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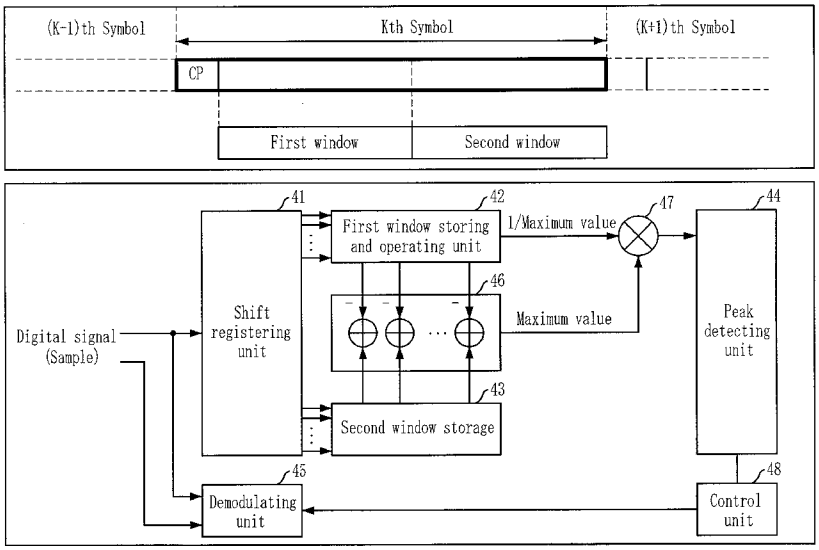
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(54) Title: APPARATUS FOR DETECTING FRAME PREAMBLE IN WIRELESS BROADBAND SYSTEM AND METHOD THEREOF



(57) Abstract: Provided are an apparatus and method for detecting a preamble of a frame in a wireless broadband Internet system. The apparatus includes a dividing unit for dividing inputted digital signals; a first storing and operating unit for sequentially storing a digital signal and calculating and outputting an inverse number of the maximum value among samples; a second storing unit for sequentially storing other digital signal; the maximum value detecting unit for detecting the maximum value by respectively summating sample values stored in the first storing and operating unit and sample values stored in the second storing unit; a multiplying unit for multiplying an inverse number of the maximum value by the maximum value; a peak detecting unit for detecting a peak value based on a multiplication result of the multiplying unit; and a control unit for detecting a preamble.

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APPARATUS FOR DETECTING FRAME PREAMBLE IN WIRELESS BROADBAND SYSTEM AND METHOD THEREOF

Description

Technical Field

The present invention relates to an apparatus and method for detecting a preamble of a frame in a wireless broadband Internet system; and, more particularly, to an apparatus and method for detecting a preamble of a frame by separating inputted digital signals and sequentially storing them in a first storage and a second storage, acquiring a first maximum value by acquiring a difference between samples stored in the first storage and samples stored in the second storage, each of which corresponds to each sample of the first storage, and dividing the first maximum value by the maximum value among the samples stored in the first storage.

Background Art

The basic concept of a wireless broadband Internet service is a service that a portable wireless terminal can access to the Internet at a high data transmission rate anywhere anytime while the wireless terminal is in motion or stop. Herein, the words "in motion or stop" mean that the portable terminal can access to the Internet flexibly not only in the indoor places such as a house and an office, but also in the outdoor places such as a park and street. The words "at a high transmission rate" mean that the wireless terminal should be able to provide a transmission rate as high as that of a very high-speed wired Internet service, which is 1 to 2Mbps for each subscriber.

At present, a high-speed wireless Internet access

technology includes High-speed Portable Internet (HPi), which is under development, Wireless Digital Subscriber Line (WDSL)-based technologies developed out of Korea, such as i-burst and flash-Orthogonal Frequency Division Multiplexing (OFDM), and improved Local Area Network (LAN).

According to the wireless broadband Internet service using a 2.3GHz band, a portable wireless terminal accesses to the Internet at a high transmission rate, while the wireless terminal is in motion or stop, and receives diverse information and contents.

As far as experts in communication technology predicts, diverse kinds of terminals such as personal computers (PC), lap-top computers, and Personal Digital Assistants (PDA), may be used as the wireless terminal. However, the initial wireless terminals, which are dedicated to each service, are likely to evolve and be integrated into a multi-mode terminal in future, as communication technology makes a progress. When it comes to mobility, the multi-mode terminal is expected to secure users with walking-speed nomadic mobility, which is a bit faster than the current wireless LAN of 2.4GHz. It will provide stable transmission rates of over 1Mbps, although the transmission rates are different according to the used technology. Thus, it is expected that the wireless broadband Internet service can be provided smoothly.

The wireless broadband Internet service overcomes the limit of current systems using 2.3 Mbps in the aspects of used domain and service charge, and provides a high-speed Internet access service while the terminal is in motion or stop at a quality and price of Asymmetric Digital Subscriber Line (ADSL).

The wireless broadband Internet service provides data a transmission rate faster than the conventional

International Mobile Telecommunication (IMT) 2000, and it can provide the Internet services both indoor and outdoor in motion.

Also, the wireless broadband Internet service provides a seamless service while the wireless terminal is in motion by supporting handoff between cells, which is the same as the conventional mobile communication service. Just as the wired Internet service does, the wireless broadband Internet service maximizes band efficiency so that subscribers can access to the Internet at all times by paying a fixed-rate charge. In other words, the wireless broadband Internet service overcomes a market limit that the conventional mobile communication service has by securing economical efficiency and provides the same Internet access environment as the wired Internet access environment by using diverse kinds of portable computer terminals including a laptop computer and a personal computer (PC).

Meanwhile, since securing frequencies becomes a hot topic in the current wireless communication market, Time Division Duplexing (TDD) performing communication in a single frequency is drawing attention from researchers. It seems that development in parts and equipment capable of performing synchronization at an accurate time has made it possible.

Theoretically, the TDD technology can provide not only the same service by using timeslots that are smaller than those of Frequency Division Duplexing (FDD) technology, but also has a technological characteristic that it is proper to transmission of many applications because it has a similar configuration to that of the current Internet service through asymmetric arrangement of uplink/downlink timeslots. After all, the TDD technology provides high-speed transmission rate while using frequency half as much as the FDD technology. Thus,

it provides the service at a relatively low price.

The characteristics of the TDD technology have attracted wireless communication service providers. However, the TDD technology has been put aside from the communication industry due to a time delay according to transmission distance and a difficulty in detecting synchronization for dynamic allocation of timeslots. Recently, however, diverse technologies have been developed and used to overcome the problems to thereby expand the market. As aforementioned, since the TDD technology can be easily combined with the current wired Internet communication system, it is drawing attention again.

Hereinafter, frames used in a wireless broadband Internet system adopting Orthogonal Frequency Division Modulation/Multiplexing Access (OFDMA) or the TDD technology will be described.

The frames of the OFDMA/TDD wireless broadband Internet service is composed of a total of 42 OFDMA symbols. The first and second symbols form a preamble and the third symbol is an information block (SICH) having information on an uplink/downlink ratio.

In general, the wireless broadband Internet system can be designed differently according to an environment. Therefore, when it fails to accurately perform TDD time synchronization identifying uplink and downlink in a receiving part or a repeater, communication may not be performed at all, which is a severe problem. Thus, it is important to synchronize frames accurately to analyze signals of the information block (SICH).

Conventionally, frame synchronization is detected by using an energy ratio of an input signal or by using a preamble.

According to the frame synchronization method using an energy ratio of a digital input signal, an energy

value of the digital signal, i.e., frames, is measured and compared with the energy value of the previous input signal.

To put it in detail with reference to the following Equation 1, the absolute values of sample values are acquired by using a window having one symbol size, i.e., 1024 samples, and then they are summated.

$$C_k = \sum_{j=k-N+1}^{k} |X_j| \Big/ \sum_{j=k+1}^{N-k} |X_j| \qquad \text{Eq. 1}$$

where C_k denotes an energy ratio; X denotes a digital signal; and N denotes the size of Fast Fourier Transform (FFT). The N value is 1024 in case of a wireless broadband Internet system.

Subsequently, the energy ratio is measured by comparing the summation value with a previous summation value through a division operation. Herein, the energy ratio may be acquired by summating an imaginary number and a real number of each sample value without using a multiplier.

Peaks are detected based on the acquired energy ratio. That is, a peak detector detects a peak at a moment when it receives an energy ratio of a large value difference while receiving energy ratios of a small value difference monotonously. A controller determines the moment as a starting time point of a frame and transmits activating signals to a demodulator. Synchronization is acquired through the process.

Meanwhile, the conventional synchronization detecting method using an energy ratio has a problem that synchronization is hardly detected when time difference between a previous frame and a current frame drops by less than one OFDMA symbol due to channel effect or time delay caused by a transmission environment. This is

because peaks are not detected based on the energy ratios.

The synchronization detecting method using a preamble can be divided into two: One is to set up a preamble having 1024 samples, i.e., a coefficient, as a learning signal and substitute it into input signals, and the other is to use the repetition property of a preamble.

According to the synchronization detecting method using a learning signal, a peak is detected based on correlation calculation between a predetermined learning signal and an input signal. The moment when a peak is detected is regarded as a starting time point of a frame. The process can be expressed as the following Equation 2:

$$C_k = \sum_{j=k+1}^{N+k} P_{j-k} X_j \qquad \text{Eq. 2}$$

where C_k denotes the $(j-k)^{th}$ value of a learning signal; and P denotes a preamble signal.

The synchronization detecting method based on the repetition property of a preamble will be described herein.

A wireless broadband Internet Specification defines that a preamble has a repetition property after inverse FFT (IFFT) by adding '0' to an sample value at an even-numbered position before the IFFT.

Accordingly, preamble symbols are the two symbols of a signal repeated once at a period of 512 samples, among the signals inputted to a synchronization unit of a wireless broadband Internet system, e.g., a receiving part or a repeater. In other words, one frame is composed of 42 symbols and the first and second symbols form a preamble. Each preamble symbol is composed of 1024 samples except for a cyclic prefix (CP). The initial 512 samples are repeated to thereby form 1024 samples.

A peak is detected by calculating correlation of two windows, i.e., buffers, each storing 512 samples. When a peak is detected, the time point when the peak is detected is determined as a starting time point of a frame. Herein, whereas a peak of a signal is detected at one time point in the conventional communication system, a peak of an OFDMA signal lasts as much as a cyclic prefix due to the addition of the cyclic prefix for maintaining orthogonal property of the signal.

Therefore, the time point when a peak begins is determined as a starting point of a frame.

The process can be expressed as the following Equation 3.

$$C_k = \sum_{j=1}^{N-M} X_j X_{j+M} \qquad \text{Eq. 3}$$

where M is 512.

The conventional synchronization detecting method using a preamble as a learning signal, which is one of correlation methods using a preamble, can detect frame synchronization regardless of crossing between uplink and downlink or multi-path noise. However, the method has a problem that it increases the amount of multiplication calculation, increases costs because it requires 1024 multipliers, and causes delay in signal reception.

Also, the conventional synchronization detecting method based on the repetition property of a preamble, in which synchronization is detected by performing correlation calculation onto the first 512 samples and the last 512 samples among the inputted 1024 samples, has an advantage that it uses a small memory, compared to the method using a learning signal. However, it has a shortcoming that it requires many multipliers, i.e., 512 multipliers, to multiply the coefficient of each input signal by the coefficient of each learning signal as many

times as the number of coefficient pairs, when correlation is calculated by using a preamble.

The increase in the number of multipliers leads to signal delay. Also, since a chip for processing digital signals becomes big, it is difficult to realize the system.

After all, among conventional synchronization detecting methods, the synchronization detecting method using an energy ratio cannot accurately detect synchronization according to a channel environment, and the synchronization detecting method using a preamble correlator has problems that it takes a lot of cost due to the increase in the multiplication amount and that it delays signal reception.

Disclosure

Technical Problem

It is, therefore, an object of the present invention devised to resolve the above problems to provide an apparatus and method for detecting a preamble of a frame by separating inputted digital signals and sequentially storing them in a first storage and a second storage, acquiring a first maximum value by acquiring a difference between samples stored in the first storage and samples stored in the second storage, each of which corresponds to each sample of the first storage, and dividing the first maximum value by the maximum value among the samples stored in the first storage.

Other objects and advantages of the invention will be understood by the following description and become more apparent from the embodiments in accordance with the present invention, which are set forth hereinafter. It will be also apparent that objects and advantages of the invention can be embodied easily by the means defined in

claims and combinations thereof.

Technical Solution

In accordance with one aspect of the present invention, there is provided an apparatus for detecting a frame preamble in a wireless broadband Internet system, including: a dividing unit for dividing inputted digital signals, which are samples, into first digital signals and second digital signals; a first storing and operating unit for sequentially storing the first digital signals and calculating and outputting an inverse number of the maximum value among the first samples; a second storing unit for sequentially storing the second digital signals; the maximum value detecting unit for detecting the maximum value by respectively summating sample values of the first digital signals stored in the first storing and operating unit and sample values of the second digital signals stored in the second storing unit, each of which corresponds to each of the sample values of the first digital signals; a multiplying unit for multiplying an inverse number of the maximum value outputted from the first storing and operating unit by the maximum value detected in the maximum value detecting unit; a peak detecting unit for detecting a peak value based on a multiplication result of the multiplying unit; and a control unit for detecting a preamble when the peak value detected in the peak detecting unit exists within a threshold section.

In accordance with another aspect of the present invention, there is provided a method for detecting a frame preamble in a wireless broadband Internet system, including the steps of: a) dividing inputted digital signals, which are samples, into first digital signals and second digital signals and sequentially storing the

first digital signals in a first storing and operating unit and the second digital signals stored in a second storing unit; b) detecting the maximum value by respectively summating sample values of the first digital signals stored in the first storing and operating unit and sample values of the second digital signals stored in the second storing unit, each of which corresponds to each of the sample values of the first digital signals; c) multiplying an inverse number of the maximum value outputted from the first storing and operating unit by the maximum value detected in the step b); d) detecting a peak value based on the multiplication result; and e) detecting a preamble when the detected peak value exists within a threshold section.

Advantageous Effects

The present invention can detect a preamble of a frame by separating inputted digital signals and sequentially storing them in a first storage and a second storage, acquiring a first maximum value by acquiring a difference between samples stored in the first storage and samples stored in the second storage, each of which corresponds to each sample of the first storage, and dividing the first maximum value by the maximum value among the samples stored in the first storage.

Also, the present invention can minimize a chip size by using a few multipliers.

Description of Drawings

The above and other objects and features of the present invention will become apparent from the following description of the preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram showing a receiving-end of a wireless broadband Internet system to which the present invention is applied;

Fig. 2 is a block diagram showing a wireless broadband repeating apparatus to which the present invention is applied;

Fig. 3 is a block diagram illustrating a synchronization detecting unit of the wireless broadband repeating apparatus in accordance with the embodiment of the present invention;

Fig. 4 shows a frame preamble detecting apparatus in accordance with the embodiment of the present invention;

Fig. 5 is a graph illustrating a frame preamble detection result of the frame preamble detecting apparatus in accordance with an embodiment of the present invention; and

Fig. 6 is a flowchart describing a frame preamble detecting method in the wireless broadband Internet system in accordance with an embodiment of the present invention.

Best Mode for the Invention

Other objects and advantages of the present invention will become apparent from the following description of the embodiments with reference to the accompanying drawings. Therefore, those skilled in the field of this art of the present invention can embody the technological concept and scope of the invention easily. In addition, if it is considered that detailed description on a related art may obscure the points of the present invention, the detailed description will not be provided herein. The preferred embodiments of the present invention will be described in detail hereinafter with reference to the attached drawings.

Fig. 1 is a block diagram showing a receiving-end of a wireless broadband Internet system to which the present invention is applied.

As shown in Fig. 1, the receiving-end of the wireless broadband Internet system includes an analog-to-digital converting unit 11, a synchronization detecting unit 13 and a demodulating unit 19. The analog-to-digital converting unit 11 converts an analog signal inputted through a channel into a digital signal. The synchronization detecting unit 13 detects frame synchronization by using a digital signal sample inputted from the analog-to-digital converting unit 11. The demodulating unit 19 is activated upon receipt of a control signal from the synchronization detecting unit 13 and demodulates a digital signal.

As a peak value exists within a threshold section, the synchronization detecting unit 13 detects a starting time point of a frame preamble and acquires synchronization. The threshold section may range from about -10dB to about -15dB with reference to Fig. 5.

Also, the demodulating unit 19 includes a cyclic prefix (CP) and pilot symbol remover 12, a serial-to-parallel converter 17, a Fast Fourier Transform (FFT) processor 14, an equalizer 15, a parallel-to-serial converter 18, and a decoding unit 16. The cyclic prefix and pilot symbol remover 12 removes a cyclic prefix and a pilot symbol in the digital signal. The serial-to-parallel converter 17 converts serial data inputted from the cyclic prefix and pilot symbol remover 12 into parallel data. The FFT processor 14 performs FFT on the data converted in the serial-to-parallel converter 17. The equalizer 15 corrects distortion caused in a procedure of amplifying the signal, i.e., data, processed in the FFT processor 14 and equalizes characteristics. The parallel-to-serial converter 18 converts the data,

which are equalized in the equalizer 15 and inputted in series, into parallel data. The decoding unit 16 decodes the serial data converted in the parallel-to-serial converter 18.

Fig. 2 is a block diagram showing a wireless broadband repeating apparatus to which the present invention is applied.

As shown in Fig. 2, the wireless broadband repeating apparatus includes a band-pass filtering unit 21, a coupling unit 23, a synchronization detecting unit 24, a control unit 25, a switch 26, a transmission (TX) repeater 22 and a (RX) reception repeater 27. The band-pass filtering unit 21 filters a reception signal. The coupling unit 23 performs a coupling process on a signal passing the band-pass filtering unit 21. The synchronization detecting unit 24 detects frame synchronization by using a digital signal sample coupled in the coupling unit 23. The control unit 25 controls the switch 26 such that the signal passing the band-pass filtering unit 21 according to the synchronization signal detected in the synchronization detecting unit 24 is transmitted to a transmission repeater 22. The switch 26 switches the signal passing the band-pass filtering unit 21 by control of the control unit 25 such that the signal is transmitted to the transmission repeater 22 and transmitted to a destination. The transmission repeater 22 relays a downlink signal. The reception repeater 27 relays uplink signals. Since a receiving procedure is the reverse of the transmitting procedure, the receiving procedure will not be described in detail hereinafter.

As a peak value exists within a threshold section, the synchronization detecting unit 24 detects a starting time point of the frame preamble and acquires synchronization. The threshold section may range from about -10dB to about -15dB with reference to Fig. 5.

Also, the synchronization detecting unit 24 may check whether the repeating apparatus normally operates.

Fig. 3 is a block diagram illustrating the synchronization detecting unit of the wireless broadband repeating apparatus in accordance with the embodiment of the present invention.

As shown in Fig. 3, the synchronization detecting unit of the wireless broadband repeating apparatus includes an IQ demodulator 31, an analog-to-digital converter 32, a frame preamble detector 33 and a time controller 34. The IQ demodulator 31 demodulates an inputted Intermediate Frequency (IF) signal. The analog-to-digital converter 32 converts an analog signal demodulated in the IQ demodulator 31 into a digital signal. The frame preamble detector 33 divides the inputted digital signal, sequentially stores the divided digital signals in first and second storages, extracts a maximum value by calculating differences between samples stored in the first storage and samples stored in the second storage, each of which corresponds to each sample of the first storage, and detects a frame preamble according to a result obtained by dividing the first maximum value by a second maximum value among the samples stored in the first storage. The time controller 34 controls an operation time, i.e., timing, of uplink and downlink switches when the frame preamble detector 33 detects a frame preamble.

Fig. 4 shows the frame preamble detecting apparatus in accordance with the embodiment of the present invention.

As shown in Fig. 4, the frame preamble detecting apparatus according to the present invention includes a shift register 41, a first window storing and operating unit 42, a second window storage 43, the maximum value detecting unit 46, a multiplying unit 47, a peak

detecting unit 44, a control unit 48, and a demodulating unit 45. The shift register 41 shifts, divides and sequentially stores an inputted digital signal sample in the first window storing and operating unit 42 and the second window storage 43 which have the predetermined capacity, e.g., the capacity capable of storing 512 samples. The first window storing and operating unit 42 sequentially stores a digital signal, i.e., a sample, inputted through the shift register 41 and calculates and outputs an inverse number of a maximum value among sample values. The second window storage 43 sequentially stores the digital signal inputted through the shift register 41. The maximum value detecting unit 46 detects the maximum value by respectively summating samples, i.e., values, stored in the first window storing and operating unit 42 and samples, i.e., values, stored in the second window storage 43, each of which corresponds to each other. The multiplying unit 47 multiplies the maximum value detected in the maximum value detecting unit 46 by the inverse number of the maximum value calculated and outputted in the first window storing and operating unit 42. The peak detecting unit 44 detects a peak value based on a multiplication result of the multiplying unit 47. The control unit 48 detects a preamble by determining a peak value as a starting time point of the preamble in case that the peak value detected in the peak detecting unit 44 exists within the threshold section and activates the demodulating unit 45 according to the detected preamble. The demodulating unit 45 demodulates a digital signal by control of the control unit 48. The demodulating unit 45 is an additional element of the present invention.

Meanwhile, functions of the maximum value detecting unit 46 and the multiplying unit 47 are described through Equation 4 below.

$$C_k = \max(\mathbf{W}_1 - \mathbf{W}_2)/\max(\mathbf{W}_1)$$

$$\mathbf{W}_1 = [X_k, X_{k+1}, \cdots, X_{k+511}]$$

$$\mathbf{W}_2 = [X_{k+512}, X_{k+513}, \cdots, X_{k+1023}]$$

Eq. 4

The shift register 41 sequentially transfers one sample among 1024 samples for every predetermined number of clocks in the wireless broadband Internet system. 512 samples among 1024 samples are repeated twice due to a repetition property of the preamble. As the preambles are inputted in the shift register 41, the maximum value of the first window storing and operating unit 42 becomes larger than the maximum value of the maximum value detecting unit 46. Accordingly, the multiplication result value of the multiplying unit 47 gets larger instantly. When 1024 preamble samples are inputted in the shift register 41, the maximum value of the maximum value detecting unit 46 gets closer to 0. Accordingly, the multiplication result value of the multiplying unit 47 gets smaller.

The result value of the multiplying unit 47 forming the initial peak value maintains a peak value as many as 128 samples due to the cyclic prefix. As constituent elements of the samples stored in the first window storing and operating unit 42 and the second storage 43 are changed, the peak value has a value ranging from 0 dB to 2dB.

Also, the first window storing and operating unit 42 and the second window storage 43 respectively have the capacity capable of storing 512 samples.

To be specific, the shift register 41 can simultaneously transfer 1024 samples. That is, 1024 samples are stored in the first window storing and operating unit 42 and the second window storage 43 and transferred by adding one sample for every predetermined number of clocks.

For example, total 512 samples ranging from 1^{st} to 512^{th} are stored in the first window storing and operating unit 42 and total 512 samples ranging from 513^{th} to 1024^{th} samples are stored in the second window storage 43. After a predetermined time passes, the shift register 41 stores a new sample in a number 1 of the first window storing and operating unit 42. Herein, a sample pre-stored in the number 1 of the first window storing and operating unit 42 is stored in a number 2 and a sample stored in the number 2 is stored in the number 3. The samples are stored one by one as described above.

The peak detecting unit 44 can detect a peak value due to noise and the detected peak value is remarkably larger than the peak value at a time when an actual frame preamble is detected. Therefore, the threshold section is set up to ignore the detected peak value due to noise.

Fig. 5 is a graph illustrating a frame preamble detection result of the frame preamble detecting apparatus in accordance with an embodiment of the present invention.

It can be seen from Fig. 5 that an initially inputted signal, i.e., noise has a result value of Equation 4 ranging from 0dB to 2dB.

As the preambles are inputted in the shift register 41, Fig. 5 shows that the value detected in the maximum value detecting unit 46 is instantly changed into a larger value than the maximum value of the first window storing and operating unit 42, as shown in a part where a graph instantly falls down under 0dB.

When the preambles are completely inputted in the shift register 41 and stored in the first window storing and operating unit 42 and the second window storage 43, the result value becomes small.

The peak value formed by the result value is maintained as long as a time for processing 128 samples due to the cyclic prefix. When different samples are stored in the first window storing and operating unit 42 and the second window storage 43, the peak value becomes the original value ranging from 0dB to 2dB.

Since the preamble of the wireless broadband Internet system generally includes two OFDMA symbols, the above procedures are repeated twice. Therefore, the control unit 48 activates the OFDMA demodulating unit 45 at a time that the initial peak value is generated in order to prevent time latency.

Fig. 6 is a flowchart describing a frame preamble detecting method in the wireless broadband Internet system in accordance with an embodiment of the present invention.

Digital signals are inputted at step S601 and sequentially stored in the first window storing and operating unit 42 and the second window storage 43 at step S602.

The maximum value detecting unit 46 detects the maximum value by respectively summating samples, i.e., values, stored in the first window storing and operating unit 42 and samples stored in the second window storage 43, each of which corresponds to each other at step S603.

An inverse number of the maximum value calculated and outputted in the first window storing and operating unit 42 is multiplied by the maximum value detected in the maximum value detecting unit 46 at step S604.

A peak value is detected based on the multiplied result at step S605.

As the detected peak value exists within the threshold section, a preamble is detected in the digital signal frame at step S606.

As described above, the technology of the present invention can be realized as a program and stored in a computer-readable recording medium, such as CD-ROM, RAM, ROM, floppy disk, hard disk and magneto-optical disk. Since the process can be easily implemented by those skilled in the art, further description will not be provided herein.

While the present invention has been described with respect to certain preferred embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

What is claimed is:

1. An apparatus for detecting a frame preamble in a wireless broadband Internet system, comprising:

a dividing means for dividing inputted digital signals, which are samples, into first digital signals and second digital signals;

a first storing and operating means for sequentially storing the first digital signals and calculating and outputting an inverse number of the maximum value among the first samples;

a second storing means for sequentially storing digital signals;

the maximum value detecting means for detecting the maximum value by respectively summating sample values of the first digital signals stored in the first storing and operating means and sample values of the second digital signals stored in the second storing means, each of which corresponds to each of the sample values of the first digital signals;

a multiplying means for multiplying an inverse number of the maximum value outputted from the first storing and operating means by the maximum value detected in the maximum value detecting means;

a peak detecting means for detecting a peak value based on a multiplication result of the multiplying means; and

a control means for detecting a preamble when the peak value detected in the peak detecting means exists within a threshold section.

2. The apparatus as recited in claim 1, wherein the control means determines an initially detected peak value among peak values within the threshold section, which are detected in one preamble symbol, as a starting time point

of the frame preamble.

3. The apparatus as recited in claim 1, wherein the first storing and operating means stores first 512 samples obtained from division in the dividing means and the second storing means stores last 512 samples obtained from division in the dividing means.

4. A method for detecting a frame preamble in a wireless broadband Internet system, comprising the steps of:

a) dividing inputted digital signals, which are samples, into first digital signals and second digital signals and sequentially storing the first digital signals in a first storing and operating means and the second digital signals in a second storing means;

b) detecting the maximum value by respectively summating sample values of the first digital signals stored in the first storing and operating means and sample values of the second digital signals stored in the second storing means, each of which corresponds to each of the sample values of the first digital signals;

c) multiplying an inverse number of the maximum value outputted from the first storing and operating means by the maximum value detected in the step b);

d) detecting a peak value based on the multiplication result; and

e) detecting a preamble when the detected peak value exists within a threshold section.

5. The method as recited in claim 4, wherein in the step e), an initially detected peak value among the peak values, which are detected in one preamble symbol and exist within the threshold section, is determined as a starting time point of the frame preamble.

6. The method as recited in claim 4, wherein the first storing and operating means stores the divided initial 512 samples and the second storing means stores the divided last 512 samples.

FIG. 1

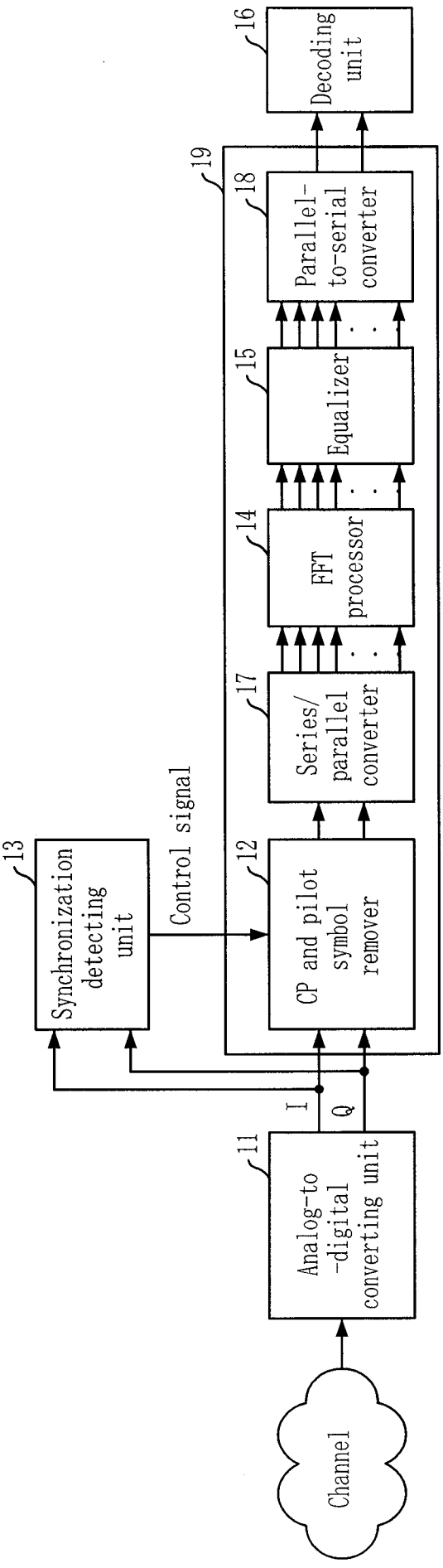

Channel
11
Analog-to-digital converting unit
I
Q
13
Synchronization detecting unit
Control signal
12
CP and pilot symbol remover
17
Series/parallel converter
14
FFT processor
15
Equalizer
18
Parallel-to-serial converter
19
16
Decoding unit

FIG. 2

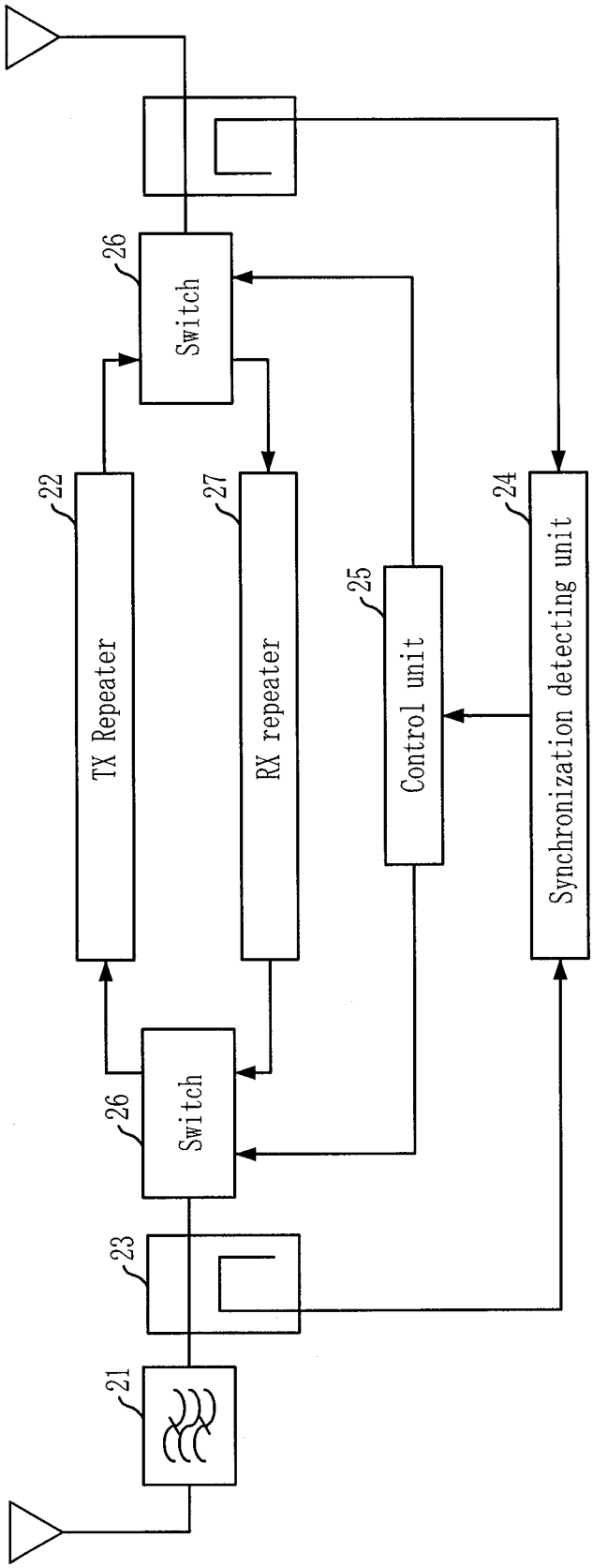

26
Switch
22
TX Repeater
27
RX repeater
25
Control unit
24
Synchronization detecting unit
26
Switch
23
21

FIG. 3

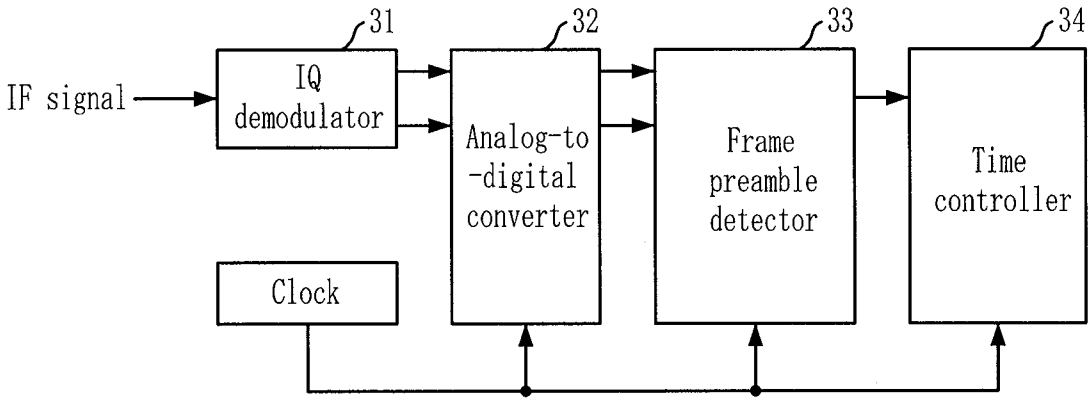

31
32
33
34
IF signal
IQ demodulator
Analog-to-digital converter
Frame preamble detector
Time controller
Clock

FIG. 4

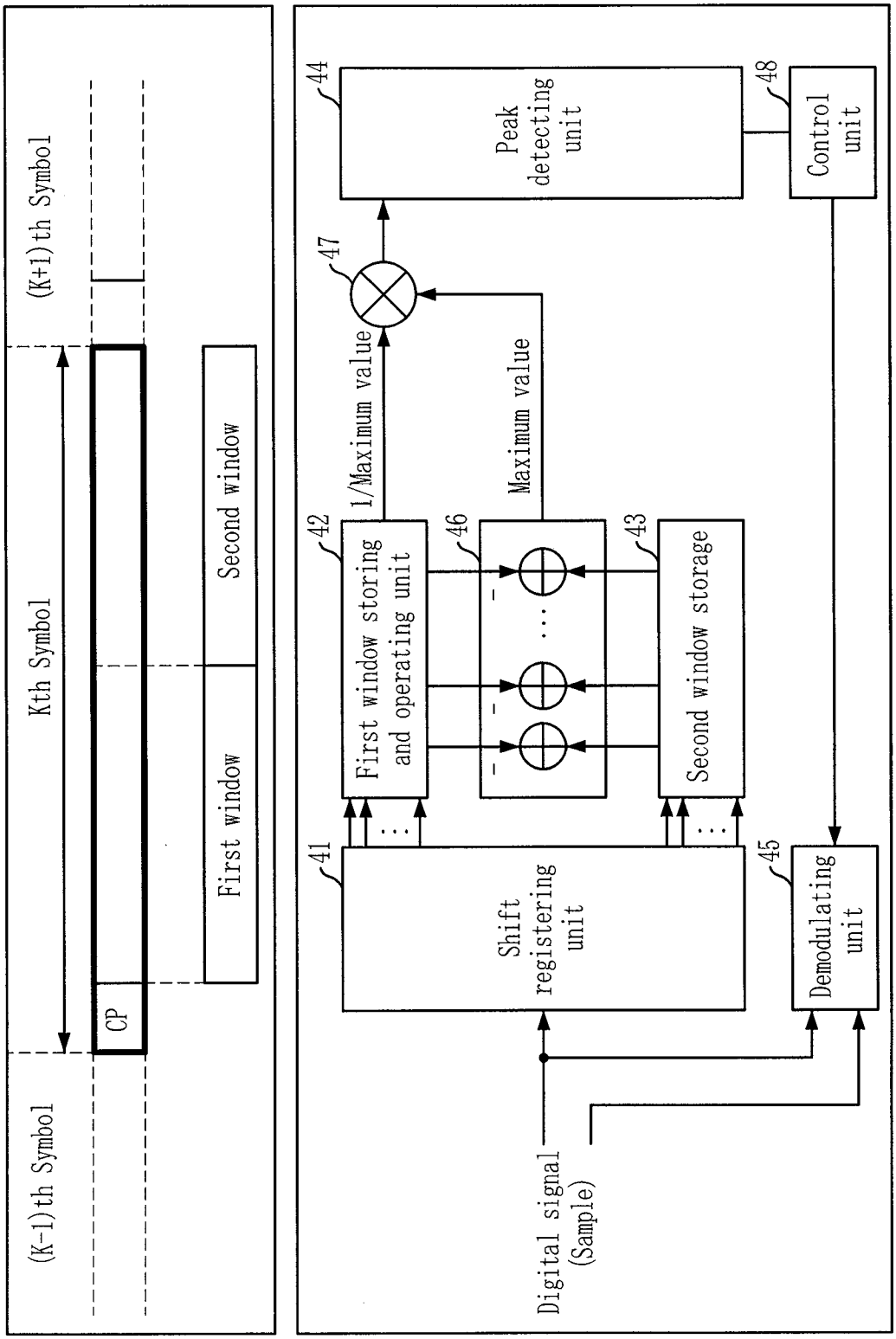

(K-1)th Symbol
Kth Symbol
(K+1)th Symbol
CP
First window
Second window
Digital signal (Sample)
Shift registering unit
41
First window storing and operating unit
42
Second window storage
43
1/Maximum value
Maximum value
46
47
Peak detecting unit
44
Demodulating unit
45
Control unit
48

FIG. 5

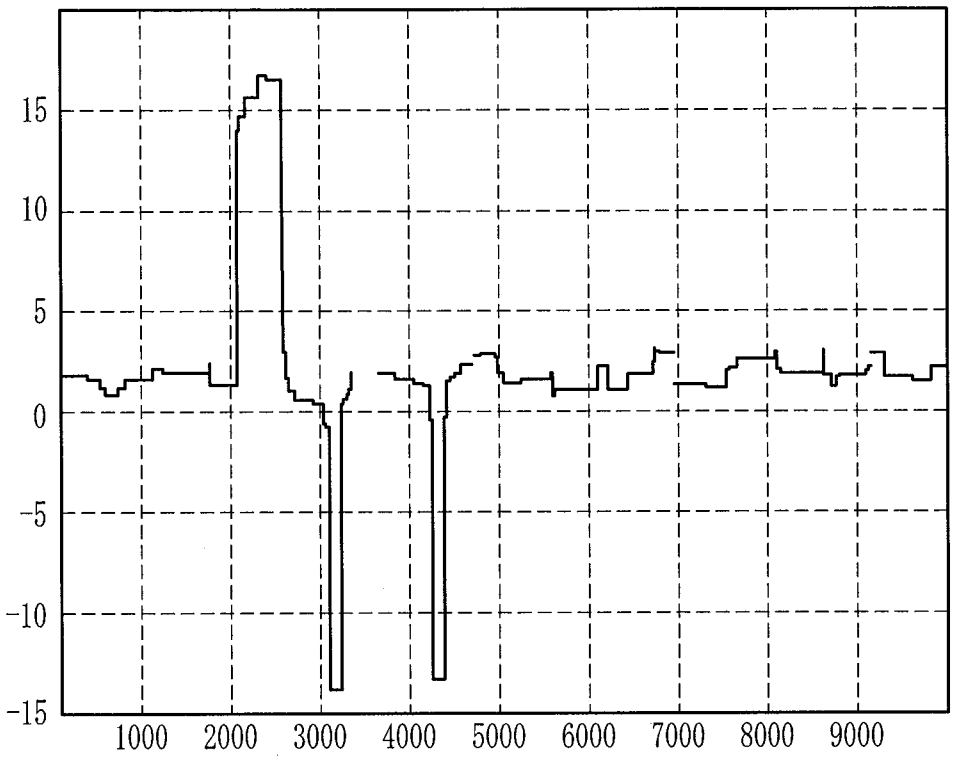
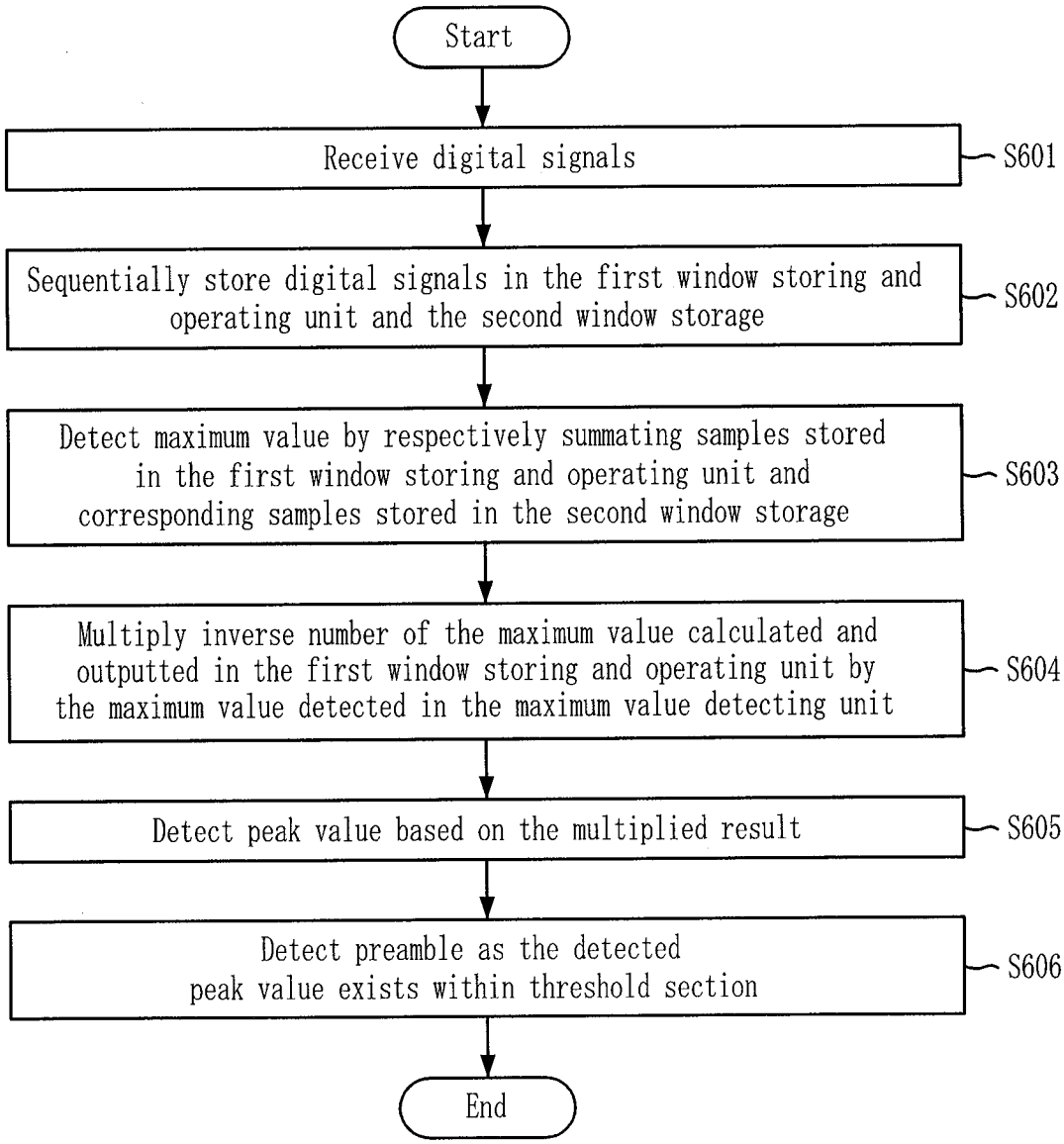


FIG. 6


Start
Receive digital signals
S601
Sequentially store digital signals in the first window storing and operating unit and the second window storage
S602
Detect maximum value by respectively summating samples stored in the first window storing and operating unit and corresponding samples stored in the second window storage
S603
Multiply inverse number of the maximum value calculated and outputted in the first window storing and operating unit by the maximum value detected in the maximum value detecting unit
S604
Detect peak value based on the multiplied result
S605
Detect preamble as the detected peak value exists within threshold section
S606
End

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/004492

A. CLASSIFICATION OF SUBJECT MATTER

H04L 1/00(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)

IPC8: H04L

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

Korean Patents and applications for inventions since 1975
Korean Utility models and applictions for Utility models since 1975
Japanese Utility models and application for Utility models since 1975

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

eKIPASS(KIPO internal)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6356607 B1(Logan Scott et al) 12 Mar. 2002 See claims 1, 6	1 - 6
A	US 6067295 A (Ahmad R. Bahai et al.) 23 May 2000 See abstract, column 3, line 57 - column 4, line 31	1 - 6
A	US 5898684 A (Bruce J. Currivan et al.) 27 Apr. 1999 See fig. 3, column 5, line 55 - column 7, line 5	1 - 6
A	KR 100436166 B1 (Electronics and Telecommunications Reasearch Institute) 12 June 2004 See abstract, figs 1, 2, claims 1-3	1 - 6

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

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2005/004492

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KR100436166B	12.06.2004	None	