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

(72) Inventors: HWANG, Duck-Dong; #518-302, Sechun-nyun Greenvill 5-danji, Singal-dong, Giheung-gu, Yongin-si, Gyeonggi-do 446-587 (KR). HUI, Jun-hong; #b-112, Samsung Jonghap Gisulwon, San 14-1, Nongseo-dong, Giheung-gu, Yongin-si, Gyeonggi-do 446-712 (KR).
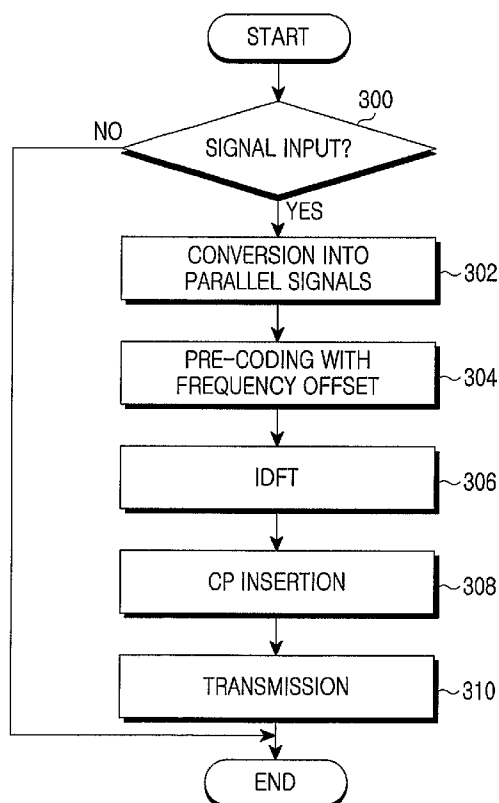
(74) Agent: LEE, Keon-Joo; Mihwa Bldg. 110-2, Myon-gryun-dong 4-ga, Chongro-gu, Seoul 110-524 (KR).

(54) Title: PRE-CODING METHOD FOR PROVIDING DIVERSITY GAIN IN ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING SYSTEM AND TRANSMISSION APPARATUS AND METHOD USING THE PRE-CODING METHOD

(57) Abstract: A pre-coding method for improving diversity gain in an Orthogonal Frequency Division Multiplexing (OFDM) system and a transmission apparatus and method are disclosed. The transmission method includes converting an input transmission signal into parallel signals, pre-coding the parallel signals with a predetermined frequency offset, performing Inverse Discrete Fourier Transform (IDFT) on the pre-coded signals, and up-converting the IDFT signals and outputting the up-converted signals to a wireless network. By performing pre-coding on a transmission signal with a frequency offset in an OFDM system, diversity gain can be improved.

WO 2007/100216 A1

FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, 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*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

- 1 -

PRE-CODING METHOD FOR PROVIDING DIVERSITY GAIN IN ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING SYSTEM AND TRANSMISSION APPARATUS AND METHOD USING THE PRE-CODING METHOD

5

BACKGROUND OF THE INVENTION

1. Field of the Invention

10   The present invention generally relates to an apparatus and method for improving diversity gain in a wireless communication system, and in particular, to a pre-coding method for improving diversity gain in a mobile communication system based on Orthogonal Frequency Division Multiplexing (OFDM) and a transmission apparatus and method using the pre-coding method.

15

2. Description of the Related Art

Generally, the term "wireless communication system" refers to a system that has been developed for communication between terminals where a fixed wire network is not used for connecting to a terminal. The wireless
20   communication system can typically be a mobile communication system, a wireless local area network (WLAN), a Wireless broadband (Wibro) system, and a mobile Ad Hoc system.

Unlike general wireless communication, mobile communication
25   assumes a user's mobility. One purpose of mobile communication is to allow users to exchange information media using cellular phones and wireless pagers anywhere, anytime, and anyplace.

A typical mobile communication system is a cellular system. The term
30   "cellular system" refers to a system in which a service area is divided into several cells and each of the cells has installed therein a single wireless base station (cellular base station) operating at a different frequency than the frequency assigned to its adjacent cell, thereby allowing the reuse of frequency. A service area covered by the single wireless base station is referred to as a cell.
35   As such, the system operates per unit cell and thus is called a cellular system.

- 2 -

With the rapid development of communication technology, current mobile communication systems have evolved from the initial stage of providing only a voice service to the stage of providing a data service to users moving at high speeds. Rapidly developing wireless communication techniques in various forms have been widely used in our daily lives. After Code Division Multiplexing Access (CDMA) communication technology, known as second-generation communication technology, current communication technology enables high-speed transmission of data information as well as voice information using third-generation wireless communication technology called International Mobile Telecommunications (IMT)-2000. In addition, Wibro or a next-generation wireless communication system that transmits higher-speed data aims at efficiently providing a high-speed packet data service. Such development of communication technology has been made in order to provide higher-quality services to users and to provide techniques for efficient system operation to operators. A representative one of the communication technology is an OFDM system that performs communication using multi-carriers.

The OFDM system divides a broadband channel into several narrow band channels, allocates frequencies that are orthogonal to each other to the channels, and transmits different data simultaneously on the orthogonal frequencies, thus being suitable for high-speed data transmission. The OFDM system can increase the number of symbol intervals for each sub-carrier to as many as the number of sub-carriers, thereby effectively reducing Inter Symbol Interference (ISI) caused by a frequency selective fading channel, and thereby simplifying the structure of a receiver.

Although the OFDM system can reduce ISI and fading resulting from multiple paths, gain from a diversity effect cannot be expected. Therefore, the OFDM system also needs a technique for improving diversity gain.

SUMMARY OF THE INVENTION

An aspect of the present invention is to address at least the above problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the present invention is to provide a pre-coding

- 3 -

method for improving diversity gain in an Orthogonal Frequency Division Multiplexing (OFDM) system.

5   Another aspect of the present invention is to provide a transmission apparatus and method using a pre-coding method for improving diversity gain in an OFDM system.

       According to one aspect of the present invention, there is provided a transmission apparatus which provides diversity gain in an Orthogonal

10   Frequency Division Multiplexing (OFDM) system. The transmission apparatus includes a Serial-to-Parallel (S/P) converter for converting an input transmission signal into parallel signals, a pre-coder for pre-coding the parallel signals with a predetermined frequency offset, an Inverse Discrete Fourier Transform (IDFT) unit for performing IDFT on the pre-coded signals, and a Radio Frequency (RF)

15   unit for up-converting the IDFT signals and outputting the up-converted signals to a wireless network.

       According to another aspect of the present invention, there is provided a transmission method which provides diversity gain in an OFDM system. The

20   transmission method includes converting an input transmission signal into parallel signals, pre-coding the parallel signals with a predetermined frequency offset, performing IDFT on the pre-coded signals, and up-converting the IDFT signals and outputting the up-converted signals to a wireless network.

25   **BRIEF DESCRIPTION OF THE DRAWINGS**

       The above and other features and advantages of an exemplary embodiment of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in

30   which:
       FIG. 1 is a block diagram of a transmitter using a pre-coding method in an Orthogonal Frequency Division Multiplexing (OFDM) system according to an exemplary embodiment of the present invention;

- 4 -

FIG. 2 is a block diagram of a receiver including an equalizer in an OFDM system according to an exemplary embodiment of the present invention; and

FIG. 3 is a flowchart showing the operation of a transmitter in an OFDM system according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENT

The matters defined in the description such as a detailed construction and elements are provided to assist in a comprehensive understanding of an exemplary embodiment 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. Also, descriptions of well-known functions and constructions are omitted for clarity and conciseness. Throughout the drawings, the same drawing reference numerals will be understood to refer to the same elements, features and structures.

FIG. 1 is a block diagram of a transmitter 100 using a pre-coding method in an Orthogonal Frequency Division Multiplexing (OFDM) system according to an exemplary embodiment of the present invention.

Referring to FIG. 1, the transmitter 100 includes a Serial-to-Parallel (S/P) converter 110 for converting an input bit stream into a plurality of parallel bit streams, a pre-coder 120 for pre-coding the parallel bit streams output from the S/P converter 110 and outputting the pre-coded bit streams as parallel transmission symbols, an Inverse Discrete Fourier Transform (IDFT) unit 130 for performing IDFT on each of the parallel transmission symbols output from the pre-coder 120, a Cyclic Prefix Inserter (CPI) 140 for inserting a Cyclic Prefix (CP) for a guard interval, and a Radio Frequency (RF) unit 150 for up-converting a signal output from the CPI 140 and outputting the up-converted signal via a corresponding antenna ANT.

The present invention provides a technique for improving the diversity gain of a transmission signal by applying a frequency offset to the pre-coder 120

that provides diversity gain. The pre-coder 120 can be implemented by a pre-coding matrix to be described later.

The pre-coder 120 is used to provide diversity gain in an OFDM system or a multiple transmit antenna system. For example, the pre-coder 120 in an MxM unitary matrix with special properties converts symbol vectors that are sets of symbols through a pre-coding matrix to transmit each of the symbols through M different channels. If all the M channels do not undergo serious fading, the symbols can be reconstructed stably at a receiver.

The pre-coder 120 provides a diversity gain of about M in non-correlated channels. Generally, research on pre-coders has focused on algebraic number theory. However, a conventional pre-coding method using algebraic number theory cannot be implemented when the pre-coding matrix has a large size M or is not a unitary matrix. On the other hand, a matrix of a direct Discrete Fourier Transform (DFT) type or a Hadamard type does not guarantee full diversity gain, though easily implementing the pre-coder 120. Thus, the present invention provides a pre-coding matrix of the pre-coder 120, which can reduce transmission energy at a transmission side and uses a unitary matrix. Because it is based on DFT, the pre-coding matrix of the present invention can be used as a fast algorithm even when M is large.

Hereinafter, the pre-coder 120 of the present invention will be described in detail. The present invention provides the pre-coder 120 for Quadrature Amplitude Modulation (QAM) signal constellation based on DFT, which applies a frequency offset during pre-coding. To improve the diversity gain of a transmission signal based on a frequency offset, any row of a pre-coding matrix should not be spanned by a differential signal of the QAM constellation and the pre-coder 120 satisfies such a condition.

To generate the pre-coding matrix, parameters are required as follows:

Table 1

Parameter	Description

- 6 -

S	Set of symbol vectors having size M, Elements of these symbols vectors are comprised of used symbol constellation.
E	Set of error vectors having size M, Elements of these error vectors indicate difference vectors between elements of S.
m	Size of parameter S.
P	Set of output vectors having size M, generated from E by pre-coder.
F	Pre-coding transformation.
e	Elements of E.

In Table 1, "S" indicates a set of symbol vectors having a size of M and elements of these symbol vectors are comprised of the symbol constellation. "E" indicates a set of error vectors having a size of M and elements of these error vectors indicate difference vectors indicating differential signals between the elements of S. If S has a size of m, the size of E is equal to the number of selections of two from m. "P" indicates a set of output vectors having a size of M, generated from E by the pre-coder 120.

The pre-coder 120 using an MxM pre-coding matrix is used to spread error symbols of E into M carriers and thus the output vectors of P do not have "0" at any one of M symbol positions.

When "F" is pre-coding transformation as in Table 1, the above description is equivalent to the design standard of the pre-coder 120 in which any element e of E is a linear combination of M basis vectors of F. If e is a linear combination of fewer vectors than the M basis vectors, a pre-coding transformed vector has non-zero positions corresponding to the number of basis vectors used in the linear combination. If a basis vector of F is not spanned by the constellation for elements of e, the above-described standard is met.

On the assumption that basis vectors of a DFT kernel are generated by points of $2kn\pi/M$ (n and k=0, 1, 2, ..., M-1), these points can be spanned by

- 7 -

error signal constellation between Binary Phase Shift Keying (BPSK) signal points and signal points of Quadrature Phase Shift Keying (QPSK) can be spanned by $k\pi$ (k=0, 1, 2, 3). The signal points spanned by QPSK are generated in DFT in which M is a power greater than 2.

5

In the present invention, the pre-coder 120 has a frequency offset for preventing the basis vectors e from being spanned for sets of BPSK and QPSK signals through constellation analysis of a QAM signal.

10   To this end, signal points of the basis vectors are expressed as Equation (1):

$(2k+1)n\pi/M$ $\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$ (1),

where $n = 0, 1, ..., (M-1)$ and $k = 1, 2, ..., M$.

15   For M = 2, the signal points of the basis vectors can also be expressed as Equation (2):

$kn\pi/4$ $\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$ (2),

where $n = 0, 1$ and $k = 1, 5$.

20   In the present invention, matrices of the pre-coder 120 are expressed as Equation (3) for M = 2, and matrices of the pre-coder 120 are expressed as Equation (4) for M > 2 (i.e., M >= 3).

$$\frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ e^{-j\frac{\pi}{4}} & e^{-j\frac{5\pi}{4}} \end{bmatrix}, M = 2 \qquad \cdots\cdots\cdots\cdots\cdots\cdots\cdots (3)$$

25

$$\frac{1}{\sqrt{M}}\begin{bmatrix} 1 & 1 & \cdots & 1 \\ e^{-j\frac{\pi}{M}} & e^{-j\frac{3\pi}{M}} & \cdots & e^{-j\frac{(2M-1)\pi}{M}} \\ \vdots & \vdots & \ddots & \vdots \\ e^{-j\frac{(M-1)\pi}{M}} & e^{-j\frac{3(M-1)\pi}{M}} & \cdots & e^{-j\frac{(2M-1)(M-1)\pi}{M}} \end{bmatrix}, M \geq 3 \qquad \cdots\cdots\cdots (4)$$

FIG. 2 is a block diagram of a receiver 200 including an equalizer in an OFDM system according to an exemplary embodiment of the present invention.

- 8 -

Referring to FIG. 2, the receiver 200 includes an RF unit 210 for down-converting signals received via a plurality of receive antennas corresponding to the transmit antennas of FIG. 1, a CP Remover (CPR) 220 for removing a CP from a signal output from the RF unit 210, a DFT unit 230 for performing DFT

5   on a CP-removed signal, an equalizer 240 for removing distortion caused by pre-coding from the DFT signal, and a Parallel-to-Serial (P/S) converter 250. Although not shown in FIG. 2, the receiver 200 may further include maximum likelihood, variance of a sphere detector, Minimum Mean Square Error (MMSE), zero-forcing, and a continuous interference filter.

10

The pre-coded vector is a diagonal element of a spatial-temporal transmission matrix at multiple transmit antennas and in this case, the number of antennas has to be smaller than M.

15   FIG. 3 is a flowchart of the operation of the transmitter 100 according to an exemplary embodiment of the present invention. Referring to FIG. 3, if a signal is input in step 300, the S/P converter 110 converts the input signal into parallel signals in step 302. The pre-coder 120 pre-codes the parallel signals with a frequency offset in step 304. The pre-coding in step 304 is performed using

20   Equation (3) or Equation (4) according to the size M of the pre-coder 120. In step 306, the IDFT unit 130 performs IDFT on the pre-coded signals. The CPI 140 inserts a CP into the IDFT signal in step 308, and the RF unit 150 up-converts the CP-inserted signal and transmits the up-converted signal to a wireless network via an antenna ANT in step 310.

25

As described above, by performing pre-coding on a transmission signal with a frequency offset in an OFDM system, diversity gain can be improved.

While the invention has been shown and described with reference to an

30   exemplary 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.

- 9 -

WHAT IS CLAIMED IS:

1.   A transmission apparatus which provides diversity gain in an Orthogonal Frequency Division Multiplexing (OFDM) system, the transmission apparatus comprising:

a Serial-to-Parallel (S/P) converter for converting an input transmission signal into parallel signals;

a pre-coder for pre-coding the parallel signals with a predetermined frequency offset;

an Inverse Discrete Fourier Transform (IDFT) unit for performing IDFT on the pre-coded signals; and

a Radio Frequency (RF) unit for up-converting the IDFT signals and outputting the up-converted signals to a wireless network.

2.   The transmission apparatus of claim 1, wherein the frequency offset is set in order not to span basis vectors of a kernel of the IDFT unit.

3.   The transmission apparatus of claim 2, wherein a signal point on a constellation of the basis vectors is expressed according to the frequency offset as:

$$(2k+1)n\pi/M \qquad ,$$

where $n = 0, 1, ..., (M-1)$, $k = 1, 2, ..., M$, and M indicates the size of the pre-coder.

4.   The transmission apparatus of claim 3, wherein for $M = 2$, a signal point on a constellation of the basis vectors is expressed as:

$$kn\pi/4 \qquad ,$$

where $n = 0, 1$ and $k = 1, 5$.

5.   The transmission apparatus of claim 1, wherein for $M = 2$, matrices of the pre-coder are expressed as:

$$\frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ e^{-j\frac{\pi}{4}} & e^{-j\frac{5\pi}{4}} \end{bmatrix}, M = 2$$

- 10 -

6.   The transmission apparatus of claim 1, wherein for M >= 3, matrices of the pre-coder are expressed as:

$$\frac{1}{\sqrt{M}}\begin{bmatrix} 1 & 1 & \cdots & 1 \\ e^{-j\frac{\pi}{M}} & e^{-j\frac{3\pi}{M}} & \cdots & e^{-j\frac{(2M-1)\pi}{M}} \\ \vdots & \vdots & \ddots & \vdots \\ e^{-j\frac{(M-1)\pi}{M}} & e^{-j\frac{3(M-1)\pi}{M}} & \cdots & e^{-j\frac{(2M-1)(M-1)\pi}{M}} \end{bmatrix}, M \geq 3$$

7.   The transmission apparatus of claim 1, wherein the transmission signal is a Quadrature Amplitude Modulation (QAM) signal.
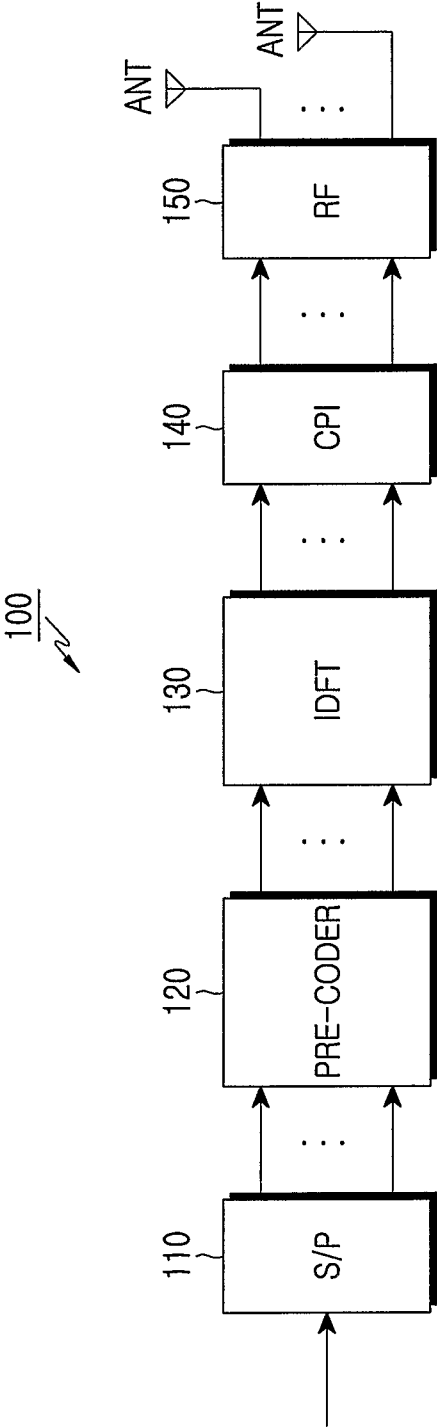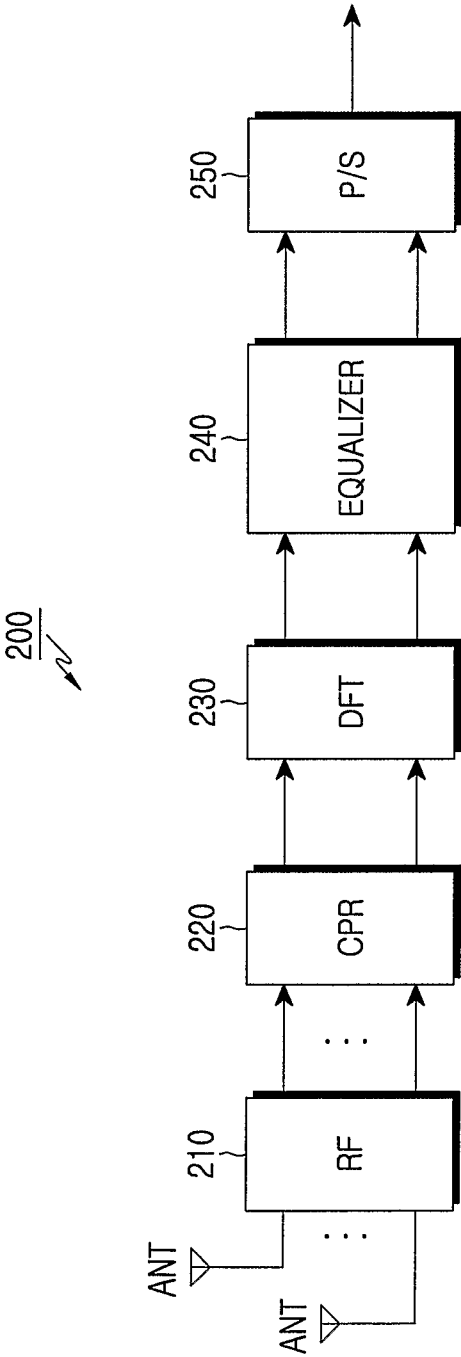
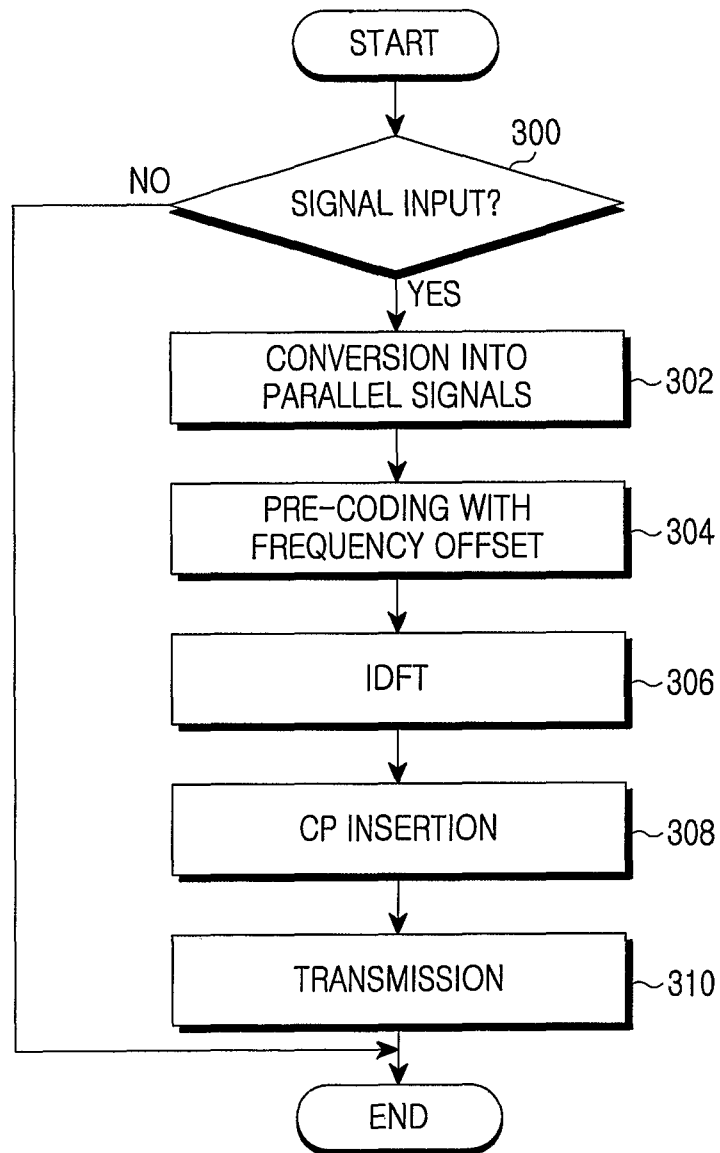8.   A transmission method which provides diversity gain in an Orthogonal Frequency Division Multiplexing (OFDM) system, the transmission method comprising:

converting an input transmission signal into parallel signals;

pre-coding the parallel signals with a predetermined frequency offset;

performing Inverse Discrete Fourier Transform (IDFT) on the pre-coded signals; and

up-converting the IDFT signals and outputting the up-converted signals to a wireless network.

9.   The transmission method of claim 8, wherein the frequency offset is set in order not to span basis vectors of a kernel for the IDFT.

10.   The transmission method of claim 9, wherein a signal point on a constellation of the basis vectors is expressed according to the frequency offset as:

(2k+1)nπ/M   ,

where n = 0, 1, ..., (M-1), k = 1, 2, ..., M, and M indicates the size of a pre-coder for performing the pre-coding.

11.   The transmission method of claim 10, wherein for M = 2, a signal point on a constellation of the basis vectors is expressed as:

knπ/4   ,

where n = 0, 1 and k = 1, 5.

- 11 -

12.   The transmission method of claim 8, wherein for M = 2, matrices of a pre-coder for performing the pre-coding are expressed as:

$$\frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ e^{-j\frac{\pi}{4}} & e^{-j\frac{5\pi}{4}} \end{bmatrix}, M = 2$$

5

13.   The transmission method of claim 8, wherein for M >= 3, matrices of a pre-coder for performing the pre-coding are expressed as follows:

$$\frac{1}{\sqrt{M}}\begin{bmatrix} 1 & 1 & \cdots & 1 \\ e^{-j\frac{\pi}{M}} & e^{-j\frac{3\pi}{M}} & \cdots & e^{-j\frac{(2M-1)\pi}{M}} \\ \vdots & \vdots & \ddots & \vdots \\ e^{-j\frac{(M-1)\pi}{M}} & e^{-j\frac{3(M-1)\pi}{M}} & \cdots & e^{-j\frac{(2M-1)(M-1)\pi}{M}} \end{bmatrix}, M \geq 3$$

14.   The transmission method of claim 8, wherein the transmission signal is a Quadrature Amplitude Modulation (QAM) signal.

10

FIG.1

FIG.2

```
            ┌──────────┐
            │  START   │
            └──────────┘
                 │
                 ▼           300
            ◇─────────────◇
   NO ◁─────   SIGNAL INPUT?
            ◇─────────────◇
                 │ YES
                 ▼
        ┌─────────────────┐
        │  CONVERSION INTO │  ~302
        │  PARALLEL SIGNALS│
        └─────────────────┘
                 │
                 ▼
        ┌─────────────────┐
        │  PRE-CODING WITH │  ~304
        │ FREQUENCY OFFSET │
        └─────────────────┘
                 │
                 ▼
        ┌─────────────────┐
        │      IDFT        │  ~306
        └─────────────────┘
                 │
                 ▼
        ┌─────────────────┐
        │   CP INSERTION   │  ~308
        └─────────────────┘
                 │
                 ▼
        ┌─────────────────┐
        │   TRANSMISSION   │  ~310
        └─────────────────┘
                 │
                 ▼
            ┌──────────┐
            │   END    │
            └──────────┘
```

FIG.3

A.	CLASSIFICATION OF SUBJECT MATTER

H04L 27/26(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 27/26

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
Japanese 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)
e-KIPASS(KIPO internal):"precod*"and"diversity"and"OFDM"and"convert*"

C.	DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,473,467 B1 (Wallace et al.) 29 October 2002 See Abstract, Col. 3, line 34 - Col.21, line 44. Figures 1-3.	1,2,7-9, 14
A		3-6,10-13
A	US 6,934,320 B2 (Tujkovic et al.) 23 August 2005 See Col. 1, line 44 - Col. 3, line 20. Figures 1,3	1-14
A	WO 99/12274 A1 (MOTOROLA INC.) 17 July 1998 See page 8, line 11 - page 15, line 23. page 25, line 11 - page 26, line 9. Figures 3,4,8	1-14
A	KR 10-2004-0064152 A (SAMSUNG ELEC. INC.) 16 July 2004 See page 5, line 48 - page 6, line 33. page 7, line 18 - page 8, line 9. page 9, line 55 - page 11 line 53. Figures 5,7,9	1-14

☐ 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	"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
"E" earlier application or patent but published on or after the international filing date	"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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)	"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
"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	"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 JUNE 2007 (12.06.2007)	**12 JUNE 2007 (12.06.2007)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer PARK, SANG HYUN Telephone No. 82-42-481-8263

Form PCT/ISA/210 (second sheet) (April 2007)

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US06473467B1	29.10.2002	AU200145921A1	15.10.2001
		AU200145921A5	15.10.2001
		AU2005202708A1	14.07.2005
		BR200109693A	13.01.2004
		CA2402152AA	11.10.2001
		CA2402152A1	11.10.2001
		EP01628419A2	22.02.2006
		EP01758267A1	28.02.2007
		EP1269665A2	02.01.2003
		EP1628419A2	22.02.2006
		EP1758267A1	28.02.2007
		IL151397A0	10.04.2003
		JP15530010	07.10.2003
		JP17341603	08.12.2005
		JP2003530010T2	07.10.2003
		JP2005341603A2	08.12.2005
		KR1020030000748I	23.01.2003
		MXPA02009370A	12.02.2003
		NO20024634A	20.11.2002
		NO20024634A0	27.09.2002
		RU2002129011A	27.02.2004
		RU2005118847A	27.12.2006
		TW508922B	01.11.2002
		TW508922A	01.11.2002
		UA72583C2	15.03.2005
		US2006023666AA	02.02.2006
		US2006088007AA	27.04.2006
		US2006093067AA	04.05.2006
		US6473467B1	29.10.2002
		US6473467BA	29.10.2002
		US6952454BA	04.10.2005
		WO0176110A2	11.10.2001
		WO200176110A2	11.10.2001
		WO200176110A3	07.03.2002
US06934320B2	23.08.2005	AU2003219369A1	03.11.2003
		AU2003219369AA	03.11.2003
		CN1647407A	27.07.2005
		EP1520350A2	06.04.2005
		JP17523639	04.08.2005
		JP2005523639T2	04.08.2005
		KR1020040099457	26.11.2004
		MXPA04010118A	13.12.2004
		US2003198282A1	23.10.2003
		US2003198282AA	23.10.2003
		US6934320BB	23.08.2005
		WO03090364A2	30.10.2003
		WO2003090364A2	30.10.2003
		WO2003090364A3	27.01.2005
		WO2003090364B1	17.02.2005

Form PCT/ISA/210 (patent family annex) (April 2007)

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO99/12274A1	17.07.1998	BR9811628A	22.01.2002
		CA2302491AA	11.03.1999
		CA2302491C	06.12.2005
		CA2302491A1	11.03.1999
		CA2302491C	11.03.1999
		CN1237728C	18.01.2006
		CN1270716	18.10.2000
		CN1270716A	18.10.2000
		EP01020039A1	19.07.2000
		EP1020039A1	19.07.2000
		EP1020039A4	29.09.2004
		IL134645A0	30.04.2001
		IL134645A1	28.03.2004
		JP13515295	18.09.2001
		JP2001515295T2	18.09.2001
		KR1020010023616	26.03.2001
		US6173005B1	09.01.2001
		US6173005BA	09.01.2001
		WO9912274A1	11.03.1999
KR1020040064152A	16.07.2004	CN1272919C	30.08.2006
		CN1518240A	04.08.2004
		EP01437852A2	14.07.2004
		EP1437852A2	14.07.2004
		JP16222283	05.08.2004
		JP2004222283A2	05.08.2004
		KR2004064152A	16.07.2004
		US20040136465A1	15.07.2004
		US2004136465AA	15.07.2004