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APPARATUS FOR GENERATING PERIODIC BEACON SIGNALS FOR USE IN A
CDMA BASE STATION

Field of the Invention

The present invention relates to a code division multiple access (CDMA) base station; and, more particularly, to a periodic beacon signal generating apparatus used for hand-off between base stations.

Background of the Invention

Fig. 1, shows a conventional code division multiple access (CDMA) base station system which comprises a digital channel signal modulation circuit 110, a modulated signal combination circuit 120, a CDMA bandwidth modulation circuit 130, a radio frequency (RF) converting circuit 140, a output amplifying circuit 150 and a band-pass-filtering circuit 160.

The RF converting circuit 140 includes an up-converter (not shown) and the output amplifying circuit 150 includes a high-power amplifier (not shown). At the digital channel signal modulation circuit 110, a digital CDMA signal is modulated by multiplying by an assigned Walsh code. At the modulated signal combination circuit 120, the modulated digital CDMA signal from the digital channel signal modulation circuit 110 is combined with other signals received from other digital channel signal modulation circuits (not shown).

At the CDMA bandwidth modulation circuit 130, the combined signal from the modulation signal combination circuit 120 is modulated by multiplying by a pseudo noise code to generate a CDMA transmit immediate frequency (TxIF) signal. The up-converter (not shown) of the RF converting circuit 140 converts the frequency of the TxIF signal to radio frequency to generate a transmit radio frequency (TxRF) signal.

The TxRF signal is amplified at the output amplifying circuit 150 and then filtered by using an assigned bandwidth at the band-pass-filtering circuit 160.

On the other hand, call-drop occurs frequently when an ordinary base station having a plurality of frequency assignments (FA's) is adjacently aligned to the smaller base station having single FA or fewer FA than the ordinary base station. Hand-off is provided when a caller moves between the FA of the ordinary base station and the FA of the smaller base station, if both FA's are commonly available within coverage of the ordinary base station and the smaller base station. However, call-drop occurs when the caller moves between the FA of the ordinary base station and the FA of the smaller base station, if the FA of the ordinary base station is not available within the coverage of the smaller base station.

In order to prevent the call-drop, a multiple number of beacon signals are transmitted, with predetermined hand-off parameters to induce the hand-off procedure. Each of the beacon signals is transmitted from the base station into the area which is similar to the traffic FA, the FA for each of the beacon

signals being available within the adjacent base station of the smaller base station.

Fig. 2 is a block diagram of a conventional beacon operating apparatus 200 used in the CDMA base station. In Fig. 2, the digital channel signal modulation circuit 110, the modulated signal combination circuit 120 and the CDMA bandwidth modulation circuit 120 are combined into one of a CDMA modulation circuit for the traffic FA (or a traffic FA CDMA modulation circuit) 210 and a CDMA modulation circuit for the beacon FA (or a beacon FA CDMA modulation circuit) 220. The traffic FA CDMA modulation circuit 210 is dedicated to traffic FA and connected to the frequency converting circuit 230. The beacon FA CDMA modulation circuit 220 includes N beacon FA modulation circuits 220-1 to 220-N, N being a positive integer and identical to required number of operated beacon signals.

As shown in Fig. 2, each of the beacon FA modulation circuits 220-1 to 220-N is connected to one of its corresponding one of frequency converting circuits 240-1 to 240-N as shown by one of dashed lines and the traffic FA modulation circuit 210 as shown by a solid line.

The N beacon signals is continuously generated as shown in Fig. 5A and combined with the traffic signal from the frequency converting circuit 230 at the frequency combining circuit 250 to be applied to the output amplifying circuit 150.

However, in the conventional beacon signal operation as described above, the N number of frequency converting circuits 240-1 to 240-N are included in the beacon operating apparatus

200 and each of the frequency converting circuits 240-1 to 240-N generates its corresponding beacon signal continuously. Since the continuously generated beacon signals increase load at the output end, it is required the N up-converters and the high power amplifier or liner power amplifier to sustain the N beacon signals. And, since the continuously generated beacon signals increase forward noise during hand-off procedure after the beacon signal acquisition of a caller's terminal, hand-off success rate is decreased.

Summary of the Invention

It is, therefore, a primary object of the present invention to provide a beacon signal generating apparatus, for use in a CDMA base station, capable of economizing facilities, minimizing load at the output end and improving hand-off success rate by transmitting each of a multiple beacon signals time-divisionally.

Another object of the present invention is to provide a beacon signal generating method, for use in a CDMA base station, capable of reducing forward noise.

In accordance with one aspect of the present invention, there is provided an apparatus for generating a plurality of beacon signals for use in a CDMA base station, comprising: a level controller for controlling signal the level of each of a plurality of beacon transmit immediate frequency (TxIF) signals; a frequency converter for converting frequency of each

TxIF signal received from the level controller to generate corresponding one of a plurality of transmit radio frequency (TxRF) signal; a timing controller for controlling the level controller and frequency converter by using a system synchronization signal and predetermined control information to generate each of the plurality of the beacon signals time-divisionally; and a storing unit for registering the predetermined control information, wherein each of the TxIF signals is applied to the level controller from one of a beacon signal modulator and a traffic modulator, both being included in the CDMA base station.

In accordance with another aspect of the present invention, there is provided a method for generating a plurality of beacon signals for use in a CDMA base station, comprising the steps of: level controlling signal the level of each of a plurality of first beacon TxIF signals to generate a plurality of second beacon TxIF signals; converting the frequency of each of the second beacon TxIF signals means to generate corresponding one of a plurality of beacon TxRF signal; transmitting each of the plurality of the beacon TxRF signals time-divisionally by using a system synchronization signal and predetermined control information; and registering the predetermined control information.

Brief Description of the Drawings

The above and other objects and features of the present

invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 presents a block diagram of a conventional CDMA base station;

Fig. 2 provides a block diagram of a conventional beacon signal operating apparatus used in the conventional CDMA base station in Fig. 1;

Fig. 3 offers a block diagram of a CDMA base station in accordance with the present invention;

Fig. 4 represents a block diagram of a preferred embodiment of the inventive periodic beacon signal generating apparatus;

Fig. 5A illustrates a timing diagram of output signals from the CDMA base station in Fig. 1; and

Fig. 5B illustrates a timing diagram of output signals from the CDMA base station in Fig. 3.

Detailed Description of the Preferred Embodiments

Referring to Fig. 3, there is provided a block diagram of a code division multiple access (CDMA) base station 300 in accordance with the present invention. The CDMA base station 300 comprises a traffic frequency assignment (FA) CDMA modulation circuit 310, a beacon FA CDMA modulation circuit 320, a frequency converting circuit 330, a periodic beacon signal generating apparatus 340 and a radio frequency (RF) combination circuit 350.

As shown in Fig. 3, the CDMA base station 300 in accordance with the present invention comprises single periodic beacon signal generating apparatus 340 regardless of the number of the beacon signals operated by the CDMA base station 300.

The periodic beacon signal generating apparatus 340 synchronizes the multiple beacon signals requested by the CDMA base station 300, by using a transmit immediate frequency (TxIF) signal applied from one of the traffic FA CDMA modulation circuit 310 and the beacon FA CDMA modulation circuit 320, and a system synchronization signal received externally. And the periodic signal generating apparatus 340 applies each of the multiple beacon signals time-divisionally to the frequency combination circuit 350 to thereby minimize load at output end and forward noise during hand-off. For example, the system synchronization signal is the even second signal of a global positioning system (GPS) signal.

Referring to Fig. 4, there is provided a block diagram of a preferred embodiment of a periodic beacon signal generating apparatus 340 including a level controller 410 for controlling level of the TxIF signal, a frequency converter 420 for converting the frequency of the TxIF signal to radio frequency to transmit radio frequency (TxRF) signal, time division controller 430 for controlling the level controller 410 and the frequency converter 420 by using the system synchronization signal and a control information store 440 for registering operation frequency, on/off timing and signal level for each of the beacon signals.

In Fig. 4, the TxIF signal is applied to the level controller 410 from one of the traffic FA CDMA modulation circuit 310 and the beacon FA CDMA modulation circuit 320. In the preferred embodiment of the invention for a cellular system, the TxIF signal has 1.23 MHz bandwidth in 800 MHz band CDMA system, 4.95 MHz center frequency and 0 to -20 dbm signal level. And also, the TxIF includes information, such as timing information, Walsh code and pseudo noise sequence, required for CDMA communications.

The level controller 410 controls level of the applied TxIF signal according to control signal from the control information store 440 and then applies the level-controlled TxIF signal to the frequency converter 430.

At the frequency converter 420, the frequency of the TxIF signal from the level controller 410 is converted to the radio frequency to generate the TxRF signal for each beacon signal by using a known scheme, e.g., phase lock loop (PLL) scheme, under the control of the time division controller 430. In the preferred embodiment of the invention for the cellular system, the TxRF signal has the frequency from 869 MHz to 894 MHz.

The time division controller 430 is constructed by a known micro processor or a digital circuit and controls the level controller 410 and the frequency converter 420 according to information registered at the control information store 440.

The control information store 440 registers operation frequency on/off timing and signal level, for each of the beacon signals. For example, the operation frequency and the on/off

timing is registered using a DIP switch or a memory and the signal level is registered by using a volume switch.

Referring to Fig. 5B, there is provided a timing diagram of output signals from the CDMA base station in Fig. 3.

As shown in Fig. 5B, each of the multiple beacon signals is transmitted time divisionally, i.e., periodically, when the multiple beacon signals are operated for hand-off between the base stations, the traffic FA for each of the base station being different from each other. Therefore, load at output end and forward noise during the hand-off are minimized.

As described above, since the inventive periodic beacon signal generating apparatus 340 for use in the CDMA base station generates each of the multiple beacon signals time-divisionally, it is required single frequency converting circuit, e.g., an up-converter, regardless of the number of beacon signal operations in the CDMA base station. Therefore, facilities is economized and load at the output end is minimized. And hand-off success rate is improved since forward noise during the hand-off is minimized.

While the present invention has been shown and described with respect to the particular embodiments, it will be apparent to those skilled in the art that many changes and modifications may be made without departing from the spirit and scope of the invention as defined in the appended claims.



What is claimed is:

1. An apparatus for generating a plurality of beacon signals for use in a code division multiple access (CDMA) base station, comprising:

level controlling means for controlling signal the level of each of a plurality of beacon transmit immediate frequency (TxIF) signals;

frequency converting means for converting frequency of each TxIF signal received from the level controlling means to generate corresponding one of a plurality of transmit radio frequency (TxRF) signal;

timing controlling means for controlling the level controlling means and frequency converting means by using a system synchronization signal and predetermined control information to generate each of the plurality of the beacon signals time-divisionally; and

storing means for registering the predetermined control information.

2. The apparatus of claim 1, wherein each of the TxIF signals is applied to the level controlling means from a beacon signal modulating means included in the CDMA base station.

3. The apparatus of claim 1, wherein each of the TxIF signals is applied to the level controlling means from a traffic signal modulating means included in the CDMA base station.



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4. The apparatus of claim 1, wherein the TxIF signal applied to the level converting means has 1.23 MHz bandwidth for 800 MHz band CDMA communications, 4.95 MHz center frequency and 0 to -20dbm signal level.

5. The apparatus of claim 1, wherein the predetermined control information includes operation frequency, on/off timing and signal level for each of the plurality of beacon signals.

6. The apparatus of claim 5, wherein the storing means includes:

a plurality of DIP switches, each for registering operation frequency and on/off timing for each of the beacon signals; and

volume switches, each for registering the signal level for each of the beacon signals.

7. The apparatus of claim 1, wherein the system synchronization signal is even second signal of global positioning system (GPS) signal provided externally.

8. A method for generating a plurality of beacon signals for use in a code division multiple access (CDMA) base station, comprising the steps of:

level controlling signal the level of each of a plurality of first beacon transmit immediate frequency (TxIF) signals to generate a plurality of second beacon TxIF signals;

converting the frequency of each of the second beacon TxIF



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signals means to generate corresponding one of a plurality of beacon transmit radio frequency (TxRF) signal;

transmitting each of the plurality of the beacon TxRF signals time-divisionally by using a system synchronization signal and predetermined control information; and

registering the predetermined control information.

9. The method of claim 8, wherein each of the TxIF signals has 1.23 MHz bandwidth for 800 MHz band CDMA communications, 4.95 MHz center frequency and 0 to -20dbm signal level.

10. The method of claim 8, wherein the predetermined control information includes operation frequency, on/off timing and signal level for each of the plurality of beacon signals.

11. The method of claim 8, wherein the system synchronization signal is the even second signal of a global positioning system (GPS) signal provided externally.