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An agency of Industry Canada

CA 2715593 C 2013/05/28

(11)(21) **2 715 593**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(86) Date de dépôt PCT/PCT Filing Date: 2009/06/05
(87) Date publication PCT/PCT Publication Date: 2010/04/29
(45) Date de délivrance/Issue Date: 2013/05/28
(85) Entrée phase nationale/National Entry: 2010/08/16
(86) N° demande PCT/PCT Application No.: CN 2009/072165
(87) N° publication PCT/PCT Publication No.: 2010/045795
(30) Priorité/Priority: 2008/10/24 (CN200810170643.5)

(51) Cl.Int./Int.Cl. *H04W 88/02* (2009.01)

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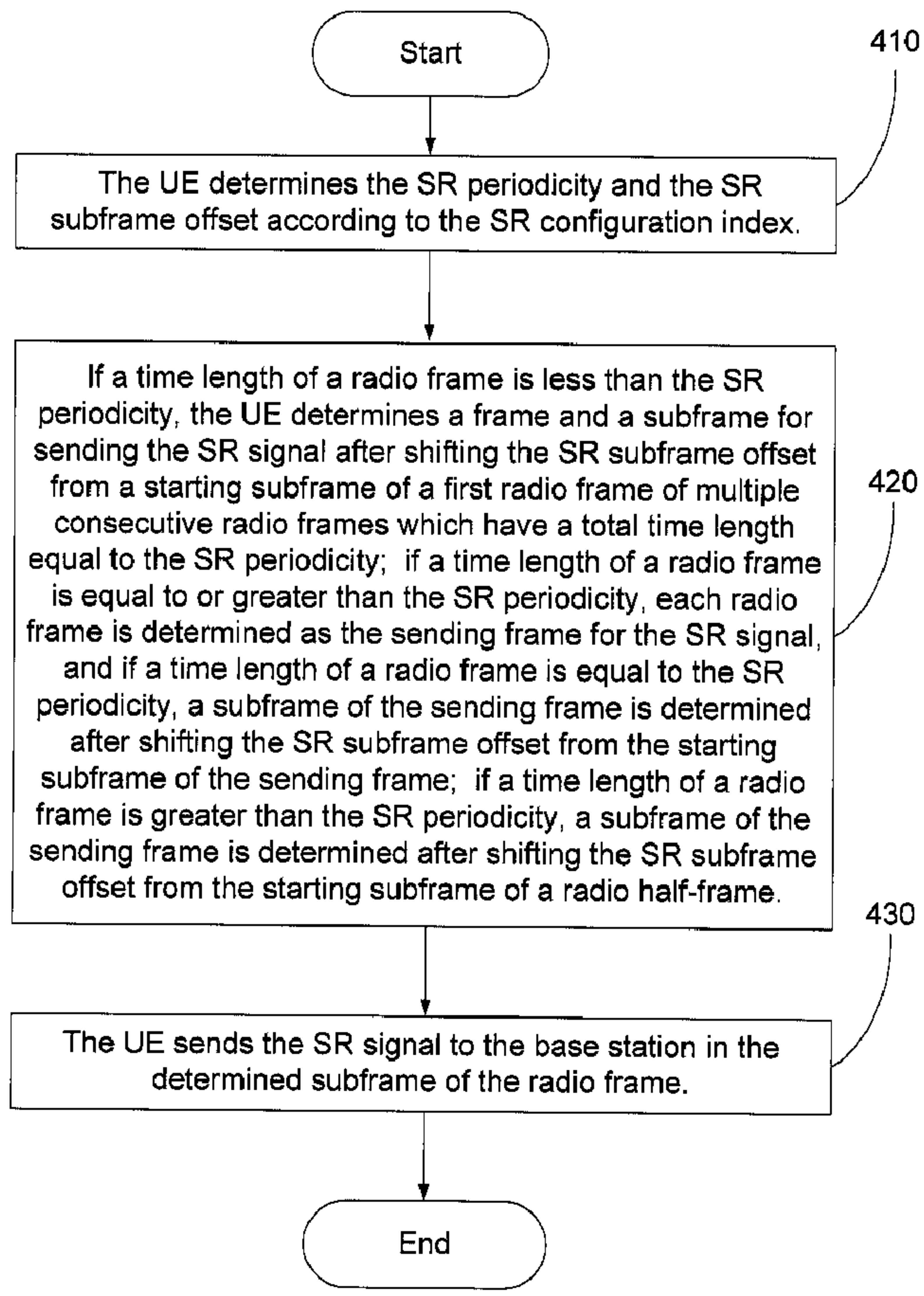
(54) Titre : PROCEDE ET DISPOSITIF D'ENVOI POUR SIGNAL DE DEMANDE D'ORDONNANCEMENT (SR)
(54) Title: A SENDING METHOD AND DEVICE FOR SCHEDULING REQUEST (SR) SIGNAL



(57) Abrégé/Abstract:
A sending method and device for scheduling request (SR) signal is used for UE to send an uplink signal to a base station in the long term evolution (LTE) system. The method involves that: after a starting sub-frame of the first radio frame in several consecutive

(57) Abrégé(suite)/Abstract(continued):

radio frames whose total time length is equal to the SR cycle is moved for a SR sub-frame deviation, a sending frame and sub-frame for the SR signal is confirmed, when the time length of a radio frame is less than the SR cycle; each radio frame is confirmed as the sending frame of the SR signal, when the time length of the radio frame is equal to or greater than SR cycle, and: a starting sub-frame of the sending frame is moved for a SR sub-frame deviation and located to the sub-frame of the sending frame when the time length of the radio frame time length is equal to the SR cycle; a starting sub-frame of a radio semi-frame is moved for a SR sub-frame deviation and located to the sub-frame of the sending frame when the time length of the radio frame is greater than the SR cycle; the SR signal is transmitted by UE to a base station on the sub-frame of the confirmed sending frame.

(12) 按照专利合作条约所公布的国际申请

(19) 世界知识产权组织
国 际 局

(43) 国际公布日
2010 年 4 月 29 日 (29.04.2010)

PCT

(10) 国际公布号
WO 2010/045795 A1

(51) 国际专利分类号:
H04W 88/02 (2009.01)

(21) 国际申请号: PCT/CN2009/072165

(22) 国际申请日: 2009 年 6 月 5 日 (05.06.2009)

(25) 申请语言: 中文

(26) 公布语言: 中文

(30) 优先权:
200810170643.5 2008 年 10 月 24 日 (24.10.2008) CN

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(81) 指定国 (除另有指明，要求每一种可提供的国家保护): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY,

[见续页]

(54) Title: A SENDING METHOD AND DEVICE FOR SCHEDULING REQUEST (SR) SIGNAL

(54) 发明名称: 一种调度请求信号的发送方法及装置

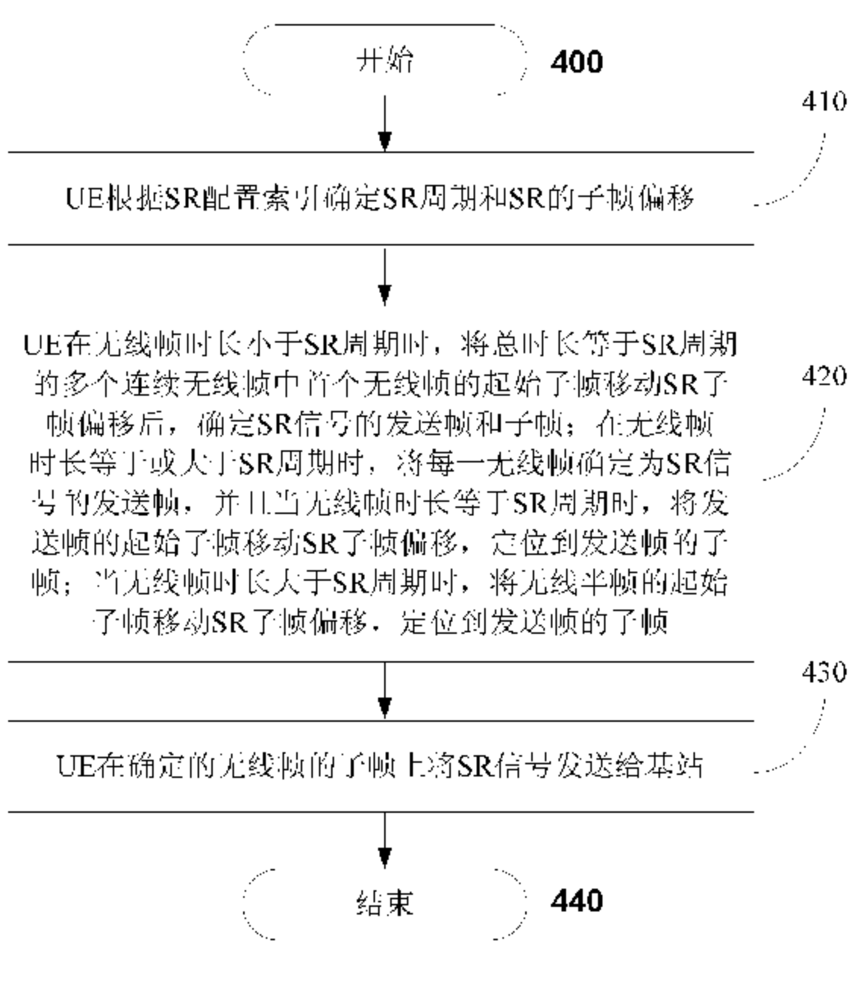

图 4 /**Fig.4**

400 BEGIN
410 SR CYCLE AND SR SUB-FRAME DEVIATION IS CONFIRMED BY UE ACCORDING TO SCHEME INDEX OF SR
420 AFTER A STARTING SUB-FRAME OF THE FIRST RADIO FRAME IN SEVERAL CONSECUTIVE RADIO FRAMES WHOSE TOTAL TIME LENGTH IS EQUAL TO THE SR CYCLE IS MOVED FOR A SR SUB-FRAME DEVIATION, A SENDING FRAME AND SUB-FRAME FOR THE SR SIGNAL IS CONFIRMED BY UE, WHEN THE TIME LENGTH OF A RADIO FRAME IS LESS THAN THE SR CYCLE; EACH RADIO FRAME IS CONFIRMED AS THE SENDING FRAME OF THE SR SIGNAL, WHEN THE TIME LENGTH OF THE RADIO FRAME IS EQUAL TO OR GREATER THAN SR CYCLE, AND: A STARTING SUB-FRAME OF THE SENDING FRAME IS MOVED FOR A SR SUB-FRAME DEVIATION AND LOCATED TO THE SUB-FRAME OF THE SENDING FRAME WHEN THE TIME LENGTH OF THE RADIO FRAME TIME LENGTH IS EQUAL TO THE SR CYCLE; A STARTING SUB-FRAME OF A RADIO SEMI-FRAME IS MOVED FOR A SR SUB-FRAME DEVIATION AND LOCATED TO THE SUB-FRAME OF THE SENDING FRAME WHEN THE TIME LENGTH OF THE RADIO FRAME IS GREATER THAN THE SR CYCLE
430 THE SR SIGNAL IS TRANSMITTED BY UE TO A BASE STATION ON THE SUB-FRAME OF THE CONFIRMED SENDING FRAME
440 END

(57) Abstract: A sending method and device for scheduling request (SR) signal is used for UE to send an uplink signal to a base station in the long term evolution (LTE) system. The method involves that: after a starting sub-frame of the first radio frame in several consecutive radio frames whose total time length is equal to the SR cycle is moved for a SR sub-frame deviation, a sending frame and sub-frame for the SR signal is confirmed, when the time length of a radio frame is less than the SR cycle; each radio frame is confirmed as the sending frame of the SR signal, when the time length of the radio frame is equal to or greater than SR cycle, and: a starting sub-frame of the sending frame is moved for a SR sub-frame deviation and located to the sub-frame of the sending frame when the time length of the radio frame time length is equal to the SR cycle; a starting sub-frame of a radio semi-frame is moved for a SR sub-frame deviation and located to the sub-frame of the sending frame when the time length of the radio frame is greater than the SR cycle; the SR signal is transmitted by UE to a base station on the sub-frame of the confirmed sending frame.

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WO 2010/045795 A1

WO 2010/045795 A1

TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW。

(84) **指定国** (除另有指明，要求每一种可提供的地区保护): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), 欧亚 (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), 欧洲 (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)。

本国际公布:

— 包括国际检索报告(条约第 21 条(3))。

(57) **摘要**:

一种调度请求信号(SR)的发送方法及装置，用于长期演进（LTE）系统UE向基站的上行信号的发送。该方法包括：在无线帧时长小于ＳＲ周期时，将总时长等于ＳＲ周期的多个连续无线帧中首个无线帧的起始子帧移动ＳＲ子帧偏移后，确定ＳＲ信号的发送帧和子帧；在无线帧时长等于或大于ＳＲ周期时，将每一无线帧确定为ＳＲ信号的发送帧，并且：当无线帧时长等于ＳＲ周期时，将发送帧的起始子帧移动ＳＲ子帧偏移定位到发送帧的子帧；当无线帧时长大于ＳＲ周期时，将无线半帧的起始子帧移动ＳＲ子帧偏移定位到发送帧的子帧；ＵＥ在确定的发送帧的子帧上将ＳＲ信号发向基站。

A SENDING METHOD AND DEVICE FOR SCHEDULING REQUEST (SR) SIGNAL

TECHNICAL FIELD

The present invention relates to a method for sending an uplink signal in a communication system, and particularly to a method and a corresponding device for a mobile terminal to send a scheduling request signal to a base station in a long term evolution (LTE) system.

BACKGROUND

Fig. 1 is a schematic diagram illustrating a frame structure in a time division duplex (TDD) mode in an LTE system. The frame structure is also referred to as frame structure type 2. In the frame structure, one 10ms (which occupies 307200 Ts, with 30720 Ts/ms) radio frame is divided into two half-frames, the length of each half-frame is 5ms (i.e. 153600 Ts), each half-frame contains 5 subframes, and the length of each subframe is 1ms. The function of each subframe is shown in Table 1. Specifically, D denotes a downlink subframe for transmitting a downlink signal, and U denotes an uplink subframe (also referred to as a normal uplink subframe) for transmitting an uplink signal. In addition, one uplink/downlink subframe is divided into 2 time slots, and the length of each time slot is 0.5ms. S denotes a special subframe, which contains three special time slots, i.e. a downlink pilot time slot (DwPTS), a guard period (GP) and an uplink pilot time slot (UpPTS). In an actual system, an uplink/downlink configuration index may be notified to a user equipment (UE) through a broadcasting message.

Table 1

Configuration	Switch point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D

5	10 ms	D	S	U	D	D	D	D	D	D	D

A frame structure in a frequency division duplex (FDD) mode in the LTE system is also referred to as frame structure type 1, as shown in Fig. 2. One 10ms radio frame is divided into 20 time slots, and the length of each time slot is 0.5ms. 2 adjacent time slots constitutes a subframe of a length of 1ms, i.e. subframe i is composed of time slot 2i and time slot 2i+1, where i=0,1,2,...9. In the FDD mode, 10 subframes are all used for transmitting the uplink or downlink signals, and the uplink and downlink signals are differentiated from each other by different frequency bands.

In the LTE system, resource allocation is performed by taking a physical resource block (PRB, which is briefly referred to as a resource block (RB)) as a unit. One PRB occupies 12 subcarriers (a subcarrier also referred to as a resource element (RE), and the frequency of each subcarrier is 15kHz) in a frequency domain, and occupies one time slot in a time domain, i.e. occupies 7 SC-FDMA symbols of normal cyclic prefix (Normal CP) or 6 SC-FDMA symbols of extended cyclic prefix (Extended CP) in the time domain. If an uplink system bandwidth corresponds to N_{RB}^{UL} RBs in total in the frequency domain, the indexes of the RBs are 0, 1, ... , N_{RB}^{UL}-1, and the indexes of the REs are 0, 1, ... , $N_{RB}^{UL} \cdot N_{SC}^{RB}$-1, where N_{SC}^{RB} is the number of the subcarriers that an RB corresponds to in the frequency domain. Taking the Normal CP for example, the structure of the PRB is shown in Fig. 3.

A scheduling request (SR) is a request signal sent from a UE to a base station when the UE hopes to send signals at a higher data rate. It is specified that the SR signal is transmitted over a physical uplink control channel (PUCCH). The UE acquires a corresponding SR periodicity and subframe offset according to an SR configuration index I_{SR} sent from the base station, as shown in Table 2.

Table 2

SR configuration index I_{SR}	SR periodicity (ms)	SR subframe offset
0–4	5	I_{SR}
5–14	10	I_{SR} -5
15–34	20	I_{SR} -15

35–74	40	I_{SR} -35
75–154	80	I_{SR} -75
155	OFF	N/A

For example, if the SR configuration index I_{SR} sent from the base station is 6, the UE can find that the SR periodicity is 10ms and the SR subframe offset is I_{SR}-5=6-5=1 from Table 2.

According to the above-mentioned table, it is only determined how the UE can obtain a sending periodicity for the SR signal and the subframe offset thereof according to I_{SR}, but it is not indicated in which subframe of radio frame the UE sends the SR signal. This means that the UE cannot be ensured to utilize the radio frame sufficiently and effectively, and this even causes that the SR signal sent from the UE may not be received reliably by the base station. Therefore, it is currently required to propose a method which can allow the UE to determine the radio frame and subframe for sending the SR signal according to the SR sending periodicity and the subframe offset.

SUMMARY

The technical problem to be solved in the present invention is to provide a method and device for sending a scheduling request signal, which can ensure that every radio frame is utilized sufficiently and effectively when a terminal sends the SR signal to a base station.

To solve the above-mentioned problem, the present invention provides a method for sending an SR signal, which is used for a UE in an LTE system to send an uplink signal to a base station, the method comprises:

the UE determines a radio frame and a subframe for sending the SR signal: if a time length of a radio frame is less than an SR periodicity, a sending frame and a subframe for the SR signal are determined after shifting an SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity; if a time length of a radio frame is equal to or greater than the SR periodicity, each radio frame is determined as the sending frame for the SR signal, and if a time length of a radio frame is equal to the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from

the starting subframe of the sending frame; and if a time length of a radio frame is greater than the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame; and

the UE sends the SR signal to the base station in the determined subframe of the sending frame.

Further, the process of that the UE determines the radio frame and the subframe for sending the SR signal may comprise:

the UE may determine that a system frame number n_f of the sending frame satisfies an equation $(10 \times n_f) \bmod N_{SR\_P} = 0$ if the SR subframe offset is 0; and the UE may determine that a system frame number n_f of the sending frame satisfies an equation $\left[10 \times \left(n_f - \left\lfloor \frac{N_{OFFSET,SR}}{10} \right\rfloor\right)\right] \bmod N_{SR\_P} = 0$ if the SR subframe offset is not 0; and

the UE may determine the subframe of the sending frame according to a time slot index n_s that satisfies an equation $\left(\left\lfloor \frac{n_s}{2} \right\rfloor - N_{OFFSET,SR} \bmod 10\right) \bmod N_{SR\_P} = 0$;

in the above-mentioned equations, mod is a modulus operator, N_{SR_P} is the SR periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor\ \rfloor$ is a floor operator.

Further, the process of that the UE determines the radio frame and the subframe for sending the SR signal may comprise:

the UE may determine an n_f that satisfies an equation $(10 \times n_f + \lfloor n_s/2 \rfloor - N_{OFFSET,SR}) \bmod N_{SR\_P} = 0$ as a system frame number of the sending frame, and may determine the subframe of the sending frame according to a time slot index n_s that satisfies the equation, where mod is a modulus operator, N_{SR_P} is the SR periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor\ \rfloor$ is a floor operator.

Further, before the UE determines the radio frame and the subframe for sending the SR signal, the method may further comprise: the UE may determine the SR periodicity and the SR subframe offset according to an SR configuration index sent from the base station, namely the SR configuration index 0~155 may be divided into 6 portions: 0~4, 5~14, 15~34, 35~74, 75~154 and 155, which is used for indicating that the corresponding

SR periodicity is 5ms, 10ms, 20ms, 40ms, 80ms and OFF respectively; and the subframe offset of the first portion is equal to the corresponding SR configuration index of the portion; the subframe offset of any other portion is equal to the corresponding SR configuration index of the portion minus a summation of the SR periodicity of every portion prior to the portion; and OFF indicates periodicity closure.

To solve the above-mentioned problem, the present invention provides a device for sending a SR signal, which is used for a UE in an LTE system to send an uplink signal to a base station, the device comprises a radio frame and subframe determining module and a sending module which are connected with each other, wherein

the radio frame and subframe determining module is used for determining a radio frame and a subframe thereof for sending the SR signal according to an SR subframe offset and an SR periodicity: if a time length of a radio frame is less than the SR periodicity, a sending frame and a subframe for the SR signal are determined after shifting the SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity; if a time length of a radio frame is equal to or greater than the SR periodicity, each radio frame is determined as the sending frame for the SR signal, and if a time length of a radio frame is equal to the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of the sending frame; if a time length of a radio frame is greater than the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame; and for outputting the determined radio frame and the subframe thereof for sending the SR signal to the sending module; and

the sending module is used for sending the SR signal to the base station in the determined subframe of the sending frame.

Further, the process of that the radio frame and subframe determining module determines the radio frame and the subframe thereof for sending the SR signal may mean that the radio frame and subframe determining module may be used for:

determining a system frame number n_f of the sending frame satisfies an equation $(10 \times n_f) \bmod N_{SR\_P} = 0$ if the SR subframe offset is 0; and determining a system frame number n_f of the sending frame satisfies an equation

$$\left[10\times\left(n_f-\left\lfloor\frac{N_{OFFSET,SR}}{10}\right\rfloor\right)\right]\bmod N_{SR\_P}=0$$ if the SR subframe offset is not 0; and

determining the subframe of the sending frame according to a time slot index n_s that satisfies an equation $\left(\left\lfloor\frac{n_s}{2}\right\rfloor - N_{OFFSET,SR}\bmod 10\right)\bmod N_{SR\_P}=0$,

in the above-mentioned equations, mod is a modulus operator, N_{SR_P} is the SR periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor\ \rfloor$ is a floor operator.

Further, the process of that the radio frame and subframe determining module determines the radio frame and the subframe thereof for sending the SR signal may mean that the radio frame and subframe determining module may be used for: determining an n_f that satisfies an equation $(10\times n_f+\lfloor n_s/2\rfloor - N_{OFFSET,SR})\bmod N_{SR\_P}=0$ as a system frame number of the sending frame, and determining the subframe of the sending frame according to a time slot index n_s that satisfies the equation, where mod is a modulus operator, N_{SR_P} is the SR periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor\ \rfloor$ is a floor operator.

Further, the device may further comprise an SR periodicity and subframe offset determining module connected to the radio frame and subframe determining module,

the SR periodicity and subframe offset determining module may be used for determining the SR periodicity and the SR subframe offset according to an SR configuration index sent from the base station, namely the SR configuration index 0~155 may be divided into 6 portions: 0~4, 5~14, 15~34, 35~74, 75~154 and 155 which is used for indicating that the corresponding SR periodicity is 5ms, 10ms, 20ms, 40ms, 80ms and OFF respectively; and the subframe offset of the first portion is equal to the corresponding SR configuration index of the portion; the subframe offset of any other portion is equal to the corresponding SR configuration index of the portion minus a summation of the SR periodicity of every portion prior to the portion; OFF indicates periodicity closure; and for outputting the determined SR periodicity and SR subframe offset to the radio frame and subframe determining module.

According to the method and device provided by the present invention, the terminal can complete a whole mapping process from the SR periodicity and subframe offset to the specific sending subframe when it sends the SR signal to the base station. Since it is ensured that the receiving position of the base station is identical to the sending position of a mobile phone, and also that there are as much as suitable radio frames in a radio frame number periodicity being used for sending the SR signal, it can be ensured that the SR signal sent from the UE can be received reliably by the base station, and also ensured that the UE utilizes the radio frame sufficiently and effectively.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram illustrating a frame structure in a TDD mode in an LTE system;

Fig. 2 is a schematic diagram illustrating a frame structure in an FDD mode in the LTE system;

Fig. 3 is a schematic diagram illustrating a structure of a PRB;

Fig. 4 is a flow chart illustrating a method for sending an SR signal according to the present invention; and

Fig. 5 is a block diagram illustrating a structure of a device for sending the SR signal in a UE according to the present invention.

DETAILED DESCRIPTION

A method for sending a scheduling request signal according to the present invention is used for a UE in an LTE system to send an uplink signal to a base station. The method which is implemented by a corresponding device in the UE includes: the UE determines an SR periodicity and an SR subframe offset according to an SR configuration index; if a time length of a radio frame is less than the SR periodicity, the UE determines a frame and a subframe for sending the SR signal after shifting the SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity; if a time length of a radio frame is equal to or greater than the SR periodicity, each radio frame is determined as the sending frame for the SR signal, and if a time length of a radio frame is equal to the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of the sending frame; if a time length of a radio frame is greater than the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame; and the UE sends the SR signal to the base station in the determined subframe of the radio frame.

If a time length of a radio frame is less than the SR periodicity, the process of that the UE determines a frame and a subframe for sending the SR signal after shifting the SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR means: taking the starting subframe of the first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity as a starting position, taking the subframe which is positioned after shifting the SR subframe offset from the starting frame as the sending subframe for the SR signal, and taking the radio frame which the subframe belongs to as the sending frame for the SR signal.

If a time length of a radio frame is equal to the SR periodicity, the process of that a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of the sending frame means: taking the starting subframe of the sending frame as the starting position, and taking the subframe which is positioned after shifting the SR subframe offset from the starting frame as the sending subframe for the SR signal.

If a time length of a radio frame is greater than the SR periodicity, the process of that a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame means: taking the starting subframe of the radio half-frame as the starting position, and taking the subframe which is positioned after shifting the SR subframe offset from the starting frame as the sending subframe for the SR signal.

The above-mentioned method and the corresponding device will be explained and described in detail hereinafter with reference to the accompanying drawings and preferred embodiments. These embodiments are merely for explanation, and the present invention is not limited thereto.

Fig. 4 is a flow chart illustrating a method for sending an SR signal according to the present invention. The procedure includes the following steps.

Step 410: The UE determines the SR periodicity and the SR subframe offset according to the SR configuration index. The determination method is as shown in Table 2.

Step 420: The UE determines the radio frame for sending the SR and the sub-frame thereof according to the SR periodicity and the SR subframe offset.

The determination method is as follows: if a time length of a radio frame is less than the SR periodicity, the UE determines a frame and a subframe for sending the SR signal after shifting the SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity; if a time length of a radio frame is equal to or greater than the SR periodicity, each radio frame is determined as the sending frame for the SR signal, and if a time length of a radio frame is equal to the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of the sending frame; if a time length of a radio frame is greater than the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame.

specific methods are as follows.

Method 1

The UE determines that a system frame number n_f of the sending frame satisfies an equation $(10 \times n_f) \bmod N_{SR\_P} = 0$ if the SR subframe offset is 0; and the UE determines that a system frame number n_f of the sending frame satisfies an equation $\left[10 \times \left(n_f - \left\lfloor \frac{N_{OFFSET,SR}}{10} \right\rfloor\right)\right] \bmod N_{SR\_P} = 0$ if the SR subframe offset is not 0; and

the UE determines the subframe of the sending frame according to a time slot index n_s that satisfies an equation $\left(\left\lfloor \frac{n_s}{2} \right\rfloor - N_{OFFSET,SR} \bmod 10\right) \bmod N_{SR\_P} = 0$;

in the above-mentioned equations, mod is a modulus operator, N_{SR_P} is the SR periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor\ \rfloor$ is a floor operator.

Method 2

The UE determines an n_f that satisfies an equation $(10 \times n_f + \lfloor n_s/2 \rfloor - N_{OFFSET,SR}) \bmod N_{SR\_P} = 0$ as a system frame number of the sending frame, and determines the subframe of the sending frame according to a time slot index n_s that satisfies the equation, where mod is a modulus operator, N_{SR_P} is the SR periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor\ \rfloor$ is a floor operator.

Step 430: The UE sends the SR signal to the base station in the determined subframe of the radio frame having the system frame number n_f.

Embodiment 1

If the SR periodicity N_{SR_P} is 5ms and the subframe offset $N_{OFFSET,SR}$ is 2, the system frame number n_f of the subframe and the radio frame for sending the SR signal satisfies the equation $(10\times n_f+\lfloor n_s/2\rfloor - N_{OFFSET,SR})\mathrm{mod}N_{SR\_P}=0$, where n_s is the time slot index.

N_{SR_P}=5, $N_{OFFSET,SR}$=2 are introduced into the above-mentioned equation, then the system frame number n_f of the subframe and the radio frame for sending the SR signal satisfies $(10\times n_f+\lfloor n_s/2\rfloor - 2)\mathrm{mod}5=0$.

If n_f=0,

since $N_{OFFSET,SR}$=2, n_s=4, 5 or n_s=14, 15,

$(10\times0+4/2-2)\mathrm{mod}5=0\mathrm{mod}5=0$, where the condition is satisfied,

$(10\times0+5/2-2)\mathrm{mod}5=0.5\mathrm{mod}5=0$, where the condition is satisfied,

thus subframe 2, i.e. the 3rd subframe, satisfies the above-mentioned condition;

similarly, subframe 7, i.e. the 8th subframe, also satisfies the above-mentioned condition; and

similarly, if n_f=1,2,......, every 3rd subframe and every 8th subframe satisfy the above-mentioned condition.

Therefore, the UE sends the SR signal in the 3rd subframe (subframe 2, corresponding to time slot number 4, 5) and the 8th subframe (subframe 7, corresponding to time slot number 14, 15) of each radio frame.

Embodiment 2

If the SR periodicity N_{SR_P} is 10ms and the subframe offset $N_{OFFSET,SR}$ is 2, the system frame number n_f of the subframe and the radio frame for sending the SR signal satisfies the equation $(10 \times n_f + \lfloor n_s/2 \rfloor - N_{OFFSET,SR}) \bmod N_{SR\_P} = 0$, where n_s is the time slot index.

N_{SR_P}=10, $N_{OFFSET,SR}$=2 are introduced into the above-mentioned equation, then the system frame number n_f of the subframe and the radio frame for sending the SR signal satisfies $(10 \times n_f + \lfloor n_s/2 \rfloor - 2) \bmod 10 = 0$.

If n_f=0,

since $N_{OFFSET,SR}$=2, n_s=4, 5 or n_s=14, 15,

(10×0+4/2-2)mod10=0mod10=0, where the condition is satisfied,

(10×0+5/2-2)mod10=0.5mod10=0, where the condition is satisfied,

thus subframe 2, i.e. the 3rd subframe, satisfies the above-mentioned condition; and

(10×0+14/2-2)mod10=5mod10=5, where the condition is not satisfied,

(10×0+15/2-2)mod10=5.5mod10=5, where the condition is not satisfied,

thus subframe 7, i.e. the 8th subframe, does not satisfy the above-mentioned condition.

Similarly, if n_f=1,2,......, every 3rd subframe satisfies the above-mentioned condition.

Therefore, the UE sends the SR signal in the 3rd subframe (subframe 2, corresponding to time slot number 4, 5) of each radio frame.

Embodiment 3

If the SR periodicity N_{SR_P} is 20ms and the subframe offset $N_{OFFSET,SR}$ is 12, the system frame number n_f of the subframe and the radio frame for sending the SR signal satisfies the equation $(10 \times n_f + \lfloor n_s/2 \rfloor - N_{OFFSET,SR}) \bmod N_{SR\_P} = 0$, where n_s is the time slot index.

If n_f=0,

since $N_{OFFSET,SR}$=12, n_s=4, 5,

(10×0+4/2-2)mod20=0mod20=0, where the condition is satisfied, (10×0+5/2-2)mod20=0.5mod20=0, where the condition is satisfied,

thus the 3rd subframe, i.e. subframe 2, of the 1st radio frame satisfies the above-mentioned condition;

if n_f=1,

(10×1+4/2-2)mod20=10mod20=10, where the condition is not satisfied,

(10×1+5/2-2)mod20=10.5mod20=10, where the condition is not satisfied;

if n_f=2,

(10×2+4/2-2)mod20=20mod20=0, where the condition is satisfied,

(10×2+5/2-2)mod20=20.5mod20=0, where the condition is satisfied;

if n_f=3,

(10×3+4/2-2)mod20=30mod20=10, where the condition is not satisfied,

(10×3+5/2-2)mod20=0.5mod20=10, where the condition is not satisfied; and

......

Therefore, the UE sends the SR signal in the 3rd subframe (corresponding to time slot number 4, 5) of the radio frame having an odd n_f (the 1st, 3rd, 5th ...... radio frame, i.e. n_f=0, n_f=2, n_f=4......).

Fig. 5 illustrates a device for sending the SR signal that is devised based on the above-mentioned method in the present invention. The device 500 includes an SR periodicity and subframe offset determining module 510, a radio frame and subframe determining module 520 and a sending module 530 which are connected in turn.

The SR periodicity and subframe offset determining module 510 is used for determining an SR periodicity and an SR subframe offset according to an SR configuration index, and outputting the determined SR periodicity and SR subframe offset to the radio frame and subframe determining module 520.

The determination method is shown in Table 2.

The radio frame and subframe determining module 520 is used for determining a radio frame and a subframe for sending the SR signal according to the inputted SR periodicity and SR subframe offset, and outputting the determined radio frame and subframe to the sending module.

If a time length of a radio frame is less than the SR periodicity, the radio frame and subframe determining module 520 determines a frame and a subframe for sending the SR signal after shifting the SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity; if a time length of a radio frame is equal to or greater than the SR periodicity, each radio frame is determined as the sending frame for the SR signal, and if a time length of a radio frame is equal to the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of the sending frame; if a time length of a radio frame is greater than the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame.

The sending module 530 is used for sending the SR signal to the base station in the determined subframe of the radio frame.

The foregoing is merely preferred embodiments of the present invention, and the present invention is not limited thereto. Those skilled in the art may devise various alterations and variations for the present invention. Any modifications, equivalents, improvements, or the like made without departing from the spirit and principle of the present invention are intended to fall into the scope of the present invention.

INDUSTRIAL APPLICABILITY

According to the present invention, the terminal can complete a whole mapping process from the SR periodicity and subframe offset to the specific sending subframe when it sends the SR signal to the base station, thus it can be ensured that the SR signal sent from the UE can be received reliably by the base station, and also ensured that the UE can utilize the radio frame sufficiently and effectively.

CLAIMS

What is claimed is:

1. A method for sending a scheduling request (SR) signal, which is used for a user equipment (UE) in a long term evolution system to send an uplink signal to a base station, comprising:

the UE determining a radio frame and a subframe for sending the SR signal: if a time length of a radio frame is less than an SR periodicity, a sending frame and a subframe for the SR signal are determined after shifting an SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity; if a time length of a radio frame is equal to or greater than the SR periodicity, each radio frame is determined as the sending frame for the SR signal, and if a time length of a radio frame is equal to the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of the sending frame, and if a time length of a radio frame is greater than the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame; and

the UE sending the SR signal to the base station in the determined subframe of the sending frame.

2. The method according to claim 1, wherein the process of that the UE determines the radio frame and the subframe for sending the SR signal comprises:

the UE determines that a system frame number n_f of the sending frame satisfies an equation $(10 \times n_f) \bmod N_{SR\_P} = 0$ if the SR subframe offset is 0; and the UE determines that a system frame number n_f of the sending frame satisfies an equation $\left[10 \times \left(n_f - \left\lfloor \frac{N_{OFFSET,SR}}{10} \right\rfloor\right)\right] \bmod N_{SR\_P} = 0$ if the SR subframe offset is not 0; and

the UE determines the subframe of the sending frame according to a time slot index n_s that satisfies an equation $\left(\left\lfloor \frac{n_s}{2} \right\rfloor - N_{OFFSET,SR} \bmod 10\right) \bmod N_{SR\_P} = 0$;

in the above-mentioned equations, mod is a modulus operator, N_{SR_P} is the SR periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor \ \rfloor$ is a floor operator.

3. The method according to claim 1, wherein the process of that the UE determines the radio frame and the subframe for sending the SR signal comprises:

the UE determines an n_f that satisfies an equation $(10\times n_f+\lfloor n_s/2\rfloor-N_{OFFSET,SR})\bmod N_{SR\_P}=0$ as a system frame number of the sending frame, and determines the subframe of the sending frame according to a time slot index n_s that satisfies the equation, where mod is a modulus operator, N_{SR_P} is the SR periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor \ \rfloor$ is a floor operator.

4. The method according to any of claims 1 to 3, before the UE determines the radio frame and the subframe for sending the SR signal, further comprising: the UE determining the SR periodicity and the SR subframe offset according to an SR configuration index sent from the base station, namely the SR configuration index 0~155 is divided into 6 portions: 0~4, 5~14, 15~34, 35~74, 75~154 and 155, which is used for indicating that the corresponding SR periodicity is 5ms, 10ms, 20ms, 40ms, 80ms and OFF respectively; and the subframe offset of the first portion is equal to the corresponding SR configuration index of the portion; the subframe offset of any other portion is equal to the corresponding SR configuration index of the portion minus a summation of the SR periodicity of every portion prior to the portion; and OFF indicates periodicity closure.

5. A device for sending a scheduling request (SR) signal, which is used for a user equipment (UE) in a long term evolution system to send an uplink signal to a base station, comprising a radio frame and subframe determining module and a sending module which are connected with each other, wherein

the radio frame and subframe determining module, is used for determining a radio frame and a sub-frame thereof for sending the SR signal according to an SR subframe offset and an SR periodicity: if a time length of a radio frame is less than the SR periodicity, a sending frame and a subframe for the SR signal are determined after shifting the SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity; if a time length of a radio frame is equal to or greater than the SR periodicity, each radio frame is determined as the sending frame for the SR signal, and if a time length of a radio frame is equal to the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of the sending frame; if a time length of a radio frame is greater than the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame; and for outputting the determined radio frame and the sub-frame thereof for sending the SR signal to the sending module; and

the sending module, is used for sending the SR signal to the base station in the determined sub-frame of the sending frame.

6. The device according to claim 5, wherein the process of that the radio frame and subframe determining module determines the radio frame and the subframe thereof for sending the SR signal means that the radio frame and subframe determining module is used for:

determining a system frame number n_f of the sending frame satisfies an equation $(10 \times n_f) \bmod N_{SR\_P} = 0$ if the SR subframe offset is 0; and determining a system frame number n_f of the sending frame satisfies an equation $\left[10 \times \left(n_f - \left\lfloor \frac{N_{OFFSET,SR}}{10} \right\rfloor\right)\right] \bmod N_{SR\_P} = 0$ if the SR subframe offset is not 0; and

determining the subframe of the sending frame according to a time slot index n_s that satisfies an equation $\left(\left\lfloor \frac{n_s}{2} \right\rfloor - N_{OFFSET,SR} \bmod 10\right) \bmod N_{SR\_P} = 0$,

in the above-mentioned equations, mod is a modulus operator, N_{SR_P} is the SR periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor \ \rfloor$ is a floor operator.

7. The device according to claim 5, wherein the process of that the radio frame and subframe determining module determines the radio frame and the subframe thereof for sending the SR signal means that the radio frame and subframe determining module is used for: determining an n_f that satisfies an equation $(10 \times n_f + \lfloor n_s/2 \rfloor - N_{OFFSET,SR}) \bmod N_{SR\_P} = 0$ as a system frame number of the sending frame, and determining the subframe of the sending frame according to a time slot index n_s that satisfies the equation, where mod is a modulus operator, N_{SR_P} is the SR

periodicity, $N_{OFFSET,SR}$ is the SR subframe offset, and $\lfloor \rfloor$ is a floor operator.

8. The device according to any of claims 5 to 7, further comprising an SR periodicity and subframe offset determining module connected to the radio frame and subframe determining module,

the SR periodicity and subframe offset determining module, is used for determining the SR periodicity and the SR subframe offset according to an SR configuration index sent from the base station, namely the SR configuration index 0~155 is divided into 6 portions: 0~4, 5~14, 15~34, 35~74, 75~154 and 155 which is used for indicating that the corresponding SR periodicity is 5ms, 10ms, 20ms, 40ms, 80ms and OFF respectively; and the subframe offset of the first portion is equal to the corresponding SR configuration index of the portion; the subframe offset of any other portion is equal to the corresponding SR configuration index of the portion minus a summation of the SR periodicity of every portion prior to the portion; OFF indicates periodicity closure; and for outputting the determined SR periodicity and SR subframe offset to the radio frame and subframe determining module.

Fig. 1

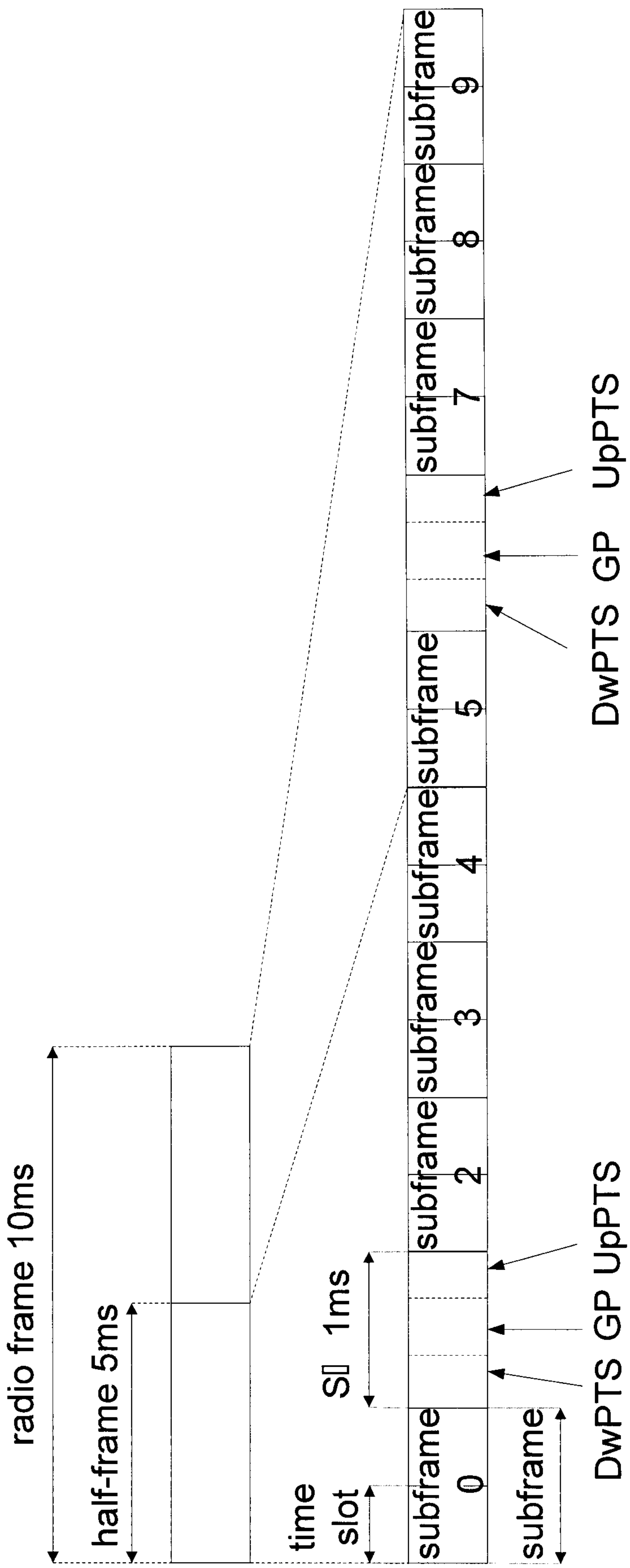

radio frame 10ms
half-frame 5ms
time slot
subframe 0
S 1ms
DwPTS GP UpPTS
subframe 2
subframe 3
subframe 4
subframe 5
DwPTS GP UpPTS
subframe 7
subframe 8
subframe 9
subframe

Fig. 2

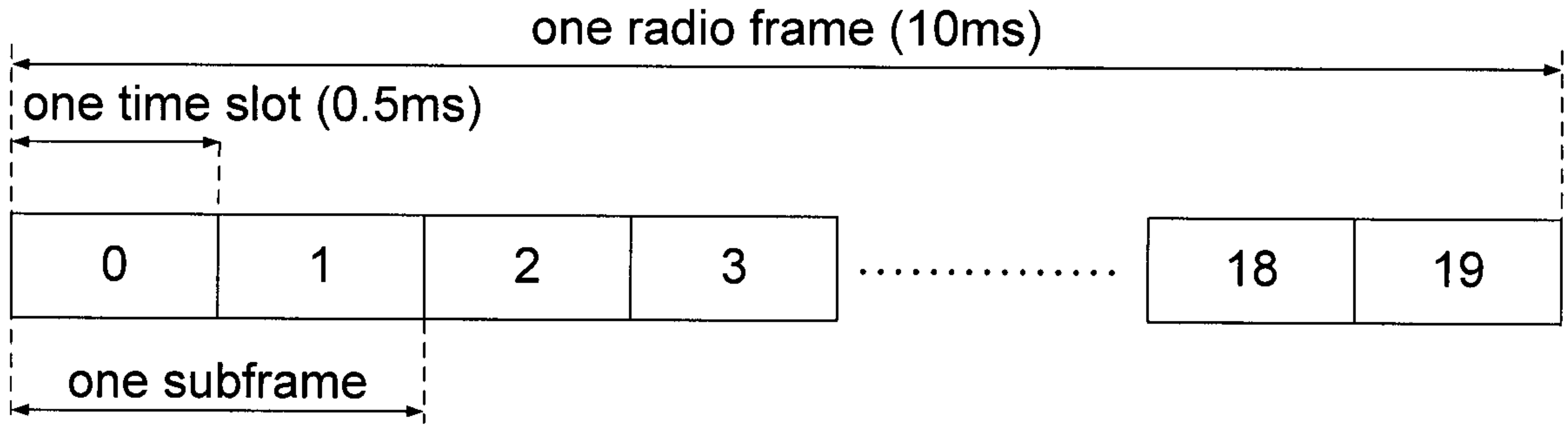

one radio frame (10ms)
one time slot (0.5ms)
0
1
2
3
18
19
one subframe

Fig. 3

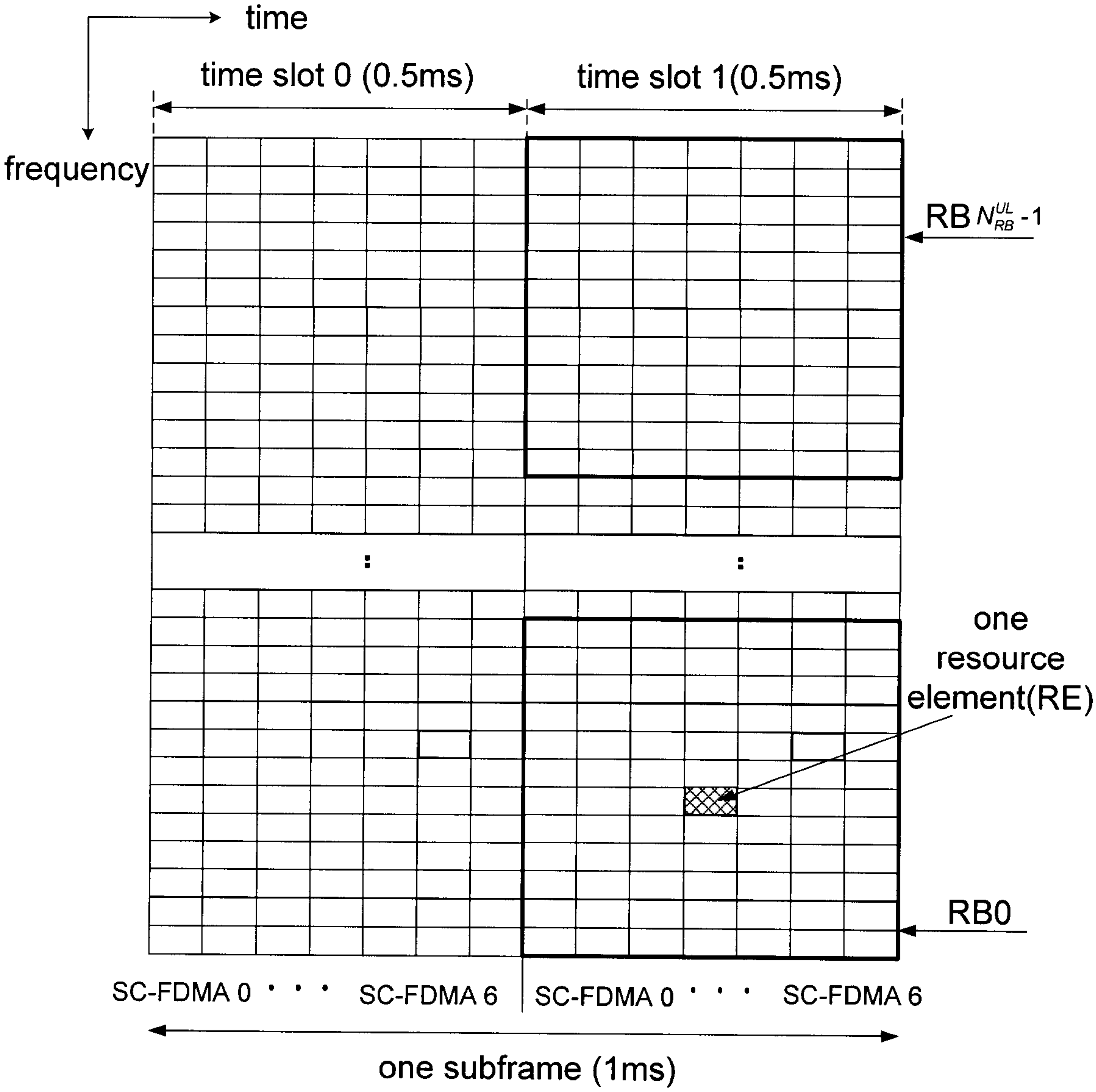

time
time slot 0 (0.5ms)
time slot 1(0.5ms)
frequency
RB N_{RB}^{UL}-1
one resource element(RE)
RB0
SC-FDMA 0
SC-FDMA 6
SC-FDMA 0
SC-FDMA 6
one subframe (1ms)

Fig. 4

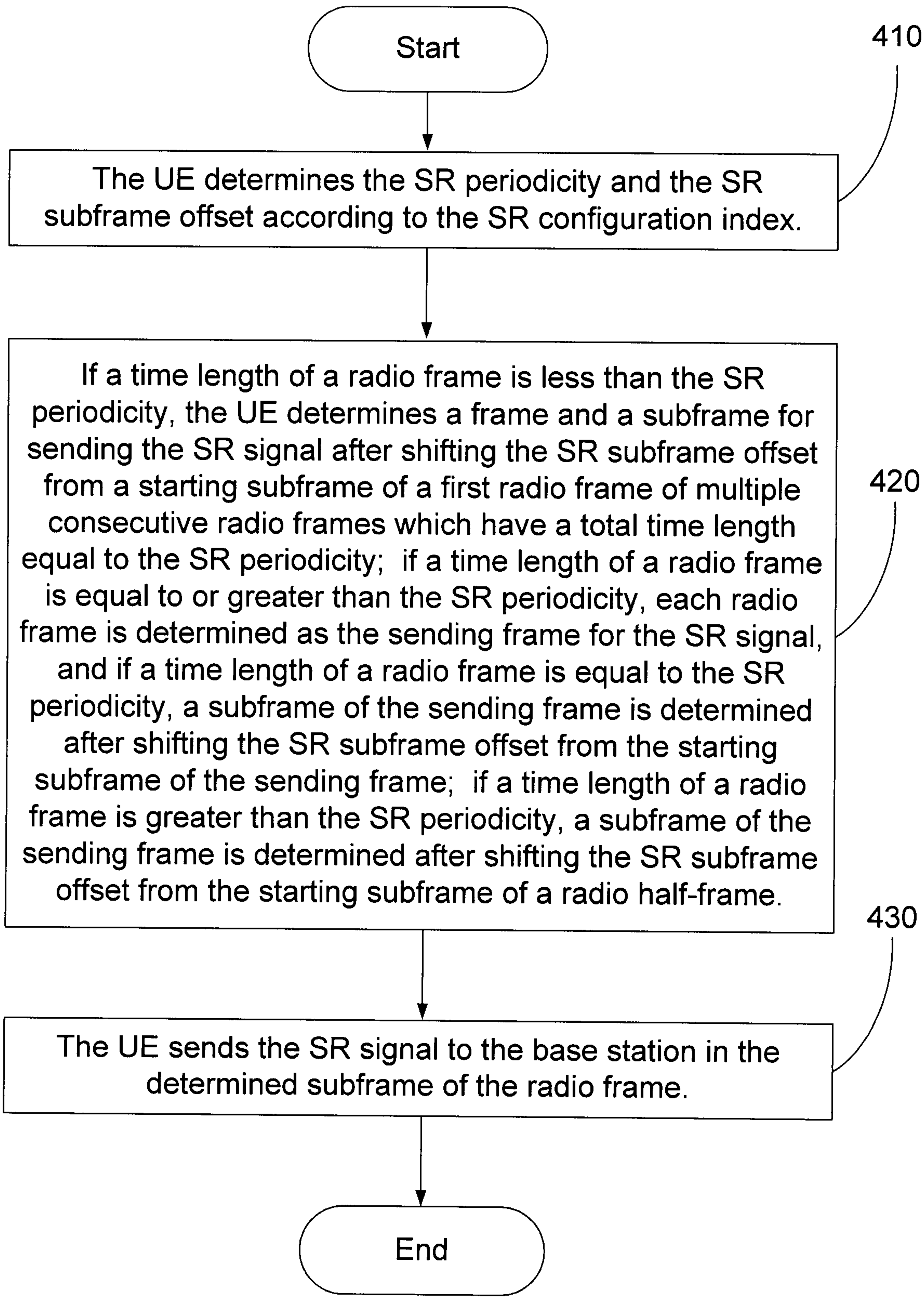
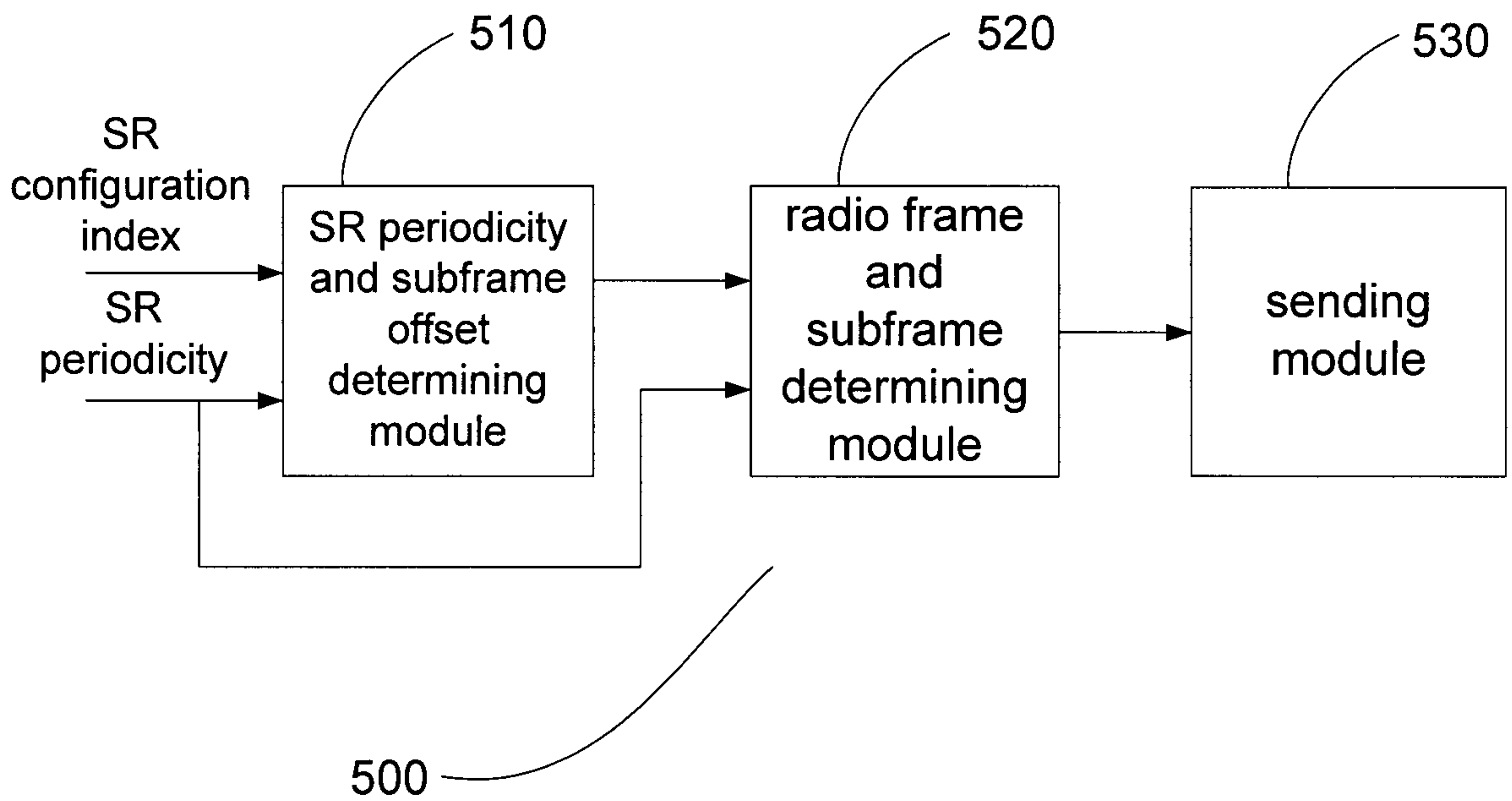
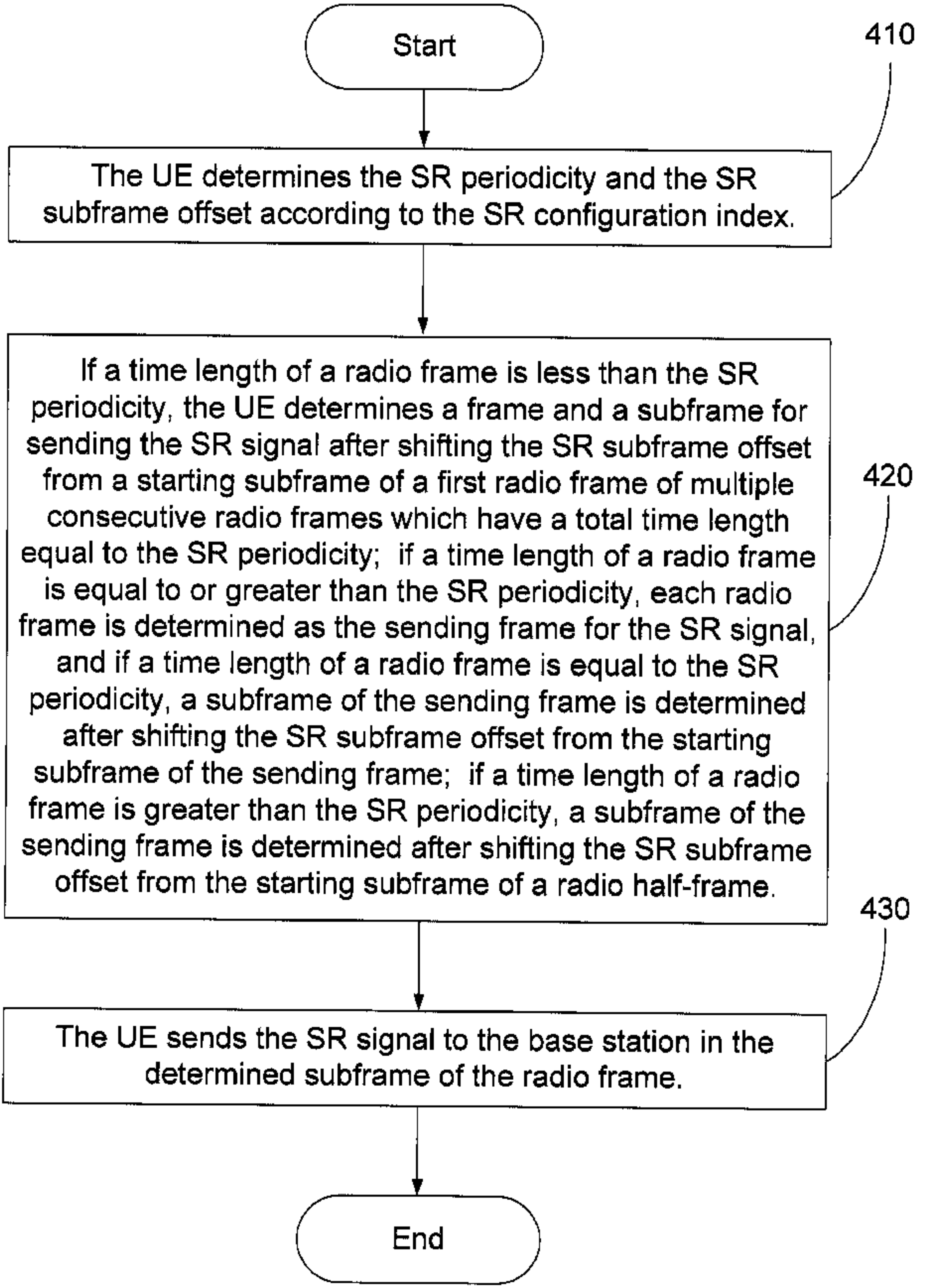

Start
410
The UE determines the SR periodicity and the SR subframe offset according to the SR configuration index.
420
If a time length of a radio frame is less than the SR periodicity, the UE determines a frame and a subframe for sending the SR signal after shifting the SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity; if a time length of a radio frame is equal to or greater than the SR periodicity, each radio frame is determined as the sending frame for the SR signal, and if a time length of a radio frame is equal to the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of the sending frame; if a time length of a radio frame is greater than the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame.
430
The UE sends the SR signal to the base station in the determined subframe of the radio frame.
End

Fig. 5


510
520
530
SR configuration index
SR periodicity
SR periodicity and subframe offset determining module
radio frame and subframe determining module
sending module
500


Start
410
The UE determines the SR periodicity and the SR subframe offset according to the SR configuration index.
420
If a time length of a radio frame is less than the SR periodicity, the UE determines a frame and a subframe for sending the SR signal after shifting the SR subframe offset from a starting subframe of a first radio frame of multiple consecutive radio frames which have a total time length equal to the SR periodicity; if a time length of a radio frame is equal to or greater than the SR periodicity, each radio frame is determined as the sending frame for the SR signal, and if a time length of a radio frame is equal to the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of the sending frame; if a time length of a radio frame is greater than the SR periodicity, a subframe of the sending frame is determined after shifting the SR subframe offset from the starting subframe of a radio half-frame.
430
The UE sends the SR signal to the base station in the determined subframe of the radio frame.
End