SPRUSSON FERGUSON

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I/We, the Applicant(s)/Nominated Person(s) specified below, request I/We be granted a patent for the invention disclosed in the accompanying standard complete specification.

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[54] Invention Title:
Radio Communication Method and Radio Communication System between Base Station and Mobile Station

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1. A radio communication method for a radio communication system which includes a base station connected to an analog network and a mobile station connected to said base station by a radio circuit, characterized in that said base station performs, when an analog signal which is a modem modulation signal such as a facsimile modem signal or a data modem signal is received from said analog network, PCM/CODEC processing of the analog signal, modulates the analog signal into a PCM signal of a high transmission speed, separates the PCM signal into two ADPCM signals of a low transmission speed, allocates the two ADPCM signals of the low transmission speed to two time slots by channel CODEC processing and performs data transmission as two radio communications through said radio circuit, and said mobile station demodulates the data received from said base station into an analog signal by a processing
procedure reverse to the processing procedure by said base station and performs communication of the analog signal with a wide bandwidth of the high transmission speed regarding the analog signal as a speech signal.

5. A radio communication system which includes a radio base station (10) connected to an analog network, and a mobile station (20) connected to said base station (20) by a radio circuit, characterized in that said base station (10) includes a main control section (11) for controlling components of said base station (10), an analog circuit interface section (12) for receiving an analog signal from said analog network, a signal type discrimination section (19) for discriminating whether the analog signal received by said analog circuit interface section (12) is a modem modulation signal from a facsimile modem or a data modem or a speech signal, a PCM/CODEC section (14) for modulating the analog signal from said analog circuit interface section (12) into a PCM signal of 64 kbps and for conversely demodulating a PCM signal of 64 kbps into an analog signal, an ADPCM/CODEC section (16) for modulating the analog signal from said analog circuit interface section (12) into an ADPCM signal of 32 kbps and for conversely demodulating an ADPCM signal of 32 kbps into an analog signal, a switch section (13) for switching connection of said analog circuit interface
section (12) alternatively to said PCM/Codec section
(14) or said ADPCM/Codec section (18), a demultiplexing
section (15) for demultiplexing a PCM signal of 64 kbps
and an ADPCM signal of 32 kbps, a channel Codec section
(17) for performing allocation of communication channels
to time slots of said radio circuit and performing
framing and deframing of radio frames of a control
channel and a communication channel, and a radio
interface section (18) for receiving data from said
radio circuit and transmitting data through said radio
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Invention Title: Radio Communication Method and Radio Communication System between Base Station and Mobile Station

The following statement is a full description of this invention, including the best method of performing it known to me/us:-
Radio Communication Method and Radio Communication System between Base Station and Mobile Station

This invention relates to a radio communication method and a radio communication system between a base station and a mobile station which are applied to a digital cordless telephone system which makes use of a personal handyphone system (PHS) and by which communication by a modem modulation signal such as a facsimile modem signal or a data modem signal or a speech signal is performed by demultiplexing of a PCM (Pulse Code Modulation) signal of 64 kbps and an ADPCM (Adaptive Differential PCM) signal of 32 kbps.

A digital cordless telephone system which makes use of a handyphone system (PHS) is conventionally used. An exemplary one of such digital cordless telephone systems is disclosed, for example, in Japanese Patent Laid-Open Application No. Heisei 5-328425.

The cordless telephone system disclosed in the document mentioned above is directed to realization of talking of a high quality by an ADPCM signal of 32 kbps.
Further, as a multiplexing system for a speech signal, a circuit having a transmission speed of 64 kbps such as an ISDN (Integrated Services Digital Network) is used. In the multiplexing system, an ADPCM signal of 32 kbps is multiplexed to allow duplex communication by 32 kbps.

In this instance, a mutual exchanging apparatus between a μ-law, A-law system of 64 kbps as a digitalization sampling system for a speech signal and an ADPCM system of 32 kbps is provided to allow setting of which one of the systems should be used. By such mutual exchanging processing, if, during communication using the ADPCM system of 32 kbps, a new request for communication to the same communication destination is received, additional communication using the same circuit is possible.

However, in the conventional cordless telephone system described above which is directed to realization of talking of a high quality by an ADPCM signal of 32 kbps, when a base station connected to a public network performs data transmission through a radio circuit regarding a modem modulation signal from a facsimile (FAX) modem or a data modem as a speech signal, a PHS mobile station which receives the ADPCM signal of 32 kbps by the transmission converts the ADPCM signal of 32
kbps having a narrow bandwidth once into an analog signal and sends out the analog signal to the facsimile machine or data terminal.

Consequently, the data quality is deteriorated considerably and besides the transmission speed is dropped. In this instance, the transmission speed of 9,600 bps is guaranteed for practical use. This also applies to another case wherein a base station is connected to an ISDN network.

It is an object of the present invention to provide a radio communication method and a radio communication system which allow, where they are applied to a digital cordless telephone system or the like which makes use of a handyphone system (PHS) connected to an analog circuit or an ISDN network, data transmission in a wide band regarding a modem modulation signal from a modem of a facsimile machine or a data terminal as a speech signal and allow communication at a high transmission speed without deterioration of the data quality.

In order to attain the object described above, according to an aspect of the present invention, there
is provided a radio communication method for a radio communication system which includes a base station connected to an analog network and a mobile station connected to the base station by a radio circuit, wherein the base station performs, when an analog signal which is a modem modulation signal such as a facsimile modem signal or a data modem signal is received from the analog network, PCM/CODEC processing of the analog signal, modulates the analog signal into a PCM signal of a high transmission speed, separates the PCM signal into two ADPCM signals of a low transmission speed, allocates the two ADPCM signals of the low transmission speed to two time slots by channel CODEC processing and performs data transmission as two radio communications through the radio circuit, and the mobile station demodulates the data received from the base station into an analog signal by a processing procedure reverse to the processing procedure by the base station and performs communication of the analog signal with a wide bandwidth of the high transmission speed regarding the analog signal as a speech signal.

The base station may perform, when a speech signal which is an analog signal is received from the analog network, ADPCM/CODEC processing for the speech
signal, allocate the one ADPCM signal to one time slot and perform data transmission through the one radio circuit.

According to another aspect of the present invention, there is provided a radio communication method for a radio communication system which includes a base station connected to an ISDN network and a mobile station connected to the base station by a radio circuit, wherein the base station separates a modem modulation signal such as a facsimile modem signal or a data modem signal which is a PCM signal of a high speed sent thereto from the ISDN network into two ADPCM signals of a low transmission speed, allocates the two ADPCM signals of the low transmission speed to two time slots by channel CODEC processing and performs data transmission as two radio communications through the radio circuit, and the mobile station demodulates the data received from the base station into an analog signal by a processing procedure reverse to the processing procedure by the base station and performs communication of the analog signal with a wide bandwidth of the high transmission speed regarding the analog signal as a speech signal.

The base station may perform, when the PCM
signal of the high transmission speed sent thereto from
the ISDN network is a speech signal, PCM/ADPCM
processing to convert the speech signal of the received
PCM signal into an ADPCM signal of the low transmission
speed, allocate the one ADPCM signal to one time slot
and perform data transmission through the one radio
circuit.

A radio communication system according to the
present invention may have two forms including a form
wherein it comprises a radio base station connected to
an analog network and a mobile station connected to the
base station by a radio circuit and another form wherein
it comprises a radio base station connected to an ISDN
network and a mobile station connected to the base
station by a radio circuit. Where the radio
communication system has the former form, the base
station includes a main control section for controlling
components of the base station, an analog circuit
interface section for receiving an analog signal from
the analog network, a signal type discrimination section
for discriminating whether the analog signal received by
the analog circuit interface section is a modem
modulation signal from a facsimile modem or a data modem
or a speech signal, a PCM/CODEC section for modulating
the analog signal from the analog circuit interface section into a PCM signal of 64 kbps and for conversely demodulating a PCM signal of 64 kbps into an analog signal, an ADPCM/CODEC section for modulating the analog signal from the analog circuit interface section into an ADPCM signal of 32 kbps and for conversely demodulating an ADPCM signal of 32 kbps into an analog signal, a switch section for switching connection of the analog circuit interface section alternatively to the PCM/CODEC section or the ADPCM/CODEC section, a demultiplexing section for demultiplexing a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a channel CODEC section for performing allocation of communication channels to time slots of the radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, and a radio interface section for receiving data from the radio circuit and transmitting data through the radio circuit.

Meanwhile, the mobile station includes a main control section for controlling components of the mobile station, a radio interface section for receiving data from the base station through the radio circuit and transmitting data through the radio circuit, a channel CODEC section for performing allocation of communication
channels to time slots of the radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, a demultiplexing section for performing demultiplexing of a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a PCM/CODEC section for demodulating a PCM signal of 64 kbps into an analog signal and for conversely modulating an analog signal into a PCM signal of 64 kbps, an ADPCM/CODEC section for demodulating an ADPCM signal of 32 kbps into an analog signal and for conversely modulating an analog signal into an ADPCM signal of 32 kbps, an analog interface section for performing inputting and outputting processing of an analog signal, a switch section for switching the connection of the analog interface section to the PCM/CODEC section or the ADPCM/CODEC section, and a signal type discrimination section for discriminating whether or not an analog signal received by the analog interface section is a modem modulation signal such as a facsimile modem signal or a data modem signal or a speech signal.

On the other hand, where the radio communication system has the second-mentioned form wherein the radio base station is connected to an ISDN network, the base station includes a main control section for controlling
components of the base station, a digital circuit interface section for receiving a PCM signal of 64 kbps from the ISDN network, a signal type discrimination section for discriminating whether the digital signal received by the digital circuit interface section is a modem modulation signal such as a facsimile modem signal or a data modem signal or a speech signal, a PCM/ADPCM conversion section for performing conversion between a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a demultiplexing section for demultiplexing a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a switch section for switching connection of the digital circuit interface section alternatively to the demultiplexing section or the PCM/ADPCM conversion section, a channel codec section for performing allocation of communication channels to time slots of the radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, and a radio interface section for receiving data from the radio circuit and transmitting data through the radio circuit.

Meanwhile, the mobile station is constructed in a similar manner to the mobile station in the radio communication system of the form wherein the base station is connected to the analog circuit.
It is to be noted that the base station and the mobile station may be constructed such that they may perform transmission by signal processing reverse to that upon reception. Further, the base station and the mobile station may be constructed so as to serve as a parent machine and a child machine, respectively, of a digital cordless telephone system which makes use of a handheld phone system.

With the radio communication methods and the radio communication systems described above, where the base station is connected to an analog network, if the analog signal sent thereto from the analog network is a modem modulation signal such as a facsimile modem signal or a data modem signal, the analog signal is modulated into a PCM signal of a high transmission speed (64 kbps). Further, the PCM signal is demultiplexed into two ADPCM signals of a low transmission speed (32 kbps), and the two ADPCM signals of the low transmission speed are allocated to two time slots by channel CODEC processing and data transmission is performed as two radio communications through the radio circuit.

Thus, where the radio communication methods and the radio communication systems described above are applied to a digital cordless telephone system which
makes use of a handyphone system (PHS) connected to an analog circuit, data transmission with a wide band can be performed regarding a modem modulation signal from a modem of a facsimile machine or a data terminal as a speech signal and communication of a high quality at a high transmission speed can be achieved.

On the other hand, where the base station is connected to an ISDN network, a PCM signal of a high transmission speed (64 kbps) in the form of a modulation signal such as a facsimile modem signal or a data modem signal sent from the ISDN network to the base station is separated into two ADPCM signals of a low transmission speed (32 kbps). Then, the two ADPCM signals of the low transmission speed are allocated to two time slots, and data transmission is performed as two radio communications through the radio circuit.

Thus, also in this instance, data transmission with a wide band can be performed when an ISDN network is used, and communication of a high quality at a high transmission speed can be achieved.

The above and other objects, features and advantages of the present invention will become apparent from the following description and the appended claims, taken in conjunction with the accompanying drawings in
which like parts or elements are denoted by like reference characters.

FIG. 1 is a block diagram of a radio communication system to which the present invention is applied;

FIG. 2 is a flow chart illustrating a processing procedure of operation of the radio communication system of FIG. 1 before data transmission of a base station is started;

FIG. 3 is a flow chart illustrating a processing procedure of operation of the radio communication system of FIG. 1 before communication and talking of a mobile station is started; and

FIG. 4 is a block diagram of another radio communication system to which the present invention is applied where it is connected to an ISDN network.

Referring first to FIG. 1, there is shown in block diagram a radio communication system to which the present invention is applied.

The radio communication system shown in FIG. 1
is constructed as a digital cordless telephone system which makes use of a handyphone system. The radio communication system includes a base station (CS) 10 and a mobile station (PS) 20 which serve as a parent machine and a child machine, respectively.

The base station (CS) 10 includes a CS main control section 11 for controlling components of the base station (CS) 10, and a CS analog circuit interface (I/F) section 12 for receiving an analog signal sent thereto from a public network (analog network). The base station (CS) 10 further includes a CS signal type discrimination section 19 for discriminating whether an analog signal received by the CS analog circuit interface section 12 is a modulation signal from a facsimile modem or a data modem or a speech signal.

The base station (CS) 10 further includes a CS-PCM/CODEC section 14 for modulating an analog signal received by the CS analog circuit interface section 12 into a PCM signal of 64 kbps and for conversely demodulating a PCM signal of 64 kbps into an analog signal.

The base station (CS) 10 further includes a CS-ADPCM/CODEC section 16 for modulating an analog signal received by the CS analog circuit interface section 12
into an ADPCM signal of 32 kbps and for conversely demodulating an ADPCM signal of 32 kbps into an analog signal.

The base station (CS) 10 further includes a CS switch section 13 for connecting the CS analog circuit interface section 12 alternatively to the CS-PCM/CODEC section 14 or the CS-ADPCM/CODEC section 16.

The base station (CS) 10 further includes a CS demultiplexing section 15 for demultiplexing a PCM signal of 64 kbps into two signals equivalent to ADPCM signals of 32 kbps, and a CS channel CODEC section 17 for performing allocation of communication channels to time slots in the radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel.

The base station (CS) 10 further includes a CS radio interface section 18 for receiving data sent thereto through the radio circuit by means of a CS antenna Ant and performing transmission of data through the radio circuit (CS antenna Ant).

Meanwhile, the mobile station (PS) 20 of the communication system includes a PS main control section 21 for controlling components of the mobile station (PS) 20, a PS radio interface (I/F) section 28 for receiving
data sent thereto from the base station (CS) 10 through the radio circuit by means of the PS antenna Ant and performing data transmission through the radio circuit (PS antenna Ant), and a PS channel CODEC section 27 for performing allocation of communication channels to time slots in the radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel. The mobile station (PS) 20 further includes a PS demultiplexing section 25 for performing demultiplexing of a PCM signal of 64 kbps and two signals equivalent to ADPCM signals of 32 kbps.

The mobile station (PS) 20 further includes a PS-PCM/CODEC section 24 for demodulating a PCM signal of 64 kbps into an analog signal and for conversely modulating an analog signal into a PCM signal of 64 kbps, and a PS-ADPCM/CODEC section 26 for demodulating an ADPCM signal of 32 kbps into an analog signal and for conversely modulating an analog signal into an ADPCM signal of 32 kbps. The mobile station (PS) 20 further includes a PS analog interface (I/F) section 22 for performing processing of input and output signals each in the form of an analog signal.

The mobile station (PS) 20 further includes a PS switch section 23 for switching the connection of the PS
analog interface section 22 to the PS-PCM/CODEC section 24 or the PS-ADPCM/CODEC section 26, and a PS signal type discrimination section 29 for discriminating whether or not an analog signal received by the PS analog interface section 22 is a modem modulation signal from a facsimile modem or a data modem or a speech signal.

Operation of the radio communication system is described in detail below with reference to FIGS. 1, 2 and 3. FIG. 2 illustrates in flow chart a processing procedure of operation of the radio communication system before data transmission of the base station (CS) is started, and FIG. 3 illustrates in flow chart a processing procedure of operation of the radio communication system before communication and talking of the mobile station (PS) is started.

First, in an initial state, the CS switch section 13 of the base station (CS) 10 is in a switched state wherein it connects the CS analog circuit interface section 12 to the CS-ADPCM/CODEC section 16 (on between a-c). Meanwhile, it is assumed that the PS switch section 23 of the mobile station (PS) 20 is connected to the PS-ADPCM/CODEC section 26 side (on between a-f).
If the base station (CS) 10 receives an analog signal sent thereto from a public network (analog network) at the CS analog circuit interface section 12 thereof (step S11), then the CS signal type discrimination section 19 discriminates whether or not the received analog signal is a modem modulation signal from a facsimile modem or a data modem or a speech signal (step S12). For the discrimination, for example, a method of detecting an answer tone of 2,100 Hz or, particularly from a facsimile modem, a CNG signal is available.

If the analog signal is a modem modulation signal from a facsimile modem or a data modem, then the CS switch section 13 disconnects the CS analog circuit interface section 12 from the CS-ADPCM/CODEC section 16 (off between a-c) and now connects the CS analog circuit interface section 12 to the CS-PCM/CODEC section 14 (on between a-b) under the control of the CS main control section 11 (step S13).

Since the CS switch section 13 connects the CS analog circuit interface section 12 to the CS-PCM/CODEC section 14 in this manner, a path is formed for the CS-PCM/CODEC section 14, and the CS-PCM/CODEC section 14 thus modulates the received modem modulation signal into
a PCM signal of 64 kbps (step S14).

The CS demultiplexing section 15 demultiplexes the modulated PCM signal of 64 kbps into two signals equivalent to ADPCM signals of 32 kbps (step S15). The CS channel CODEC section 17 allocates the two signals equivalent to ADPCM signals of 32 kbps to two time slots and transmits them as two radio communications from the CS radio interface section 18 through the radio circuit (CS antenna Ant) (step S16).

When the mobile station (PS) 20 receives the data sent thereto through the radio circuit by the PS antenna Ant and the PS radio interface section 28 (step S31 in FIG. 3), the PS signal type discrimination section 29 discriminates whether the received data are conversion data of a modem modulation signal which has been allocated to two time slots and transmitted separately as such or conversion data of a speech signal which has been allocated to one time slot and transmitted as such (step S32).

If the discrimination reveals that the received data are conversion data of a modem modulation signal allocated to two time slots and transmitted separately as such, then the PS switch section 23 disconnects the PS analog interface section 22 from the PS-ADPCM/CODEC
section 26 (off between b-f) and now connects the PS analog interface section 22 to the PS-PCM/CODEC section 24 (on between d-e) under the control of the PS main control section 21 (step S33).

For the discrimination, for example, a method wherein, when two call termination requests arrive at the mobile station (PS) 20 from the base station (CS) 10 during communication control, the received data are discriminated to be conversion data of a modem modulation signal is available.

The two signals allocated to two time slots and equivalent to ADPCM signals of 32 kbps are separated by the PS channel CODEC section 27 and forwarded to the PS demultiplexing section 25 (step S34). The PS demultiplexing section 25 multiplexes the two signals equivalent to ADPCM signals of 32 kbps and demodulates the multiplexed signal into a PCM signal of 64 kbps (step S35). The PS-PCM/CODEC section 24 demodulates the received PCM signal of 64 kbps into an analog signal (step S36).

Through the PS analog interface section 22 for which a path has been formed by selection of the PS-PCM/CODEC section 24 by the PS switch section 23 under the control of the PS main control section 21, the
demodulated modem modulation signal is transmitted to the facsimile machine, data terminal or the like thereby to start communication (step S37).

On the other hand, if the analog signal received by the CS analog circuit interface section 12 of the base station (CS) 10 is a speech signal (step S12 in FIG. 3), whether or not the analog signal is a speech signal is discriminated by the CS signal type discrimination section 19. The CS switch section 13 forms a path immediately without cutting the connection between the CS analog circuit interface section 12 and the CS-ADPCM/CODEC section 16 (on between a-c) (step S17 in FIG. 3). The CS-ADPCM/CODEC section 16 for which a path has been formed in this manner modulates the received speech signal into an ADPCM signal of 32 kbps (step S18).

Further, the CS channel CODEC section 17 allocates the modulated ADPCM signal to one time slot and transmits it as one radio communication through the radio circuit via the CS radio interface section 18 and the CS antenna Ant (step S19). The mobile station (PS) 20 receives the data sent thereto through the radio circuit using the PS antenna Ant and the PS radio interface section 28. Then, when the data are
conversion data of a speech signal allocated to one time slot, the PS signal type discrimination section 29 discriminates that the data are a speech signal.

Here, the PS switch section 23 forms a path immediately without cutting the connection between the PS analog interface section 22 and the PS-ADPCM/CODEC section 26 (on between b-f) under the control of the PS main control section 21 (step S38 of FIG. 3).

The ADPCM signal of 32 kbps allocated to one time slot is inputted to the PS-ADPCM/CODEC section 26, by which it is subsequently demodulated into an analog signal (step S40). The thus demodulated analog signal is transmitted as a speech signal to the telephone terminal through the PS-ADPCM/CODEC section 26 and the PS switch section 23 and through the PS analog interface section 22 for which a path has been formed thereby to perform talking (step S41).

On the other hand, when transmission from the radio communication system is to be performed, the mobile station (PS) 20 discriminates, by the PS signal type discrimination section 29 thereof, whether an analog signal received by the PS analog interface section 22 is a modem modulation signal of a facsimile modem or a data modem or a speech signal and switches
the PS switch section 23 in accordance with the
discrimination. Thereafter, a procedure reverse to that
for the termination is performed thereby to perform
talking.

Referring now to FIG. 4, there is shown in block
diagram another radio communication system to which the
present invention is applied where it is connected to an
ISDN network.

The radio communication system is basically
similar to the radio communication system described
hereinafore with reference to FIG. 1 except that the
base station (CS) 10 is connected to an ISDN network and
includes a CS digital circuit interface section 31 for
receiving a PCM signal of 64 kbps sent thereto from the
ISDN network and a CS-PCM/ADPCM conversion section 32
for performing conversion between a PCM signal of 64
kbps and an ADPCM signal of 32 kbps in place of the CS
analog circuit interface section 12, CS-PCM/CODEC
section 14 and CS-ADPCM/CODEC section 16 of the base
station (CS) 10 of the radio communication system of
FIG. 1.

In operation, in the base station (CS) 10, when
a PCM signal of 64 kbps sent thereto from the ISDN
network is a modem modulation signal from a facsimile
modem or a data modem, the CS signal type discrimination section 19 discriminates that the PCM signal of 64 kbps is a modem modulation signal. In response to the discrimination, the CS switch section 13 connects the CS digital circuit interface section 31, which has received the PCM signal of 64 kbps, to the CS demultiplexing section 15 (on between a-b) and forwards the received PCM signal of 64 kbps as it is to the CS demultiplexing section 15. Thereafter, communication with the facsimile machine or data terminal is started in accordance with a processing procedure similar to that in the radio communication system of FIG. 1.

On the other hand, when the PCM signal of 64 kbps sent thereto from the ISDN network is a speech signal, in the base station (CS) 10, the CS signal type discrimination section 19 discriminates that the PCM signal of 64 kbps is a speech signal, and the CS switch section 13 connects the CS digital circuit interface section 31, which has received the PCM signal of 64 kbps, not to the CS demultiplexing section 15 but to the CS-PCM/ADPCM conversion section 32 (on between a-b).

Then, the CS-PCM/ADPCM conversion section 32 converts the received PCM signal of 64 kbps into an ADPCM signal of 32 kbps. The thus converted ADPCM
signal of 32 kbps is transmitted to the CS channel CODEC section 17. Thereafter, talking with the telephone terminal is started in accordance with a processing procedure similar to that in the radio communication system of FIG. 1.

It is to be noted that, in transmission, communication and talking via the ISDN network is performed in accordance with a processing procedure reverse to the processing procedure for termination.

Having now fully described the invention, it will be apparent to one of ordinary skill in the art that many changes and modifications can be made thereto without departing from the spirit and scope of the invention as set forth herein.
Claims: The claims defining the invention are as follows:

1. A radio communication method for a radio communication system which includes a base station connected to an analog network and a mobile station connected to said base station by a radio circuit, characterized in that said base station performs, when an analog signal which is a modem modulation signal such as a facsimile modem signal or a data modem signal is received from said analog network, PCM/CODEC processing of the analog signal, modulates the analog signal into a PCM signal of a high transmission speed, separates the PCM signal into two ADPCM signals of a low transmission speed, allocates the two ADPCM signals of the low transmission speed to two time slots by channel CODEC processing and performs data transmission as two radio communications through said radio circuit, and said mobile station demodulates the data received from said base station into an analog signal by a processing procedure reverse to the processing procedure by said base station and performs communication of the analog signal with a wide bandwidth of the high transmission speed regarding the analog signal as a speech signal.

2. A radio communication method as set forth in claim 1, characterized in that said base station
performs, when a speech signal which is an analog signal is received from said analog network. ADPCM/CODEC processing for the speech signal, allocates the one ADPCM signal to one time slot and performs data transmission through the one radio circuit, and said mobile station demodulates the data received from said base station into an analog signal by a processing procedure reverse to the processing procedure by said base station and performs talking.

3. A radio communication method for a radio communication system which includes a base station connected to an ISDN network and a mobile station connected to said base station by a radio circuit, characterized in that said base station separates a modem modulation signal such as a facsimile modem signal or a data modem signal which is a PCM signal of a high speed sent thereto from said ISDN network into two ADPCM signals of a low transmission speed, allocates the two ADPCM signals of the low transmission speed to two time slots by channel CODEC processing and performs data transmission as two radio communications through said radio circuit, and said mobile station demodulates the data received from said base station into an analog signal by a processing procedure reverse to the
processing procedure by said base station and performs communication of the analog signal with a wide bandwidth of the high transmission speed regarding the analog signal as a speech signal.

4. A radio communication method as set forth in claim 3, characterized in that said base station performs, when the PCM signal of the high transmission speed sent thereto from said ISDN network is a speech signal, PCM/ADPCM processing to convert the speech signal of the received PCM signal into an ADPCM signal of the low transmission speed, allocates the one ADPCM signal to one time slot and performs data transmission through the one radio circuit, and said mobile station demodulates the data received from said base station into an analog signal by a processing procedure reverse to the processing procedure by said base station and performs talking.

5. A radio communication system which includes a radio base station (10) connected to an analog network, and a mobile station (20) connected to said base station (20) by a radio circuit, characterized in that said base station (10) includes a main control section (11) for controlling components of said base
station (10), an analog circuit interface section (12) for receiving an analog signal from said analog network, a signal type discrimination section (19) for discriminating whether the analog signal received by said analog circuit interface section (12) is a modem modulation signal from a facsimile modem or a data modem or a speech signal, a PCM/CODEC section (14) for modulating the analog signal from said analog circuit interface section (12) into a PCM signal of 64 kbps and for conversely demodulating a PCM signal of 64 kbps into an analog signal, an ADPCM/CODEC section (16) for modulating the analog signal from said analog circuit interface section (12) into an ADPCM signal of 32 kbps and for conversely demodulating an ADPCM signal of 32 kbps into an analog signal, a switch section (13) for switching connection of said analog circuit interface section (12) alternatively to said PCM/CODEC section (14) or said ADPCM/CODEC section (16), a demultiplexing section (15) for demultiplexing a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a channel CODEC section (17) for performing allocation of communication channels to time slots of said radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, and a radio
interface section (18) for receiving data from said radio circuit and transmitting data through said radio circuit.

6. A radio communication system which includes a radio base station (10) connected to an analog network, and a mobile station (20) connected to said base station (20) by a radio circuit, characterized in that said mobile station includes a main control section (21) for controlling components of said mobile station (20), a radio interface section (28) for receiving data from said base station (10) through the radio circuit and transmitting data through said radio circuit, a channel CODEC section (27) for performing allocation of communication channels to time slots of said radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, a demultiplexing section (25) for performing demultiplexing of a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a PCM/CODEC section (24) for demodulating a PCM signal of 64 kbps into an analog signal and for conversely modulating an analog signal into a PCM signal of 64 kbps, an ADPCM/CODEC section (26) for demodulating an ADPCM signal of 32 kbps into an
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analog signal and for conversely modulating an analog signal into an ADPCM signal of 32 kbps, an analog interface section (22) for performing inputting and outputting processing of an analog signal, a switch section (23) for switching the connection of said analog interface section (22) to said PCM/CODEC section (24) or said ADPCM/CODEC section (26), and a signal type discrimination section (29) for discriminating whether or not an analog signal received by said analog interface section (22) is a modem modulation signal such as a facsimile modem signal or a data modem signal or a speech signal.

7. A radio communication system which includes a radio base station (10) connected to an analog network, and a mobile station (20) connected to said base station (20) by a radio circuit, characterized in that said base station (10) includes a main control section (11) for controlling components of said base station (10), an analog circuit interface section (12) for receiving an analog signal from said analog network, a signal type discrimination section (19) for discriminating whether the analog signal received by said analog circuit interface section (12) is a modem
modulation signal from a facsimile modem or a data modem or a speech signal, a PCM/Codec section (14) for modulating the analog signal from said analog circuit interface section (12) into a PCM signal of 64 kbps and for conversely demodulating a PCM signal of 64 kbps into an analog signal, an ADPCM/Codec section (16) for modulating the analog signal from said analog circuit interface section (12) into an ADPCM signal of 32 kbps and for conversely demodulating an ADPCM signal of 32 kbps into an analog signal, a switch section (13) for switching connection of said analog circuit interface section (12) alternatively to said PCM/Codec section (14) or said ADPCM/Codec section (16), a demultiplexing section (15) for demultiplexing a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a channel Codec section (17) for performing allocation of communication channels to time slots of said radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, and a radio interface section (18) for receiving data from said radio circuit and transmitting data through said radio circuit; and that said mobile station includes a main control section (21) for controlling components of said mobile
station (20), a radio interface section (28) for receiving data from said base station (10) through the radio circuit and transmitting data through said radio circuit, a channel CODEC section (27) for performing allocation of communication channels to time slots of said radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, a demultiplexing section (25) for performing demultiplexing of a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a PCM/CODEC section (24) for demodulating a PCM signal of 64 kbps into an analog signal and for conversely modulating an analog signal into a PCM signal of 64 kbps, an ADPCM/CODEC section (26) for demodulating an ADPCM signal of 32 kbps into an analog signal and for conversely modulating an analog signal into an ADPCM signal of 32 kbps, an analog interface section (22) for performing inputting and outputting processing of an analog signal, a switch section (23) for switching the connection of said analog interface section (22) to said PCM/CODEC section (24) or said ADPCM/CODEC section (26), and a signal type discrimination section (29) for discriminating whether or not an analog signal received by said analog interface section (22) is a modem modulation signal such
as a facsimile modem signal or a data modem signal or a speech signal.

8. A radio communication system which includes a radio base station (10) connected to an ISDN network, and a mobile station (20) connected to said base station (20) by a radio circuit, characterized in that said base station (10) includes a main control section (11) for controlling components of said base station (10), a digital circuit interface section (31) for receiving a PCM signal of 64 kbps from said ISDN network, a signal type discrimination section (19) for discriminating whether the digital signal received by said digital circuit interface section (31) is a modem modulation signal such as a facsimile modem signal or a data modem signal or a speech signal, a PCM/ADPCM conversion section (32) for performing conversion between a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a demultiplexing section (15) for demultiplexing a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a switch section (13) for switching connection of said digital circuit interface section (31) alternatively to said demultiplexing section (15) or said PCM/ADPCM conversion section (32), a channel CODEC section (17) for performing allocation of
communication channels to time slots of said radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, and a radio interface section (18) for receiving data from said radio circuit and transmitting data through said radio circuit.

9. A radio communication system which includes a radio base station (10) connected to an ISDN network, and a mobile station (20) connected to said base station (20) by a radio circuit, characterized in that said mobile station includes a main control section (21) for controlling components of said mobile station (20), a radio interface section (28) for receiving data from said base station (10) through the radio circuit and transmitting data through said radio circuit, a channel CODEC section (27) for performing allocation of communication channels to time slots of said radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, a demultiplexing section (25) for performing demultiplexing of a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a PCM/CODEC section (24) for demodulating a PCM signal of 64 kbps into an analog signal and for conversely modulating an analog signal.
into a PCM signal of 64 kbps, an ADPCM/CODEC section (26) for demodulating an ADPCM signal of 32 kbps into an analog signal and for conversely modulating an analog signal into an ADPCM signal of 32 kbps, an analog interface section (22) for performing inputting and outputting processing of an analog signal, a switch section (23) for switching the connection of said analog interface section (22) to said PCM/CODEC section (24) or said ADPCM/CODEC section (26), and a signal type discrimination section (29) for discriminating whether or not an analog signal received by said analog interface section (22) is a modem modulation signal such as a facsimile modem signal or a data modem signal or a speech signal.

10. A radio communication system which includes a radio base station (10) connected to an ISDN network, and a mobile station (20) connected to said base station (20) by a radio circuit, characterized in that said base station (10) includes a main control section (11) for controlling components of said base station (10), a digital circuit interface section (31) for receiving a PCM signal of 64 kbps from said ISDN network, a signal type discrimination section (19) for discriminating whether the digital signal received by
said digital circuit interface section (31) is a modem modulation signal such as a facsimile modem signal or a data modem signal or a speech signal, a PCM/ADPCM conversion section (32) for performing conversion between a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a demultiplexing section (15) for demultiplexing a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a switch section (13) for switching connection of said digital circuit interface section (31) alternatively to said demultiplexing section (15) or said PCM/ADPCM conversion section (32), a channel CODEC section (17) for performing allocation of communication channels to time slots of said radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, and a radio interface section (18) for receiving data from said radio circuit and transmitting data through said radio circuit; and that

said mobile station includes a main control section (21) for controlling components of said mobile station (20), a radio interface section (28) for receiving data from said base station (10) through the radio circuit and transmitting data through said radio circuit, a channel CODEC section (27) for performing
allocation of communication channels to time slots of said radio circuit and performing framing and deframing of radio frames of a control channel and a communication channel, a demultiplexing section (25) for performing demultiplexing of a PCM signal of 64 kbps and an ADPCM signal of 32 kbps, a PCM/CODEC section (24) for demodulating a PCM signal of 64 kbps into an analog signal and for conversely modulating an analog signal into a PCM signal of 64 kbps, an ADPCM/CODEC section (26) for demodulating an ADPCM signal of 32 kbps into an analog signal and for conversely modulating an analog signal into an ADPCM signal of 32 kbps, an analog interface section (22) for performing inputting and outputting processing of an analog signal, a switch section (23) for switching the connection of said analog interface section (22) to said PCM/CODEC section (24) or said ADPCM/CODEC section (26), and a signal type discrimination section (29) for discriminating whether or not an analog signal received by said analog interface section (22) is a modem modulation signal such as a facsimile modem signal or a data modem signal or a speech signal.
11. A radio communication method substantially as described herein with reference to the accompanying drawings.

12. A radio communication system substantially as described herein with reference to the accompanying drawings.

DATED this Nineteenth Day of December 1997

NEC Corporation
Patent Attorneys for the Applicant

SPRUSON & FERGUSON
Abstract:

Radio Communication Method and Radio Communication System between Base Station and Mobile Station

When a base station (10) receives an analog signal (facsimile or data modem modulation signal) from a public network, a CS switch section (13) connects an analog circuit interface section (12) to a CS-PCM/Codec section (14). The CS-PCM/Codec section modulates the modem modulation signal into a PCM signal of 64 kbps, which is then demultiplexed into two signals equivalent to ADPCM signals of 32 kbps by a CS demultiplexing section (15). Thereafter, a CS channel Codec section (17) allocates the two signals equivalent to ADPCM signals of 32 kbps to two time slots and transmits the data through two radio circuits. A base station (20) performs demodulation of received data into an analog signal by a processing procedure reverse to that by the base station. Communication is performed with a wide bandwidth of 64 kbps regarding a modem modulation signal as a speech signal.

SELECTED FIGURE: FIG. 1
FIG. 2

START

S11

ARRIVAL OF ANALOG SIGNAL

S12

ARRIVING SIGNAL = MODEM MODULATION SIGNAL?

S13

YES

SWITCHING OF SWITCH, ON BETWEEN a-b

S14

MODULATION INTO PCM SIGNAL OF 64 kbps

S15

SEPARATION INTO TWO SIGNALS OF 32 kbps (EQUIVALENT TO ADPCM SIGNALS)

S16

ALLOCATE TWO SIGNALS TO TWO TIME SLOTS & START TRANSMISSION OF TWO RADIO COMMUNICATION DATA

S17

NO

MAINTAIN SWITCH, ON BETWEEN a-c

S18

MODULATION INTO ADPCM SIGNAL OF 32 kbps

S19

ALLOCATE ADPCM SIGNAL TO ONE TIME SLOT & START TRANSMISSION OF ONE RADIO COMMUNICATION DATA

END
FIG. 3

START
S31 ARRIVAL OF RADIO DATA
S32 ARRIVING SIGNAL = CONVERSION DATA OF MODEM MODULATION SIGNAL

S33 YES
SWITCHING OF SWITCH, ON BETWEEN d-e
DELIVER TWO SIGNALS OF 32 kbps TO PS DEMULTIPLEXING SECTION
MULTIPLEX TWO SIGNALS OF 32 kbps INTO PCM SIGNAL OF 64 kbps

S35
DEMODULATION INTO ANALOG SIGNAL
TRANSMISSION TO FACSIMILE MACHINE OR DATA TERMINAL (START OF COMMUNICATION)

S36
DEMODULATION INTO ANALOG SIGNAL
TRANSMISSION TO TELEPHONE TERMINAL (START OF TALKING)

S37
S38 NO
MAINTAIN SWITCH, ON BETWEEN d-f
DELIVER ONE SIGNAL OF 32 kbps TO PS-ADPCM CODEC SECTION
S39
S40
S41 END