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(54) **BASE STATION APPARATUS, COMMUNICATION TERMINAL APPARATUS, AND COMMUNICATION METHOD**

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PCT Pub. Date: **Aug. 23, 2001**

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H04W 72/08 (2009.01)

(52) **U.S. Cl.**
USPC **455/452.2**; 455/450; 370/329; 370/332

(58) **Field of Classification Search**
CPC H04W 28/04; H04W 72/04; H04W 16/14; H04W 36/04; H04W 36/18
USPC 455/452.2, 561, 450, 452.1, 451, 464, 455/509, 513; 370/332, 328, 329, 330, 353, 370/345, 252; 375/260, 219, 209, 222, 216, 375/232
See application file for complete search history.

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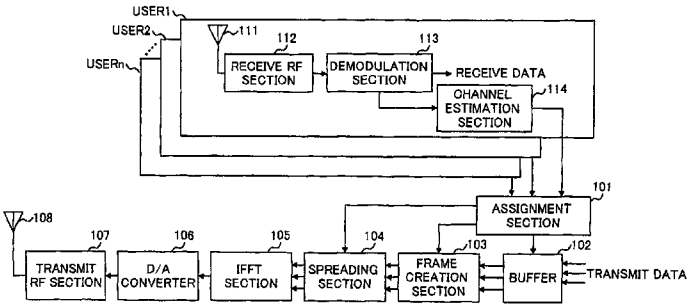
Primary Examiner — Phuoc H Doan
(74) *Attorney, Agent, or Firm* — Dickinson Wright PLLC

(57) **ABSTRACT**

An assignment section **101** determines communication resource assignment to communication terminals based on a transmission rate at which communication is possible for each subcarrier of each communication terminal, and instructs a buffer section **102** to output forward transmission data. In addition, the assignment section **101** instructs a frame creation section **103** to perform forward transmission data symbolization, and also outputs a signal indicating communication resource assignment to each communication terminal. The buffer section **102** holds forward transmission data, and outputs forward transmission data to the frame creation section **103** in accordance with instructions from the assignment section **101**. The frame creation section **103** symbolizes a resource assignment signal and transmission data to create a frame, which it outputs to a spreading section **104**.

8 Claims, 9 Drawing Sheets



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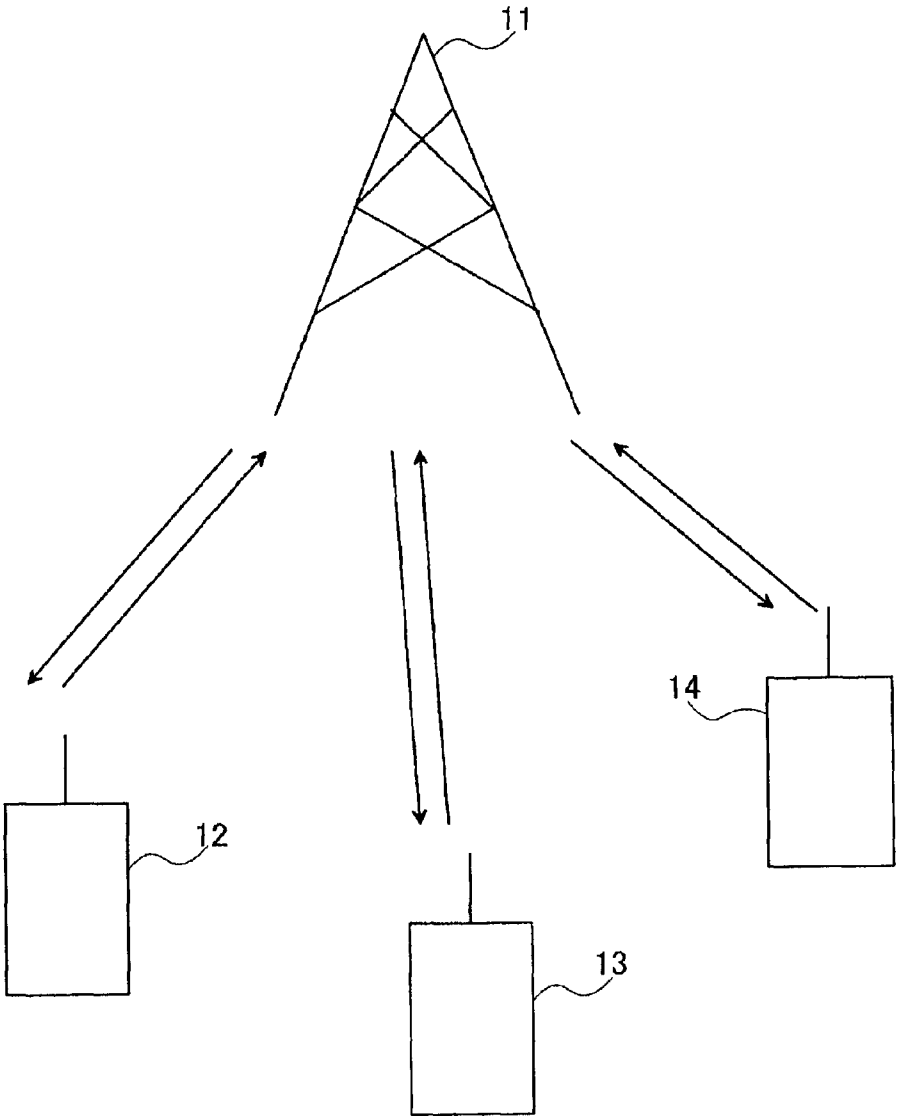

FIG.1

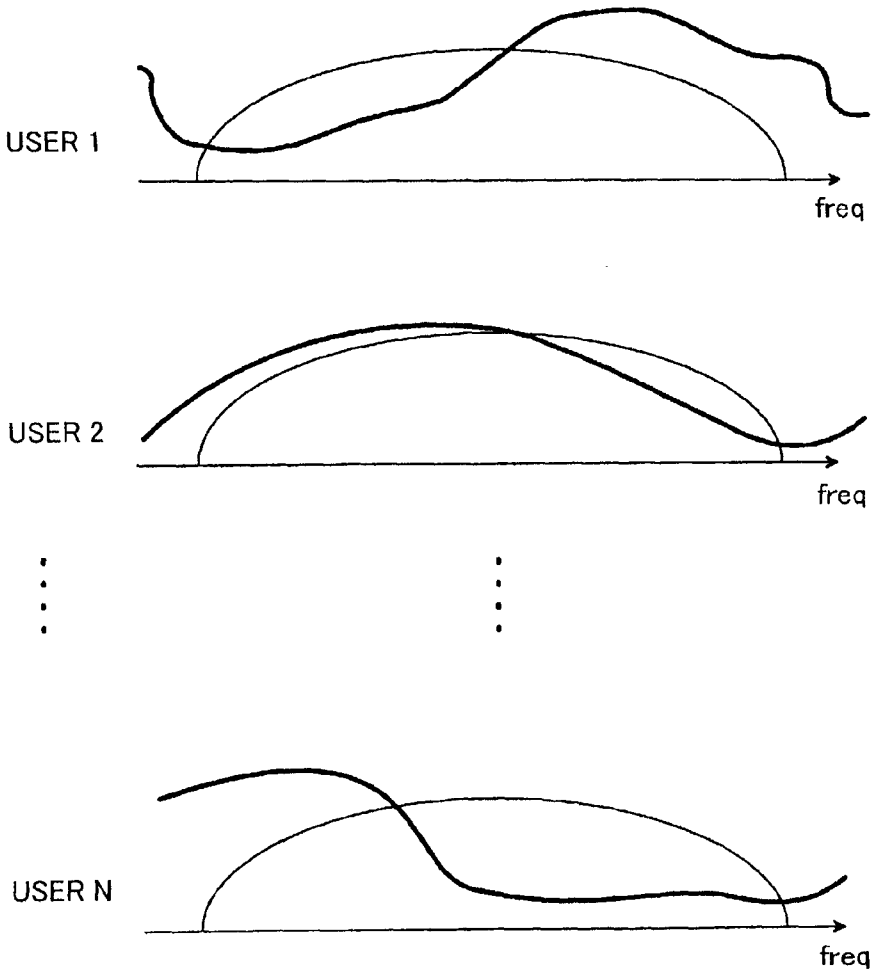

FIG.2

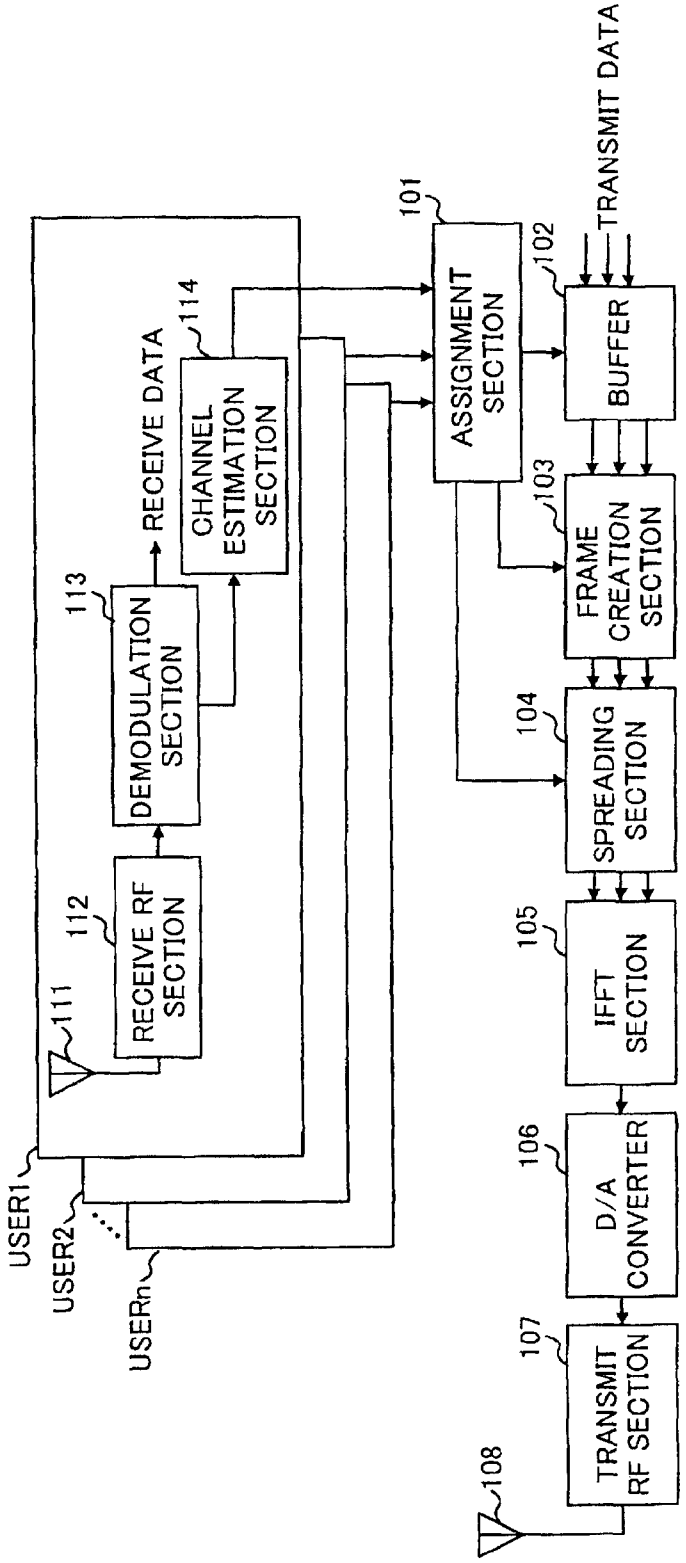
USER1
USER2
USERn
111
RECEIVE RF SECTION
112
DEMODULATION SECTION
113
RECEIVE DATA
CHANNEL ESTIMATION SECTION
114
ASSIGNMENT SECTION
101
TRANSMIT DATA
BUFFER
102
FRAME CREATION SECTION
103
SPREADING SECTION
104
IFFT SECTION
105
D/A CONVERTER
106
TRANSMIT RF SECTION
107
108

FIG.3

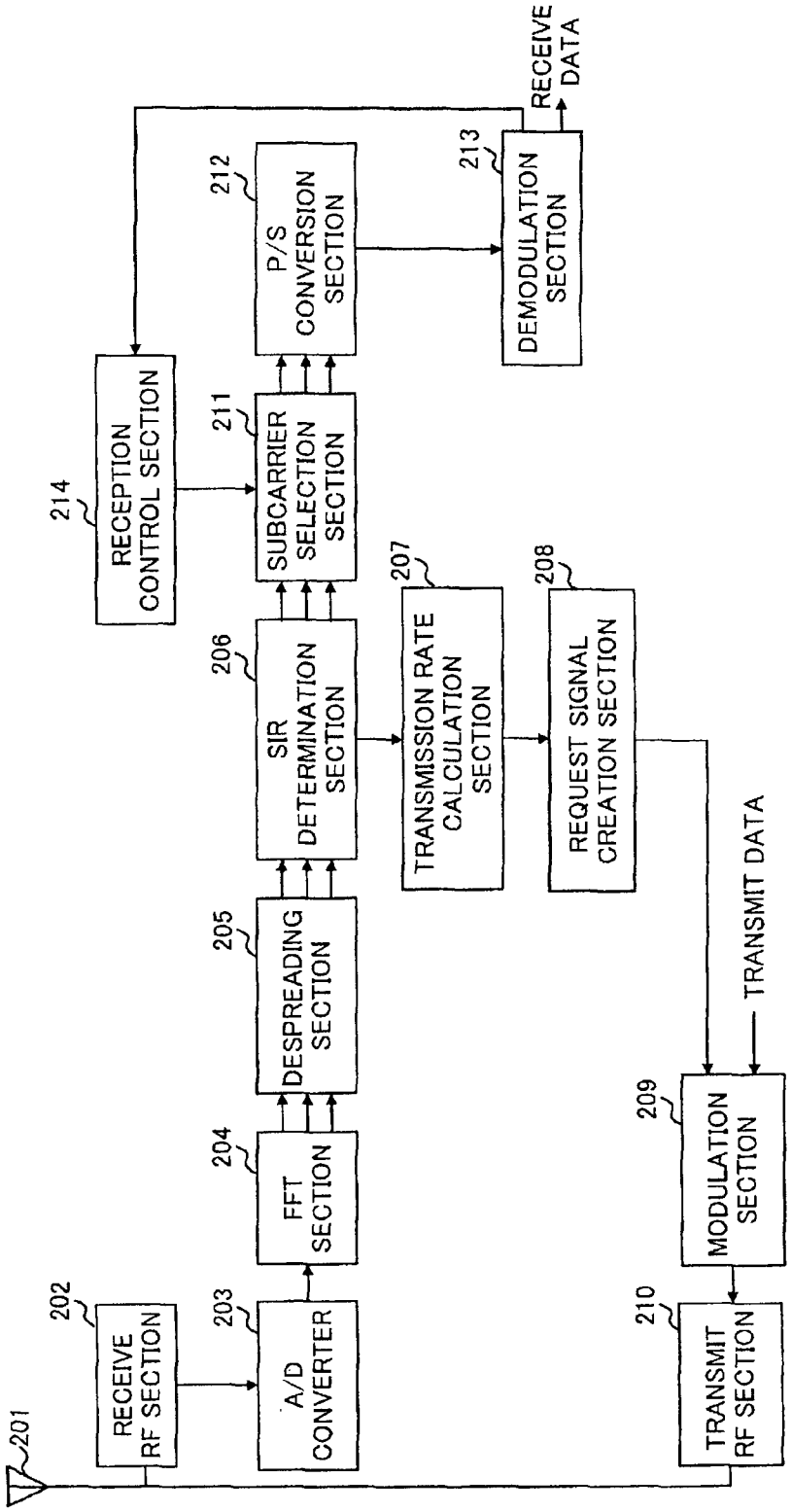
201
202
RECEIVE RF SECTION
203
A/D CONVERTER
204
FFT SECTION
205
DESPREADING SECTION
206
SIR DETERMINATION SECTION
207
TRANSMISSION RATE CALCULATION SECTION
208
REQUEST SIGNAL CREATION SECTION
209
MODULATION SECTION
210
TRANSMIT RF SECTION
TRANSMIT DATA
211
SUBCARRIER SELECTION SECTION
212
P/S CONVERSION SECTION
213
DEMODULATION SECTION
RECEIVE DATA
214
RECEPTION CONTROL SECTION

FIG.4

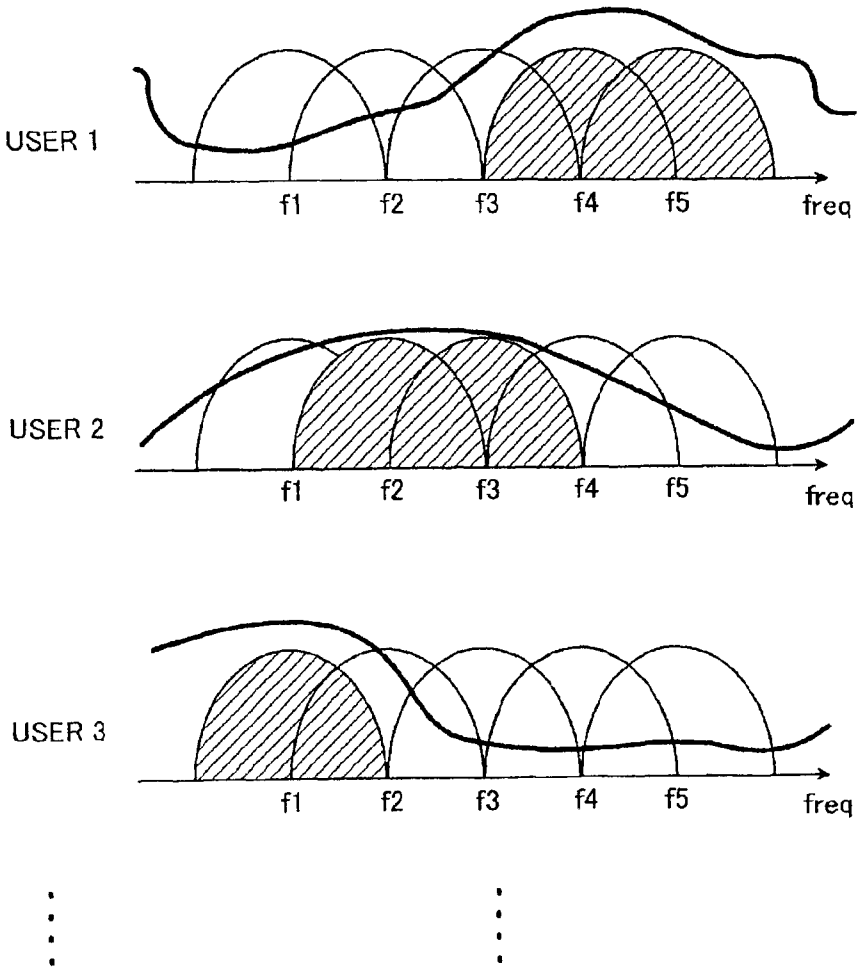
USER 1
f1
f2
f3
f4
f5
freq
USER 2
f1
f2
f3
f4
f5
freq
USER 3
f1
f2
f3
f4
f5
freq

FIG.5

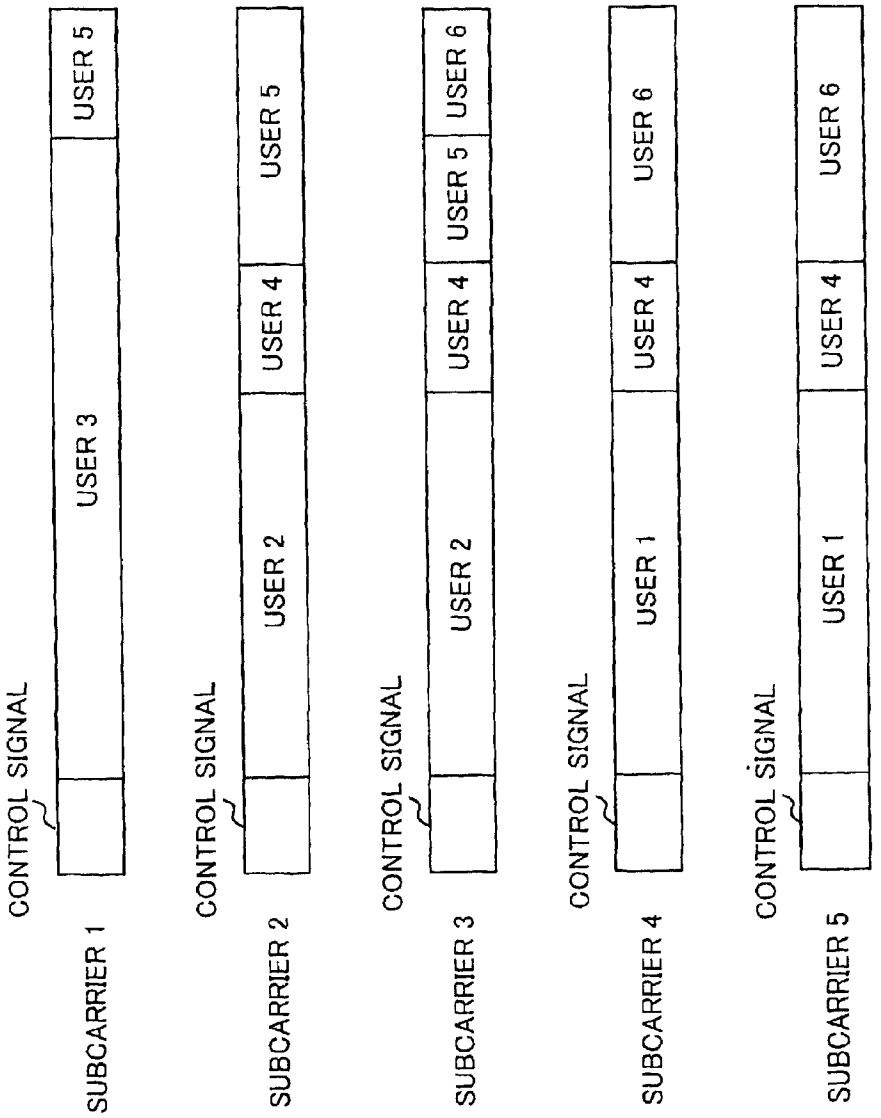
CONTROL SIGNAL
USER 3
USER 5
SUBCARRIER 1
CONTROL SIGNAL
USER 2
USER 4
USER 5
SUBCARRIER 2
CONTROL SIGNAL
USER 2
USER 4
USER 5
USER 6
SUBCARRIER 3
CONTROL SIGNAL
USER 1
USER 4
USER 6
SUBCARRIER 4
CONTROL SIGNAL
USER 1
USER 4
USER 6
SUBCARRIER 5

FIG.6

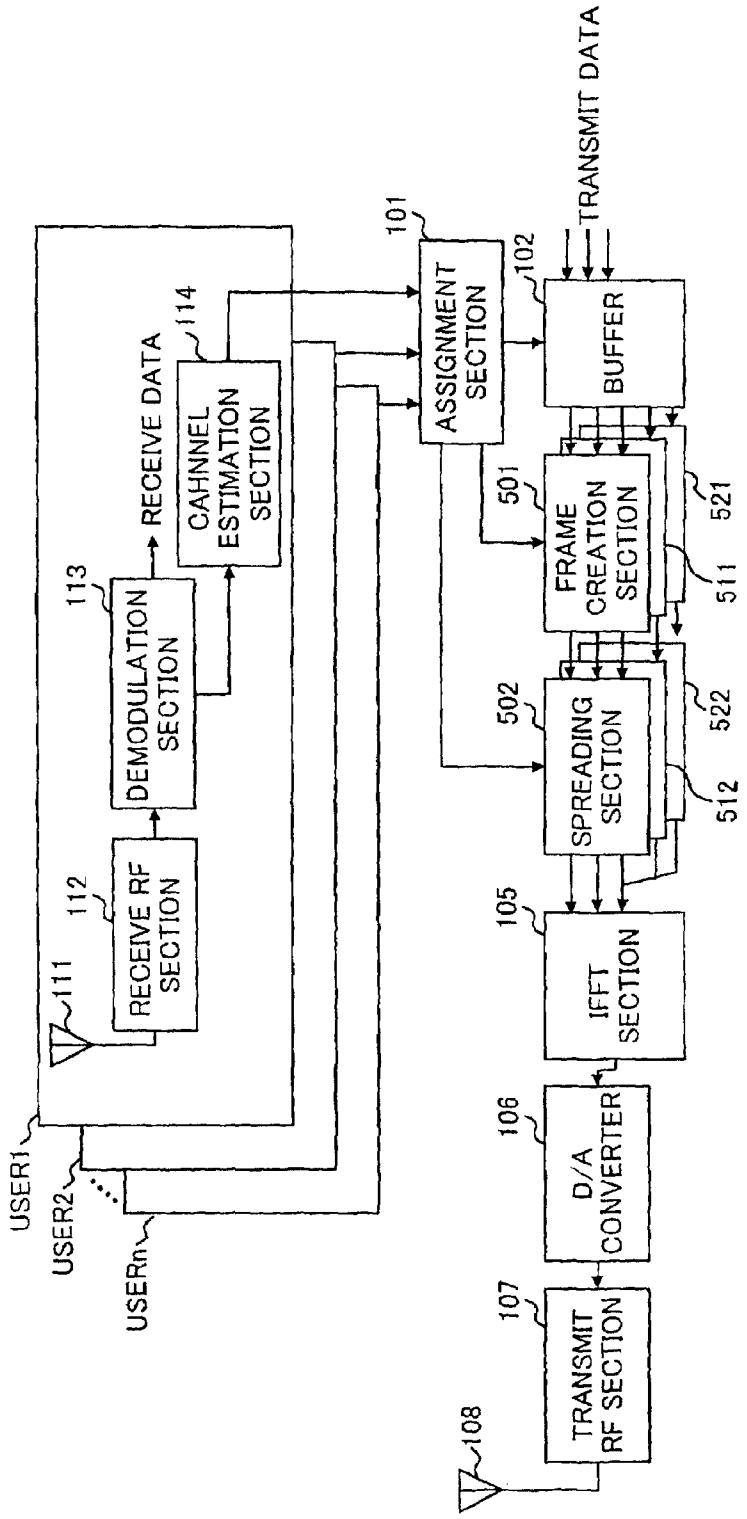
USER1
USER2
USERn
111
RECEIVE RF SECTION
112
DEMODULATION SECTION
113
RECEIVE DATA
CAHNNEL ESTIMATION SECTION
114
ASSIGNMENT SECTION
101
TRANSMIT DATA
BUFFER
102
FRAME CREATION SECTION
501
521
511
SPREADING SECTION
502
522
512
IFFT SECTION
105
D/A CONVERTER
106
TRANSMIT RF SECTION
107
108

FIG. 7

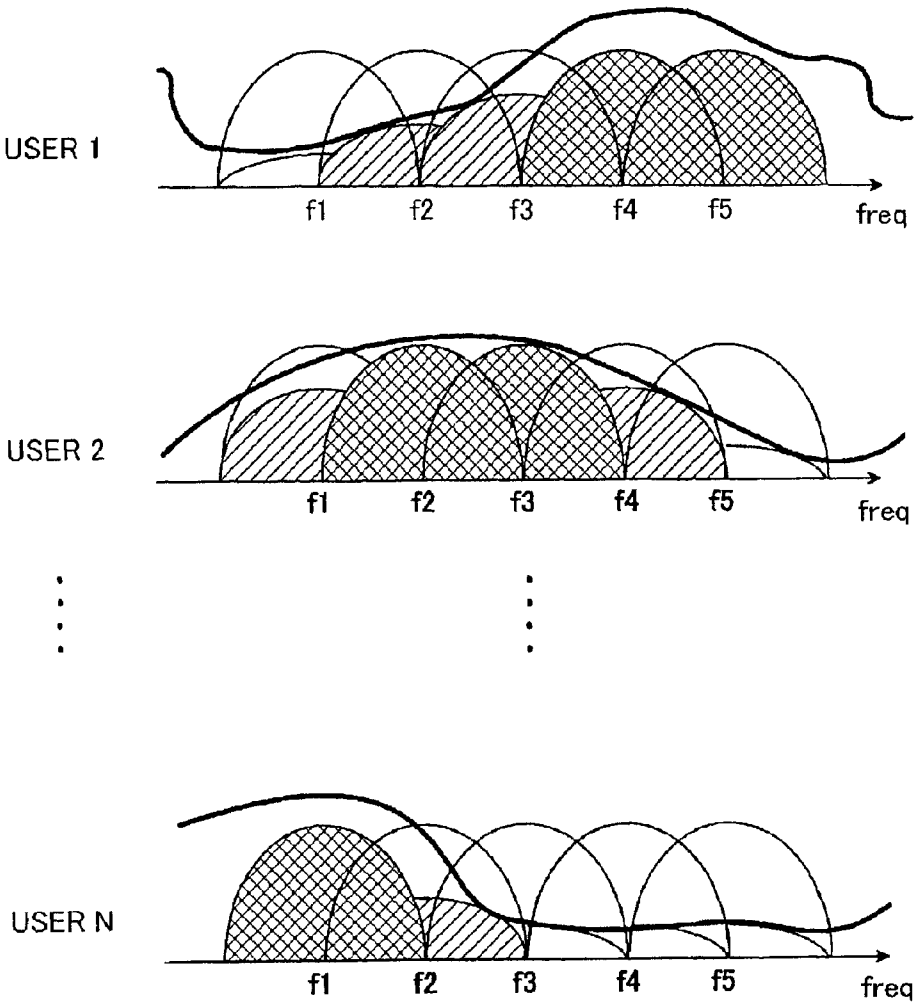
USER 1
f1
f2
f3
f4
f5
freq
USER 2
f1
f2
f3
f4
f5
freq
USER N
f1
f2
f3
f4
f5
freq

FIG.8

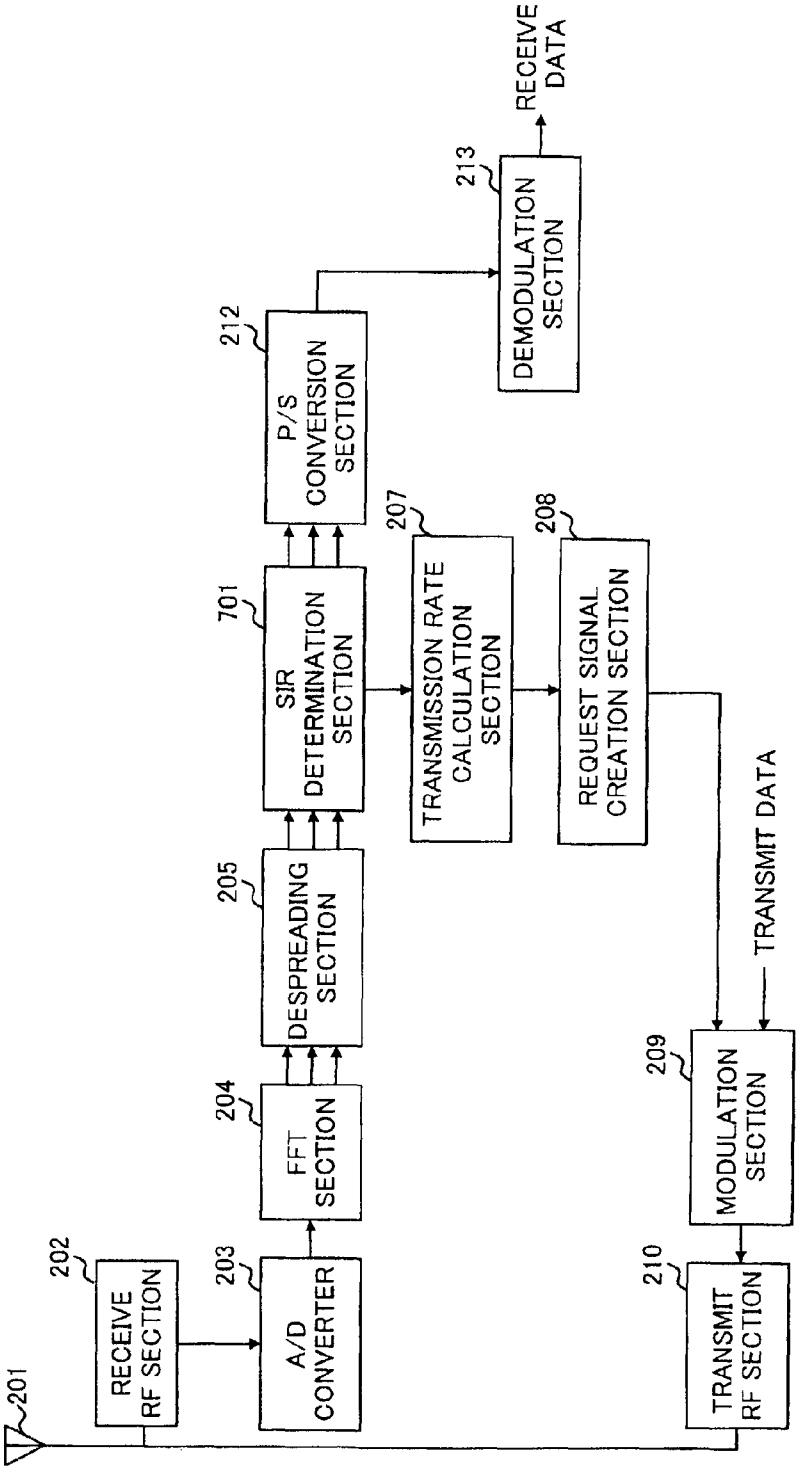
201
202
RECEIVE RF SECTION
203
A/D CONVERTER
204
FFT SECTION
205
DESPREADING SECTION
701
SIR DETERMINATION SECTION
212
P/S CONVERSION SECTION
213
DEMODULATION SECTION
RECEIVE DATA
207
TRANSMISSION RATE CALCULATION SECTION
208
REQUEST SIGNAL CREATION SECTION
TRANSMIT DATA
209
MODULATION SECTION
210
TRANSMIT RF SECTION

FIG.9

BASE STATION APPARATUS, COMMUNICATION TERMINAL APPARATUS, AND COMMUNICATION METHOD

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This is a broadening continuation reissue application (as opposed to a continuation of a reissue application). The parent reissue is application Ser. No. 12/613,256 filed Nov. 5, 2009 (now U.S. Pat. No. Re. 43,614), which is a reissue application of U.S. Pat. No. 7,292,862 (application Ser. No. 09/958,956) which has a 371 date of Dec. 31, 2001, and which issued on Nov. 6, 2007 and which is a national stage of PCT/JP2001/01056 filed Feb. 15, 2001, which is based on Japanese Application No. 2000-038877 filed Feb. 16, 2000, the entire contents of each of which are incorporated by reference herein.

TECHNICAL FIELD

The present invention relates to a base station apparatus, communication terminal apparatus, and communication method.

BACKGROUND ART

In a cellular communication system, one base station performs radio communication with a plurality of communication terminals simultaneously, and therefore, as demand has increased in recent years, so has the need for higher transmission efficiency.

One technology for increasing the transmission efficiency of a downlink from a base station to a communication terminal is HDR (High Data Rate). HDR is a method whereby scheduling for assigning communication resources to communication terminals is performed by time division, and data transmission efficiency is further improved by setting the transmission rate for each communication terminal according to the communication quality. This method is suitable for connection via the Internet and the like.

The operations performed by a base station and communication terminals in order to set the transmission rate in HDR will be described below using FIG. **1**. In FIG. **1**, a base station **11** is currently performing communication with communication terminals **12** to **14**.

First, the base station **11** transmits a pilot signal to each of communication terminals **12** to **14**. Each of communication terminals **12** to **14** estimates the communication quality according to the SIR (Signal to Interference Ratio) of the received pilot signal, etc., and finds a transmission rate at which communication with the base station is possible. Then, based on the transmission rate at which communication is possible, each of communication terminals **12** to **14** selects a communication mode, which is a combination of packet length, error correction, and modulation method, and transmits a signal indicating the communication mode to the base station **11**.

Based on the communication mode selected by each of communication terminals **12** to **14**, the base station **11** performs scheduling, sets a transmission rate for each communication terminal, and sends a signal to each of communication terminals **12** to **14** via a control channel indicating communication resource assignment to each communication terminal.

The base station **11** then transmits only data for the relevant communication terminal in its assigned time. For example, if time t**1** has been assigned to communication terminal **12**, the base station **11** transmits data for communication terminal **12** in time t**1**, and does not transmit to communication terminals **13** and **14**.

In this way, data transmission efficiency has conventionally been increased for the overall system by setting a transmission rate for each communication terminal according to the communication quality by means of HDR.

Here, the communication quality of some bands may degrade due to frequency selective fading. Also, the band portion for which communication quality degrades differs for each communication terminal.

In FIG. **2**, for example, communication terminal **12** has good communication quality on the high-frequency side but poor communication quality on the low-frequency side, while communication terminal **13** has good communication quality on the low-frequency side but poor communication quality on the high-frequency side, and communication terminal **14** also has good communication quality on the low-frequency side but poor communication quality on the high-frequency side.

However, as the above-described conventional base station and communication terminals perform communication using the entire band, a problem is that communication quality degrades and transmission efficiency falls in a band affected by frequency selective fading.

DISCLOSURE OF THE INVENTION

It is an objective of the present invention to provide a base station apparatus, communication terminal apparatus, and communication method that enable high transmission efficiency to be maintained even in an environment affected by frequency selective fading.

This objective is achieved by estimating the communication quality for each subcarrier in each communication terminal, and transmitting data from the base station to each communication terminal using a subcarrier for which the communication quality is good.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is drawing showing a communication mode using the conventional HDR method;

FIG. **2** is a drawing showing the effects of frequency selective fading in a communication band;

FIG. **3** is a block diagram showing the configuration of a base station according to Embodiment 1 of the present invention;

FIG. **4** is a block diagram showing the configuration of a communication terminal according to the above-mentioned embodiment;

FIG. **5** is a drawing showing the effects of frequency selective fading and band assignment in communication between a base station and communication terminals according to the above-mentioned embodiment:

FIG. **6** is a drawing showing an example of resource assignment in slots for transmission from a base station to communication terminals according to the above-mentioned embodiment;

FIG. **7** is a block diagram showing the configuration of a base station according to Embodiment 2 of the present invention;

FIG. **8** is a drawing showing communication resource assignment according to the above-mentioned embodiment; and

FIG. **9** is a block diagram showing the configuration of a communication terminal according to Embodiment 3 of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

With reference now to the attached drawings, embodiments of the present invention will be explained in detail below.

(Embodiment 1)

FIG. **3** is a block diagram showing the configuration of a base station according to Embodiment 1 of the present invention.

In FIG. **3**, an assignment section **101** determines communication resource assignment to each communication terminal based on a transmission rate at which communication is possible for each subcarrier of each communication terminal estimated by a channel estimation section **114** to be described below, and gives instructions to a buffer section **102** for forward transmission data output. The assignment section **101** also instructs a frame creation section **103** to perform forward transmission data symbolization, and outputs a signal indicating communication resource assignment to each communication terminal (hereinafter referred to as "resource assignment signal"). In addition, the assignment section **101** indicates to a spreading section **104** a spreading code to be multiplied by the forward transmission data.

The buffer section **102** holds forward transmission data, and outputs forward transmission data to the frame creation section **103** in accordance with instructions from the assignment section **101**.

The frame creation section **103** generates a pilot signal, symbolizes forward transmission data output from the buffer section **102** in accordance with instructions from the assignment section **101**, and inserts a pilot signal at predetermined intervals to create a frame, which it outputs to the spreading section **104**. The frame creation section **103** also symbolizes the resource assignment signal and transmission data to create a frame, which it outputs to the spreading section **104**.

At the start of communication, the frame creation section **103** outputs only a pilot signal to the spreading section **104**.

The spreading section **104** spreads frame creation section **103** output signals in accordance with instructions of the assignment section **101**, and outputs them to an IFFT section **105**.

The IFFT section **105** performs an inverse fast Fourier transform of the spreading section **104** output signals, and outputs the resulting signal to a D/A converter **106**. The D/A converter **106** performs digital-to-analog conversion of the IFFT section **105** output signal, and outputs the resulting signal to a transmit RF section **107**. The transmit RF section **107** converts the frequency of the D/A converter **106** output signal to a radio frequency, and outputs this signal to an antenna **108**. The antenna **108** transmits the transmit RF section **107** output signal to a communication terminal.

Antenna **111** receives a signal transmitted by radio from a communication terminal and outputs it to a receive RF section **112**. The receive RF section **112** converts the received signal frequency to baseband and outputs it to a demodulation section **113**.

The demodulation section **113** demodulates the baseband signal and outputs received data. In addition, the demodulation section **113** outputs a data rate request (hereinafter referred to as "DRR") signal included in the baseband signal to the channel estimation section **114**. The DRR signal will be explained later together with a description of the communication terminal configuration.

Based on the DRR signal, the channel estimation section **114** estimates a transmission rate at which communication with each communication terminal is possible for each subcarrier, and outputs the estimation results to the assignment section **101**.

A receive RF section **112**, demodulation section **113**, and channel estimation section **114** are provided for each user.

FIG. **4** is a block diagram showing the configuration of a communication terminal according to this embodiment.

In FIG. **4**, an antenna **201** receives a radio signal transmitted from the base station shown in FIG. **3**, and outputs it to a receive RF section **202**. In addition, the antenna **201** transmits a transmit signal output from a transmit RF section **210** to the base station shown in FIG. **3** as a radio signal.

The receive RF section **202** converts the frequency of a radio frequency signal received by the antenna **201** to baseband, and outputs it to an A/D converter **203**. The A/D converter **203** performs analog-to-digital conversion of the baseband signal and outputs it to an FFT section **204**. The FFT section **204** performs a fast Fourier transform of the A/D converter **203** output signal and outputs the results to a despreading section **205**. The despreading section **205** despreads the FFT section **204** output signals and outputs the resulting signals to an SIR determination section **206**.

The SIR determination section **206** extracts a pilot signal from the despreading section **205** output signals, and outputs components other than the pilot signal to a subcarrier selection section **211**. In addition, the SIR determination section **206** finds the SIR for each subcarrier based on the extracted pilot signal, and outputs it to a transmission rate calculation section **207**.

The transmission rate calculation section **207** calculates a possible transmission rate with respect to the base station for each subcarrier based on the SIR, and outputs the calculation results to a request signal creation section **208**.

Based on the calculation results of the transmission rate calculation section **207**, the request signal creation section **208** creates a DRR signal for requesting the subcarrier transmission rate of each subcarrier from the base station, which it outputs to a modulation section **209**. The modulation section **209** modulates the DRR signal and inbound transmission data, and outputs the result to the transmit RF section **210**.

The transmit RF section **210** performs frequency conversion of the modulation section **209** output signal to radio frequency, and outputs this signal to the antenna **201**.

In accordance with notification from a reception control section **214**, the subcarrier selection section **211** selects components other than the pilot signal output from the SIR determination section **206** in each subcarrier, and outputs these to a P/S conversion section **212**.

The P/S conversion section **212** performs parallel-to-serial conversion of the output signals from the subcarrier selection section **211** and outputs the resulting signal to a demodulation section **213**.

The demodulation section **213** demodulates the output signal from the P/S conversion section **212** to extract received data, and also outputs a control signal to the reception control section **214**.

Based on the control signal, the reception control section **214** reports the subcarrier by which a signal addressed to this station is carried to the subcarrier selection section **211**.

Next, the signal flow until determination of the downlink transmission rate between the base station shown in FIG. **3** and the communication terminal shown in FIG. **4** will be described.

First, a pilot signal is created in the frame creation section **103** of the base station. The pilot signal is spread by the spreading section **104** together with forward transmission data, undergoes an inverse fast Fourier transform by the IFFT section **105**, digital-to-analog conversion by the D/A converter **106**, and frequency conversion to a radio frequency by the transmit RF section **107**, and is transmitted to the communication terminal from the antenna **108**.

In the communication terminal, a signal received by the antenna **201** undergoes frequency conversion to baseband by the receive RF section **202**, analog-to-digital conversion by the A/D converter **203**, and a fast Fourier transform by the FFT section **204**, and is despread by the despreading section **205**. The pilot signal is then extracted from the despreading section **205** by the SIR determination section **206**, and the SIR is found based on the pilot signal.

Then the transmission rate calculation section **207** calculates a transmission rate at which communication is possible for each subcarrier based on the SIR, and the request signal creation section **208** creates a DRR signal for requesting the transmission rate of each subcarrier.

The DRR signal is modulated by the modulation section **209** together with inbound transmission data, undergoes frequency conversion to a radio frequency by the transmit RF section **210**, and is transmitted to the base station from the antenna **201**.

In the base station, a signal received by the antenna **111** undergoes frequency conversion to baseband by the receive RF section **112** and is demodulated by the demodulation section **113**, and the DRR signal included in the demodulated baseband signal is output to the channel estimation section **114**. Based on the DRR signal, the channel estimation section **114** estimates for each subcarrier a transmission rate at which communication with each terminal is possible.

Based on the transmission rate at which communication is possible for each subcarrier of each communication terminal, the assignment section **101** determines communication resource assignment to each communication terminal, and outputs a resource assignment signal to the frame creation section **103**.

The resource assignment signal is despread by the spreading section **104** together with forward transmission data, undergoes an inverse fast Fourier transform by the IFFT section **105**, digital-to-analog conversion by the D/A converter **106**, and frequency conversion to a radio frequency by the transmit RF section **107**, and is sent to each communication terminal from the antenna **108** via a control channel.

Based on the resource assignment signal, each communication terminal receives data in the reception time and on the subcarrier assigned to it.

Outbound transmission data to be sent to communication terminals from the base station is stored in the buffer section **102** until communication resource assignment has been decided. After a resource assignment signal has been transmitted, forward transmission data is output from the buffer section **102** to the frame creation section **103** in accordance with the resource assignment signal, and symbolized.

When forward transmission data is symbolized, the subcarrier and communication rate are set based on the resource assignment signal.

Symbolized forward transmission data undergoes an inverse fast Fourier transform by the IFFT section **105**, digital-to-analog conversion by the D/A converter **106**, and frequency conversion to a radio frequency by the transmit RF section **107**, and is transmitted from the antenna **108**.

Next, an actual example of communication resource assignment will be described.

FIG. **5** is a drawing showing the effects of frequency selective fading and band assignment in communication between a base station and communication terminals.

The bold lines in FIG. **5** show the effect of fading on band communication quality.

The user **1** communication terminal has good communication quality in bands f**4** and f**5** but poor communication quality in bands f**1**, f**2**, and f**3**. The user **2** communication terminal has good communication quality in bands f**2** and f**3** but poor communication quality in bands f**1**, f**4**, and f**5**. And the user **3** communication terminal has good communication quality in band f**1** but poor communication quality in bands f**2**, f**3**, f**4**, and f**5**.

Thus, in communication with the respective communication terminals, bands with good communication quality are assigned.

FIG. **6** is a drawing showing an example of resource assignment in slots for transmission from a base station to communication terminals. The horizontal axis shows times at which slot transmission is performed.

In data transmission from the base station, control signals and data are included in a slot of a predetermined length. The control signals include signals that indicate the data transmission timing and transmission rate to each user communication terminal, and data is arranged according to the control signal information.

In FIG. **6**, subcarrier **1** uses band f**1**, subcarrier **2** uses band f**2**, subcarrier **3** uses band f**3**, subcarrier **4** uses band f**4**, and subcarrier **5** uses band f**5**.

The base station assigns band f**1** to communication with the user **3** communication terminal, assigns bands f**2** and f**3** to communication with the user **2** communication terminal, and assigns bands f**4** and f**5** to communication with the user **3** communication terminal.

User **3** data is assigned to the subcarrier **1** time slot, user **2** data is assigned to the subcarrier **2** time slot, user **2** data is assigned to the subcarrier **3** time slot, user **1** data is assigned to the subcarrier **4** time slot, and user **1** data is assigned to the subcarrier **5** time slot.

Thereafter, bands with good communication quality are also assigned to users **4**, **5**, and **6**.

By estimating the communication quality for each subcarrier in each communication terminal and transmitting data from the base station to each communication terminal using a subcarrier with good communication quality in this way, it is possible to maintain high transmission efficiency even in an environment subject to frequency selective fading. Also, by receiving data on each subcarrier, it is possible to maintain high transmission efficiency even in an environment subject to frequency selective fading.

A resource assignment signal can be transmitted using a different frequency or different modulation method from a data signal.

Also, a resource assignment signal can be transmitted for each subcarrier, as subcarrier-unit resource assignment information. In this case, resource assignment signals can be simplified by having the base station create resource assignment signals in each subcarrier and transmit them using the same subcarrier as the data, and having communication terminals received data in each subcarrier based on a received communication resource assignment signal.

In this embodiment, a station's own address symbol is extracted from post-despreading symbols output from the

SIR determination section **206**, but with the present invention, a station's own address symbol can be extracted as long as it is a symbol after a fast Fourier transform and before demodulation.

In this case, in FIG. **3**, a symbol is output from the FFT section **204**, despreading section **205**, or P/S conversion section **212** to the subcarrier selection section **211**.

(Embodiment 2)

FIG. **7** is a block diagram showing the configuration of a base station according to Embodiment 2 of the present invention.

Parts identical to those in FIG. **3** are assigned the same reference numerals as in FIG. **3** and their detailed explanations are omitted.

The base station apparatus in FIG. **7** comprises a plurality of spreading sections **502**, **512**, **522**, and a plurality of frame creation sections **501**, **511**, **521**, and differs from the base station in FIG. **3** in that a signal with a low spreading ratio is transmitted in a band with good communication quality, and a signal with a high spreading ratio is transmitted in a band with poor communication quality due to the effects of frequency selective fading, etc.

In FIG. **7**, an assignment section **101** determines communication resource assignment to each communication terminal based on a transmission rate at which communication is possible for each subcarrier of each communication terminal estimated by a channel estimation section **114**, and gives instructions to a buffer section **102** for forward transmission data output. The assignment section **101** also instructs frame creation sections **501**, **511**, **521** to perform forward transmission data symbolization, and outputs a resource assignment signal. In addition, the assignment section **101** indicates to spreading sections **502**, **512**, **522** respectively a spreading code to be multiplied by the forward transmission data.

Frame creation sections **501**, **511**, **521** generate a pilot signal, symbolize forward transmission data output from the buffer section **102** in accordance with instructions from the assignment section **101**, and insert a pilot signal at predetermined intervals to create a frame, which they output to spreading sections **502**, **512**, **522**. At the start of communication, frame creation sections **501**, **511**, **521** output only a pilot signal to spreading sections **502**, **512**, **522**.

Spreading sections **502**, **512**, **522** spread the frame creation section **501**, **511**, **521** output signals using the respective spreading codes indicated by the assignment section **101**, and output them to an IFFT section **105**.

By having spreading sections **502**, **512**, **522** perform spreading individually using spreading codes indicated by the assignment section **101** in this way, it is possible to transmit symbols with a spreading ratio set for individual communication terminals for the respective subcarriers.

Next, communication resource assignment will be described. FIG. **8** is a drawing showing communication resource assignment according to Embodiment 2.

In FIG. **8**, the horizontal axis shows frequencies and the vertical axis shows communication quality. The bold lines show variations in communication quality due to frequency selective fading in communication with each communication terminal.

The user **1** communication terminal has good communication quality in bands f**4** and f**5**, rather poor communication quality in bands f**2** and f**3**, and poor communication quality in band f**1**. The user **2** communication terminal has good communication quality in bands f**2** and f**3**, rather poor communication quality in bands f**1** and f**4**, and poor communication quality in band f**5**.

Thus, the base station transmits signals with a low spreading ratio to the user **1** communication terminal in bands f**4** and f**5**, and transmits signals with a high spreading ratio in lower-frequency bands f**2** and f**3**.

Also, the base station transmits signals with a low spreading ratio to the user **1** communication terminal in bands f**2** and f**3**, and transmits signals with a high spreading ratio in lower-frequency bands f**1** and f**4**.

In this way, a communication apparatus of the present invention, by transmitting signals with a low spreading ratio in bands with good communication quality, and transmitting signals with a high spreading ratio in bands with poor communication quality due to the effects of frequency selective fading, etc., can transmission data at a high transmission rate by transmitting signals with a low spreading ratio in bands with good communication quality.

Also, by transmitting a signal with a high spreading ratio in a band with poor communication quality, it is possible to reduce the influence on other signals spread on the same subcarrier.

(Embodiment 3)

FIG. **9** is a block diagram showing the configuration of a communication terminal according to Embodiment 3 of the present invention. Parts identical to those in FIG. **4** are assigned the same reference numerals as in FIG. **4** and their detailed explanations are omitted.

In FIG. **9**, an SIR determination section **701** finds the ratio of the interference component to a signal in another band based on a received pilot signal, and outputs the result to a transmission rate calculation section **207** as an SIR.

In addition, the SIR determination section **701** determines a signal that meets a predetermined threshold value from among received signals to be a signal for communication with that station and outputs it to a P/S conversion section **212**, and discards signals that do not meet the predetermined threshold value as interference signals.

By estimating communication quality for each subcarrier in each communication terminal and transmitting data from the base station to each communication terminal using a subcarrier with good communication quality in this way, it is possible to maintain high transmission efficiency even in an environment subject to frequency selective fading. Also, by receiving data on each subcarrier, it is possible to maintain high transmission efficiency even in an environment subject to frequency selective fading.

In the embodiments of the present invention, a transmission rate at which communication with the base station is possible is calculated based on an SIR, but this is not a limitation, and a value that indicates the quality of a communication line, such as signal-to-noise ratio, may also be used as a basis for calculating a transmission rate.

Also, in the embodiments of the present invention, despreading processing is carried out on symbols after a fast Fourier transform, but this is not a limitation, and it is also possible for a fast Fourier transform to be carried out on symbols after subcarrier selection or after parallel-to-serial conversion.

Moreover, the present invention can be applied to any communication method as long as it uses frequency division.

As can be seen from the above descriptions, it is possible to estimate the communication quality for each subcarrier in each communication terminal, and to transmission data from a base station to each communication terminal using a subcarrier for which the communication quality is good.

This application is based on the Japanese Patent Application No. 2000-038877 filed on Feb. 16, 2000, entire content of which is expressly incorporated by reference herein.

The invention claimed is:

[1. A base station apparatus comprising:

a receiver that receives a signal representing communication quality estimated per subcarrier in a communication terminal apparatus of a communicating party;

an assigner that assigns subcarriers for use in communication with the communication terminal apparatus in accordance with the signal representing communication quality; and

a transmitter that transmits data to the communication terminal apparatus using the subcarriers assigned by the assigner.]

[2. The base station apparatus of claim 1 wherein the transmitter transmits subcarrier assignment information per subcarrier.]

[3. The base station apparatus of claim 1, wherein the assigner assigns the subcarriers, for use in communication with the communication terminal apparatus, per time slot.]

[4. The base station apparatus of claim 1, wherein the assigner determines a spreading factor, of the data transmitted from the transmitter, in accordance with the signal representing communication quality.]

[5. A communication terminal apparatus comprising a demodulator that demodulates a signal, addressed to said communication terminal apparatus and carried by subcarriers, in accordance with the subcarrier assignment information transmitted from the base station apparatus of claim 2.]

[6. The communication terminal apparatus of claim 5, wherein the demodulator performs threshold determination of quality of the signal addressed to said communication terminal apparatus and demodulates said signal when the quality is above a predetermined threshold.]

[7. A communication method comprising:

receiving a signal at a base station apparatus, said signal representing communication quality estimated per subcarrier in a communication terminal apparatus of a communicating party;

assigning subcarriers for use in communication with the communication terminal apparatus in accordance with the signal representing communication quality;

transmitting subcarrier assignment information and data to the communication terminal apparatus using the assigned subcarriers; and

demodulating a signal addressed to the communication terminal apparatus and carried by the subcarriers, in accordance with the subcarrier assignment information transmitted from the base station apparatus.]

[8. A communication method comprising:

receiving a signal at a base station apparatus, said signal representing communication quality estimated per subcarrier in a communication terminal apparatus of a communicating party;

assigning subcarriers for use in communication with the communication terminal apparatus in accordance with the signal representing communication quality;

transmitting data to the communication terminal apparatus using the assigned subcarriers; and

performing threshold determination of quality of a signal addressed to the communication terminal apparatus and demodulating said signal when the quality is above a predetermined threshold.]

9. A communication method comprising:

receiving, at a base station apparatus, a signal transmitted from a terminal apparatus, the signal indicating communication quality calculated in said terminal apparatus for each of bands, into which a frequency domain comprised of subcarriers is divided, and each of the bands comprising a subcarrier;

assigning, to said terminal apparatus, a resource comprised of consecutive subcarriers in a part of the bands;

transmitting, from said base station apparatus to said terminal apparatus, assignment information indicating the resource assigned to said terminal apparatus; and

transmitting, from said base station apparatus to said terminal apparatus, data using the resource,

wherein the assignment information is transmitted using another resource which is different from the resource assigned to said terminal apparatus.

10. A communication method comprising:

receiving, at a base station apparatus, a signal transmitted from a terminal apparatus, the signal indicating communication quality calculated in said terminal apparatus for each of bands, into which a frequency domain comprised of subcarriers is divided, and each of the bands comprising a subcarrier;

assigning, to said terminal apparatus, a resource comprised of consecutive subcarriers in a part of the bands;

transmitting, from said base station apparatus to said terminal apparatus, assignment information indicating the resource assigned to said terminal apparatus; and

transmitting, from said base station apparatus to said terminal apparatus, data using the resource,

wherein the assignment information is transmitted with a modulation scheme which is different from that for the data.

11. A communication method comprising:

transmitting, from a terminal apparatus to a base station apparatus, a signal indicating communication quality calculated for each of bands, into which a frequency domain comprised of subcarriers is divided, and each of the bands comprising a subcarrier;

receiving, at said terminal apparatus, assignment information, which indicates a resource assigned to said terminal apparatus and which is transmitted from said base station apparatus to said terminal apparatus, the resource being comprised of consecutive subcarriers in a part of the bands; and

receiving, at said terminal apparatus, data transmitted from said base station apparatus using the resource, which said base station apparatus assigns to said terminal apparatus, in accordance with the assignment information,

wherein the assignment information is transmitted using another resource which is different from the resource assigned to said terminal apparatus.

12. A communication method comprising:

transmitting, from a terminal apparatus to a base station apparatus, a signal indicating communication quality calculated for each of bands, into which a frequency domain comprised of subcarriers is divided, and each of the bands comprising a subcarrier;

receiving, at said terminal apparatus, assignment information, which indicates a resource assigned to said terminal apparatus and which is transmitted from said base station apparatus to said terminal apparatus, the resource being comprised of consecutive subcarriers in a part of the bands; and

receiving, at said terminal apparatus, data transmitted from said base station apparatus using the resource, which said base station apparatus assigns to said terminal apparatus, in accordance with the assignment information,

wherein the assignment information is transmitted with a modulation scheme which is different from that for the data.

13. A base station apparatus comprising:

a receiver configured to receive a signal transmitted from a terminal apparatus, the signal indicating communication quality calculated in said terminal apparatus for each of bands, into which a frequency domain comprised of subcarriers is divided, and each of the bands comprises a subcarrier;

an assigner configured to assign, to said terminal apparatus, a resource comprised of consecutive subcarriers in a part of the bands;

a transmitter configured to transmit, to said terminal apparatus, assignment information indicating the resource assigned to said terminal apparatus, and configured to transmit, to said terminal apparatus, data using the resource,

wherein the assignment information is transmitted using another resource which is different from the resource assigned to said terminal apparatus.

14. A base station apparatus comprising:

a receiver configured to receive a signal transmitted from a terminal apparatus, the signal indicating communication quality calculated in said terminal apparatus for each of bands, into which a frequency domain comprised of subcarriers is divided, and each of the bands comprises a subcarrier;

an assigner configured to assign, to said terminal apparatus, a resource comprised of consecutive subcarriers in a part of the bands;

a transmitter configured to transmit, to said terminal apparatus, assignment information indicating the resource assigned to said terminal apparatus, and configured to transmit, to said terminal apparatus, data using the resource,

wherein the assignment information is transmitted with a modulation scheme which is different from that for the data.

15. A terminal apparatus comprising:

a transmitter configured to transmit, to a base station apparatus, a signal indicating communication quality calculated for each of bands, into which a frequency domain comprised of subcarriers is divided, and each of the bands comprises a subcarrier; and

a receiver configured to receive assignment information, which indicates a resource assigned to said terminal apparatus and which is transmitted from said base station apparatus, the resource being comprised of consecutive subcarriers in a part of the bands, and configured to receive data transmitted from said base station apparatus using the resource, which said base station apparatus assigns to said terminal apparatus, in accordance with the assignment information,

wherein the assignment information is transmitted using another resource which is different from the resource assigned to said terminal apparatus.

16. A terminal apparatus comprising:

a transmitter configured to transmit, to a base station apparatus, a signal indicating communication quality calculated for each of bands, into which a frequency domain comprised of subcarriers is divided, and each of the bands comprises a subcarrier; and

a receiver configured to receive assignment information, which indicates a resource assigned to said terminal apparatus and which is transmitted from said base station apparatus, the resource being comprised of consecutive subcarriers in a part of the bands, and configured to receive data transmitted from said base station apparatus using the resource, which said base station apparatus assigns to said terminal apparatus, in accordance with the assignment information,

wherein the assignment information is transmitted with a modulation scheme which is different from that for the data.

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