(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 May 2009 (22.05.2009)

PCT

(10) International Publication Number
WO 2009/064089 A1

(51) International Patent Classification:
H04B 7/14 (2006.01)

(21) International Application Number:
PCT/KR2008/006537

(22) International Filing Date:
6 November 2008 (06.11.2008)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2007-0115706
13 November 2007 (13.11.2007) KR

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(54) **Title:** MOBILE REPEATING METHOD IN MOBILE COMMUNICATION SYSTEM AND REPEATER THEREOF

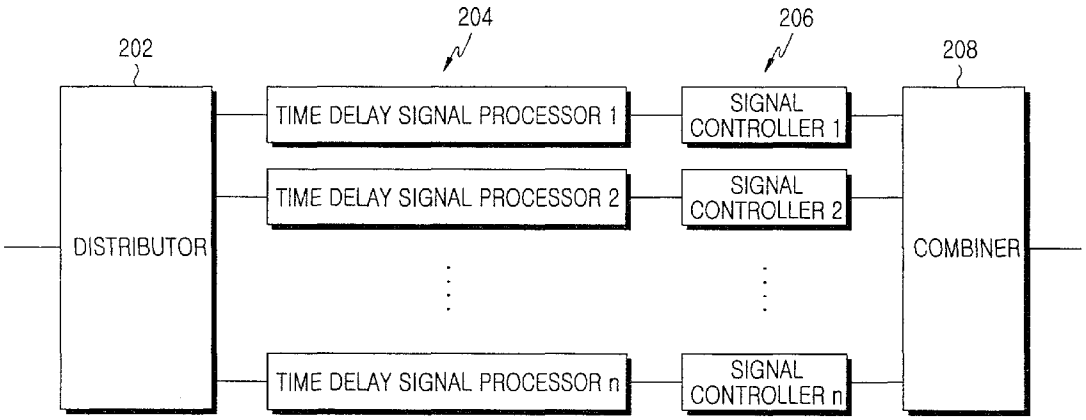


FIG.3

(57) **Abstract:** A radio relay in a mobile communication system is provided. The radio relay includes a link antenna for performing radio communication with a Base station Transceiver Subsystem (BTS); a service antenna for performing radio communication with a terminal; a downlink signal amplifying processor for amplifying a signal from the BTS; an uplink signal amplifying processor for amplifying a signal of the terminal; a link antenna connector for connecting the uplink and downlink signal amplifying processors to the link antenna; a service antenna connector for connecting the uplink and downlink signal amplifying processors to the service antenna; and a time delay signal processing unit, situated inside or outside the downlink signal amplifying processor, for distributing a downlink signal into a plurality of signals, delaying the distributed signals by different time delays, and combining back the delayed signal.

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MOBILE REPEATING METHOD IN MOBILE COMMUNICATION SYSTEM AND REPEATER THEREOF

BACKGROUND OF THE INVENTION

1. Field of the invention

The present invention relates generally to a mobile communication relay technology in a cellular mobile communication network, and in particular, to a radio relay, which is installed to be connected to a Base station Transceiver Subsystem (BTS) not by wire, but by wireless, and a relay method thereof.

2. Description of the Related Art

Generally, a cellular mobile communication network includes Mobile Switching Centers (MSC), Base Station Controllers (BSC), BTSs, and Mobile Stations (MS; or subscriber terminals), and commonly, a plurality of BTSs are installed to expand a serviceable area. Thus, a partial communication shadow area may occur where the signal transmitted from a BTS cannot be smoothly received at an MS due to natural and artificial obstacles. A wire/wireless relay for relaying transmission/reception signals between the BTS and the MS is installed in such a communication shadow area. In particular, some of the radio relays can be mounted on a moving object such as public transportation to provide seamless radio communication services to MSs in the corresponding moving object.

However, since a radio relay for mobile communication is not connected to a particular BTS by wire, the relay may retransmit the signal to its service area without eliminating Pseudo Noise (PN) congestion, which the most significant problem in operation of the radio relay system. In this case, the service provider should annoyingly allocate unnecessary channel resources in a duplicated manner.

Particularly, in case of a high building in the downtown, it is intended to determine a direction of a link antenna connected with a BTS so as to select one PN if possible. Generally, however, since this is not easy, even though one or more PNs are connected inevitably, it is not possible to avoid the situation in order to relay signals in the in-building environment.

FIG. 1 is a schematic block diagram illustrating a structure of a general radio relay for mobile communication. Referring to FIG. 1, a radio relay can include a link antenna 102 for radio signal exchange with a BTS, a service antenna 112 for radio signal exchange with a terminal, a downlink signal amplifying processor 106 for amplifying a downlink signal from the BTS, an uplink signal amplifying processor 116 for amplify an uplink signal, a link antenna connector 104 for connecting the uplink/downlink signals to the link antenna 102, a service antenna connector 114 for connecting the uplink/downlink signals to the service antenna 112, and a controller 110 for controlling the overall operation of the relay.

Since the relay formed as shown in FIG. 1 cannot but be connected up to the unwanted BTS unavoidably in the above-stated PN congestion area, it has many problems to be managed in the field.

In order to solve the problems, there has been proposed a scheme of digitally reprocessing a signal acquired from the link antenna and thus reprocessing the remaining signals except for a desired PN with a changed meaningless PN so that the terminal cannot access PNs other than the desired PN. Such a scheme needs a high-speed digital signal processing device for restoring a signal received from the link antenna to a digital signal, detecting PNs from the digital signal, and properly processing each PN. However, this scheme causes a considerable increase in the cost and product size due to installation of the digital signal processing device, and it should restore the received signal to a digital signal, distort unwanted signals through fast calculation, and then convert the signal back into an analog signal, thus causing an increase in the time required for performing the corresponding operation.

SUMMARY OF THE INVENTION

Therefore, an aspect of the present invention is to provide a radio relay method in a mobile communication system and a relay thereof, for allowing a terminal to simply efficiently select one PN signal, without requiring digital signal processing, making it possible to eliminate PN congestion.

According to one aspect of the present invention, there is provided a radio relay in a mobile communication system. The radio relay includes a link antenna for performing radio communication with a Base station Transceiver Subsystem (BTS); a service antenna for performing radio communication with a terminal; a downlink signal amplifying processor for amplifying a signal from the BTS; an uplink signal amplifying processor for amplifying a signal of the terminal; a link antenna connector for connecting the uplink and downlink signal amplifying processors to the link antenna; a service antenna connector for connecting the uplink and downlink signal amplifying processors to the service antenna; and a time delay signal processing unit, situated inside or outside the downlink signal amplifying processor, for distributing a downlink signal into a plurality of signals, delaying the distributed signals by different time delays, and combining back the delayed signals.

According to another aspect of the present invention, there is provided a radio relay method in a mobile communication system. The radio relay method includes wirelessly receiving a downlink signal from a Base station Transceiver Subsystem (BTS); distributing the received downlink signal into a plurality of signals; delaying the distributed downlink signals by different time delays; combining the delayed distributed downlink signal signals; and wirelessly transmitting the combined downlink signal to a mobile station.

As described above, the radio relay scheme according to the present invention arranges, in the radio relay system, a plurality of time delay elements for distributing a received signal, delaying the distributed signals by different delay times, and combining the delayed signals so as to help a terminal select the same PN, thereby making it possible to simply determine a direction of the antenna by measuring only the signal strength during installation of the link antenna, and to help the terminal always select only one stabilized PN even despite a change in the external environment during operation. In this manner, the present invention can relay very stable and efficient signals to the terminal, and enable the service provider to facilitate efficient call channel management.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic block diagram illustrating a structure of a general radio relay for mobile communication;

FIG. 2 is a schematic block diagram illustrating a structure of a radio relay for mobile communication according to an embodiment of the present invention; and

FIG. 3 is a detailed block diagram illustrating a structure of the time delay signal processing unit 200 in FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Preferred embodiments of the present invention will now be described in detail with reference to the annexed drawings. The matters defined in the description such as a detailed construction and elements are provided to assist in a comprehensive understanding of exemplary embodiments of the invention. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiment described herein can be made without departing from the scope and spirit of the invention.

FIG. 2 is a schematic block diagram illustrating a structure of a radio relay for mobile communication according to an embodiment of the present invention. Referring to FIG. 2, in a relay according to the present invention, a link antenna 102 and a service antenna 112 are antennas that face a BTS and a device replacing the BTS, respectively, similarly to the conventional ones. The link antenna 102 is an antenna serving to receive a signal from the BTS or send a terminal's signal amplified by a corresponding relay to the BTS, and the service antenna 112, an antenna connected to the terminal, serves as an antenna for relaying a BTS's signal to the terminal or receiving the terminal's signal. The antennas can be mounted in the relay in an integrated manner, or can be mounted such that they are connected by a Radio Frequency (RF) cable and disposed in proper places.

It is considered that the link antenna 102 is mounted after a BTS's signal desired at a corresponding installed position is compared with other BTSs' signals and previously properly adjusted so that it can be best received, or that its reception direction is adjusted.

An uplink/downlink amplifying device includes a downlink signal amplifying processor 106 for amplifying a signal from the BTS, and an uplink signal amplifying processor 116 for amplify a signal from the terminal, and further includes a link antenna connector 104 for connecting the uplink/downlink signals to the link antenna 102, and a service antenna connector 114 for connecting the uplink/downlink signals to the service antenna 112.

A controller 110 for controlling the overall operation of the relay can include a signal detector for detecting strength of transmission/reception input and output, and an alarm detector for sensing defects of components, and can control all functions and parts of the relay.

Although the structure of such a relay can be similar to the conventional structure, a time delay signal processing unit 200, which is situated inside or outside the downlink signal amplifying processor 106, can be further included in the structure according to characteristics of the present invention. The time delay signal processing unit 200 distributes a received downlink signal into a plurality of signals, delays the distributed signals by different time delays, and combines back the delayed signals.

The downlink signal amplifying processor 106 can be constructed such that it amplifies a signal input to the time delay signal processing unit 200 in its front stage, or amplifies a signal output from the time delay signal processing unit 200 in its rear stage. In addition, the time delay signal processing unit 200 may adopt therein structures for amplifying the distributed signals individually. The structure and operation of the time delay signal processing unit 200 will now be described in detail with reference to accompanying drawing.

FIG. 3 is a detailed block diagram illustrating a structure of the time delay signal processing unit 200 in FIG. 2. Referring to FIG. 3, the time delay signal processing unit 200 according to an embodiment of the present invention includes a distributor 200 for distributing an input signal to a plurality of paths, a plurality of time delay signal processors 204 for time-delaying the signals distributed by the distributor 200 so that they have different delay times, a plurality of signal controllers 206 for performing a switching operation or an attenuation operation

for applying signal limitation to each of the output signals of the time delay signal processors 204 according to the external control signal or to the set condition during the installation, and a combiner 208 for combining outputs of the signal controllers 206.

The number of time delay paths of the signals being delayed through the time delay signal processors 204 after being distributed by the distributor 202 is 2 or more, and it is equal to or less than the number of finger demodulators that the terminal can handle. In the time delay signal processors 204, time delay values are previously set to proper delay values taking into account functions of the terminal's finger demodulators and the general radio signal fading state, such that from the viewpoint of the terminal, the delayed signals are processed as if they are signals received through different paths.

The signal controllers 206 can be composed of switches, or attenuators having a high attenuation level, for limiting the input/output in their established paths when necessary, and thus can have an additional structure for limiting the number of retransmission PNs. Such a function of the signal controllers 206 is a function for allowing more than one PNs to be provided to a service area, and it can be used for increasing or decreasing the number of PNs, when necessary.

Although the time delay signal processing unit 200 constructed in this way is shown in FIG. 3 as an exemplary structure, the same function can be maintained even though the time delay signal processing unit 200 has the same basic structure and is constructed such that the distributed outputs of the distributor 202 pass through the time delay signal processors 204 after passing through the signal controllers 206.

The relay according to the present invention, since it has the structure of FIG. 3, has the function that a signal being received through the link antenna is artificially modified before being output as if it is received through a plurality of other paths.

Recently, a CDMA terminal has a structure that examines only the high-quality signals received through different paths as BTS signals received from the

corresponding terminal's antenna, and performs signal processing for each finger designed in order of a signal having higher strength among the signals whose quality is greater than a reference value.

The signals relayed by the relay according to the present invention are a plurality of signals which are amplified only at different delay times, and since the signal relayed through each path designed to have the same signal gain is amplified as many times as the number of paths for which a highest-quality signal among the signals received through the link antenna is set, when the terminal analyzes each of signals received through each corresponding finger demodulator and allocates an active set according to the quality level of the signals, each finger demodulator selects only the same PN (i.e., PN selected for the highest-quality signal). For example, in the conventional scheme, even though the PN signal of the BTS A among PN signals of BTSs A, B and C as relay signals is highest in strength, when even the PN signals of the remaining BTSs B and C are greater than or equal to a reference value, the finger demodulators in the terminal may acquire PN signals of the BTSs A, B and C. However, according to the present invention, each finger best selects only the PN signal of the BTS A.

As a result, though signals are received from the link antenna and amplified through the paths having different time delays, the present invention can perform a function of delivering an input signal to the terminal, to allow the terminal to positively receive as many PN signals as only one PN or as the number of controlled PNs.

In conclusion, the present invention makes it possible to effectively use one or more desired PNs in a service area from the inevitable PN congestion area.

The structure and operation of a radio relay method in a mobile communication system and a relay thereof according to the present invention can be achieved as described above. While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

CLAIMS

1. A radio relay in a mobile communication system, the relay comprising:

a link antenna for performing radio communication with a Base station Transceiver Subsystem (BTS);

a service antenna for performing radio communication with a terminal;

a downlink signal amplifying processor for amplifying a signal from the BTS;

an uplink signal amplifying processor for amplifying a signal of the terminal;

a link antenna connector for connecting the uplink and downlink signal amplifying processors to the link antenna;

a service antenna connector for connecting the uplink and downlink signal amplifying processors to the service antenna; and

a time delay signal processing unit, situated inside or outside the downlink signal amplifying processor, for distributing a downlink signal into a plurality of signals, delaying the distributed signals by different time delays, and combining back the delayed signals.

2. The radio relay of claim 1, wherein the time delay signal processing unit comprises:

a distributor for distributing an input signal to a plurality of paths;

a plurality of time delay signal processors for time-delaying the signals distributed by the distributor so that the distributed signals have predetermined different delay times; and

a combiner for combining outputs of the time delay signal processors.

3. The radio relay of claim 2, wherein the time delay signal processing unit further comprises:

a plurality of signal controllers, provided on a plurality of paths established between the distributor and the combiner, for performing a switching operation or an attenuation operation for applying signal limitation to each path.

4. A radio relay method in a mobile communication system, the method comprising:

wirelessly receiving a downlink signal from a Base station Transceiver Subsystem (BTS);

distributing the received downlink signal into a plurality of signals;

delaying the distributed downlink signals by different time delays;

combining the delayed distributed downlink signal signals; and

wirelessly transmitting the combined downlink signal to a mobile station.

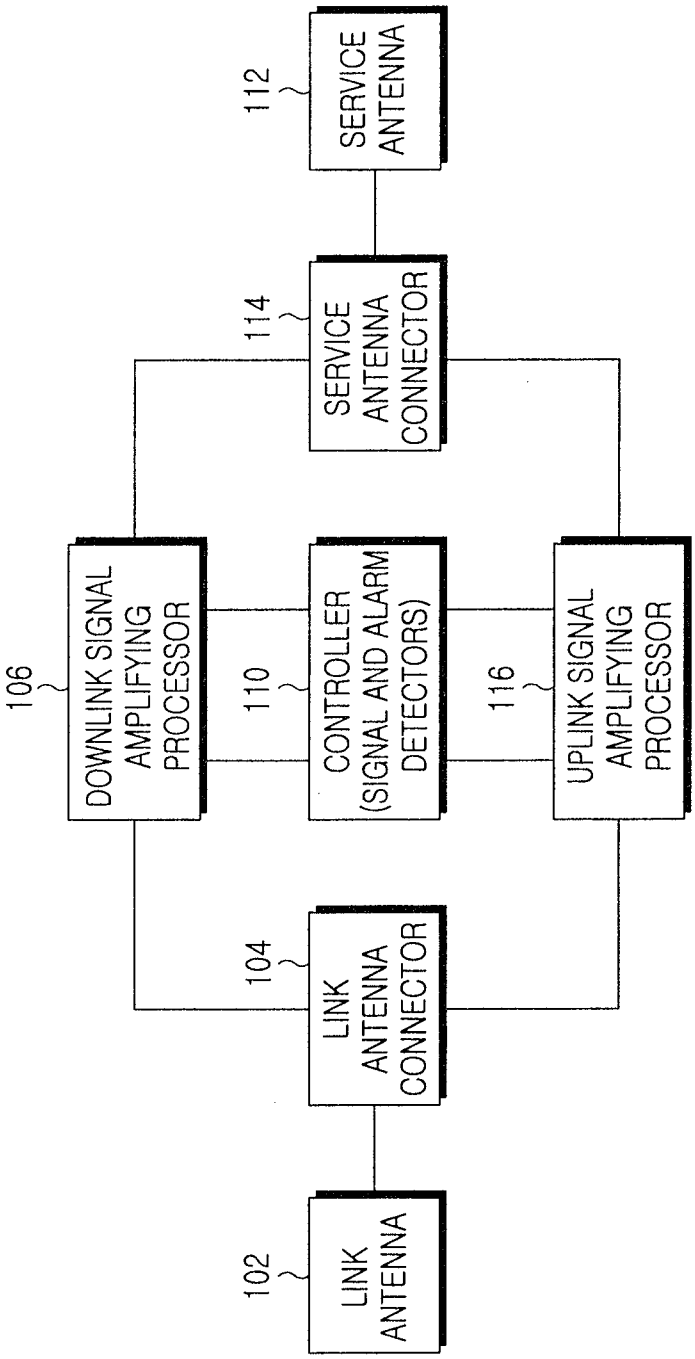

112
SERVICE ANTENNA
114
SERVICE ANTENNA CONNECTOR
106
DOWNLINK SIGNAL AMPLIFYING PROCESSOR
110
CONTROLLER (SIGNAL AND ALARM DETECTORS)
116
UPLINK SIGNAL AMPLIFYING PROCESSOR
104
LINK ANTENNA CONNECTOR
102
LINK ANTENNA

FIG. 1

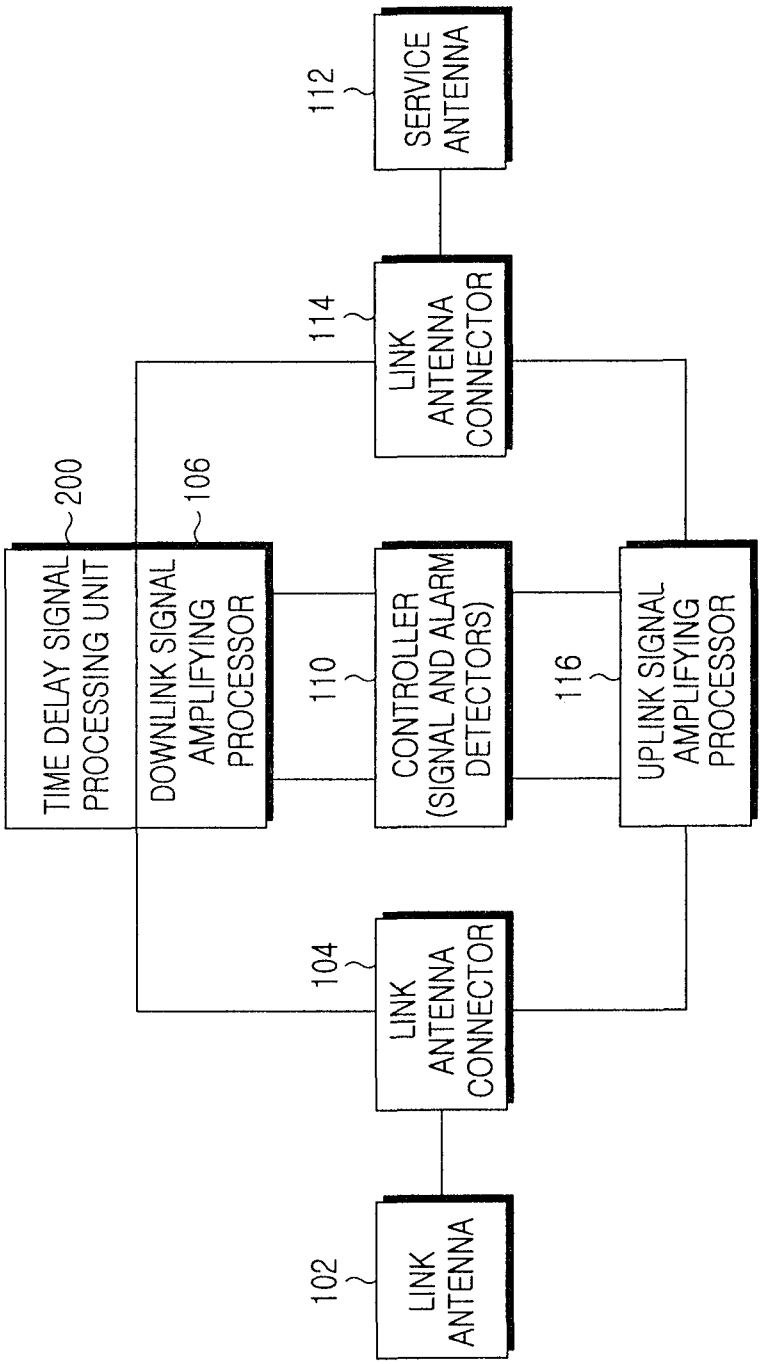

112
SERVICE ANTENNA
114
LINK ANTENNA CONNECTOR
200
106
TIME DELAY SIGNAL PROCESSING UNIT
DOWNLINK SIGNAL AMPLIFYING PROCESSOR
110
CONTROLLER (SIGNAL AND ALARM DETECTORS)
116
UPLINK SIGNAL AMPLIFYING PROCESSOR
104
LINK ANTENNA CONNECTOR
102
LINK ANTENNA

FIG.2

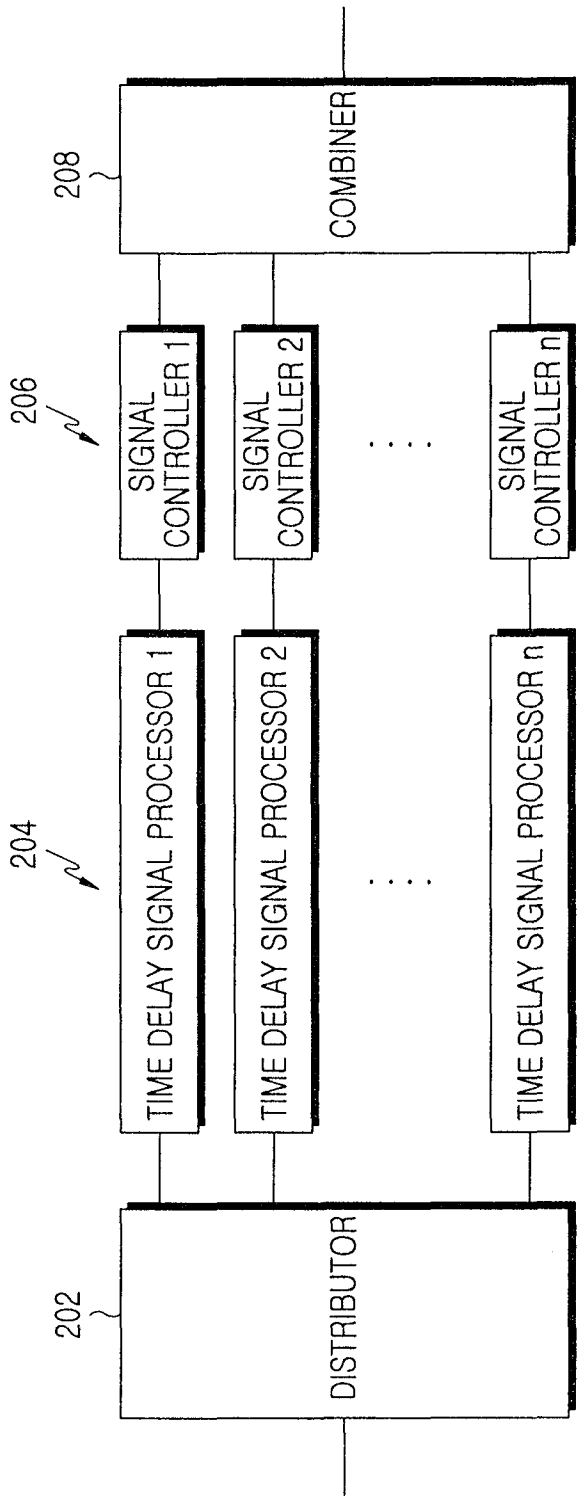

208
COMBINER
206
SIGNAL CONTROLLER 1
SIGNAL CONTROLLER 2
SIGNAL CONTROLLER n
204
TIME DELAY SIGNAL PROCESSOR 1
TIME DELAY SIGNAL PROCESSOR 2
TIME DELAY SIGNAL PROCESSOR n
202
DISTRIBUTOR

FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/006537

A. CLASSIFICATION OF SUBJECT MATTER

H04B 7/14(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04B 7/14, H04B 7/02, H04B 7/08, H04B 7/10, H04B 7/15, H04B 7/26, H04J 13/00, H04B 7/155,

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) & Keywords : "PN", "delay", "combiner", "distributer", "repeater", "delay diversity"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/44308 A1 (REPEATER TECHNOLOGIES) 2 September 1999 see abstract, page 8,line 30 - page 9, line 13, claims 1,15 and figs. 2,5,7	1-4
A	KR 10-2004-0071516 A (MIRACOM TECHNOLOGY CO., LTD) 12 August 2004 see claims 1-5 and figs. 1-3	1-4
A	KR 10-2004-0092183 A(PANTECH CO., LTD) 3 November 2004 see claim 1 and fig. 2	1-4
A	US 2004/266338 A1 (DOUGLAS NEAL ROWITCH) 30 December 2004 see abstract, fig.3 and paragraphs 54-56	1-4

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 APRIL 2009 (16.04.2009)	**23 APRIL 2009 (23.04.2009)**

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/006537

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