestimmen (120) des Referenzsignals gemäß der Sequenzgruppennummer; und
Übertragen (130) des Referenzsignals,
wobei das Erhalten (110) der Sequenzgruppennummer des Referenzsignals gemäß der mindestens einen der Informationen aufweist: Erhalten der Sequenzgruppennummer des Referenzsignals durch die folgende Weise:

die Sequenzgruppennummer $u = (f_{gh}(x) + f_{ss}) \bmod C$;
wobei $f_{gh}(x)$ eine Funktion in Bezug *auf x* ist, *x* mindestens eine der Informationen aufweist, C eine Gesamtzahl der Sequenzgruppen ist, und f_{ss} gemäß einem Parameter erhalten wird, der in empfangenen Signalisierungsinformationen enthalten ist, wobei

$$f_{gh}(x) = \left(\sum_{i=0}^{D-1} c(D * h(x) + i) * 2^i \right) \bmod C;$$

wobei $h(x)$ eine Funktion in Bezug *auf x* ist; und
wobei D eine ganze Zahl größer oder gleich 8 ist, c(z) ein z-ter Wert in einer Sequenz ist, die durch die Zufallssequenzfunktion $c(\cdot)$ erzeugt wird, und z eine nicht negative ganze Zahl ist, und wobei das Verfahren

erfüllt:

$$D \geq \lceil \log_2 C \rceil + \left\lceil \log_2 \left(\frac{C}{x_1} \right) \right\rceil - 1$$

wobei $x_1 = 2^{\lceil \log_2 C \rceil} - C$.

2. Verfahren nach Anspruch 1, wobei *h(x)* die folgende Formel erfüllt:

$$h(l_2, N, n_s) = l_2 + n_s * N,$$

wobei l_2 die Indexinformationen der Zeitbereichssymbole ist, in der sich das Referenzsignal unter den N Zeitbereichssymbolen befindet, die in der Zeiteinheit enthalten sind, $0 \leq l_2 \leq N$, und n_s der Zeiteinheitsindex ist, der gemäß dem Unterträgerabstand des BWP erhalten wird, in der sich das Referenzsignal befindet.

3. Verfahren nach Anspruch 1 oder 2, wobei N gemäß einem der Folgenden bestimmt wird:

N wird in Signalisierungsinformationen befördert;
N ist im Voraus vereinbart;
N ist die Anzahl der Zeitbereichssymbole, die in einem Schlitz enthalten sind, in der sich das Referenzsignal befindet; oder
N ist die Anzahl der Zeitbereichssymbole, die in einem Unterrahmen enthalten sind, in der sich das Referenzsignal befindet.

4. Vorrichtung zum Übertragen eines Referenzsignals, die aufweist:
ein Erhaltungsmodul, das konfiguriert ist, eine Sequenzgruppennummer eines Referenzsignals gemäß mindestens einer der folgenden Informationen zu erhalten:

einer Anzahl N von Zeitbereichssymbolen, die in einer Zeiteinheit enthalten sind, in der sich das Referenzsignal befindet; Indexinformationen von Zeitbereichssymbolen, in der sich das Referenzsignal unter N Zeitbereichssymbolen befindet, die in einer Zeiteinheit enthalten sind; oder einen Zeiteinheitsindex, der gemäß einem Unterträgerabstand eines Bandbreitenteils, BWP, erhalten wird, in der sich das Referenzsignal befindet;
ein Bestimmungsmodul, das konfiguriert ist, das Referenzsignal gemäß der Sequenzgruppennummer zu bestimmen; und
ein Übertragungsmodul, das konfiguriert ist, das Referenzsignal zu übertragen,
wobei das Erhalten der Sequenzgruppennummer des Referenzsignals gemäß der mindestens einen der Informationen aufweist: Erhalten der Sequenzgruppennummer des Referenzsignals durch die folgende Weise:

die Sequenzgruppennummer $u = (f_{gh}(x) + f_{ss}) \bmod C$;
wobei $f_{gh}(x)$ eine Funktion in Bezug auf x ist, x mindestens eine der Informationen aufweist, C eine Gesamtzahl der Sequenzgruppen ist, und f_{ss} gemäß einem Parameter erhalten wird, der in empfangenen Signalisierungsinformationen enthalten ist, wobei

$$f_{gh}(x) = \left(\sum_{i=0}^{D-1} c(D * h(x) + i) * 2^i \right) \bmod C;$$

wobei $h(x)$ eine Funktion in Bezug *auf x* ist; und
wobei D eine ganze Zahl größer oder gleich 8 ist, c(z) ein z-ter Wert in einer Sequenz ist, die durch die Zufallssequenzfunktion $c(\cdot)$ erzeugt wird, und z eine nicht negative ganze Zahl ist, und wobei die folgende Eigenschaft erfüllt ist:

$$D \geq \lceil \log_2 C \rceil + \left\lceil \log_2 \left(\frac{C}{x_1} \right) \right\rceil - 1$$

wobei $x_1 = 2^{\lceil \log_2 C \rceil} - C$.

5. Vorrichtung nach Anspruch 4, wobei $h(x)$ die folgende Formel erfüllt:

$$h(l_2, N, n_s) = l_2 + n_s * N,$$

wobei l_2 die Indexinformationen der Zeitbereichssymbole ist, in der sich das Referenzsignal unter den N Zeitbereichssymbolen befindet, die in der Zeiteinheit enthalten sind, $0 \leq l_2 \leq N$, und n_s der Zeiteinheitsindex ist, der gemäß dem Unterträgerabstand des BWP erhalten wird, in der sich das Referenzsignal befindet.

6. Vorrichtung nach Anspruch 4 oder 5, wobei N gemäß einem der Folgenden bestimmt wird:

N wird in Signalisierungsinformationen befördert;
N ist im Voraus vereinbart;
N ist die Anzahl der Zeitbereichssymbole, die in einem Schlitz enthalten sind, in der sich das Referenzsignal befindet; oder
N ist die Anzahl der Zeitbereichssymbole, die in einem Unterrahmen enthalten sind, in der sich das Referenzsignal befindet.

7. Computerlesbares Speichermedium, das gespeicherte Programme aufweist, die wenn sich durch einen Computer ausgeführt werden, den Computer veranlassen, das Verfahren nach einem der Ansprüche 1 bis 3 auszuführen.

Revendications

1. Procédé de transmission d'un signal de référence, comprenant :
l'acquisition (110) d'un numéro de groupe de séquences du signal de référence en fonction d'au moins un des éléments d'information suivants :

un nombre N de symboles de domaine temporel compris dans une unité temporelle où se trouve le signal de référence ; des informations d'index de symboles de domaine temporel où se trouve le signal de référence parmi les N symboles de domaine temporel compris dans l'unité temporelle ; ou un index d'unité temporelle obtenu en fonction d'un espacement de sous-porteuse d'une partie de bande passante, BWP, où se trouve le signal de référence ;
la détermination (120) du signal de référence en fonction du numéro de groupe de séquences ; et
la transmission (130) du signal de référence,
où l'acquisition (110) du numéro de groupe de séquences du signal de référence en fonction du ou des éléments d'information comprend : l'acquisition du numéro de groupe de séquences du signal de référence de la manière suivante :

numéro de groupe de séquences $u = (f_{gh}(x) + f_{ss}) \bmod C$;
où $f_{gh}(x)$ est une fonction relative à x, x comprend au moins un des éléments d'information, C est un nombre total de groupes de séquence, et f_{ss} est obtenu en fonction d'un paramètre compris dans les informations de signalisation reçues, où

$$f_{gh}(x) = \left(\sum_{i=0}^{D-1} c(D * h(x) + i) * 2^i \right) \bmod C$$

où $h(x)$ est une fonction relative à x ; et
où D est un entier supérieur ou égal à 8, $c(z)$ est une $z^{\text{ième}}$ valeur dans une séquence générée par une fonction de séquence aléatoire $c(\cdot)$, et z est un entier non négatif, et où ledit procédé satisfait à :

$$D \geq \lceil \log_2 C \rceil + \left\lceil \log_2 \left(\frac{C}{x_1} \right) \right\rceil - 1$$

où $x_1 = 2^{\lceil \log_2 C \rceil - 1} - C$.

2. Procédé selon la revendication 1, où *h(x)* satisfait à la formule suivante :

$$h(l_2, N, n_s) = l_2 + n_s * N,$$

où l_2 est les informations d'index des symboles de domaine temporel où se trouve le signal de référence parmi les N symboles de domaine temporel compris dans l'unité temporelle, $0 \le l_2 \le N$, et n_s est l'index d'unité temporelle obtenu en fonction de l'espacement de sous-porteuse de la BWP où se trouve le signal de référence.

3. Procédé selon la revendication 1 ou la revendication 2, où N est déterminé en fonction d'un des éléments suivants :

N est acheminé dans des informations de signalisation ;
N est préalablement convenu ;
N est le nombre de symboles de domaine temporel compris dans un créneau où se trouve le signal de référence ; ou
N est le nombre de symboles de domaine temporel compris dans une sous-trame où se trouve le signal de référence.

4. Dispositif pour la transmission d'un signal de référence, comprenant :
un module d'acquisition, prévu pour acquérir un numéro de groupe de séquences d'un signal de référence en fonction d'au moins un des éléments d'information suivants :

un nombre N de symboles de domaine temporel compris dans une unité temporelle où se trouve le signal de référence ; des informations d'index de symboles de domaine temporel où se trouve le signal de référence parmi N symboles de domaine temporel compris dans une unité temporelle ; ou un index d'unité temporelle obtenu en fonction d'un espacement de sous-porteuse d'une partie de bande passante, BWP, où se trouve le signal de référence;
un module de détermination, prévu pour déterminer le signal de référence en fonction du numéro de groupe de séquences ; et
un module de transmission, prévu pour transmettre le signal de référence,
où l'acquisition du numéro de groupe de séquences du signal de référence en fonction du ou des éléments d'information comprend : l'acquisition du numéro de groupe de séquences du signal de référence de la manière suivante :

numéro de groupe de séquences $u = (f_{gh}(x) + f_{ss}) \bmod C$;
où $f_{gh}(x)$ est une fonction relative à x, *x* comprend au moins un des éléments d'information, C est un nombre total de groupes de séquence, et f_{ss} est obtenu en fonction d'un paramètre compris dans des informations de signalisation reçues, où

$$f_{gh}(x) = \left(\sum_{i=0}^{D-1} c(D * h(x) + i) * 2^i \right) \bmod C \ ;$$

où *h(x)* est une fonction relative à *x* ; et
où D est un entier supérieur ou égal à 8, *c(z)* est une $z^{\text{ième}}$ valeur dans une séquence générée par une fonction de séquence aléatoire *c*(·), et z est un entier non négatif, et où la caractéristique suivante est satisfaite :

$$D \ge \lceil \log_2 C \rceil + \left\lceil \log_2 \left(\frac{C}{x_1} \right) \right\rceil - 1$$

où $x_1 = 2^{\lceil \log_2 C \rceil - 1} - C$.

5. Dispositif selon la revendication 4, où *h(x)* satisfait à la formule suivante :

$$h(l_2, N, n_s) = l_2 + n_s * N,$$

où l_2 est les informations d'index des symboles de domaine temporel où se trouve le signal de référence parmi les N symboles de domaine temporel compris dans l'unité temporelle, $0 \leq l_2 \leq N$, et n_s est l'index d'unité temporelle obtenu en fonction de l'espacement de sous-porteuse de la BWP où se trouve le signal de référence.

6. Dispositif selon la revendication 4 ou la revendication 5, où N est déterminé en fonction d'un des éléments suivants :

N est acheminé dans des informations de signalisation ;
N est préalablement convenu ;
N est le nombre de symboles de domaine temporel compris dans un créneau où se trouve le signal de référence ;
ou
N est le nombre de symboles de domaine temporel compris dans une sous-trame où se trouve le signal de référence.

7. Support d'enregistrement lisible par ordinateur, comprenant des programmes enregistrés dont l'exécution par un ordinateur entraîne l'application par ledit ordinateur du procédé selon l'une des revendications 1 à 3.

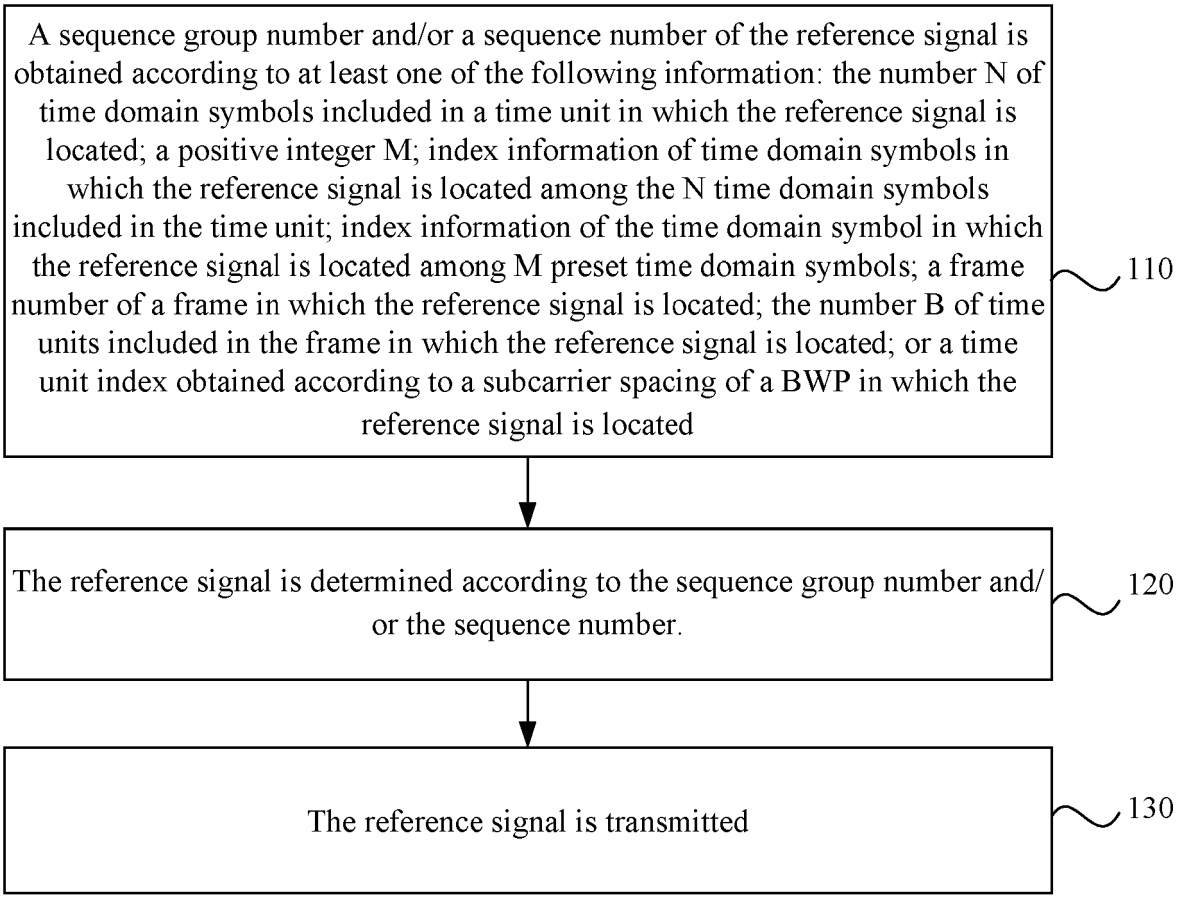
A sequence group number and/or a sequence number of the reference signal is obtained according to at least one of the following information: the number N of time domain symbols included in a time unit in which the reference signal is located; a positive integer M; index information of time domain symbols in which the reference signal is located among the N time domain symbols included in the time unit; index information of the time domain symbol in which the reference signal is located among M preset time domain symbols; a frame number of a frame in which the reference signal is located; the number B of time units included in the frame in which the reference signal is located; or a time unit index obtained according to a subcarrier spacing of a BWP in which the reference signal is located
110
The reference signal is determined according to the sequence group number and/or the sequence number.
120
The reference signal is transmitted
130

FIG. 1

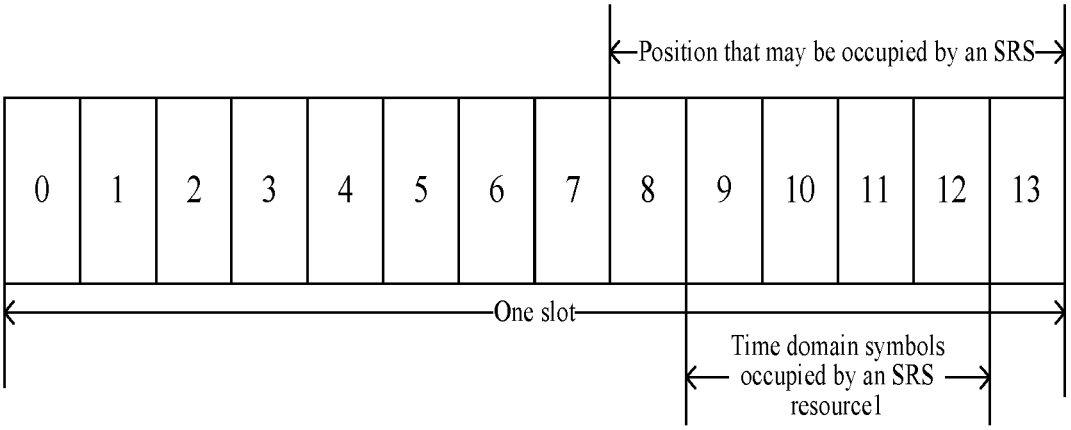
Position that may be occupied by an SRS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
One slot
Time domain symbols occupied by an SRS resource1

FIG. 2

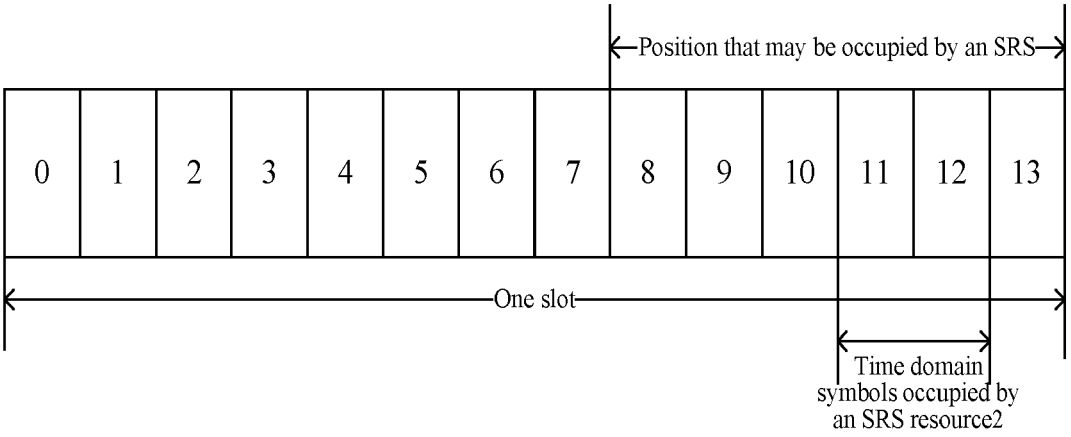
Position that may be occupied by an SRS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
One slot
Time domain symbols occupied by an SRS resource2

FIG. 3

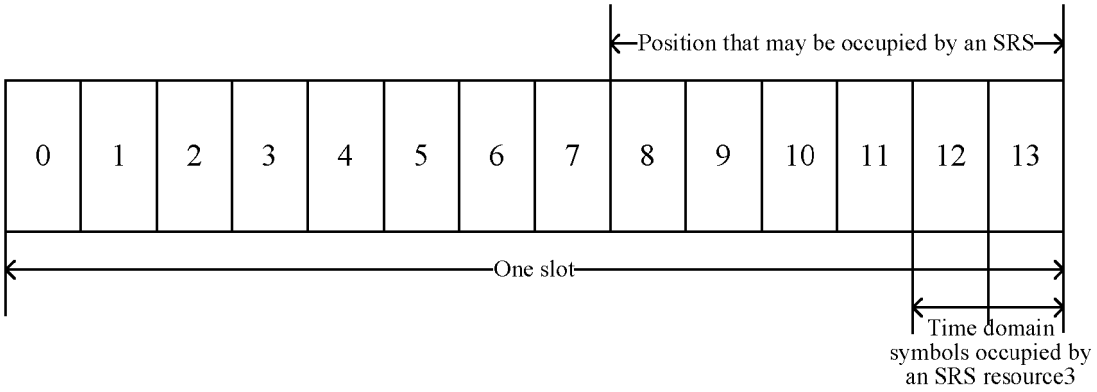
Position that may be occupied by an SRS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
One slot
Time domain symbols occupied by an SRS resource3

FIG. 4

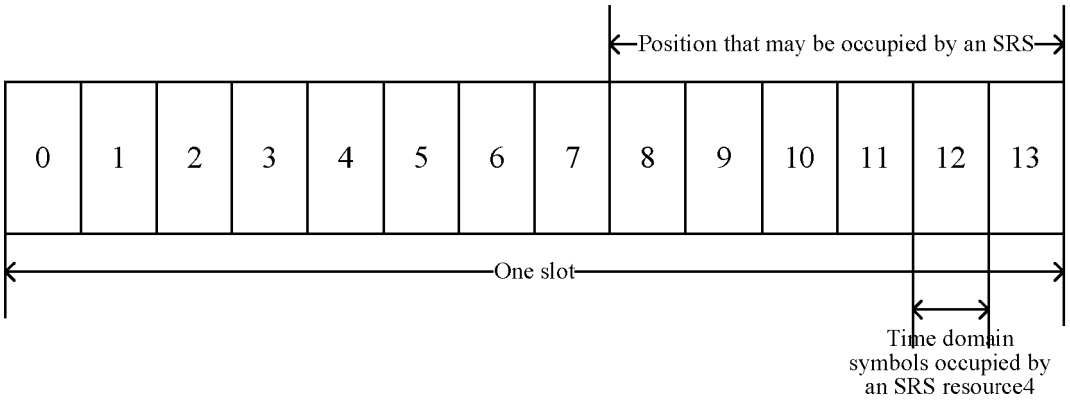
Position that may be occupied by an SRS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
One slot
Time domain symbols occupied by an SRS resource4

FIG. 5

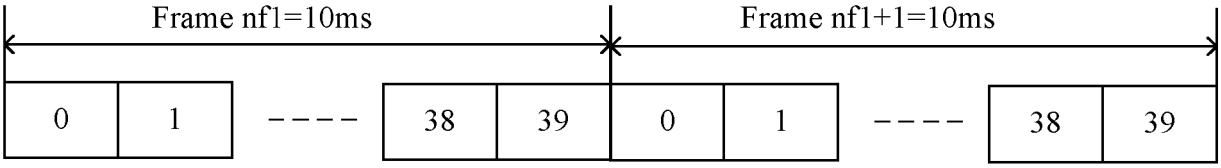
Frame nf1=10ms
Frame nf1+1=10ms
0
1
38
39
0
1
38
39

FIG. 6

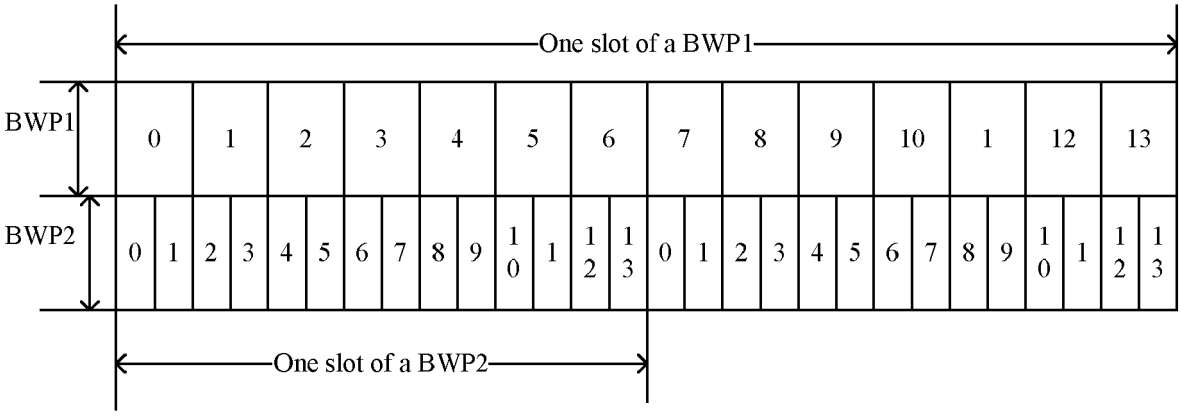
One slot of a BWP1
BWP1
0
1
2
3
4
5
6
7
8
9
10
1
12
13
BWP2
0
1
2
3
4
5
6
7
8
9
10
1
12
13
0
1
2
3
4
5
6
7
8
9
10
1
12
13
One slot of a BWP2

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- **LG ELECTRONICS.** On SRS design. *3GPP draft; R1-1719914,* 27 December 2017, vol. RAN WG1 **[0005]**
- **LG ELECTRONICS.** Design of short PUCCH for UCI of up to 2 bits for NR. *3GPP draft; R1-1717956,* 09 October 2017, vol. RAN WG1 **[0006]**