

# SYNC SIGNAL TRANSMISSION METHOD IN CDMA MOBILE COMMUNICATIONS SYSTEM AND CDMA MOBILE COMMUNICATIONS SYSTEM

## BACKGROUND OF THE INVENTION

### FIELD OF THE INVENTION

5       The present invention relates to a sync signal transmission method in a CDMA (Code Division Multiple Access) mobile communications system, a CDMA mobile communications system and a base station.

### 10       DESCRIPTION OF RELATED ART

      A mobile communication system like a widespread mobile phone system offers its services by dividing the entire service area into rather small radio zones called cells. 15 As shown in Fig. 1, such a system comprises a plurality of base stations 10 to cover the divided radio zones (cells), and mobile stations 20 to communicate with the base stations by establishing radio channels.

      The radio signal transmitted from a base station 10 20 at certain transmission power travels through space with a certain attenuation, and arrives at a receiving site. The attenuation the radio signal undergoes, increases with the distance between the transmitting and the receiving sites. Hence, it is common that a perch channel 25 transmitted from a distant base station 10 is received at a lower received level, and a perch channel transmitted from a near base station 10 is received at a higher received level. In practice, however, the propagation loss is not

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determined only by the distance, but varies depending on such conditions as the geography and buildings. As a result, the received power of the perch channels from the base stations 10 fluctuate sharply as the mobile stations 5 20 move. In the condition in which the received levels of the perch channels from the base stations 10 fluctuate always, perches above a required received level alters incessantly such that the received level of the current perch drops suddenly, or the received level of a perch 10 unreceivable increases abruptly above the receivable level. Thus, to receive the signals from the base stations 10 with better quality, it is important for the mobile stations 20 to continuously monitor the perches from the base stations 10, and to select the best base station 10.

15 Direct Sequence CDMA (DS-CDMA) is a scheme for multiple users to carry out communications using the same radio frequency band. This is established by spreading the spectrum of the data modulated signal of each user with a spreading code. The radio signal of each user is 20 identified by a spreading code assigned to the user.

Each spreading code, used for spreading signals in the DS-CDMA mobile communications system, is a combination of a short period spreading code and a long period spreading code. The short period spreading codes have the same 25 repetition period identical to the length of one information symbol, and are used commonly by all the base stations. In contrast, the long period spreading codes have a repetition period longer than the length of the

information symbol, and vary from base station to base station.

Fig. 2 is a schematic diagram illustrating the spreading codes usage in the DS-CDMA mobile communications system.

In Fig. 2, the upper layer represents the long period spreading codes assigned to the base stations, and the lower layer represents the short period spreading codes commonly used by all base stations. Signals transmitted from each base station are identified by the long period spreading code uniquely assigned to the base station.

Fig. 3 is a schematic diagram illustrating an example of timing relationships among the long period spreading codes a mobile station receives from a plurality of base stations.

Fig. 3 supposes an asynchronous mobile communications system requiring no synchronization among the base stations. Hence, the timing of the long period spreading codes received by the mobile station takes place at random for the individual base stations.

Therefore, in an asynchronous mobile communication system, mobile stations must search for a perch quickly whose spreading code and phase are unknown. A fast method to acquire a spreading code and its arbitrary phase is described in a document by K. Higuchi, M. Sawahashi and F. Adachi, "Fast Cell Search Algorithm In Inter-Cell Asynchronous DS-CDMA Mobile Radio", IEICE Trans. Commun., Vol. E81-B, No. 7, July 1998. The method provides a

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"masking symbol" to parts of the perch channel which undergoes double spreading by the short period spreading code and long period spreading code. Here, the "masking symbol" is spread only by the short period spreading code without using the long period spreading code.

Fig. 4 is a schematic diagram illustrating a structure of a perch channel.

First, the mobile station despreads the received signal using a short period spreading code commonly used by all the base stations. This enables the mobile station to detect a peak at the timing of a masking symbol of the received signal independently of the types of the long period spreading code (first step).

Subsequently, at the timing extracted in the first step, the mobile station detects a long period spreading code group code superimposed on the masking symbol, and identifies the group to which the long period spreading code assigned to the intended base station belongs (second step).

Finally, considering the long period spreading code belonging to the group determined in the second step as the set of candidates, the mobile station identifies the long period spreading code used by the base station (third step).

In a system to which this method is applied, long period spreading codes are divided into groups in advance.

As described above, the mobile communications system comprises a lot of base stations, and each cell consists

of sectors covered by directional antennas. Accordingly, the mobile stations must receive signals sent from a great number of sectors. In addition, the signals transmitted from the sectors are reflected off surrounding buildings and divided into many paths before arriving at the mobile stations. Consequently, the signals from the sectors include many delayed waves.

As a result, with respect to the great number of the signals, the mobile stations must identify the long period spreading code and establish timing synchronization in such a condition as the codes or timings are unknown. This presents an important problem of increasing the load on the mobile stations in carrying out the neighboring cell search or base station selection, thereby impairing selection accuracy of the base stations.

#### SUMMARY OF THE INVENTION

The present invention is implemented to solve the foregoing problem. It is therefore an object of the present invention to provide a technique capable of reducing the load on a mobile station to identify the long period spreading code and to establish the timing synchronization, and capable of increasing the selection accuracy of the base station.

In a first aspect of the present invention, there is provided a sync signal transmission method in a CDMA mobile communications system including at least a plurality of

base stations and a mobile station, the sync signal transmission method comprising the steps of:

carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a repetition period longer than the information symbols and is differently assigned to each of the base stations;

transmitting the doubly spread information symbols to the mobile station; and

intermittently transmitting a sync signal, which is spread only by the short period spreading code, from the plurality of base stations to the mobile station with transmission timings shifted by a predetermined interval for each of the base stations.

In a second aspect of the present invention, there is provided a sync signal transmission method in a CDMA mobile communications system including at least a plurality of base stations and a mobile station, the sync signal transmission method comprising the steps of:

carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a

repetition period longer than the information symbols and is differently assigned to each of the base stations;

transmitting the doubly spread information symbols to the mobile station; and

5 intermittently transmitting a sync signal, which is spread by only the short period spreading code, from the plurality of base stations to the mobile station with transmission timings shifted by a predetermined interval for each of a plurality of sectors in a cell.

10 In a third aspect of the present invention, there is provided a sync signal transmission method in a CDMA mobile communications system including at least a plurality of base stations and a mobile station, the sync signal transmission method comprising the steps of:

15 carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the  
20 base stations, and the long period spreading code has a repetition period longer than the information symbols, is differently assigned to each of the base stations, and belongs to one of groups into which a plurality of long period spreading codes are divided;

25 transmitting the doubly spread information symbols to the mobile station; and

intermittently transmitting a sync signal, which is spread by only the short period spreading code, from the

plurality of base stations to the mobile station with transmission timings shifted by a predetermined interval for each of sectors using the long period spreading codes belonging to the same group.

5 In a fourth aspect of the present invention, there is provided a CDMA mobile communications system including at least a plurality of base stations and a mobile station, the CDMA mobile communications system comprising:

means for carrying out double spreading of information  
10 symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a  
15 repetition period longer than the information symbols and is differently assigned to each of the base stations;

means for transmitting the doubly spread information symbols to the mobile station; and

means for intermittently transmitting a sync signal,  
20 which is spread only by the short period spreading code, from the plurality of base stations to the mobile station with transmission timings shifted by a predetermined interval for each of the base stations.

In a fifth aspect of the present invention, there is  
25 provided a CDMA mobile communications system including at least a plurality of base stations and a mobile station, the CDMA mobile communications system comprising:

means for carrying out double spreading of information

symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a repetition period longer than the information symbols and is differently assigned to each of the base stations;

means for transmitting the doubly spread information symbols to the mobile station; and

means for intermittently transmitting a sync signal, which is spread by only the short period spreading code, from the plurality of base stations to the mobile station with transmission timings shifted by a predetermined interval for each of a plurality of sectors in a cell.

In a sixth aspect of the present invention, there is provided a CDMA mobile communications system including at least a plurality of base stations and a mobile station, the CDMA mobile communications system comprising:

means for carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a repetition period longer than the information symbols, is differently assigned to each of the base stations, and belongs to one of groups into which a plurality of long period spreading codes are divided;

means for transmitting the doubly spread information symbols to the mobile station; and

means for intermittently transmitting a sync signal, which is spread by only the short period spreading code, from the plurality of base stations to the mobile station with transmission timings shifted by a predetermined interval for each of sectors using the long period spreading codes belonging to the same group.

In a seventh aspect of the present invention, there is provided a base station in a CDMA mobile communications system for communicating with a mobile station, the base station comprising:

means for carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all base stations, and the long period spreading code has a repetition period longer than the information symbols and is differently assigned to each of the base stations;

means for transmitting the doubly spread information symbols to the mobile station; and

means for intermittently transmitting a sync signal, which is spread only by the short period spreading code, from the base station to the mobile station with transmission timings shifted by a predetermined interval for each of the base stations.

In a eighth aspect of the present invention, there

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is provided a base station in a CDMA mobile communications system for communicating with a mobile station, the base station comprising:

means for carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a repetition period longer than the information symbols and is differently assigned to each of the base stations;

means for transmitting the doubly spread information symbols to the mobile station; and

means for intermittently transmitting a sync signal, which is spread by only the short period spreading code, from the base station to the mobile station with transmission timings shifted by a predetermined interval for each of a plurality of sectors in a cell.

In a ninth aspect of the present invention, there is provided a base station in a CDMA mobile communications system for communicating with a mobile station, the base station comprising:

means for carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a

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repetition period longer than the information symbols, is differently assigned to each of the base stations, and belongs to one of groups into which a plurality of long period spreading codes are divided;

5 means for transmitting the doubly spread information symbols to the mobile station; and

means for intermittently transmitting a sync signal, which is spread by only the short period spreading code, from the base station to the mobile station with  
10 transmission timings shifted by a predetermined interval for each of sectors using the long period spreading codes belonging to the same group.

In a tenth aspect of the present invention, there is provided a mobile station in a CDMA mobile communications  
15 system, the mobile station comprising:

means for carrying out radio communications with a plurality of base stations as defined in any one of claims 7-9; and

means for selectively capturing a sync signal of a  
20 particular one of the base stations.

Since the plurality of base stations each shift their transmission timings of the sync signals by the predetermined interval, the timings of the sync signals to be received by the mobile station are limited. Thus,  
25 the load for the mobile station to carry out the neighboring cell search and base station selection is reduced. In addition, since the mobile station knows in advance that it can receive the sync signals from different base

stations at intervals different by the predetermined time period, it can carry out the neighboring cell search with narrowing its timings to the timings of the sync signals from the desired base stations. This can improve the efficiency of the neighboring cell search.

According to one aspect of the present invention, in the mobile communications system having a plurality of sets of the long period spreading codes which are grouped in advance, the base stations using the long period spreading codes in the same group transmit the sync signals, shifting their timings by the predetermined interval. This makes it possible for the mobile station to narrow the receiving timings of the long period spreading code groups and of the sync signals, thereby reducing the load on the mobile station to carry out the neighboring cell search or base station selection.

The above and other objects, features and advantages of the present invention will become more apparent from the following description of embodiments thereof taken in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram illustrating a configuration of a CDMA mobile communications system;

Fig. 2 is a schematic diagram illustrating a method of using spreading codes in a DS-CDMA mobile communications system;

Fig. 3 is a schematic diagram illustrating timings of long period spreading codes in signals sent from base stations to be received by a mobile station;

Fig. 4 is a schematic diagram illustrating a structure  
5 of a perch channel;

Fig. 5 is a block diagram showing a configuration of an embodiment of a mobile communications system in accordance with the present invention;

Fig. 6 is a schematic diagram illustrating an  
10 operation of the mobile communications system in accordance with the present invention;

Fig. 7 is a schematic diagram illustrating another operation of the mobile communications system in accordance with the present invention; and

15 Fig. 8 is a schematic diagram illustrating still another operation of the mobile communications system in accordance with the present invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

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The invention will now be described with reference to the accompanying drawings.

#### EMBODIMENT 1

25 Fig. 5 is a block diagram showing a configuration of a mobile communications system in accordance with the present invention, which shows only portions of the mobile communications system relevant to the present invention.

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The mobile communications system 500 comprises at least a base station 10, a mobile station 20, and a timing manager 30.

The base station 10, which is connected to the timing  
5 manager 30 to receive timing information therefrom,  
carries out radio communications with the mobile station  
20. The base station 10 comprises at least a long period  
spreading code generator 502, a short period spreading code  
generator 504, a long period spreading code group code  
10 generator 506, a first combiner 508, a second combiner 510,  
a spreader 512, a transmission timing regulator 514, and  
an antenna 516. The long period spreading code generator  
502, which is connected to the first combiner 508,  
generates the long period spreading code that is uniquely  
15 assigned to the base station and has a repetition period  
longer than the period of an information symbol, to be used  
for the spreading in the mobile communications system.  
The short period spreading code generator 504, which is  
connected to both the first combiner 508 and second  
20 combiner 510, generates short period spreading codes that  
are common to all the base stations and have the same  
repetition period as the information symbol, to be used  
for the spreading in the mobile communications system.  
The long period spreading code group code generator 506,  
25 which is connected to the second combiner 510, generates  
a group code of the long period spreading code. The first  
combiner 508, which is connected to the long period  
spreading code generator 502, short period spreading code

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generator 504 and spreader 512, combines the spreading codes generated by the long period spreading code generator 502 and short period spreading code generator 504, and supplies its output to the spreader 512. The second  
5 combiner 510, which is connected to the short period spreading code generator 504, long period spreading code group code generator 506 and switch SW, combines the short period spreading code generated by the short period spreading code generator 504 with the long period spreading  
10 code group code generated by the long period spreading code group code generator 506, and supplies its output to the switch SW. The spreader 512, which is connected to the first combiner 508 and switch SW, spreads perch channel information using the spreading code combined by the first  
15 combiner 508, and supplies its output to the switch SW. The switch SW normally connects the spreader 512 to the transmission timing regulator 514, but the second combiner 510 to the transmission timing regulator 514 at timings of the masking symbol, that is, the sync signal transmitted  
20 at every fixed interval from the second combiner 510. The transmission timing regulator 514, which is connected to the switch SW, antenna 516 and timing manager 30 through a communication channel, receives the timing information from the timing manager 30, and regulates the transmission  
25 timing of the signal from the spreader 512 or second combiner 510 to be transmitted to the mobile station 20 through the antenna 516. The antenna 516 connected to the transmission timing regulator 514 carries out radio

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communications with the mobile station 20. The timing manager 30 is connected to a plurality of base stations 10 to transfer the timing information to each base station. The mobile station 20 carries out the radio communications  
5 with the base station.

Next, an operation of the present embodiment of the mobile communications system 500 with the foregoing configuration will be described in detail with reference to Figs. 6-8.

10 Fig. 6 is a schematic diagram illustrating an operation of the mobile communications system in accordance with the present invention.

In Fig. 6, base stations BS1-BS5 each transmit a sync signal (masking symbol) regularly which is not spread by  
15 the long period spreading code. The base stations BS1-BS5 transmit these sync signals with shifted timing relationship among one another as depicted at bottom right of Fig. 6. The amount of shifting is fixed to the predetermined interval of the system and is known to the  
20 mobile stations in advance. Accordingly, the mobile station can acquire a plurality of sync signals efficiently in the neighboring cell search or in the base station selection by searching for sync signals from other base stations, focusing on the timings shifted by the fixed  
25 intervals from the timing of the sync signal reception, which is sent from the base station that has already been acquired by the mobile station.

Fig. 7 is a schematic diagram illustrating another

operation of the mobile communications system in accordance with the present invention.

Cells including base stations BS1-BS3 are each divided into three sectors 1-3, each of which transmits a sync  
5 signal. The sync signals are transmitted with a fixed amount of timing offset, as illustrated on the right-hand side of Fig. 7. As illustrated in Fig. 7, the transmission timings of the sync signals are each shifted by the fixed interval between the sectors under the same base station  
10 so that the sync signals are sent with an offset assigned to the system.

Fig. 8 is a schematic diagram illustrating still another operation of the mobile communications system in accordance with the present invention.

15 In Fig. 8, the long period spreading codes used by the base stations are divided into groups such that the base stations BS1-BS3 use the long period spreading codes belonging to group 1, BS4 and BS5 use those belonging to group 2 and BS6-BS8 those belonging to group 3. The  
20 transmission timings of the sync signals sent from the base stations in the same group are each shifted by a fixed interval as illustrated in the bottom right of Fig. 8.

Incidentally, to apply the present invention to a plurality of base stations at different locations, it is  
25 necessary to install an external timing source to align timing axes among the base stations. To achieve this, the foregoing embodiment employs the timing manager 30. The present invention, however, is not limited to it. For

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example, it can use the GPS or a wired network as the timing source, offering a similar effect.

According to the present invention as described above, since the base stations each shift their sync signal  
5 transmission timings by the predetermined time periods, the mobile station can narrow the receiving timings of the sync signals, offering an advantage of being able to reduce the load on the mobile station involved in the neighboring cell search or the base station selection. Since the  
10 mobile station knows in advance that it can receive the sync signals from the base stations at the timings shifted by the predetermined fixed intervals, it can carry out the neighboring cell search focusing on the desired timing of the sync signal from the intended base station, thereby  
15 improving the efficiency of the neighboring cell search.

Furthermore, in the mobile communications system according to the present invention which divides the long period spreading codes into groups in advance, the base stations using the long period spreading codes in the same  
20 group each transmit their sync signals shifting the transmission timings by the predetermined interval. This enables the mobile station to limit the group of the long period spreading codes and the receiving timing of the sync signal, thereby reducing the load on the mobile station  
25 in the neighboring cell search or base station selection.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those skilled in the art

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that changes and modifications may be made without  
departing from the invention in its broader aspect, and  
it is the intention, therefore, in the apparent claims to  
cover all such changes and modifications as fall within  
5 the true spirit of the invention.

CLAIMS:

1. A sync signal transmission method in a CDMA mobile communications system including at least a plurality of  
5 base stations and a mobile station, said sync signal transmission method characterized by comprising the steps of:

carrying out double spreading of information symbols using a short period spreading code and a long period  
10 spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a repetition period longer than the information symbols and  
15 is differently assigned to each of said base stations;

transmitting the doubly spread information symbols to said mobile station; and

intermittently transmitting a sync signal, which is spread only by the short period spreading code, from said  
20 plurality of base stations to said mobile station with transmission timings shifted by a predetermined interval for each of said base stations.

2. A sync signal transmission method in a CDMA mobile communications system including at least a plurality of  
25 base stations and a mobile station, said sync signal transmission method characterized by comprising the steps of:

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carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a repetition period longer than the information symbols and is differently assigned to each of said base stations;

transmitting the doubly spread information symbols to said mobile station; and

intermittently transmitting a sync signal, which is spread by only the short period spreading code, from said plurality of base stations to said mobile station with transmission timings shifted by a predetermined interval for each of a plurality of sectors in a cell.

3. A sync signal transmission method in a CDMA mobile communications system including at least a plurality of base stations and a mobile station, said sync signal transmission method characterized by comprising the steps of:

carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a repetition period longer than the information symbols, is

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differently assigned to each of said base stations, and belongs to one of groups into which a plurality of long period spreading codes are divided;

transmitting the doubly spread information symbols  
5 to said mobile station; and

intermittently transmitting a sync signal, which is spread by only the short period spreading code, from said plurality of base stations to said mobile station with transmission timings shifted by a predetermined interval  
10 for each of sectors using the long period spreading codes belonging to the same group.

4. A CDMA mobile communications system including at least a plurality of base stations and a mobile station, said  
15 CDMA mobile communications system characterized by comprising:

means for carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading  
20 code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a repetition period longer than the information symbols and is differently assigned to each of said base stations;

25 means for transmitting the doubly spread information symbols to said mobile station; and

means for intermittently transmitting a sync signal, which is spread only by the short period spreading code,

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from said plurality of base stations to said mobile station with transmission timings shifted by a predetermined interval for each of said base stations.

- 5 5. A CDMA mobile communications system including at least a plurality of base stations and a mobile station, said CDMA mobile communications system characterized by comprising:

means for carrying out double spreading of information  
10 symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a  
15 repetition period longer than the information symbols and is differently assigned to each of said base stations;

means for transmitting the doubly spread information symbols to said mobile station; and

means for intermittently transmitting a sync signal,  
20 which is spread by only the short period spreading code, from said plurality of base stations to said mobile station with transmission timings shifted by a predetermined interval for each of a plurality of sectors in a cell.

- 25 6. A CDMA mobile communications system including at least a plurality of base stations and a mobile station, said CDMA mobile communications system characterized by comprising:

means for carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a repetition period longer than the information symbols, is differently assigned to each of said base stations, and belongs to one of groups into which a plurality of long period spreading codes are divided;

means for transmitting the doubly spread information symbols to said mobile station; and

means for intermittently transmitting a sync signal, which is spread by only the short period spreading code, from said plurality of base stations to said mobile station with transmission timings shifted by a predetermined interval for each of sectors using the long period spreading codes belonging to the same group.

7. A base station in a CDMA mobile communications system for communicating with a mobile station, said base station characterized by comprising:

means for carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all base stations, and the long period spreading code has a

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repetition period longer than the information symbols and is differently assigned to each of said base stations;

means for transmitting the doubly spread information symbols to said mobile station; and

5 means for intermittently transmitting a sync signal, which is spread only by the short period spreading code, from said base station to said mobile station with transmission timings shifted by a predetermined interval for each of said base stations.

10

8. A base station in a CDMA mobile communications system for communicating with a mobile station, said base station characterized by comprising:

means for carrying out double spreading of information  
15 symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the base stations, and the long period spreading code has a  
20 repetition period longer than the information symbols and is differently assigned to each of said base stations;

means for transmitting the doubly spread information symbols to said mobile station; and

means for intermittently transmitting a sync signal,  
25 which is spread by only the short period spreading code, from said base station to said mobile station with transmission timings shifted by a predetermined interval for each of a plurality of sectors in a cell.

9. A base station in a CDMA mobile communications system for communicating with a mobile station, said base station characterized by comprising:

5 means for carrying out double spreading of information symbols using a short period spreading code and a long period spreading code, wherein the short period spreading code has a repetition period identical to a period of the information symbols and is assigned in common to all the  
10 base stations, and the long period spreading code has a repetition period longer than the information symbols, is differently assigned to each of said base stations, and belongs to one of groups into which a plurality of long period spreading codes are divided;

15 means for transmitting the doubly spread information symbols to said mobile station; and

means for intermittently transmitting a sync signal, which is spread by only the short period spreading code, from said base station to said mobile station with  
20 transmission timings shifted by a predetermined interval for each of sectors using the long period spreading codes belonging to the same group.

10. A mobile station in a CDMA mobile communications  
25 system, said mobile station characterized by comprising:

means for carrying out radio communications with a plurality of base stations as defined in any one of claims 7-9; and

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means for selectively capturing a sync signal of a particular one of said base stations.