PILOT REFERENCE TRANSMISSION FOR A WIRELESS COMMUNICATION SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a Continuation of U.S. patent application Ser. No. 09/702,142, entitled "PILOT REFERENCE TRANSMISSION FOR A WIRELESS COMMUNICATION SYSTEM", filed Oct. 30, 2000, which is a Continuation-in-Part of U.S. patent application Ser. No. 09/575,073, entitled "HIGH DATA RATE WIRELESS PACKET DATA COMMUNICATIONS SYSTEM," filed May 19, 2000, now U.S. Pat. No. 6,894,994, which is a Continuation-in-Part of U.S. patent application Ser. No. 08/963,386, entitled "METHOD AND APPARATUS FOR HIGH RATE PACKET DATA TRANSMISSION," filed Nov. 3, 1997, now U.S. Pat. No. 6,574,211, which claims the benefit of provisional U.S. Application Ser. No. 60/163,350, entitled "HIGH DATA RATE SYSTEM AND TECHNOLOGY," filed Nov. 3, 1999, all of which are assigned to the assignee of the invention and incorporated herein by reference.

BACKGROUND OF THE INVENTION

I. Field of the Invention

The present invention relates to data communication. More particularly, the present invention relates to a novel and improved pilot reference transmission scheme for use in a wireless communication system.

II. Description of the Related Art

In a wireless communication system, a pilot reference is often transmitted from a transmission source to a receiving device to assist the receiving device performs a number of functions. The pilot reference is typically a predetermined data pattern processed (e.g., covered and spread) in a known manner. The pilot reference can be used at the receiving device to estimate the quality of the transmission link, coherently demodulate the received transmissions, and perform other functions.

A wireless communication system such as a code division multiple access (CDMA) system or a time division multiple access (TDMA) system (e.g., a Global System for Mobile Communications (GSM) system) typically includes a number of base stations that transmit to a number of remote terminals. Each base station is designed to cover a particular coverage area and transmits to the remote terminals within its coverage area. For systems in which neighboring base stations transmit on the same frequency band to improve spectral efficiency, such as many CDMA-based systems, the transmissions from each base station act as interference to those of neighboring base stations, and possibly to its own transmissions due to multipath. This interference degrades the quality of the transmissions received at a remote terminal, including the pilot transmission.

For the conventional IS-95 CDMA system, a pilot reference is continuously transmitted on a dedicated pilot channel at a particular (relatively low) transmit power level. The remote terminal receives and processes the forward link signal to isolate the pilot channel, and further processes the pilot channel to recover the pilot reference. The interference from these other transmissions can affect the quality of the received pilot reference. This interference is worse when the orthogonality between the pilot channel and the traffic channels used for the data transmissions is lost due to, for example, multipath.

The pilot reference transmission scheme used for the IS-95 CDMA system is adequate for voice communication since the data rate is low, which allows the remote terminal more time to process the pilot reference. However, for a high-speed data transmission system in which the link condition is required to be accurately estimated within a short period of time, this continuous low-level pilot reference is not adequate.

As can be seen, a pilot reference transmission scheme that can provide a high quality pilot reference to the remote terminals and allow a remote terminal to quickly and accurately estimate the link condition is highly desirable.

SUMMARY OF THE INVENTION

The present invention provides a novel and improved pilot reference transmission scheme having various advantages over conventional schemes and is well suited for high data rate wireless communication systems. In accordance with an aspect of the invention, to maximize the amount of interference from transmissions from neighboring transmission sources (e.g., access points or base stations) during the pilot interval, and hence minimize the amount of interference from non-transmitting sources during the data intervals, the pilot references are transmitted in bursts at predetermined time intervals, and the pilot bursts from the access points are synchronized. The transmission of pilot bursts from the access points at the same predetermined time intervals results in maximum interference contributions from non-transmitting neighboring access points, facilitating reliable estimation of worst case C/I, and further allows the receiving devices (e.g., access terminals or remote terminals) to easily recognize the bursts as pilot reference.

In accordance with another aspect of the invention, each access point transmits the pilot bursts at or near its maximum transmit power level, if at all, and no user-specific data is transmitted during the pilot bursts. As a result, the pilot bursts are received at the access terminals only in the presence of pilots from other access points and are not affected by other data transmissions. With this pilot reference transmission scheme, the access terminals do not need to subtract the effect of data transmissions since these do not occur during the pilot bursts. This results in a signal-to-noise ratio for the pilot reference that represents the minimum signal-to-noise ratio during the data transmission from the given access point. This aids in rapid and reliable estimation of worst case carrier-to-interference (C/I).

A specific embodiment of the invention provides a method for transmitting pilot references from a number of transmission sources (e.g., access points or base stations). In accordance with the method, one or more signals indicative of a time reference for the communication system are received at each transmission source. The time reference can be derived from a Global Positioning System (GPS) satellite constellation. Pilot bursts for a pilot reference are generated at each transmission source (in a manner described below) and transmitted. The pilot bursts from the transmission sources are in synchronization with the system time reference and are aligned in time at the time of transmission.

The pilot bursts can be generated and transmitted at predetermined time intervals. To minimize interference from data transmissions, the pilot bursts can be transmitted at or near the maximum transmit power level of the transmission source and in the absence of any data transmission.