CODE DIVISION MULTIPLE ACCESS MOBILE COMMUNICATION SYSTEM

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a code division multiple access (CDMA) mobile communication system. In particular, the present invention relates to a cell search method using a long code masked symbol (search code) in perch channels.

2. Description of the Related Art

When a mobile terminal starts communication, or a mobile terminal moves from one base station area (cell) in which the mobile terminal is currently conducting communication to an adjacent cell (i.e., in the case of hand over) in CDMA mobile communication systems, it is necessary to conduct spread code detection or frame/slot timing synchronization. Such processing is called cell search.

As for an example of a conventional cell search method, a method of spreading only one symbol located at the end of a slot by using a special short code called long code masked symbol instead of the ordinary long code and short code is described in Technical Report of IEICE (the Institute of Electronics, Information and Communication Engineers) DSP-96-116, SAT96-111, RCS96-122 (1997–01).

This cell search method using the long code masked symbol will now be described. The cell search uses perch channels shown in FIG. **1**. The term "perch channels" means control channels for notifying reverse link interference power measured at the base station, system frame number, and the like. Furthermore, the perch channels are transmitted always with constant transmission power. Since a control signal of the perch channels is used also as a reference signal of timing synchronization conducted between the base station and the mobile terminal, the control signal of the perch channels is spread as described below. As for the perch channels, a first perch channel and a second perch channel are multiplexed. In a long code masked symbol position (search code position) **101** of a first perch channel **106**, a CSC (Common Short Code), i.e., a first search code **104** is mapped. In a long code masked symbol position **101** of a second perch channel **107**, a GISC (Group Identification Short Code), i.e., a second search code **105** is mapped. In a data symbol section **102** (a section obtained by removing a long code masked symbol section (search code section) from one slot section), a control signal transmitted to the mobile terminal is spread by a long code and short code **103**.

The long code is a long period spreading code assigned uniquely to the base station. The short code is a short period spreading code assigned uniquely to each of channels under communication (including the control channel and transmission channel). The long code has a long code length and includes many kinds. In order to facilitate its timing synchronization, therefore, the long code is classified into a plurality of groups. The GISC is a short period code provided so as to correspond to the classification of the long code. In the case where the mobile terminal is to conduct timing synchronization of the perch channels, the mobile terminal lightens the load of synchronization of the long code used by the base station (i.e., decreases time, circuit means, electric power, etc. required for the timing synchronization), by detecting the GISC and narrowing down the long code to a fixed range (i.e., by limiting candidates for the long code which may be used). The CSC is a short period spreading code defined uniquely to the mobile communication system.

The detection of the long code and the frame/slot timing used by the base station, utilizing the perch channels is conducted as follows: (1) the mobile terminal despreads the perch channels by using the CSC, and detects the slot timing on the basis of the height of the correlation value; (2) the mobile terminal conducts despreading in all GISCs in conformity to the synchronized slot timing, and detects the GISC on the basis of the height of the correlation value; (3) the mobile terminal conducts despreading by using all long codes belonging to a group associated with the GISC, and detects the long code on the basis of the height of the correlation value.

The format and transmission power of the perch channels of the conventional method are shown in FIG. **2**. The symbol rate of the perch channels is 16 kbps (spreading factor being 256) and constant in all sections including the long code masked symbol. In the long code masked symbol section in which the second perch channel is transmitted, transmission power **P1** of the first perch channel is lowered by transmission power **P2** of the second perch channel. Thereby, transmission power of the perch channels after multiplexing is constant.

In the conventional system which conducts spreading process in the long code masked symbol section at the same symbol rate as in the data symbol section, it took the longest time in a first stage (slot timing synchronization) of the cell search. In order to conduct timing synchronization in a short time, a matched filter (MF) capable of deriving correlation results at a plurality of timing instants at once is used in many cases.

FIG. **13** shows time required in each stage of the cell search in the case where cell search is conducted by despreading the perch channels having a spreading factor of 256, by use of a XF with 64 chips. The stage requiring the longest time is slot timing synchronization **1301**. For attaining faster cell search, it is an indispensable subject to shorten the time required for timing synchronization. In timing synchronization using the MF, correlation values at all timing instants in one symbol (256 chips) section are accumulated by using CSCs of a plurality of slots, thereby conducting slot timing synchronization at high precision. For example, correlation values derived for CSCs of 48 slots are accumulated. In FIG. **13**, one accumulation value with respect to timing instants of 64 chips which is the same in number as the number of taps of the MF is derived in one cycle **1301** of timing synchronization.

If the MF with 64 taps is used, coefficient mode switchover becomes necessary in order to derive correlation values at all timing instants. This results in a problem that the time required for timing synchronization, in turn the time required for cell search becomes longer. On the other hand, if a MF with 256 taps is used, then the received signal can be despread with coefficients corresponding to one symbol set in the MF intact. Since the coefficient mode switchover thus becomes unnecessary, correlation at all timing instants can be derived at high speed. However, both the gate size and power consumption of the MF become very large.

SUMMARY OF THE INVENTION

In order to conduct the cell search at high speed while suppressing the gate size and the power consumption, the spreading factor of the long code masked symbol is made smaller than spreading factors of other portions of the perch channels.